ASTRON

Annual report 2013

Cover photo: The International LOFAR Telescope (ILT) & Big Data, Danielle Futselaar © ASTRON.

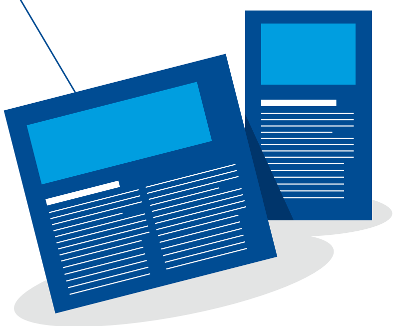
Photo on this page: prototype for the Apertif phased array feed. The Westerbork Synthesis Radio Telescope (WSRT) will be upgraded with Phased Array Feeds (PAFs), which will allow scientists to perform much faster observations with the telescope with a wider field of view. More information is available on the ASTRON/JIVE daily image: *http://www.astron.nl/dailyimage/main.php?date=20130624.*

Facts and figures of 2013

8 Awards or grants

163 employees

162 refereed articles



Funding: € 17,420,955
Expenditure: € 17,091,022
Balance: € 329.33

25 press releases

Contents

Director's Report

2013 was a year in which earlier efforts began to bear fruit. In particular, the various hardware and firmware changes made to the LOFAR telescope system in 2012, resulted in science quality data being delivered to the various Key Science Projects, and in particular the EoR (Epoch of Reionisation) Team. The data obtained over the 2012/2013 winter observing season, generated the deepest images yet of the low-frequency radio sky. These in turn, led to the best upper limits being placed on the EoR signal, as presented at a meeting in Groningen (and later Dwingeloo) to celebrate the 40 year career of ASTRON astronomer, Prof. Ger de Bruyn. Exciting results have also involved LOFAR observations of Pulsars, including the first LOFAR publication to appear in the journal Science. Results such as these were very much in evidence at the LOFAR Science meeting held in Dalfsen in April. The meeting underlined the fact that LOFAR has now entered its operational phase, following a busy observing schedule fueled by the successful 2012 'Cycle 0' call for proposals. It is also clear, that the Radio Observatory's Support Scientist Group (under the new leadership of Roberto Pizzo) has been a major facilitator in delivering science quality data to the community. Impressive images of the sky from MSSS (the Multi-frequency Snapshot Sky Survey) were a key highlight of the meeting. Although MSSS's primary function is to produce a global sky model for initial calibration purposes, it is now also obvious that even this very shallow survey can also unearth some interesting science too.

Despite all these advances, the need to make it much easier for the community to fully exploit LOFAR data became a major priority for the institute in 2013. With this in mind, we established a LOFAR Calibration and Imaging Tiger Team (CITT) under the leadership of MSSS PI and ASTRON astronomer, George Heald. The CITT is strongly focused on progressing and developing user and pipeline software, in order to deliver processed and calibrated LOFAR continuum data to the community. By October, the team was fully populated, including three full-time scientific software developers (one provided by Prof. Morganti's ERC award) and a software integrator. Key additional support is also coming from the Radio Observatory Support Scientists.

There was more good news towards the end of the year, regarding the success of our astronomers to attract individual awards - Joeri van Leeuwen was awarded an ERC consolidator grant, and Ger himself received an advanced ERC grant worth 3.5M€. These developments bring the total number of ERC fellows at ASTRON to four – a tremendous achievement, permitting the Astronomy Group to expand still further in 2014. With a staff and postdoc complement of around 30 FTEs, the Astronomy Group at ASTRON now represents a significant group – we're proud to have established one of the premier research centres for radio astronomy in the world.

The success of LOFAR is clearly also effecting the SKA Phase 1 baseline design. In 2013, the SKA Board confirmed ASTRON as the leader of both the Low-Frequency and Mid-Frequency Aperture Array (LFAA and MFAA) work packages. In addition, we are also playing a substantial role in the Science Data Processing (SDP) work package. While our contribution to the SDP WP is largely assured via the highly ➔ successful

DOME collaboration, the need to attract new and additional funding in order to fully realise our ambitions in the LFAA and MFAA Work Packages, led ASTRON and the Dutch Universities to submit a 13 M€ proposal to the National Roadmap. Submitted in October 2013, the outcome of this initiative is not expected to be known until mid-2014, fingers crossed…

The International SKA project also made many step forwards in the course of 2013. With a new SKA DG in place, a major milestone was the publication of the SKA1 Baseline Design and the associated Request for Proposals (RfP) which led to the assignment of various consortia to the various work packages. An important aspect of the evolution of the baseline design is a series of science workshops that took place through the year in order to understand how the design addresses the various key science goals. Our staff have been deeply involved in this work, both in terms of the science and technology choices to be made and in representation – in addition to leading 2 of the SKA work packages, our staff are serving on the SKA Board, the SKA Science & Engineering Advisory Committee (SEAC), the SKA Operations Group and the Science Working Groups. The appointment of Robert Braun as SKA Science Director can be an important step forward for the SKA - Robert was formerly an astronomer at ASTRON, and he and Russ Taylor edited the first scientific case for the telescope in the mid-1990s.

A welcome boost to our quest for additional SKA R&D funding in 2013 was the 1M€ grant awarded by the Northern Provinces (SNN) to support the development of SKA technology for advanced sensor networks and bio-material research. This follows an additional and again very welcome 1M€ (2014-15) received from NWO, in order to further bolster our contribution to the HTSM Top Sector, and specifically the development of Advanced Instrumentation. The latter will greatly aid one of ASTRON's core commitments - to see the technologies we have developed for the next generation of radio telescopes, also having a significant societal impact in terms of their valorization in commercial and industrial applications. One project we are very excited about is the use of aperture arrays as a central clearing station for SAR (Search & Rescue) distress signals received by multiple satellite transmissions simultaneously. Together with ESA and other partners, we hope to continue to develop this idea towards a commercial implementation.

The development of APERTIF hardware made good progress this year but we became aware of a problem related to the increasingly poor radio frequency interference (RFI) environment around the Westerbork observatory due to both local and satellite broadcasts. This has required us to introduce a room-temperature filter up-front in the receiver chain that increases the system noise from 55 to 70 K. In addition, the lower end of the original APERTIF band is also deemed to be un-useable, so the bottom end of the observable band has been raised to ~ 1100 MHz. Despite this disappointing turn of events, enthusiasm for APERTIF remains high with the new system still outperforming the current WSRT by well over an order of magnitude in terms of survey speed. At the end of the year, the APERTIF team was busy preparing the hardware that is expected to be installed on three of the WSRT telescopes in April 2014.

In August, Dr. Gert Kruithof was appointed as the new Head of our R&D department. Gert immediately made a very positive impact on the department, installing a new level of discipline and rigour in the area of project planning. This disciplined approach has also permeated into other parts of the organization, including the cross department projects such as CITT. On the advice of our Scientific Advisory Committee (SAC), we established the ASTRON Project Committee (APC) in which both internal and external PIs are fully engaged in the long-term planning process. This body has already had a very beneficial effect, and we are confident that it will help to improve general communication channels and to more transparently resolve resource conflicts.

One of the major challenges ASTRON is currently dealing with is a significant reduction of the base budget - a structural cut that rises to 4% in 2014 onwards. Since ASTRON also relies on essentially doubling its base budget via external funding, the reduced matching capability translates into a 4% cut in terms also of our total budget. Longer-term uncertainties in our base budget require us to take a close look at our various priorities, project portfolio and commitments. In particular, we require clarity on the base budget we receive from NWO beyond 2017. At the end of this year, the NWO General Board and the ASTRON Board met to have an initial discussion on some of these issues. More meetings are planned through the course of 2014 via the normal bilateral Board meetings. We're confident that we can reach a solution that preserves our ambition without our jeopardising our future.

Finally, I want to report on the fantastic progress being made with the new and renovated buildings at ASTRON this year. The new building opened its doors at the beginning of the year and the new auditorium was inaugurated with a workshop dedicated to the career of Prof. Arnold van Ardenne. The new building makes ASTRON an even better place to work than before and firmly establishes Dwingeloo as one of the major centres for radio astronomy in the world.

Prof. Michael A. Garrett
General & Scientific Director ASTRON

ASTRON Board and Management Team

The ASTRON board in 2013 consisted of:

- Prof. K. Gaemers (chair)
- Prof. dr. ir. J.A.M. Bleeker, Wassenaar
- Prof. dr. J.T.M. de Hosson, University of Groningen
- Drs. S.B. Swierstra, Assen
- Mw. Prof. dr. J.C.M. van Eijndhoven, 's-Gravenhage
- Mw. Drs. J.P. Rijsdijk, Leiderdorp

In 2013, the ASTRON Management Team consisted of (from left to right):
Dr. René Vermeulen, Prof.dr. Michael Garrett, Dr. Marco de Vos, Prof.dr. Raffaella Morganti, Dr. Gert Kruithof.

The ASTRON Management Team in front of the new wing of the ASTRON & JIVE headquarters.


Aerial photo of the ASTRON and JIVE headquarters in Dwingeloo, after the completion of the building process and the restoration of the Dwingeloo Telescope.

ASTRON in brief

ASTRON is the Netherlands Institute for Radio Astronomy. Its main mission is to make discoveries in radio astronomy happen, via the development of new and innovative technologies, the operation of world-class radio astronomy facilities (the Westerbork Synthesis Radio Telescope and the International LOFAR Telescope), and the pursuit of fundamental astronomical research. Engineers and astronomers at ASTRON have an outstanding international reputation for novel technology development and fundamental research in galactic and extra-galactic astronomy. ASTRON hosts the Joint Institute for VLBI in Europe (JIVE) and the Optical/Infrared Instrumentation group of NOVA (the Netherlands Research School for Astronomy). ASTRON is an institute of the Netherlands Organisation for Scientific Research (NWO).

Organisation & Governance

ASTRON is a foundation under Dutch law with an oversight Board. Executive authority is vested in the directorate consisting of Prof.dr. Michael Garrett, Scientific Director and Director General, and Dr. Marco de Vos, Managing Director and Deputy Director General. They report to both the ASTRON Board and the Director of NWO. NWO is also the formal employer of ASTRON staff.

The ASTRON Director General is advised by an international Science Advisory Committee (SAC) on all aspects of the institute's programme. A telescope Programme Committee sets priorities for allocating observing time on ASTRON's telescopes. The ASTRON Management Team consists of the directorate and department heads.

The International LOFAR Telescope

ASTRON designed and built the International LOFAR Telescope (ILT). LOFAR, the Low Frequency Array, operates at the lowest frequencies that can be observed from Earth. With LOFAR astronomers can look back billions of years to a time before the first stars and galaxies were formed, the so-called 'Dark Ages'. Much of the infrastructure that was needed to build this new radio telescope can also be used by other applications.

The common theme throughout is the collection, transport and real-time processing of enormous quantities of data from sensors distributed over a large area. LOFAR will address some of the most important questions in modern astronomy and astrophysics. The key science projects are:

- The Epoch of Reionization
- Deep extragalactic surveys
- Transient sources and pulsars
- Ultra high energy cosmic rays
- Solar science and space weather
- Cosmic magnetism

The Westerbork Synthesis Radio Telescope

ASTRON operates the Westerbork Synthesis Radio Telescope (WSRT). The WSRT has been built in 1969-1970 and had a major upgrade in 1990-2003. The WSRT is one of the most sensitive radio telescopes in the world and offers astronomers the chance to study a wide variety of astrophysics phenomena. The telescope consists of fourteen parabolic (dish) antennas of 25 meter in diameter.

In the APERTIF project, advanced receiver technology is developed for the WSRT, creating a two-dimensional radio 'camera' in the focal point of twelve of the dishes. This will increase the field of view of all the antennas by a factor of almost forty. Astronomers can thus quickly survey large parts of the sky, leading to a dramatic increase of the discovery space. With APERTIF, the WSRT will be once more brought to the forefront of radio astronomical facilities.

Astronomy Group

The Astronomy Group is engaged in many frontline research areas. Hydrogen is studied in both nearby and the most distant parts of the Universe. The Transient Universe is characterized at the shortest possible time-scales. The magnetic Universe is studied, from galaxies to clusters. The group is involved in the commissioning of LOFAR and in all LOFAR key science projects, as well as in the development of other new instruments like the pulsar machine PuMa-II and the APERTIF system mentioned above.

Radio Observatory

The Radio Observatory is responsible for the astronomical exploitation of the Westerbork Synthesis Radio Telescope (WSRT) and the Low Frequency Array (LOFAR).

The Westerbork Synthesis Radio Telescope, one of the most powerful radio observatories in the world, enables astronomers to study a wide range of astrophysical problems in frequencies between 115 MHz to 8650 MHz. The WSRT is an open user facility available for scientists from any country. It is also part of the European VLBI network (EVN) of radio telescopes.

LOFAR is a radio interferometric array consisting of many low-cost antennae, organised in stations arranged in an area of 100km diameter as well as several international stations and operating between 10 and 250 MHz.

Astronomers can request observing time with WSRT using the NorthStar for WSRT Web-based proposal tool and for LOFAR, using the NorthStar for LOFAR tool, following the instructions given in the 'Announcement for Opportunity' issued periodically. →

Research & Development laboratories

The ASTRON Research & Development (R&D) laboratories focus on innovative instruments for existing telescopes, such as the Westerbork telescope and LOFAR, as well as on developing technologies for future observing facilities, such as the Square Kilometre Array (SKA). The technical laboratory has several unique facilities at its disposal, such as an anechoic chamber, a clean room facility and an outdoor antenna test location. These serve both research and development of astronomical instruments and other product development.

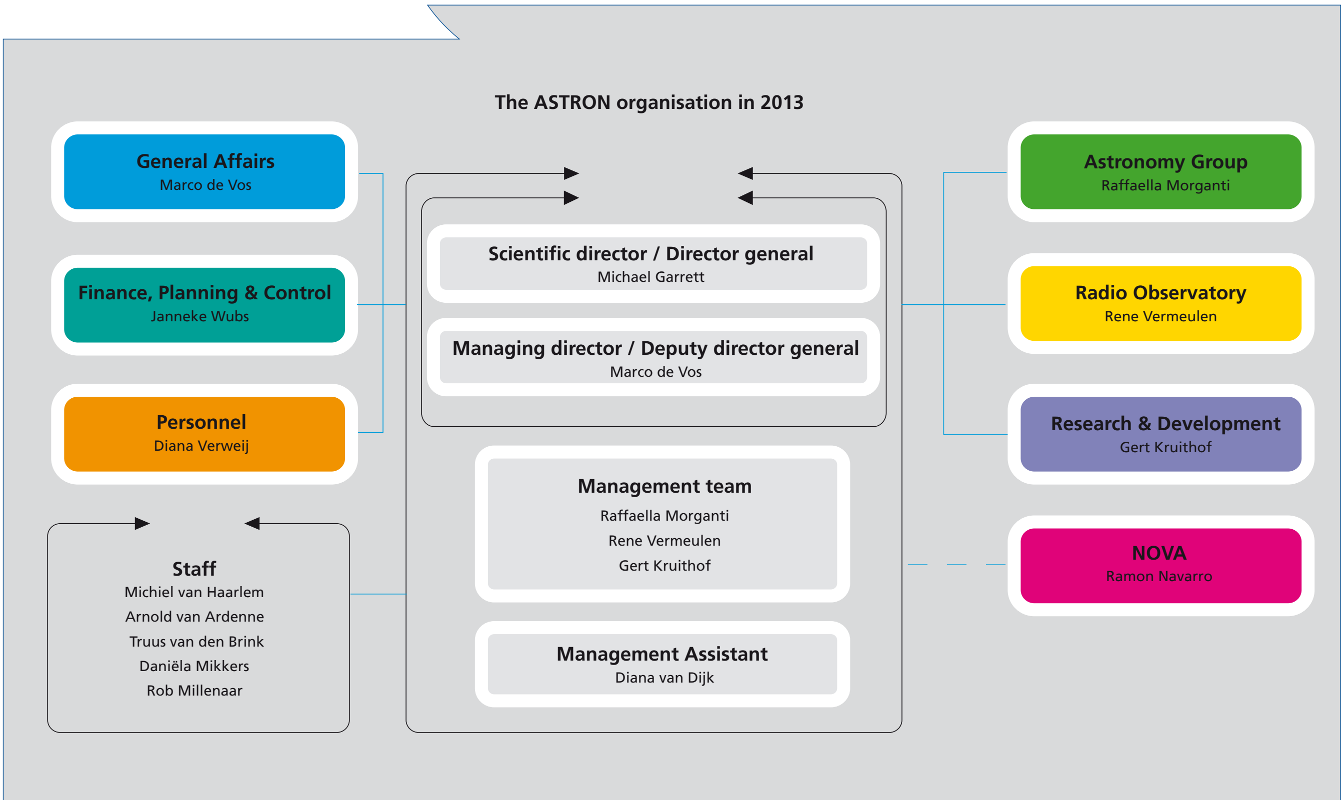
Target areas in R&D for the Square Kilometre Array are Smart Antennas (Aperture arrays and Phased Array Feeds) and Science Data Processing (Calibration and Data Intensive Computing).

The R&D department is organized along the main disciplines: antennas, low noise systems, digital and embedded signal processing, computing, mechanics and system design and integration.

Technology Transfer

ASTRON implements its mission in such a way that the benefit for industry and society is maximised. Partnerships in large development projects are a key aspect of ASTRON's Technology Transfer strategy. ASTRON is a top international research institute and as such offers its partners access to knowledge, expertise and networks.

From the perspective of the Top sectors in the Netherlands a project such as the Square Kilometre Array (SKA) is primarily an international technology programme based on a challenging case: a global consortium to build the world's largest and most sensitive radio telescope. Such a 'Big Science PPP' (Public-Private Partnership) offers unique possibilities for technology development and human capital development.



The ASTRON organisation in 2013.

Contribution to top sectors

In addressing the big questions of physics, ASTRON is facing the big challenges of technology. We therefore organize our projects such that they contribute with maximum value to society and economy. This way, astronomy makes things happen in unexpected areas.

This is primarily achieved through 'Big Science Public Private Partnerships', where industrial partners benefit from the technology development required for large research infrastructures. Such collaborations lead to mutual benefit from the technology developments required by our new instruments. They also serve to interest young people in science and technology. Together with private partners, we bring technologies developed for radio astronomy 'from the edge of the Universe to the market place'.

This approach had been extended in the past years in line with the Dutch programme of Top sectors. As an NWO institute, ASTRON is deeply committed to this strategy, within the boundary conditions of its mission. ASTRON contributes primarily to the Top sector High Tech Systems and Materials (HTSM). In 2013, an additional roadmap was concluded: Advanced Instrumentation. It covers the development and realization of instruments and infrastructure/ equipment for big science projects in national and international context, e.g. for CERN, ESA, ESO, ITER, and the SKA, as well as in the development of small series of high-end instruments for scientific, analytical and medical applications or high end production equipment using e.g. THz-, X-rays or other types of radiation based on novel components (e.g. sensors, photon sources, electronics) emerging from scientific developments.

The main projects through which a contribution could be made in 2013 were SKA-NN and DOME. SKA-NN is a Public-Private Partnership (PPP) consisting of ASTRON and four industrial partners, jointly developing technology and prototypes for SKA Aperture Array systems. The DOME project is executed by the ASTRON & IBM Center for Exascale Technology.

In all industrial collaborations and the economic valorization of our research, we consider it important to remain true to our mission and identity. ASTRON aims to be an excellent knowledge institute rather than a mediocre entrepreneur. Our gains in economic valorization are most often knowledge and reputation, private partners gain from the new business potential directly. We work both with techno-starters and medium-sized production companies. In our valorization activities, we cover both academic, polytechnic (Dutch HBO) and engineering (Dutch MBO) skill levels.

An important role of our valorization programme is to stimulate young people to choose a career in science and technology. Here we use the full appeal of both our astronomy and technology programme. We are convinced that society needs scientific and technical skills at all levels and of all kinds. Without fundamental science, applied sciences come to a halt very soon. Therefore we highly value our astronomical outreach programme and consider it our responsibility to contribute to the wider community in this way.

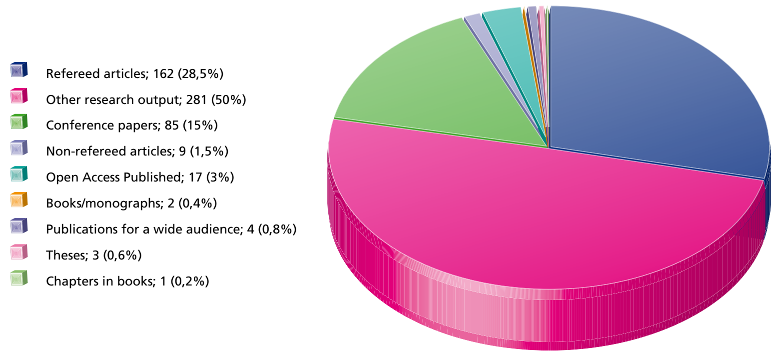

The Westerbork Synthesis Radio Telescope (WSRT).

Performance indicators

Publications

In 2013, ASTRON scientists published, among other things, 162 refereed articles in scientific journals.

The pie chart on the right shows the number of publications, such as refereed articles and conference proceedings, published in 2013 by the astronomers and engineers of ASTRON.



The different research output of ASTRON in 2013. Behind each category, the number of publications in that category is listed. Legend:

Refereed articles:	*articles published in scientific journals that use an anonymous peer review system, which is separate from the editors.*
Non-refereed articles:	*publications in journals that are non-refereed, but considered important by the field.*
Books/ monographs:	*books written for an audience of scientists and researchers that describe the results of scientific research.*
Chapters in/ contributions to books:	*contributions to scientific books aimed at an audience of scientists and researchers.*
Theses:	*publications in which the doctorate was obtained.*
Conference papers:	*complete articles published in the context of a conference (proceeding).*
Publications for a wide audience:	*popular publications on results of scientific research.*
Other research output:	*abstracts, editorships, inaugural lectures, designs and prototypes and media appearances.*
Open Access:	*a scientific article published in an Open Access magazine or placed in a repository accessible to everyone.*

Observing performance statistics

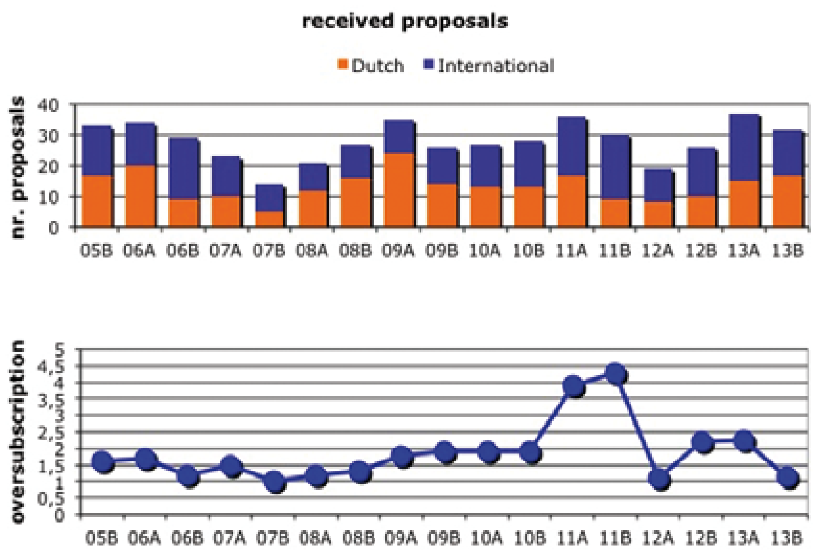
Observing time on the Westerbork telescope (WSRT)

The WSRT, requiring comparatively little maintenance, continued to deliver very satisfactory performance, at 72% net science time: 6315 hours were successfully observed on science projects, excluding all overheads. An additional 706 telescope hours were spent on general calibration, tuning, regular maintenance, and limited software development work; the remaining 1787 hours were unallocated due to inevitable gaps related to scheduling mostly 12-hour full synthesis observations on this east-west array.

The WSRT continued its role as a mainstay of the European VLBI Network, and participated with very high success rate (average 97%), delivering 1052 hours in all scheduled (e)EVN and Global VLBI projects and tests, and an additional 210 hours on projects that involved the RadioAstron space telescope.

Proposals and allocations for the Westerbork telescope

The WSRT followed the customary semi-annual observing proposal cycle in 2013. Thus, Semester 13A was run until 31 May 2013, and thereafter Semester 13 B until 30 November 2013. The WSRT PC met on 6 May 2013 for the 13B proposal review and allocations. However, in view of the impending transition to Apertif, it was decided that the 14A call, with observing starting on 1 December 2013, ➔



Proposal Statistics

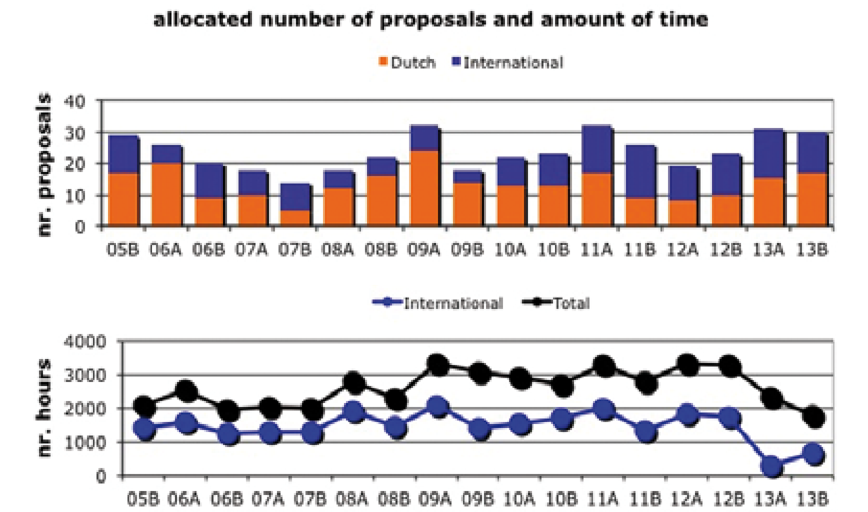
should cover allocations for the entire year of 2014. The WSRT PC, chaired by Dr. I. Prandoni (INAF), met at ASTRON on 20 November 2013.

In both 2013 semesters the amount of submitted proposals recovered from the slight dip of 2012, to the typical number of more than 30 per semester. Furthermore, the oversubscription rate in 2013 has continued around the long-term factor of 2. Statistics on the submitted and allocated projects and hours in semesters 13A and 13B, are shown on the previous page and on the right.

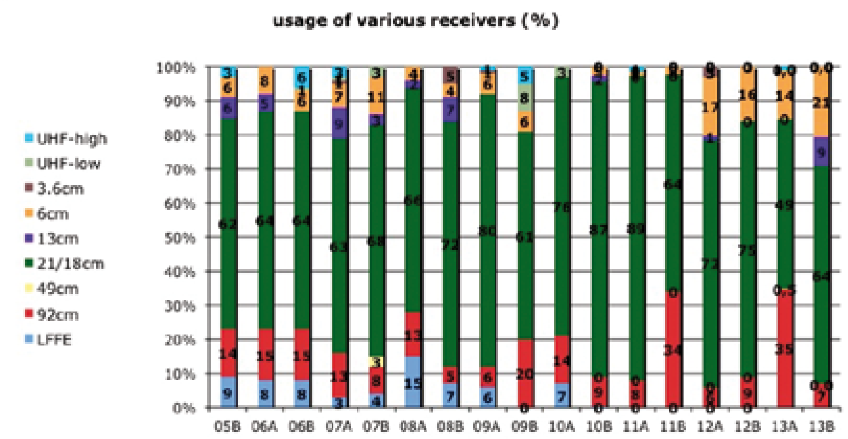
The receiver usage statistics show the classical preponderance of 21+18 cm observing, plus significant components of observing at 6cm (15%-20% per semester) and 92cm (eg 35% in Semester 13A).

LOFAR Observing time

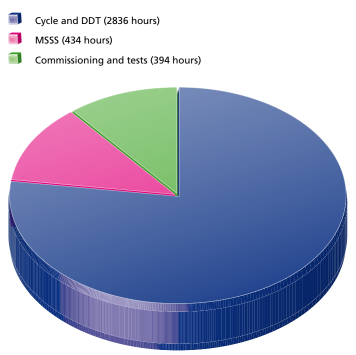
LOFAR operations in 2013 had transited from mostly commissioning observing to regular allocated user research projects. Cycle 0 had started on 1 December 2012. It extended from the originally intended completion date of 1 September 2013 through to 14 November 2013, on account of the extra time needed for ongoing development projects, most notably the online correlator and beamformer upgrade, COBALT. On 15 November 2013, Cycle 1 was initiated. As shown in the figure below, →



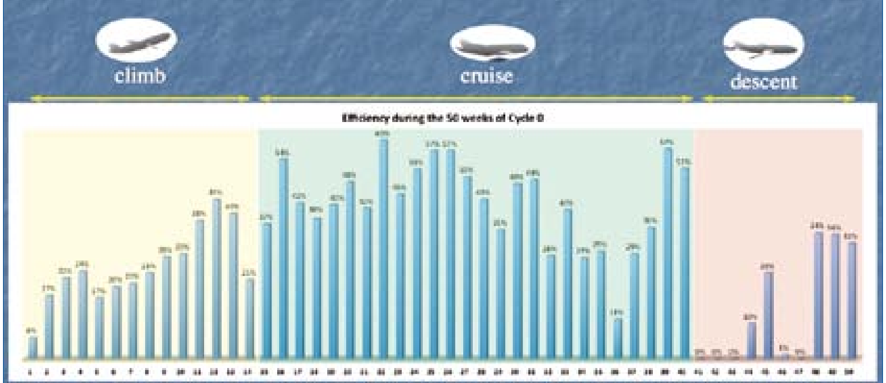
Proposal Statistics



Receiver Usage Statistics



Observing hours 2013



Efficiency Cycle 0

in 2013 a total of 2836 hours were successfully observed and guided through the standard pipeline processing pipelines. In addition, there were 434 hours spent observing for the ongoing Multifrequency Snapshot Sky Survey (MSSS), and 394 hours for commissioning and tests.

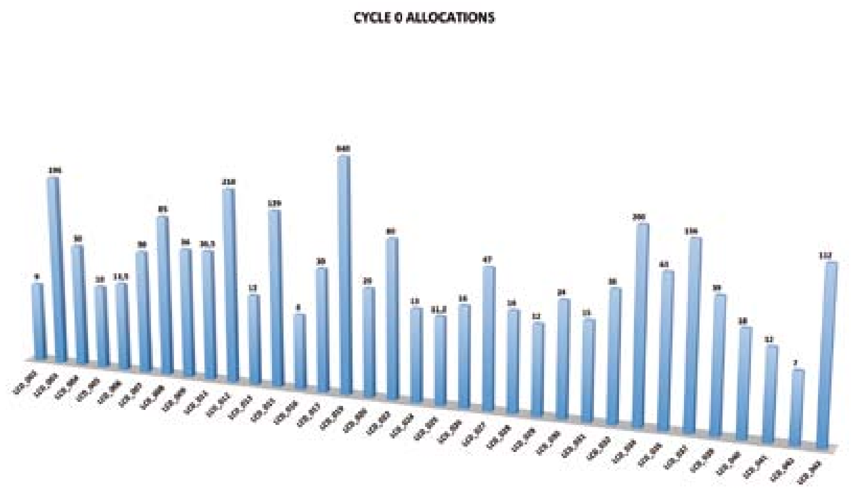
The figure on the right bottom of the previous page illustrates how the net efficiency in delivering successful observations varied throughout Cycle 0. The start-up phase, requiring much manual activity, and a later period devoted to the network reconfiguration project, are notable for their lower efficiency.

Proposals and allocations for the LOFAR telescope

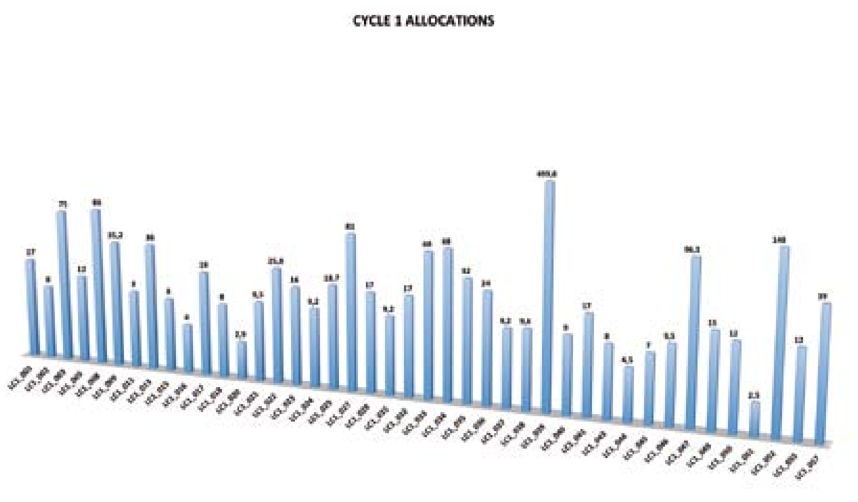
LOFAR was for most of the year devoted to Cycle 0 observing, which had been allocated in late 2012. There were also six commissioning projects, carried out under the auspices of the Technical Advisory Group (TAG). Cycle 1 proposals, submitted for the deadline of 6 September 2013, were first reviewed in September 2013 by a technical review panel involving in-house and community experts, chaired by M. Brentjens. The allocations were then determined for 60% by the National LOFAR Consortia (GLOW, FLOW, NLLAC, LOFAR-Sweden, and LOFAR-UK; each having a fraction in relation to their number of stations), for 10% based purely on science merit under Open Skies conditions by the ILT PC, and for 30% under a mixed scheme involving National Consortium preferences, and the ILT PC chaired by Prof. W. Hermsen (SRON, Amsterdam) having the final word based on science merit and schedule considerations. The ILT PC meeting took place at ASTRON on October 24th and 25th, 2013.

Statistics for Cycle 0 and Cycle 1 allocations are shown in the figures on the right.

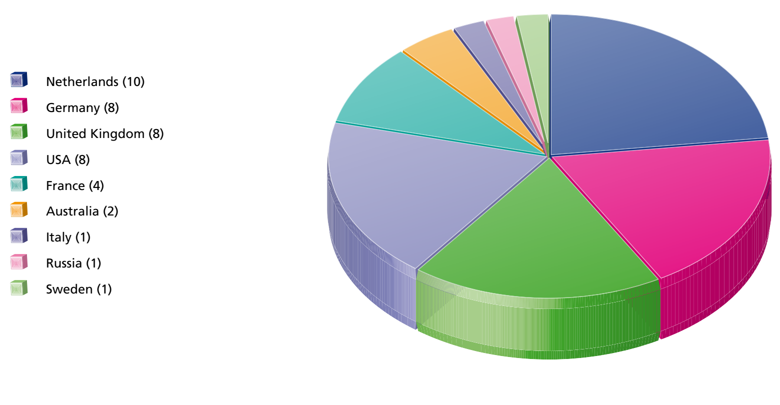
For Cycle 0, the 247 individual authors (some participating in more than one proposal) had affiliations in seventeen countries. For Cycle 1, ➔



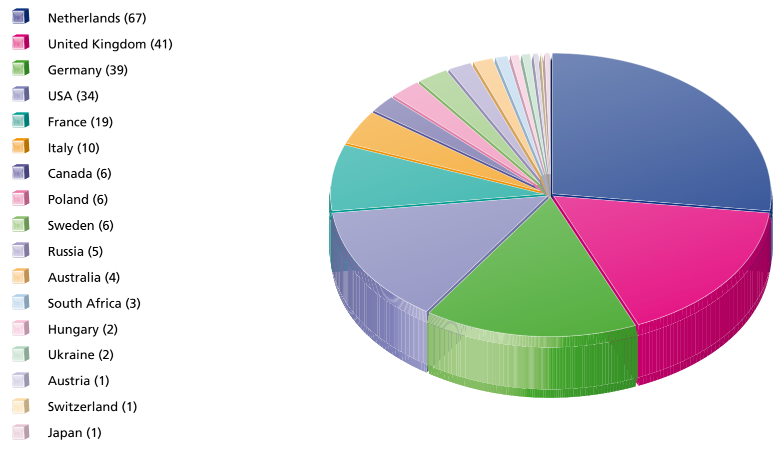
Efficiency Cycle 0



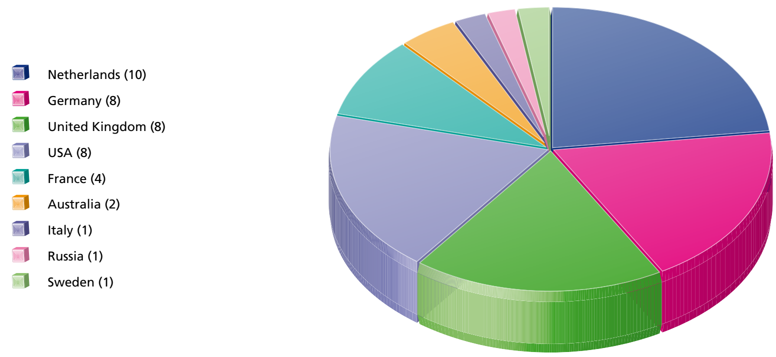
Efficiency Cycle 0



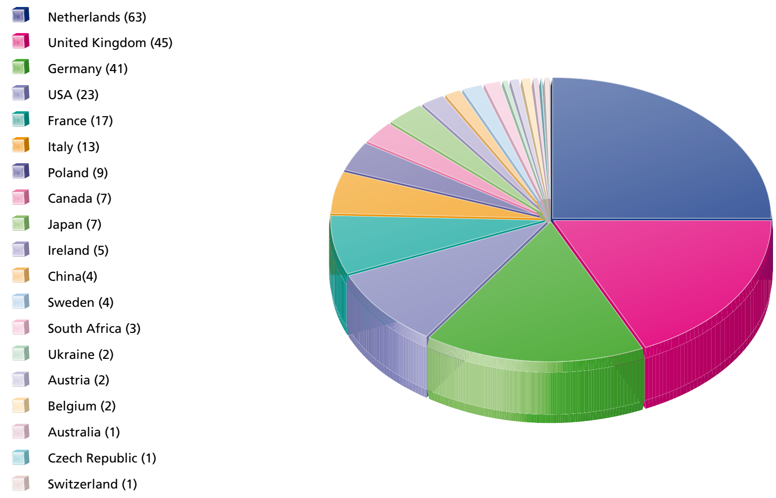
LOFAR Cycle 0: country affiliation of first author the 253 individual authors (some participating in more than one proposal) had affiliations in nineteen countries. In the figures below, we show the country of affiliation of the first authors of each proposal, and of all individual authors.



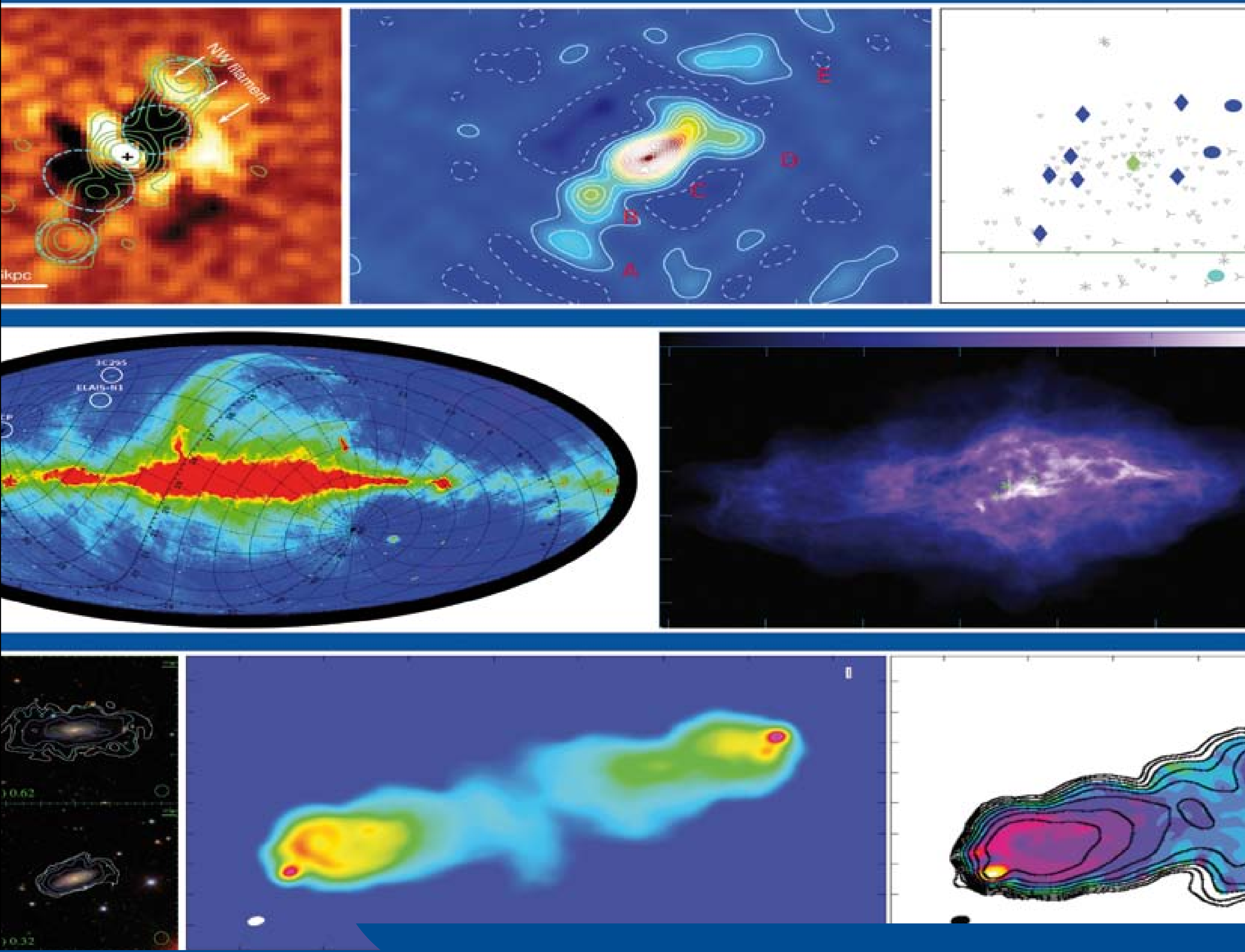
LOFAR Cycle 0: country affiliation of all authors



LOFAR Cycle 1: country affiliation of first author



LOFAR Cycle 1: country affiliation of all authors



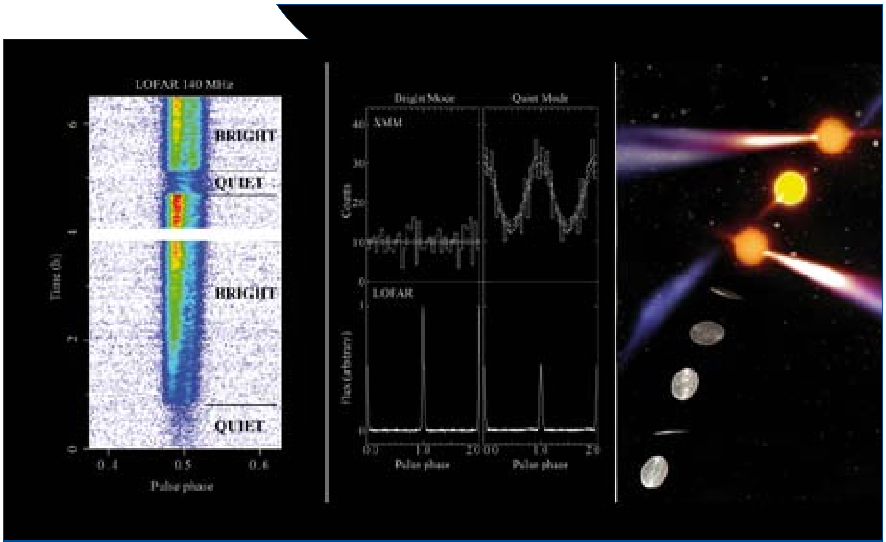
Astronomy Group

Science

In 2013 the astronomy group published 138 refereed papers, almost entirely in (very) high impact journals: two in Nature, three in Science, 28 in ApJL/ApJ, 48 in MNRAS and 33 in A&A. A few highlights from these are:

Synchronous X-ray and Radio Mode Switches: a Rapid Transformation of the Pulsar Magnetosphere

Through simultaneous observations with the LOFAR, XMM-Newton and GMRT telescopes, an international team including Joeri van Leeuwen, Jason Hessels and Vlad Kondratiev detected 'chameleon-like' synchronous switching in the radio and X-ray emission properties of PSR B0943+10 (Science 2013, 339, 436). Thus, the detection of these radio/x-ray changes in pulsar emission is key to understanding the physical relationship between the different x-ray/radio emission sites. Pulsar B0943+10 is extraordinarily bright at low radio frequency. It is special in that it has two distinct 'personalities', or 'radio modes'. It can instantaneously switch between these modes, every few hours. The team compared pulsar behaviour in radio and X-ray – whenever the pulsar is Bright in radio, there is no pulse profile in X-ray (top-left subpanel). But when the pulsar is quiet in radio, it suddenly turns on in X-ray! The X-ray pulse profile is shown in the top-right subpanel. These sudden changes in both radio and X-ray emission, mean that the entire pulsar magnetosphere must suddenly completely change state – like the two states on a flipping coin (right panel). These near-instant transformations challenge our current understanding of pulsar magnetospheres. *(Paper: Hermsen et al. 2013, Science, 339, 436).*



Left: several modes changes easily seen with LOFAR. Middle: The anti-correlated x-ray/radio profiles.

Pulsar beacon shines light on black hole diet

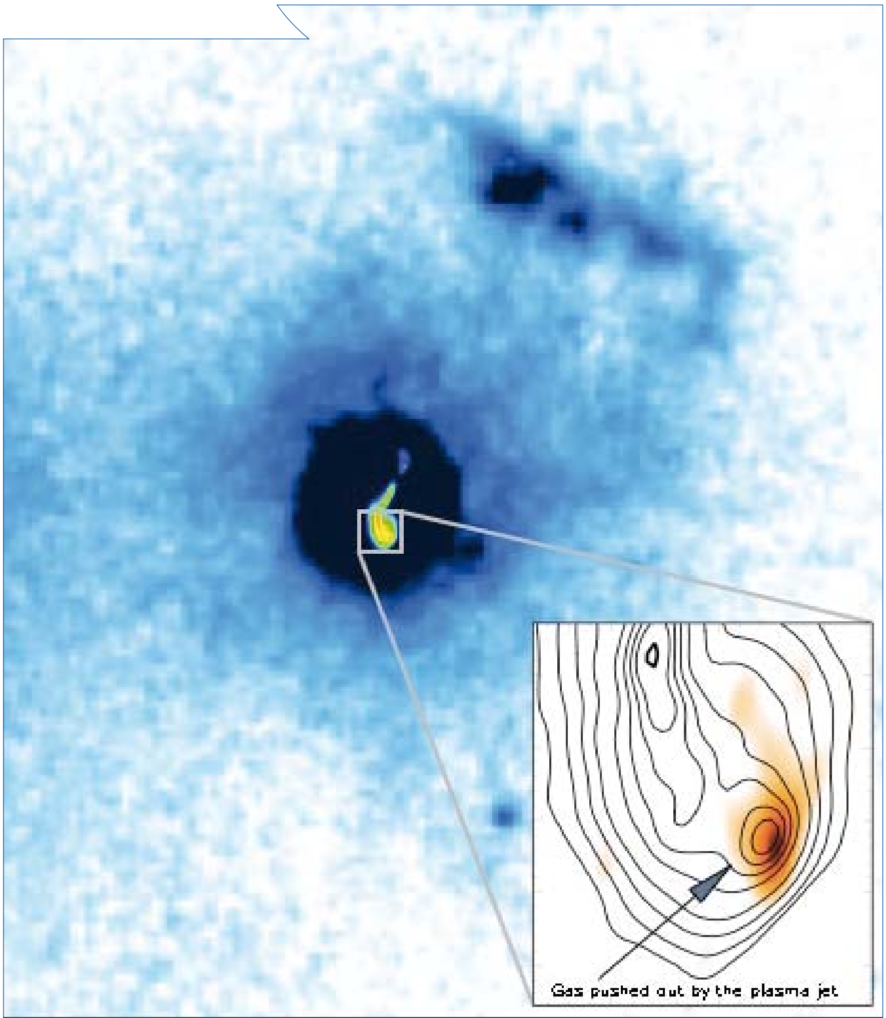
A team including Adam Deller discovered a magnetar in the Galactic Centre region. This magnetar, PSR J1745-2900, is an ultra-magnetic neutron star formed in a supernova explosion. →

Artist's impression of the magnetar PSR J1745-2900. [MPIfR/ Eatough].

The magnetar is separated from Sgr A* by less than half a light year in projection, virtually on the black hole's doorstep in Galactic terms. Thus, PSR J1745-2900 can be used to study the Galactic Centre environment. From the Faraday rotation in the magnetar radio emission, determined that the magnetic field in the gas near the magnetar is quite strong - by the time the gas reaches the event horizon of the black hole, the magnetic field would be hundreds of times stronger than that of the Earth, strong enough to explain the observed synchrotron emission of Sgr A*. *(Paper: Eatough et al. 2013, Nature 501, 391).*

Radio jets clearing the way through a galaxy

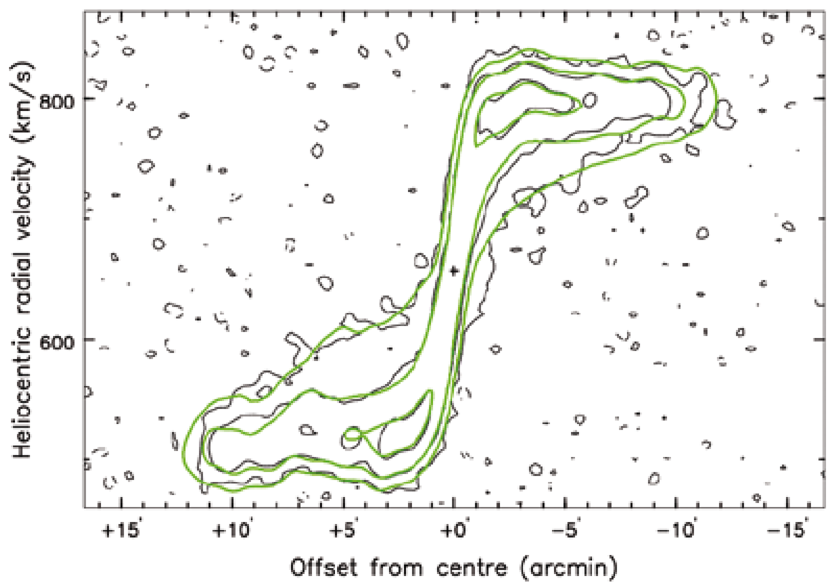
Using global VLBI observations of neutral hydrogen (HI), a team led by Raffaella Morganti and including Tom Oosterloo and Zsolt Paragi (JIVE) presented the first clear evidence that radio jets from supermassive black hole can clear the gas away from the galaxy. Thanks to the high spatial resolution of the VLBI observations, the gas distribution could be directly mapped. The fast outflowing (> 1000 km/s) gas was located at the end of the southern radio jet (see Figure). This location reveals the interaction between the plasma jet and the gas, and how it is pushed out from a galaxy. Despite the strong push received from the jet, the temperature of the gas is low – unexpected, but exactly as needed to make theory of galaxy formation and observations agree. Cold gas is the fundamental building block of new stars. If this gas is expelled, star formation stops. The results of this new study are in agreement with the feedback mechanism invoked by numerical simulations of galaxy evolution. *(Paper: Morganti et al. 2013, Science 341, 1082).*



Fast outflowing HI (in orange) imaged using VLBI observations and located against the hot spot at the end of the southern radio jet in the source 4C12.50.

HALOGAS: Extraplanar gas in NGC 3198

The WSRT HALOGAS (Hydrogen Accretion in LOcal GAlaxieS) Survey has the main aim of investigating the presence, amount, morphology →



Position-velocity diagram of NGC 3198, showing the HALOGAS data in black contours and a lagging HI thick disk model in green.

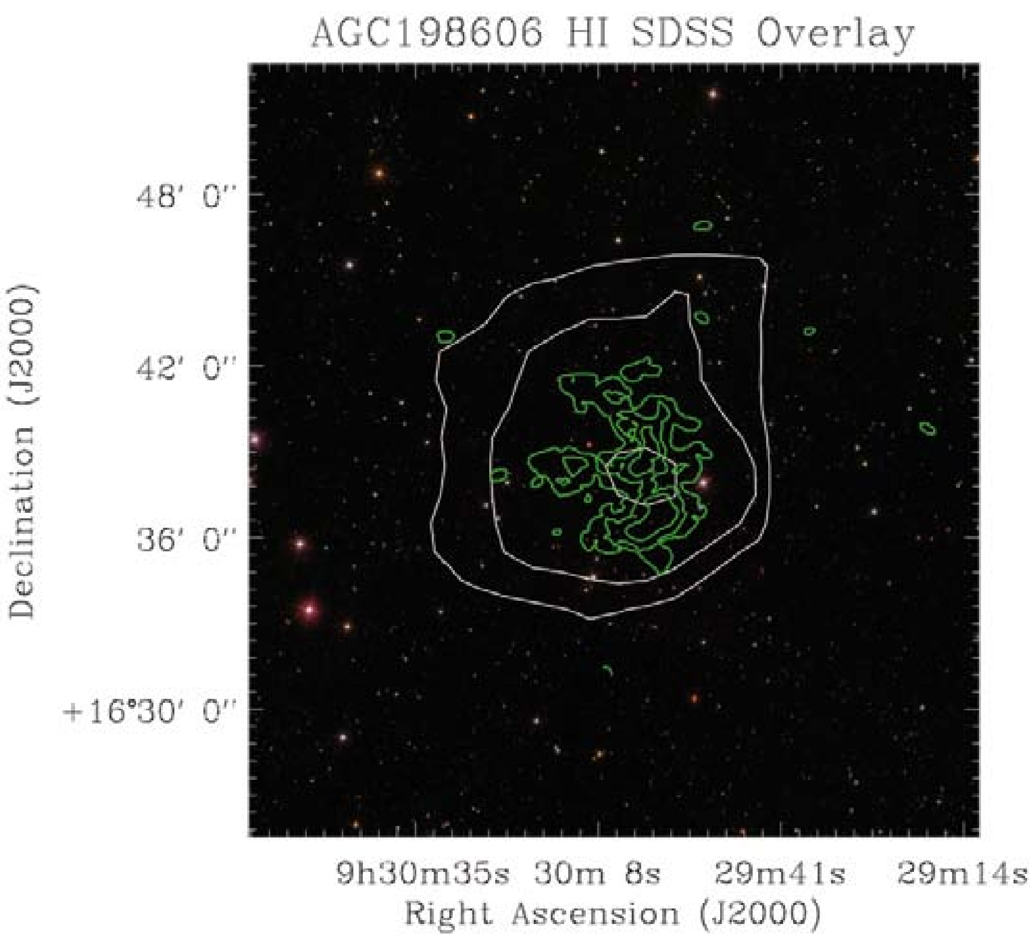
and kinematics of extraplanar HI gas in nearby spiral galaxies. A team including Gyula Jozsa, Paolo Serra, George Heald, Erwin de Blok, and Tom Oosterloo used new deep HALOGAS HI observations of NGC 3198 to produce a detailed model of the gas distribution and kinematics that matches best the observed data cube. This new model features a thick HI disk with a scale height of ~3 kpc and an HI mass of about 15% of the total HI mass; this thick disk also has a decrease in rotation velocity as a function of height (lag) of 7-15 km/s/kpc (though with large uncertainties). This extraplanar gas is detected for the first time in NGC 3198. Radially, this gas appears to extend slightly beyond the actively star-forming body of the galaxy (as traced by the Halpha emission), but it is not more radially extended than the outer, fainter parts of the stellar disk. Compared to previous studies the rotation curve is traced out to larger radii. The rotation curve is modeled in the framework of MOND (Modified Newtonian Dynamics), at modest fit quality is in this galaxy; but the new outer parts are explained in a satisfactory way. *(Paper: Gentile et al. 2013, Astronomy and Astrophysics, 554, 125).*

Ultra-compact High Velocity Clouds: Local Group Galaxies?

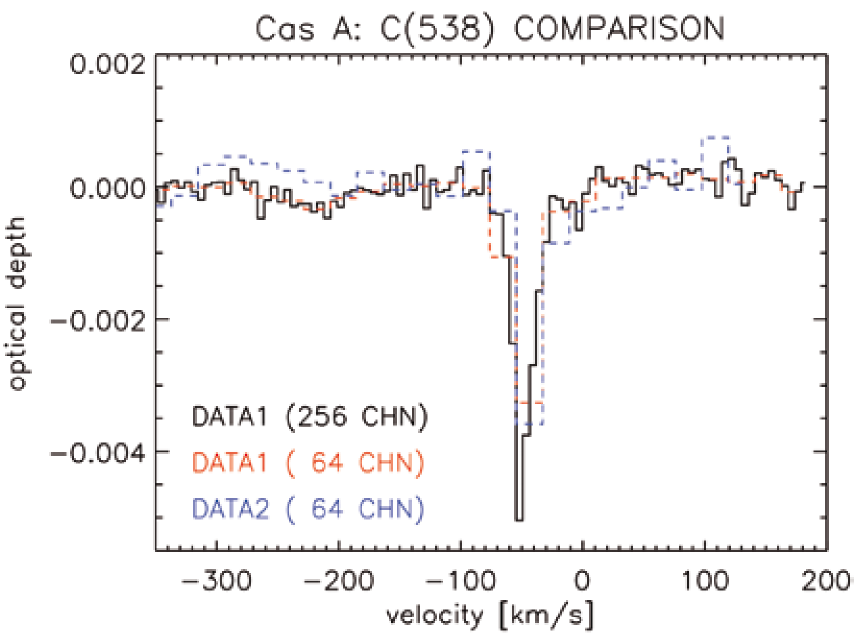
One recurring, intriguing idea is that overlooked Local Group galaxies may be discovered via their HI signature if they have a significant neutral gas component but little to no stellar content. Betsey Adams has compiled a catalog of ultra-compact high velocity clouds that have HI content and structure consistent with the hypothesis that they are gas-bearing minihalos in the Local Group. A team of international collaborators, including Betsey Adams and Tom Oosterloo, are studying these objects in detail to address the hypothesis that they are Local Group galaxies. These observations include deep targeted observations with the WIYN 3.5m telescope to search for stellar counterparts and HI imaging with Westerbork to study the HI morphology and kinematics. *(Paper: Adams et al. 2013, ApJ 768, 77)*

LOFAR detections of low-frequency radio recombination lines towards Cassiopeia A

In this letter, a team led by ASTRON astronomers Asgekar, Oonk, Yatawatta, van Weeren and McKean present the

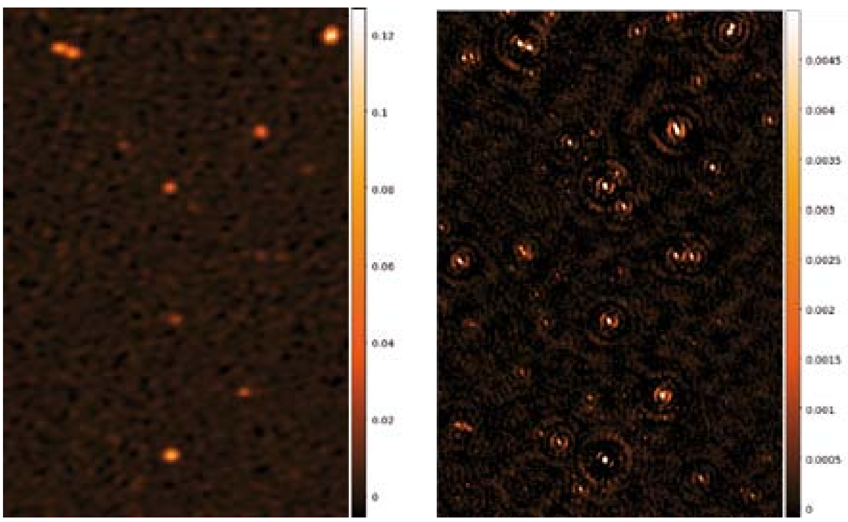


Total ALFALFA HI contours (white) and higher resolution WSRT HI contours (green) on top of a color SDSS image of one ultra-compact high velocity cloud.



Carbon 538 alpha RRL line detection towards Cas A with LOFAR LBA at 45 MHz. The plots shows the consistency between the two datasets (DATA1 and DATA2).

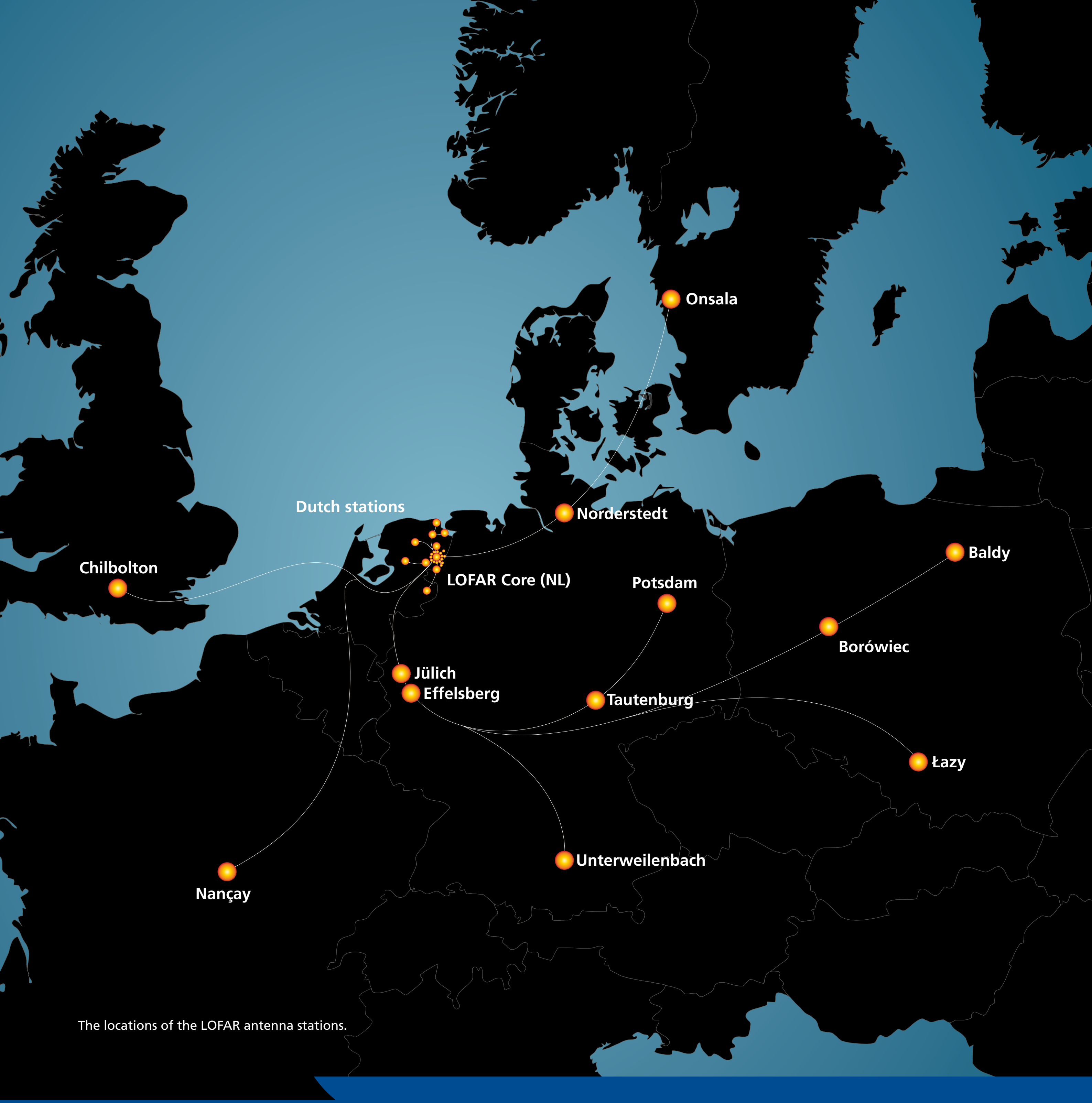
first detection of radio recombination lines (RRLs) with LOFAR. Cassiopeia A, a known strong low-frequency RRL source, was observed with the LBA during commissioning in April and Octobre 2011. Five Carbon alpha RRL's were detected in absorption between 40 and 50 MHz. The derived line velocities (v(LSR) ~ - 50 km/s) and integrated optical depths (~13 /s) of the RRLs in these spectra, extracted over the whole supernova remnant, are consistent within each LOFAR data set and with those previously reported. The spatial resolution of LOFAR allowed, for the first time, for extraction of spectra against the brightest hotspot of the remnant at low frequencies. Here significantly higher (~50 percent) optical depths are found, indicating that there is small-scale angular structure of the order of ~1 pc over the face of the remnant. These results demonstrate that LOFAR has the desired spectral stability and sensitivity to study faint spectral lines in the decameter band. *(Paper: Asgekar et al, 2013, A&A 551, L11).*



Comparison of the WENSS (left) survey with a small area of the LOFAR NCP image (right). Many more sources, at much higher angular resolution can be detected in the LOFAR image.

Epoch of Reionization

The aim of the LOFAR epoch of reionization (EoR) project is to detect the spectral fluctuations of the redshifted HI 21 cm signal. This signal is weaker by several orders of magnitude than the astrophysical foreground signals and hence, in order to achieve this, very long integrations, accurate calibration for stations and ionosphere and reliable foreground removal are essential. A total of five windows have been selected for deep LOFAR EoR observations. The results of commissioning observations of the north celestial pole (NCP) field, were recently published by Yatawatta, de Bruyn, Brentjens, and team. With about three nights of six hour each, a noise level of about 100 μJy/PSF was achieved. The best night produced a noise level only a factor of 1.4 above the thermal limit set by the noise from the Galaxy and the receivers. Artefacts that would prevent production of deeper images in much longer integrations were not found, and team is confident results will further improve with refined processing. *(Paper: Yatawatta et al. 2013, A&A 550, 136).*



The locations of the LOFAR antenna stations.

Radio Observatory

Operations with the Westerbork Synthesis Radio Telescope (WSRT)

Only about four FTE were expended over the year on WSRT maintenance, refurbishments, and other technical activities, divided over about a dozen Radio Observatory staff (mechanical, electronics, cryogenic, software, and network engineers, with specialist support from one of the systems engineers; and with assistance from personnel of other ASTRON departments). The three operators continued their regular biweekly duty roster, rotating primary WSRT, primary LOFAR, and backup responsibilities. One support scientist was in charge of WSRT scheduling, assistance to the PC, and data inspection. A satisfactory net efficiency of 72% was achieved (statistics given elsewhere).

Maintenance

Planned maintenance on the WSRT took one and a half days per week on average, with repairs in the lab continuing on other days. Corrective maintenance was needed for only eight mechanical problems in the year. However, the incidence of electronic and related problems is slowly rising. Especially the analogue part of the backend is showing its age, with nearly 32 units requiring repairs in 2013. One ADC unit had to be replaced. The DZB correlator required seven unscheduled reboots, and four DZB units required repair. There were thirteen MFFE receiver exchanges due to failed cryogenic parts; on one occasion a compressor in the cryogenic system failed. Four MFFE feed revolvers developed problems; on ten occasions an MFFE was repaired while in a telescope. The MFFE communications and control system had one problem. There were seven ICT related problems (failing hardware, one software problem). In September, a short power cut caused problems in one of the analogue-to-digital converter units. On two occasions, problems developed with the clock distribution in the WSRT system. During high winds and low temperatures in the early months of 2013, several radomes were damaged. All radomes were replaced in the fall of 2013 with new ones having an improved construction. On one occasion a lightning strike caused minimal damage to the WSRT.

Refurbishments

In June 2013, refurbishments of the telescopes started. Three telescopes were cleaned of rust and painted. The hour angle gearbox of five telescopes and the declination gearbox of four telescopes were refurbished in the fall of 2013. Also in June, the development of a new telescope controller prototype on RT2 was started; spare parts of the previous system, which is more than fifteen years old, are becoming unavailable.

Apertif

Preparations continued for the installation of Apertif. Following the placement of the containers to house the beam formers under each telescope in the spring of 2013 (see picture), the fibres connecting the beam formers with the correlator in the control building were installed; 72 of the 144 fibres in each bundle have initially been connected.

WSRT Science; selected highlights

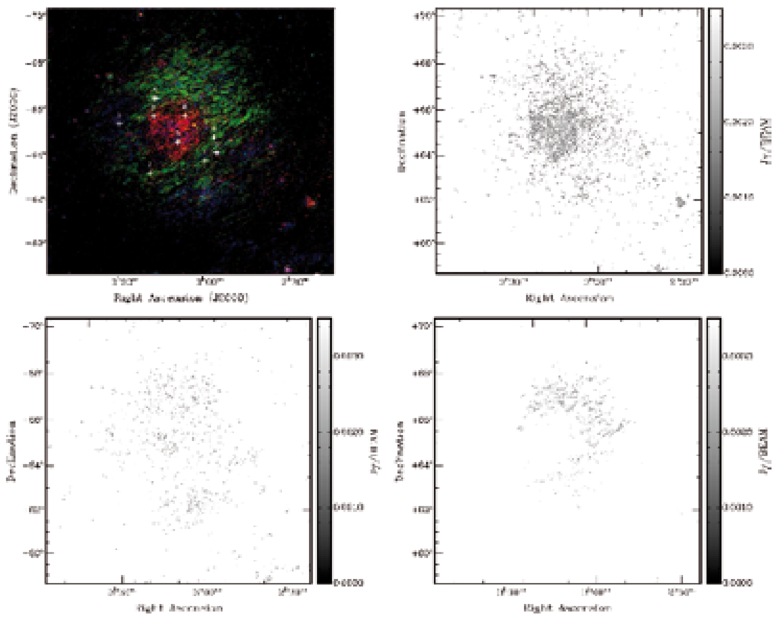
Rotation measure synthesis at 2 m wavelength of the FAN region

M. Iacobelli, M. Haverkorn, P. Katgert, A&A,549,A56 (2013)

M. Iacobelli for his PhD research used the Rotation Measure-synthesis technique at 2 m wavelength to study the complex Galactic synchrotron-emission foreground in a field in the Fan Region centred at (l,b) = (137°,7°) on scales of degrees down to arcminutes. A first structure found around RM = −5 rad m^{-2} is a nearby (probably ρ100 pc) synchrotron emission component with low Faraday depth, filling the entire field of view, suggested to correspond to the Local Bubble wall. A second, circular structure around −2 rad m^{-2} is most likely due to a nearby (distance about 200 pc) relic Strömgren sphere, →

Telescope cabins for the Apertif project at the Westerbork telescope.

associated with an old unidentified white dwarf star and expanding in a low-density environment. A third component around +2 rad m^{-2} is interpreted as the background in which the circular structure is embedded. At low Faraday depth values, a low gradient across the imaged field was detected, almost aligned with the Galactic plane. Power spectra of polarized structures in Faraday depth space provided evidence of turbulence. A sign reversal in Faraday depth from the nearby component to the circular component indicates a reversal of the magnetic field component along the line of sight.



Upper left: colour coded image of polarized intensity emission clipped at 3σ at three main Faraday depth ranges; white crosses denote lines of sight used to extract the Faraday dispersion spectra. PI clipped maps averaged over ranges in Faraday depth depicting the 'bubble', the 'ring' and the 'curtain' are shown clockwise in grey scale; red (upper right panel) is averaged PI over a range of $\phi \in [-13, -5]$ rad m^{-2}, green (lower right panel) is averaged PI over a range of $\phi \in [-4, -1]$ rad m^{-2} and blue (lower left panel) is averaged PI over a range of $\phi \in [0, +5]$ rad m^{-2}.

Unique Gravity-Lab Discovered and Modeled

Radio pulsars are famous for providing precision tests of gravitational theories. Astronomers use the clock-like signal from pulsars to precisely determine their position on the sky, their rate of energy loss, and their orbital parameters. By precisely timing the arrival of the pulsar's pulses in a relativistic binary, we can test how well general relativity (or any gravitational theory) is able to describe the data. Different pulsar systems test our understanding of gravity in different ways, and constraining the validity of the theory is of fundamental importance to physics.

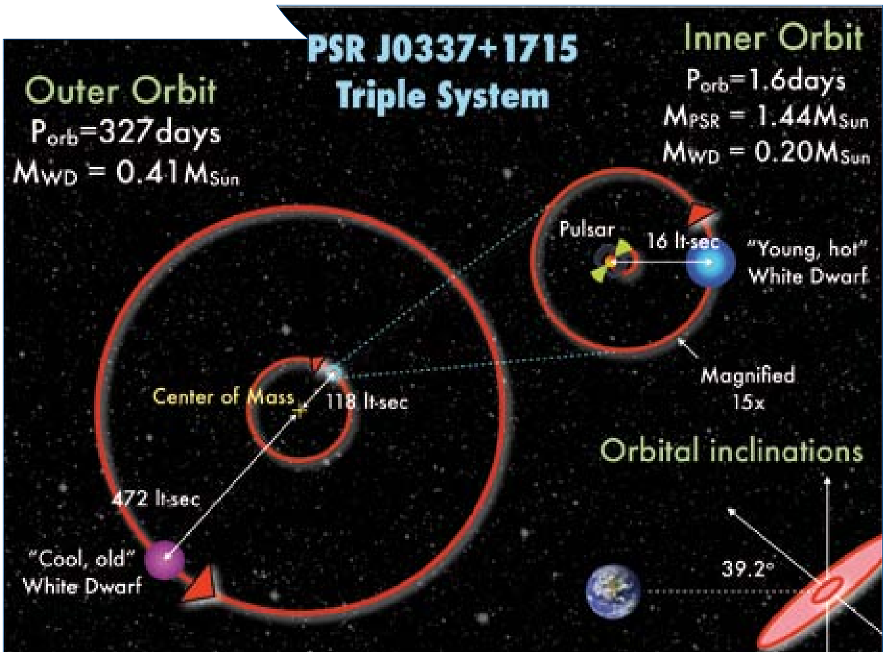


Figure 1: Diagram of the PSR J0337+1715 system, showing the orbital sizes, inclinations, and component masses derived from modeling the pulsars pulse arrival times. Credit: Jason Hessels (ASTRON/UvA).

In late 2012, an international team discovered PSR J0337+1715, a unique radio pulsar in a stellar triple system, using the Green Bank Telescope (GBT). This millisecond pulsar is in an inner orbit of 1.6 days with a white dwarf. That binary, in turn, is orbited by another white dwarf every 327 days! WSRT's PuMaII recorder observed the pulsar nearly every day for a year, in order to provide a detailed picture of the timing variations. Anne Archibald took these input measurements of the pulse arrival times and used them to construct a comprehensive picture of the orbits, stellar masses, and geometry (Ransom, Stairs, Archibald, Hessels et al. 2014, Nature, 505, 520). Importantly, the interactions between the inner and outer orbits provide additional information, which allowed Anne to determine the individual masses separately. A diagram of the system is shown in Figure 1. ➔

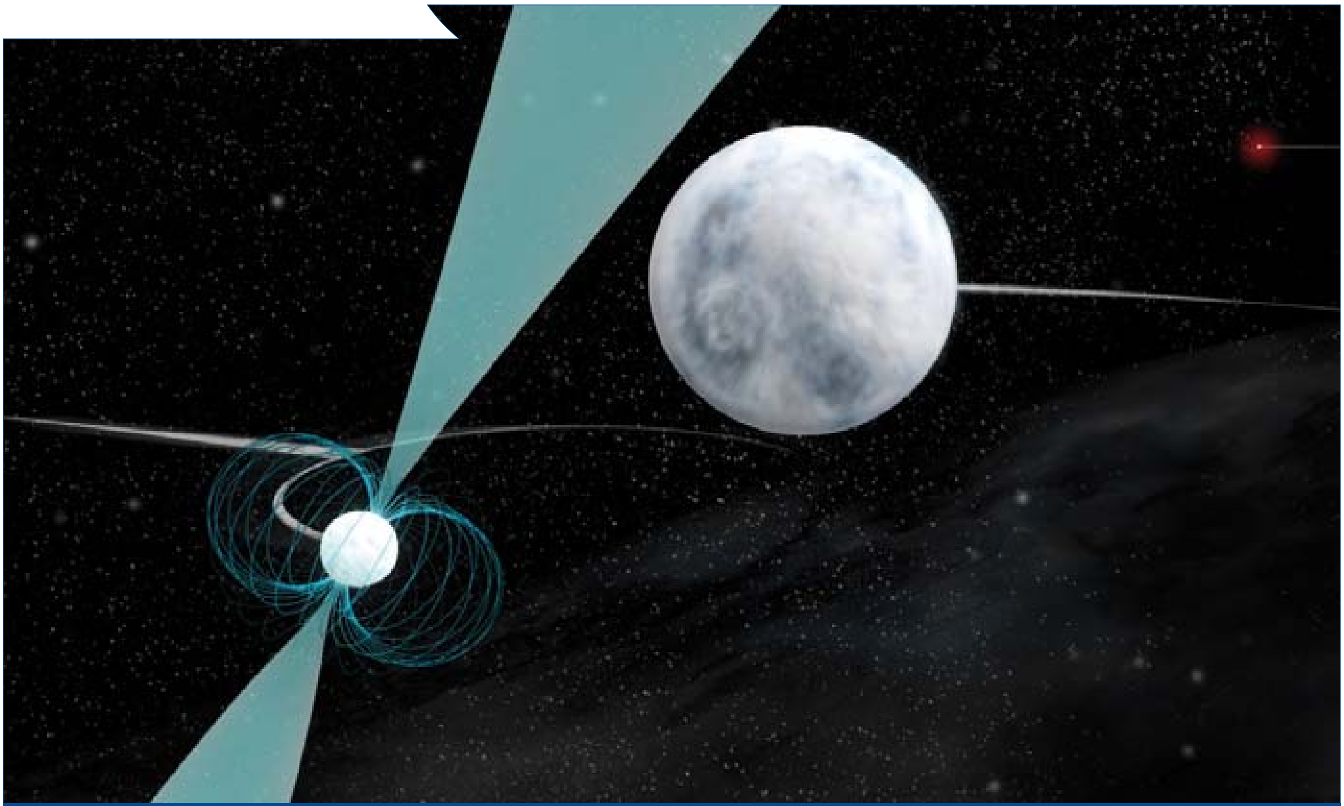


Figure 2: Artist's conception of the PSR J0337+1715 system. Credit: Bill Saxton; NRAO/AUI/NSF

While the PSR J0337+1715 system is unique and incredibly interesting from the point-of-view of its formation (see Tauris & van den Heuvel 2014, ApJ, 781, 13), it's even more exciting in terms of its prospects as a gravity-lab. In the PSR J0337+1715 triple system we can test the strong equivalence principle by looking for differences between how the pulsar and inner white dwarf fall in the gravitational potential of the outer white dwarf. The pulsar is extremely dense and thus has a large fractional gravitational binding energy. This gives us a tremendous lever arm for testing for deviations from general relativity; that is something we have begun testing using the high-precision pulsar timing measurements we continue to acquire.

The International LOFAR Telescope

LOFAR Hardware Improvements

In 2013, 244 HBA front ends were replaced, and 213 HBA front ends were repaired in situ (a HBA tile contains 16 front ends). Also, 100 damaged LBA antennas were replaced.

Radio Observatory engineers visited seven international stations for annual maintenance. Repair work was done in cooperation with local personnel. One station was fully maintained by local personnel, with on-line, remote assistance provided by Radio Observatory personnel.

In 2013, the SyncOptic boards, that distribute a common clock signal to the receivers in a station, were installed on all international stations. This has significantly improved the forward gain and stability of the station beams. The six superterp stations received upgraded SyncOptic boards, freeing one fibre link to each of these stations for use by AARTFAAC.

Thanks to a generous donation by H. Falcke (Radboud University Nijmegen) the memory modules of the Transient Buffer Boards of all Dutch LOFAR stations were upgraded to hold 5.2 seconds of data (up from 1.3 seconds) at full bandwidth. Five international stations were also upgraded.

LOFAR Long Term Archive

In early 2013 the data products ingested into the LOFAR Long Term Archive (LTA) became dominated by preprocessed 'sliced' observations. In order to keep up with the observations, small data product ingest performance was improved by a factor of more than 25.

The LOFAR imaging pipeline software was deployed on Grid clusters at all three LTA sites in Groningen, Amsterdam, and Jülich, although still in the testing phase by the end of 2013.

Access to the Groningen LTA site was severely reduced. Most significantly, an irregular system shutdown, resulting from a cooling system failure in early August, left the Target file system corrupted. By the end of the year, access to all stored data (themselves almost fully intact) had still not been restored, and the ILT decided not to store more data at the Groningen node for the time being. ➔

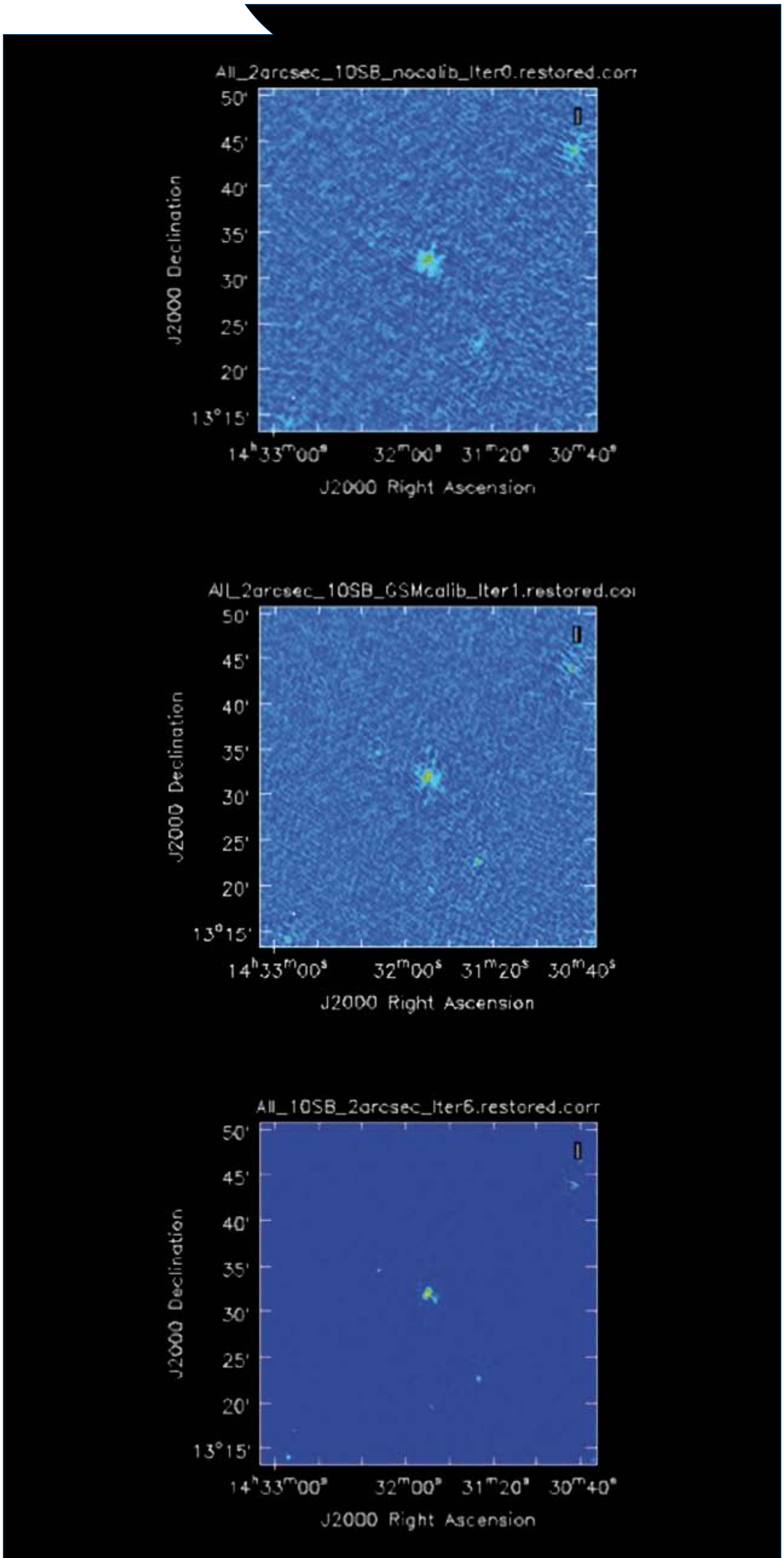


Figure 1: Illustration of the improved LOFAR image quality by the self-calibration enhancements developed by the CITT. Far left: HBA image quality without phase calibration, noise level 50 mJy. Center: Single-pass, GSM-based calibration in the current default imagine pipeline, noise level 10 mJy. Far right: 5 cycles of automated self-calibration using the development version of the pipeline, noise level 2 mJy.

LOFAR Software Development and Commissioning

As resources were shifted to COBALT development, the overall level of development of other new functionality decreased sharply. Throughout the first half of the year, the focus was on stabilizing and improving the operational system in everyday use for Cycle 0, guided by the weekly LOFAR Development Meeting (LDM).

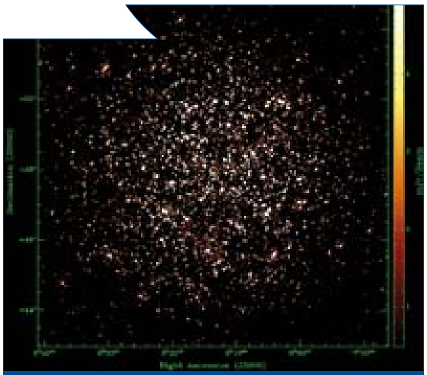
A significant development was the formation of the six-person Calibration & Imaging Tiger Team (CITT), focused solely on major enhancements to all of the principal parts of the imaging pipeline. The CITT was integrated in August 2013, with ASTRON directors' discretionary funding, a contribution from the ERC grant of R. Morganti, and later, an in-kind contribution from GLOW.

Key developments in 2013 were:

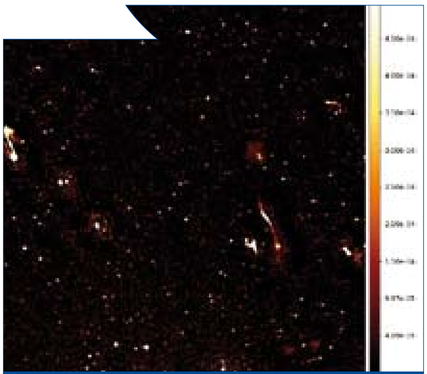
- Proof of concept to correct, for the first time world-wide, direction-dependent ionospheric effects in the image plane (using the awimager).
- Development of a self-calibration pipeline that enables substantially improved images when compared to the standard pipeline (see figure), through the use of automatic techniques.
- Implementation of 'atomic' calibration tasks as faster and more efficient routines.
- Implementation of the beam-prediction model as a standalone software module that can be shared in a convenient and consistent way across the various pieces of software that require its use.

LOFAR Science: selected highlights

Steady, significant progress in improving the low frequency data reduction and imaging techniques has enabled an impressive range of LOFAR science results in 2013. Here is a selection. ➔



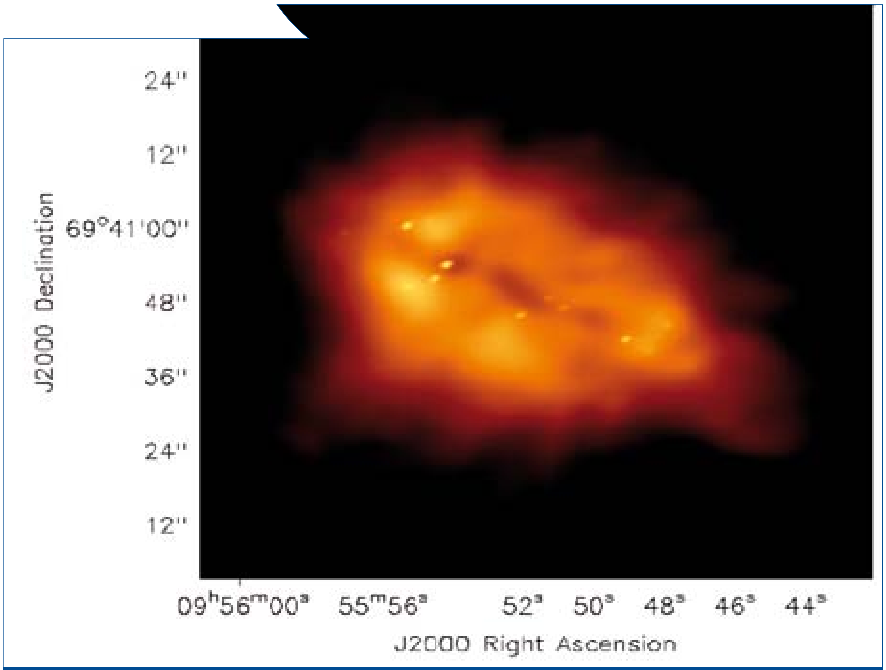
LOFAR HBA image of the 3C196 field (courtesy of V. Pandey)



LOFAR HBA image of the NCP field (courtesy of S. Yatawatta)

The Epoch of Reionisation group has used specialized software to perform direction-dependent calibration in hundreds of directions. On the left is shown their 3C196 image (courtesy of V. Pandey), with a record-breaking dynamic range of about 0.5 million, and a noise level of 0.15mJy/beam. On the right, their NCP image is shown (courtesy of S. Yatawatta). After integrating about 200 hrs of data, the EoR group reached here a noise level of about 25 μJy/beam; this is the deepest low frequency map ever made.

The remarkable 140 – 160 MHLOFAR image (courtesy of R. van Weeren) of the galaxy cluster RX J0603.3+4214 (see the picture on the right) reveals diffuse cluster emission at a resolution (6 arcsec) and depth (200 μJy/beam, close to thermal noise, after correction for direction dependent errors). For the first time, this allows direct comparison to higher frequency data, as shown in deep Giant Metrewave Radio Telescope images.

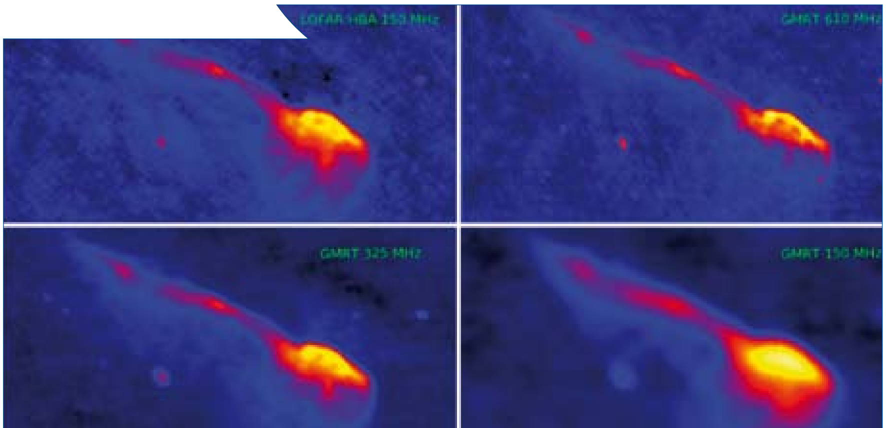


LOFAR HBA image of the central starburst region of M82 (courtesy of E. Varenius)

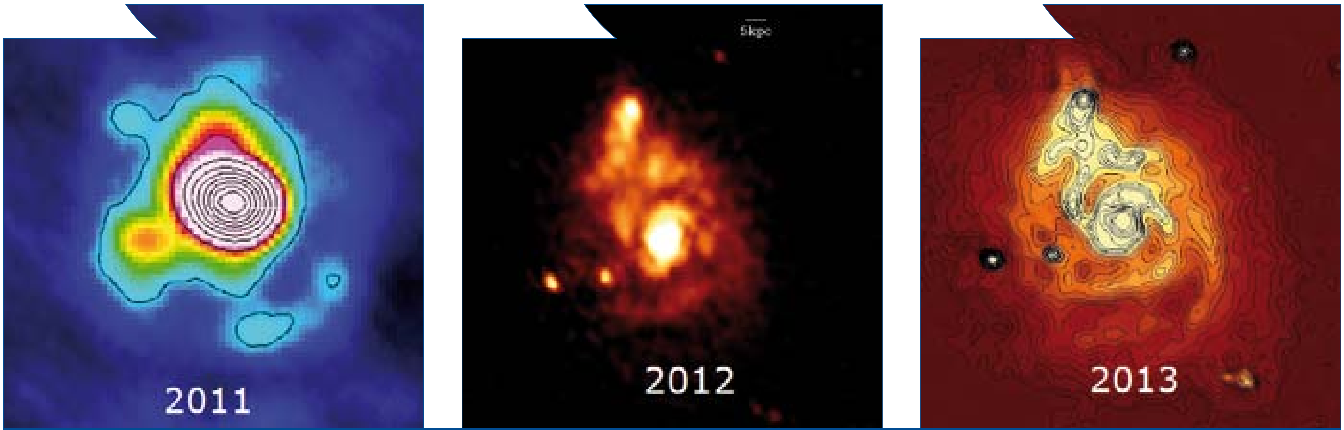
The improvement over time of LOFAR image quality is dramatically illustrated with HBA commissioning observations of the grand-design spiral galaxy M51 (courtesy of D. Mulcahy). The image rms noise level by 2013 has decreased to 0.3 mJy/beam, which is the most sensitive image of a galaxy at frequencies below 300 MHz to date. The disk can be observed to extend out to 16 kpc; the largest extent of M51 detected so far in radio continuum.

Significant progress was also made in 2013 in calibrating and imaging LOFAR datasets that include the international baselines. A highlight is the sub-arcsecond image of the central starburst region of the nearby galaxy M82. The image above (Courtesy of E. Varenius) shows a population of compact Supernova Remnants embedded in diffuse emission. This is the first weak extended object to be imaged by the full International LOFAR Telescope, and the resulting image is a new record in terms of image resolution at low frequencies.

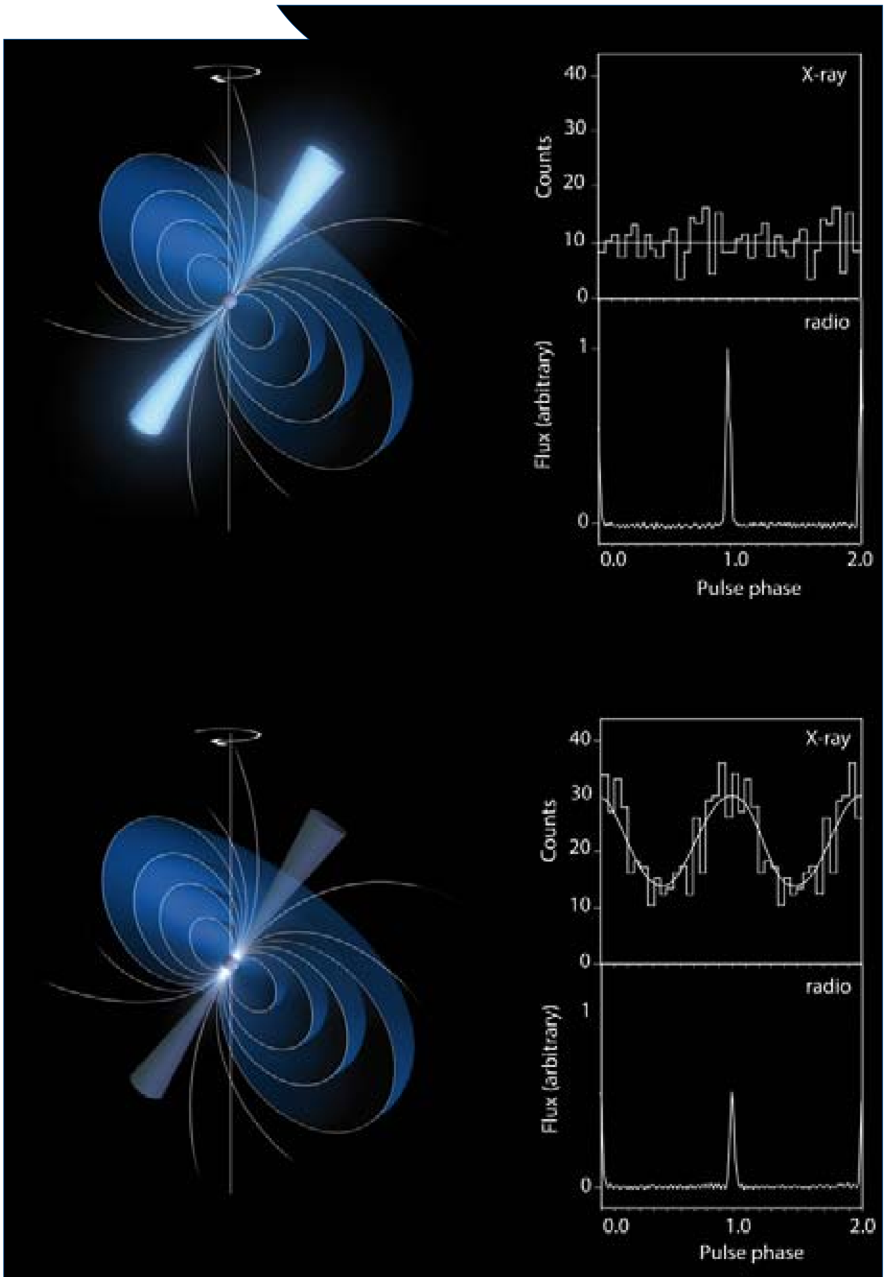
The figure on the next page illustrates one of the most remarkable scientific results obtained by the Pulsar Working Group in 2013, published in Nature by Hermsen et al. 2013. Pulsar PSR B0943+10 is well known for switching →



LOFAR HBA image of the 'toothbrush' relic source in RX J0603.3+4214 compared to GMRT



LOFAR HBA images of M51



LOFAR Pulsar profiles of PSR B0943+10

between a 'bright' and a 'quiet' mode at radio wavelengths. Observations of PSR B0943+10, performed simultaneously with the XMM-Newton X-ray satellite and ground-based radio telescopes (LOFAR and GMRT), revealed variations in X-ray emission that mimic in reverse the changes seen in radio waves.
There is as yet no model to explain the behaviour.

The MSSS project

The HBA portion of the Multifrequency Snapshot Sky Survey (MSSS) was nearly completed in 2013, with 95% (15000 square degrees) of the northern sky observed and processed with the initial standard round of calibration and imaging. Much of the analysis focused on the 'MSSS Verification Field (MVF)', a 100 square degree region. This has been used for testing and quality control, and is now the first science-ready data product. The MVF image, shown on the right page (courtesy of G. Heald), has a noise level of approximately 10 mJy/beam with a synthesized beam of 2 arcmin.

CRAF and Frequency Management

CRAF

On 1 February 2013 Hans van der Marel (Radio Observatory System Scientist) became chairman of the Euro-African Committee on Radio Astronomical Frequencies (CRAF). ➔

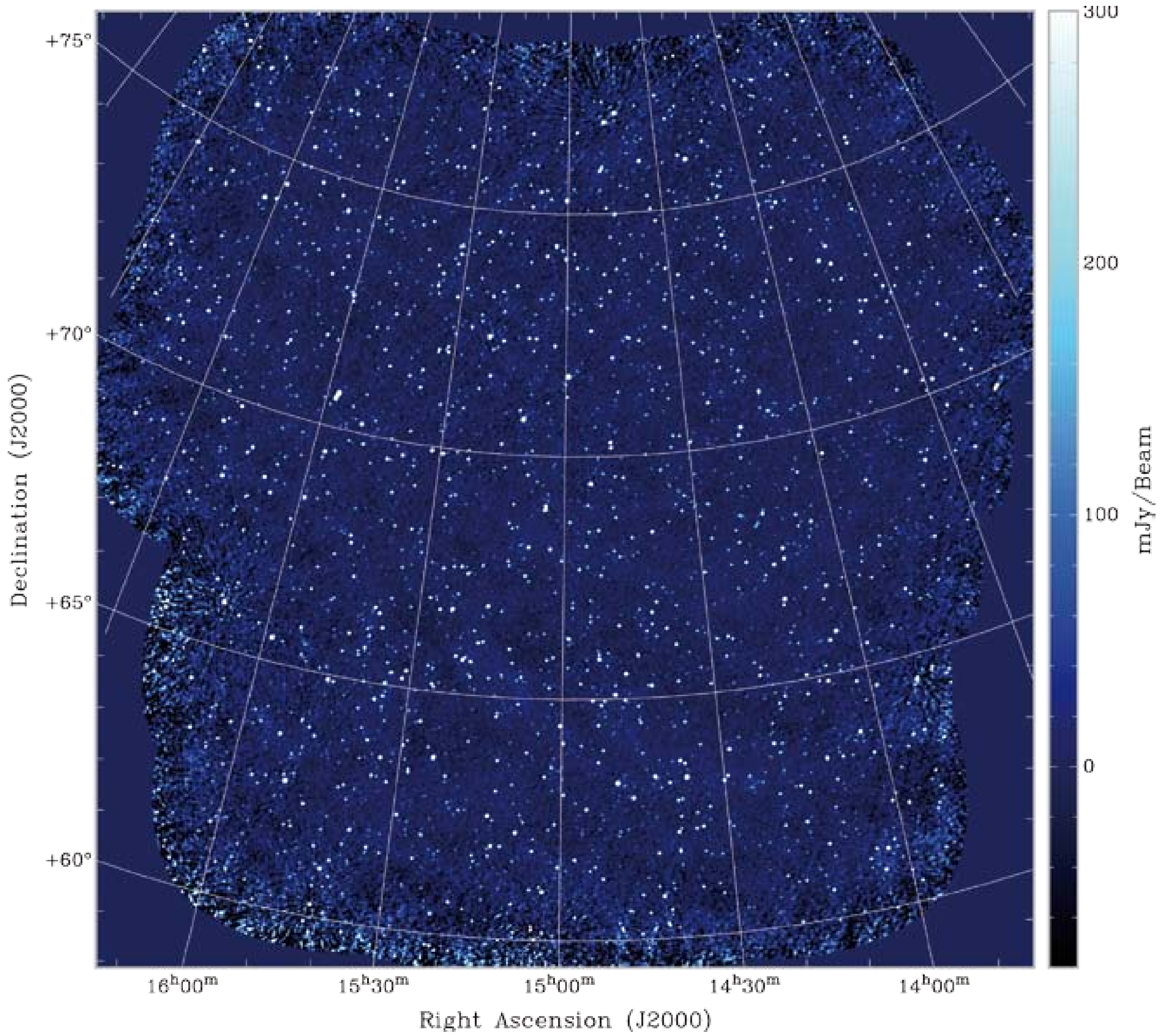
In 2013 the most important issues for CRAF were:

- Preparation for World Radio Conference 2015 (WRC-15); especially agenda item 1.1, about new allocations for mobile broadband in the frequency range 470 MHz up to 6 GHz.
- Short range radar in the 77 GHz band.
- Discussions with Iridium have been intensified, with the aim that the interference from the satellites in the band 1610.6-1613.8 MHz will decrease with the planned modernization of the constellation of satellites.

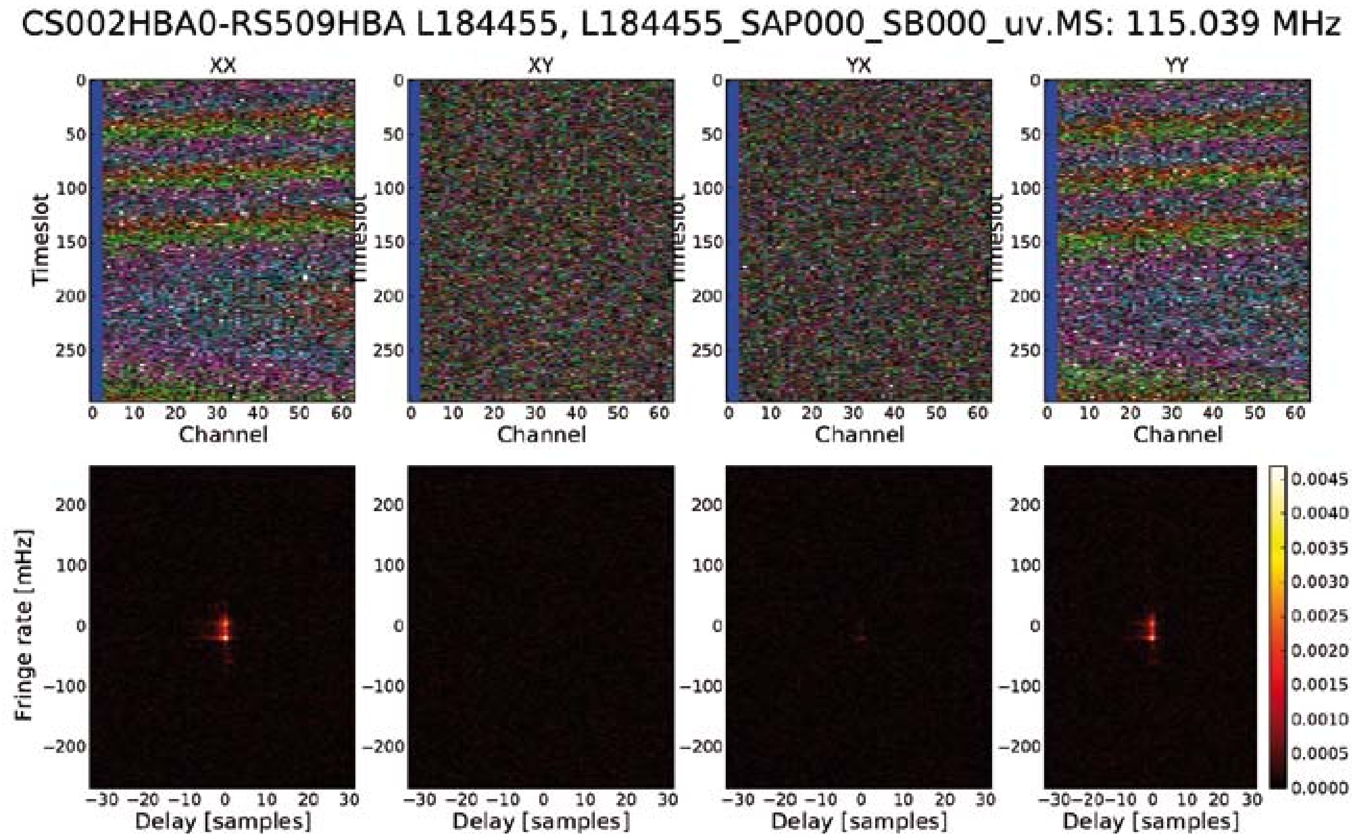
National Frequency Management Issues
On 15 March 2013 a new telecom law came into force in the Netherlands. Radio astronomy is a recognized governmental telecommunications service. A 'Behoefte Onderbouwingsplan' (BOP) – a plan required to substantiate the needs for national use of frequency – was drawn up for radio astronomy by ASTRON on behalf of the Ministry of Education, Culture, and Science, which submitted it to the national telecom agency in June 2013.

In the 608-614 MHz radio astronomy band the regulatory authorities have made possible the use of low-power wireless microphones, but under strict conditions, with ASTRON being consulted to ensure there will be no interference to the WSRT.

ASTRON is participating in a working group from the Dutch Telecommunication Agency on the scientific use of the radio spectrum and in the national preparation for the WRC-15.



LOFAR HBA image of the MSSS Verification Field (MVF)



First Fringes of LOFAR's next generation correlator (COBALT: the Correlator and Beamformer Application platform for the LOFAR Telescope) on 3C 295. The plot show the fringes (the wavy patterns on the top left and top right) as well as delay-rate spectra for the 55 km long baseline between CS002HBA0 and RS509HBA at 115 MHz. Cobalt was listening to live data from all Dutch LOFAR stations. More information is available on: *http://www.astron.nl/dailyimage/main.php?date=20131106.*

Project highlight: COBALT, Correlator and Beamformer Application for the LOFAR telescope

COBALT

On January 1st 2013, ASTRON started the COBALT (COrrelator and Beamforming Application platform for the LOFAR telescope) project to develop a CPU-GPU based system as the central correlator and beamforming platform for the International LOFAR Telescope (ILT). The COBALT system will replace the IBM BG/ P system for which the lease expired at the end of 2013. The ILT Board requested ASTRON to develop and deliver the COBALT system.

Figure 1. One of the COBALT nodes.

The COBALT system is a co-design of both Commercial-Of-The-Shelf hardware components and ASTRON written software. The system consists of eight production nodes and one development/ test node, each consisting of two CPUs (Intel Dual Xeon E5) and two GPUs (NVIDIA K10) housed in a DELL T620 box and connected by an FDR Infiniband Switching network. This gives a balanced system where each CPU connects to one GPU, one Infiniband port and two Ethernet ports and both CPUs within one node are also connected. The cooling of the GPU cards in this set-up turned out to be an issue. Special air ducts were designed and constructed by the ASTRON Mechanical Department and the CIT Groningen, which provided enough cooling for the cards. The full system passed certification by DELL at the end of the year.

The development of the software was based on existing research code in OpenCL for the correlator application, whereas the beamformed application was developed from scratch. The implementation was done in C++ and CUDA by a core team of four people making use of three weekly Agile / Scrum development cycles. This approach in combination with a focus on continuous integration and testing proved very effective. The correlator pipeline had first light in June, just before the hardware arrived. From then on the development of the beamformed pipeline started.

In the second half of the year the project was facing some delays. The final hardware became available later as planned, which delayed the start of full system testing. In parallel to the COBALT project also the network around the system was planned to be upgraded by replacing the switches. This, however, proved far more problematic than anticipated and in the end we had to resort to returning to the original configuration. The network reconfiguration will now be re-executed after the finishing of the COBALT project. As a result of these network problems, some key people were not available for COBALT development tasks, delaying the progress of the project.

Despite these delays, by the end of the year the correlator pipeline was ready for production testing and the beam formed pipeline was ready for initial commissioning tests. It was clear however that the COBALT system could not yet replace the BG/P as a production system for the LOFAR telescope. After an Operational Readiness Review in December it was therefore decided to extent the BG/P lease and to finish the COBALT project in the beginning of 2014.

Full-system fringes were achieved by the end of October. You can see an image of this at the beginning of this chapter..

Figure 2. New and old: the COBALT system (left) and the Blue Gene / P (right).

Artist impression of the Mid-Frequency Aperture Arrays of the Square Kilometre Array (SKA), to be located in the Karoo in South Africa. The SKA Aperture Array MID (AAMID) consortium, led by ASTRON, deals with the specification, design and verification of the Mid-Frequency Aperture Array (MFAA) component of the SKA.

R&D Laboratory

In 2013, a significant step towards the realization of the Square Kilometre Array (SKA) was the start of the design phase by the global SKA community. The Square Kilometre Array is the the next generation 'Big Data' radio telescope, to be located in South Africa and Australia. ASTRON plays a major role by leading two consortia on Low and Mid Frequency Aperture Arrays (LFAA and MFAA). We build directly on our unique expertise in designing and operating LOFAR and EMBRACE. Furthermore, our joint research with IBM in the ASTRON & IBM Center for Exascale Technology is essential for the success of the SKA consortia Science Data Processor (SDP) and Central Signal Processor (CSP).

The most important developments in 2013 for our observatories LOFAR and Westerbork are the projects COBALT and APERTIF. For LOFAR, the replacement of the Blue Gene supercomputer by COBALT, a parallel computing infrastructure using Graphic Processing Units (GPUs) demarcates a new era of parallel computing. APERTIF, the Phased Array Feeds in the focus of the Westerbork dishes will provide an enormous increase in the survey speed of the instrument. All the developments are supported by the continuous output of many research projects. With regard to valorization, radio astronomy provides essential technology to societal innovation as for instance shown by valorization projects like PAASAR on Search and Rescue.

Development

AARTFAAC

The AARTFAAC (Amsterdam-ASTRON Radio Transient Facility And Analysis Centre) project aims at probing the extremes of astrophysics. Within the AARTFAAC project a radio all-sky monitor is being built by adding hardware, firmware and software to the LOFAR telescope, primarily on the superterp. The number of input channels to be correlated is the largest for any radio telescope built so far and paves a way towards the SKA. In 2013, the AARTFAAC hardware was installed in the field and the firmware required to transport the data from LOFAR to a central location was written and tested. Furthermore a GPU correlator is installed in Groningen.

APERTIF

The APERTIF project is an upgrade of the Westerbork Synthesis Radio Telescope (WSRT) that will greatly improve its survey speed. As a result, large areas of the sky can be observed ten to twenty times faster than currently possible. APERTIF uses Phased Array Feeds and builds heavily on technology development in wideband antenna arrays, room-temperature low noise amplifiers, digital signal processing and calibration techniques.

In 2013, the detailed design of most hardware components was completed After a European public procurement procedure, the production of hardware for ALPHA-3, a 3-dish prototype system of APERTIF, was started. The UniBoard-based digital beam former that combines the signals from the individual PAF elements was completed and demonstrated its capabilities by the measurement of an HI absorption line and a pulsar over 300 MHz bandwidth. At the WSRT, the infrastructure for APERTIF has been prepared: Faraday cages and fiber-optic links were installed at all APERTIF dishes.

SKA LFAA and MFAA

In 2013, ASTRON took a leading role in the design of Aperture Arrays for the SKA. Based on the work carried out since 2010, the Aperture Array Design Consortium (AADC) was formed to write a bid for the Low Frequency Aperture Array (LFAA) Element of SKA1-Low. The consortium is led by ASTRON and includes partners from the UK (Cambridge and Oxford University), Italy (INAF), Australia (ICRAR) and China (KLAASA), with some smaller contributions from associate members. After negotiations with the SKA Office the bid was successful and the consortium had its kick-off in November 2013. The consortium objectives are to deliver Preliminary and Critical Designs to the SKA for review in 2014 and 2015 respectively.

During the above process the technical design work continued. A small test array installed in the Murchison Radio Observatory (Western Australia) delivered very useful data, in particular together with the MWA (Murchison Widefield Array), a low frequency SKA precursor. Uniboard systems have been built by ASTRON and its industrial partners for the signal processing back-end of the sixteen antenna elements test arrays, one for testing in Europe and one for testing in Australia. Radio on Fibre (RFoF) test links have been realized tested, an important technology for LFAA. The system progressed, in particular by building on the extensive knowledge of LOFAR. →

The SKA Mid Frequency Aperture Array Consortium, led by ASTRON as well, has also successfully reached agreements with the SKA Office. It is the most important SKA advanced instrumentation project.

SKA NN

The project SKA Noord-Nederland is a collaboration between ASTRON, MAJOR, NEWAYS, IsiTerra and S&T. SKA-NN is supported by funding from the EC/EFRO programme and the Northern Netherlands Provinces (Samenwerkingsverband Noord-Nederland, SNN), the Koers Noord programme, and from the province of Drenthe and the province of Groningen.

The focus of the project is the concept of 'Smart Antennas': intelligent, autonomous sensor systems within large networks. The project and the collaboration between science and industry elevate the technology for such systems towards other markets like health care, telecommunication, security and mobility.

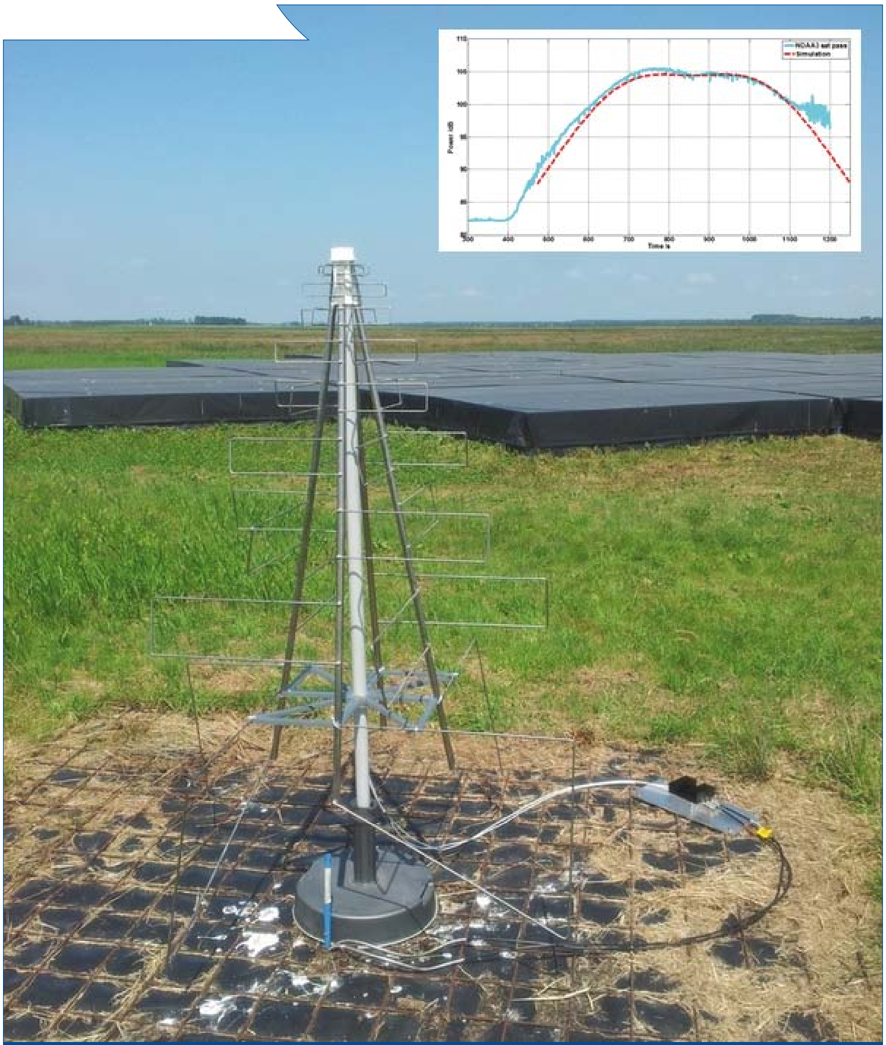
In 2013, several demonstrators have been delivered such as the EMBRACE test facility, the Uniboard system and the Environmental Tiles for the Mid Frequency Aperture Array in South Africa.

The collaborating companies are very positive about the project and the outcome so far. They strengthen themselves by creating knowledge, doing research, investing in new technology and/or quality improvement of the production and with that strengthen themselves on the market or even explored new markets.

Research

DOME

The DOME project, a collaboration between ASTRON and IBM, entered its second year in 2013. The technologies under study are focused on the signal processing challenges for the Square Kilometre Array (SKA) and the results feed directly into the SKA Work Package Consortia SDP and CSP, which started end of 2013 and will be delivering designs for the SKA preliminary design review and critical design review by the end of 2014 and 2016 respectively. Although aimed at the SKA, the DOME research output is applicable to a wide range of Big Data areas.



An LFAA antenna on the LOFAR field.

The DOME teams, based at the ASTRON & IBM Center for Exascale Technology in Drenthe at ASTRON and at the IBM Zurich Research labs, have made significant progress in the three research areas: 'sustainable green supercomputing' (reducing the energy consumption of computer systems)', 'extreme streaming' (real-time processing of gigantic data volumes), and 'nano-photonics' (optical technologies for superfast data transport).

Concerning 'green computing', the experience gained in the first year with the LOFAR retrospective analysis enabled the team to make a computing and power efficiency model. This model was applied to a number of envisioned telescope (sub) systems of the SKA, showing that many of these systems are well balanced and feasible whereas some other (subs) system concepts are not practically or economically feasible within the SKA phase-one time frame. This was one of the DOME inputs into the SKA Science Data Processor consortium (SDP), which is concerned with designing the post-correlation imaging and non-imaging processing stages. ➔

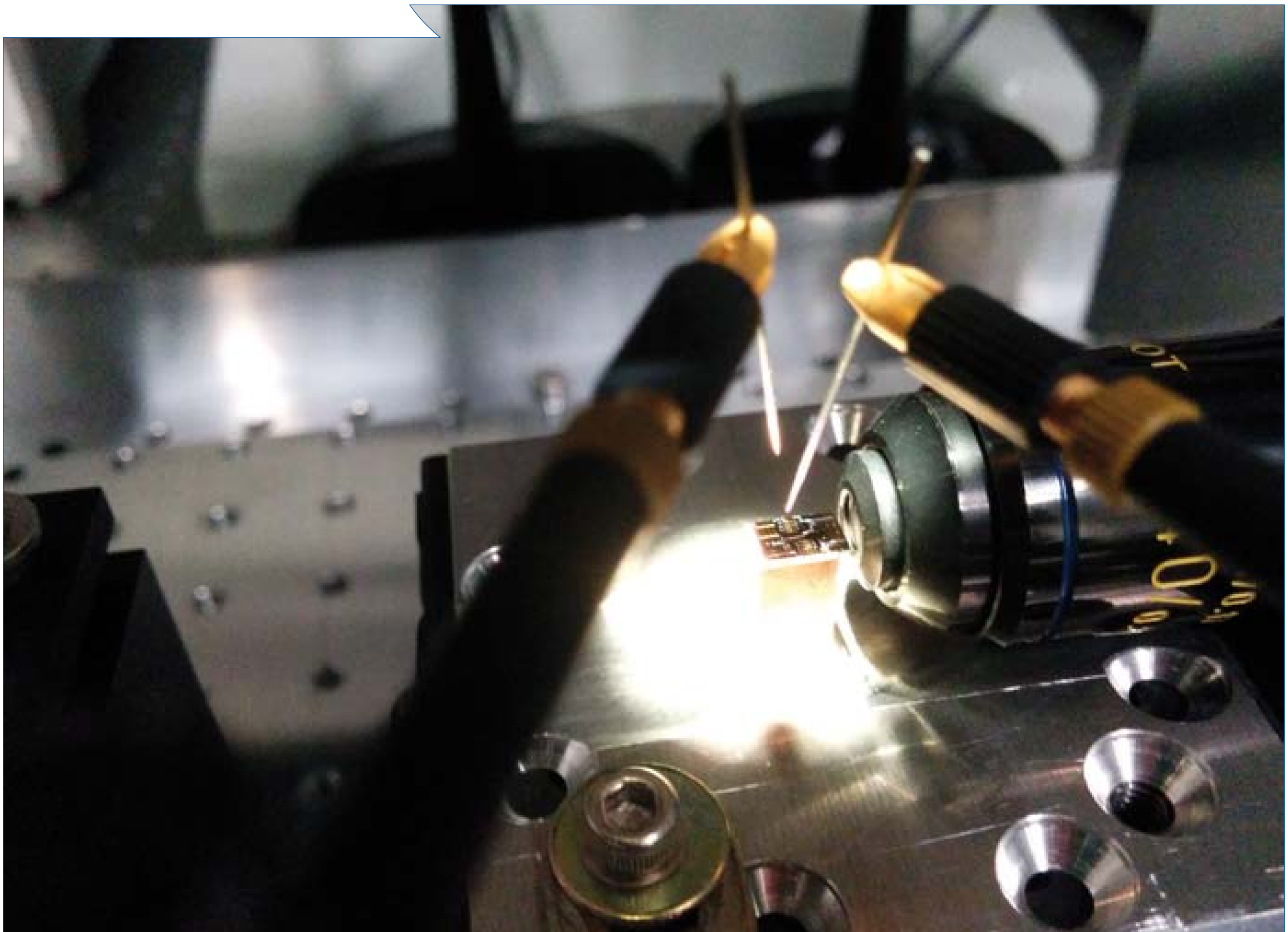
The work also included designing a modular system of three integrated circuits (ASICs), capable of carrying out basic functions such as spectral filtering, beam-forming and correlation. The circuits can be connected in different configurations, allowing a power reduction of a factor three compared to conventional approaches. This approach is put forward as a potential solution in the Aperture Array consortium (LFAA) and the correlator consortium (CSP).

As dedicated integrated circuits are less flexible when running complex algorithms on large volume data streams, the project also focuses on accelerator technologies. Accelerators are computing platforms designed to be optimal for certain classes of algorithms, for example graphical processing units (GPUs). The project made progress with assessing compute and power performance for a range of complex algorithms, applied to several types of accelerators. This experience is input to the SKA CSP and SDP consortia, especially the recent design experience of a GPU-based correlator. In addition, the project also produced a second micro-server (accelerator), currently on a test-bench and functioning.

In the research area 'extreme streaming', the storage architecture simulation system delivered in 2012 was extended to include data size and access time. Now it is possible to simulate and derive an optimal tiered storage system for a (controlled) fixed cost.

In the 'nano phonics' area, after studying digital interconnection technology in the first year, the team started looking into the designs of the Signal and Data Transport (SaDT) consortium. Concerning analogue photonics, work focused on radio frequency over fibre (RFoF) signal transport for the aperture array consortium (AA-low). Initial results indicate that RFoF signal transport may be very a cost-effective solution for transporting the signals from all antennas to central signal processing bunkers.

The connection between the DOME project and the SKA consortia is starting to shape up, but also the DOME Users Platform is gradually expanding. Two SME companies and two knowledge institutes joined the DOME Users Platform in 2013. The partners collaborate with the DOME teams on micro-servers, storage technologies, accelerators, and novel algorithms. More information about the DOME project can be found on *http://www.dome-exascale.nl/.* ➔



Photonic laser array chip.

Low Noise Tile (LNT).

UNIBOARD^2

In the UniBoard^2 project, a next generation complex signal processing board is developed, which can be used for several applications. As in UniBoard, standard interfaces are used to maximize the usability. The main goal is to use this technology for the signal processing in the SKA (Square Kilometre Array) aperture arrays. In 2013, the architecture of the board has been defined and agreed amongst all the European partners in the project led by JIVE. Furthermore a document has been produced about coding interfaces and conventions for the firmware of UniBoard^2.

Low Noise Tile

The Low Noise Tile (LNT) project is a research project to demonstrate the feasibility of a phased array tile with a very low noise temperature, an essential technology for the mid-frequency SKA aperture array. The first generation low noise tile was presented in 2011 and reached noise temperatures under 50 K. The commercial availability of better low noise amplifiers triggered the current LNT project with aims to decrease the system temperature by another 15 K. The resulting array will also be used for the comparative testing of Phased Array Feeds by the SKA Dish Consortium at the Parkes telescope in 2014.

Calibration

Considerable progress has been achieved in various aspects of calibration. The Statistically Efficient and Fast Calibration (StEFCal) algorithm was further developed by Stefan Wijnholds together with Stef Salvini (Oxford e-Research Centre) and Oleg Smirnov (Rhodes University). StEFCal is an Alternating Direction Implicit method to solve for antenna based gains, whose algorithmic complexity is only N^2, meaning that the required compute time scales with the square of the number of parameters to solve for. This is a significant improvement over non-specialized solvers, whose compute time typically scales with N^3. They have proved convergence of the algorithm in all practical circumstances and managed to achieve a dynamic range of 3.2 million in a VLA observation (world record). The StEFCal algorithm was also implemented in the real-time calibration pipeline of the Amsterdam-ASTRON Radio Transient Facility And Analysis Centre (AARTFAAC) and the standard LOFAR pre-processing pipeline.

Another aspect of calibration on which we realized considerable progress is the calibration for the effect of sources that are not modeled. The ignorance of such sources during calibration causes outliers in the data and leads →

to spurious sources and suppression of flux of weak structure in the sky. Kazemi and Yatawatta have developed a new calibration technique (Robust Calibration), where such shortcomings are minimized. Robust calibration recovers more flux than traditional calibration and is essential for detection of the Epoch of Reionization.

Exascale Computing

In the exascale computing area, we successfully applied for two research grants. NWO funds a project in which we carry out research on accelerator platforms (GPUs, Xeon Phi, DSPs). Research questions relate to architectural optimizations, energy efficiency, and programmability. The FP7 project DEEP-ER was granted and started in 2013. It focuses on I/O and resiliency of exascale computing. Both projects focus on radio astronomical applications such as filtering, correlation and imaging.

Low Frequency Radio Astronomy in Space

OLFAR is a research project together with TU Delft and UTwente on Interferometric Long-Wavelength Radio Astronomy Using Miniaturized Distributed Space Systems. It has delivered several ingredients for a future system related to synchronization and distributed correlation.

Valorization

PAASAR

The PAASAR project (Phased Array Antenna for Search And Rescue) is an ESA-ARTES funded project which aims at designing a phased array antenna sphere for the reception of all visible Medium Earth Orbit satellites containing a Search And Rescue transponder such as the European Galileo navigation satellites. This technology project contains some high risks related to the radio hardware and the calibration software. Therefore this project starts with the design of a limited amount of antenna elements to test the system functionality. The radio hardware is designed by a Spanish company TTI and tested separately; the calibration software is based on known calibration principles from radio astronomy. ASTRON is responsible for the calibration algorithms and the computing hardware delivery: ASTRON's Uniboard. The Critical Design Review has been scheduled in February.

New International LOFAR stations

Preparations started for a new International LOFAR station near Hamburg. University of Hamburg together with Bielefeld University already awarded the contract for LBA station hardware. Negotiations for the acquisition of the HBA extension are nearly settled. The University of Hamburg is currently in the process of acquiring permission of land owners and regional authorities for the site of this station. The German LOng Wavelength consortium (GLOW) already has five operational LOFAR radio astronomy antenna stations, making it ASTRON's largest international partner in the ILT.

In parallel, AstroTec Holding is negotiating with the Polish LOFAR consortium (POLFAR, representing three Polish universities) about an arrangement for supplying another three International LOFAR stations in Poland.

Connected legal entities

ASTRON has three connected legal entities: AstroTec Holding B.V. (ATH), the LOFAR Foundation/Limited Partnership and the International LOFAR Telescope Foundation (ILT).

AstroTec Holding B.V.

ATH is a wholly owned subsidiary of ASTRON to facilitate commercial activities that require a joint venture or private partner. ATH is governed by a small Board of Commissioners who report to the shareholder, ASTRON. In 2013, ATH participated in four companies, all start-ups that originated from ASTRON or LOFAR developments. DySI, developing software for dynamic system intelligence and intelligent surveillance systems, took a decision to split the company and to continue under DySI Analytics and DySI Software Innovations for keeping better focus on introducing new hardware/ service combinations respectively data analysis services. ATH inherited a share in these companies. Filitron, with a focus on RF-ID technology, continued to be dormant in 2013. Dutch Sigma is working towards market introduction of the optical precision scanner in 2014 under the brand name Yim3D. Two patent applications are in preparation. ASTRON-employees are involved in generating a new approach.

In 2013, two RF Courses were offered by ATH, which were again evaluated very positively by the participants. ATH is now also responsible for the handling of procurement, export and installation of international LOFAR stations. Especially as new manufacturing tenders are needed for additional stations, this is better handled through a private company than through ASTRON. The new LOFAR station near Hamburg, for which the contract was signed in 2014, was the first handled in this way. A new lead with the Polish LOFAR consortium regarding three ILT stations is under negotiation at the time of writing this annual report.

LOFAR Foundation/Limited Partnership

To develop, operate and exploit the LOFAR sensor network, a Limited Partnership (Dutch: Commanditaire Vennootschap) was established by the partners. The LOFAR Foundation is the sole general partner ('beherend vennoot'). With LOFAR being an operational entity, the role of the LOFAR Foundation is primarily to handle contracts. The LOFAR infrastructure is rented out commercially to various users, including the ILT. In 2012, the contract with the ILT was completed. Contracts with TU/Delft (Geophysics) and KNMI (Infrasound) were negotiated. The contract with TU/Delft is expected to be processed early 2013. The LOFAR Foundation will search for new potential users of the infrastructure, in particular to help continue that Infrasound application. Limited capacity is available however, and new applications will have to be developed through the technology transfer offices of the partners.

International LOFAR Telescope Foundation

The ILT has been established for the operation of LOFAR as a radio telescope. The ILT was founded in November 2010 as a Foundation under Dutch law. International partners joined in June 2011: the German GLOW consortium, the French FLOW consortium, LOFAR Sweden and LOFAR-UK. All these consortia own one or more LOFAR stations, which are used in connection with the forty LOFAR stations in the Netherlands and the central computing facilities. The partners share the cost of the central functions in an agreed ratio and support their national stations. ASTRON provides the staff for the central support. The General Director of ASTRON is member of the ILT Board. The ILT Director is seconded from ASTRON, the current director is dr. René Vermeulen.

NOVA Optical/ Infrared Instrumentation Group

These are exciting times at the NOVA optical infrared instrumentation group. A lot of progress has been made on a suite of interesting projects. These projects can be in an entirely different phase: starting with a first idea or development of the concept to detailed design. From hardware realization and integration to commissioning at the telescope. Below you can find a short summary of the projects and activities in 2013.

Funding for the European Extremely Large Telescope (E-ELT) is not complete yet. Also for the development of the instruments for the E-ELT, we have to wait for the Brazilian parliament to approve ESO membership. This allows us to develop prototypes for some essential components in collaboration with several Dutch high tech companies: an immersed grating for the METIS high resolution spectrograph, a cryogenic chopper that allows accurate observation of objects that are fainter than the sky background and vibration free cooling techniques. The possibilities and implications for micro-arcsecond astrometry using MICADO have been investigated. EAGLE and OPTIMOS-EVE have merged into a new multi object instrument called MOSAIC. Extremely fast adaptive optics algorithms are developed for EPICS and tested on a GPU based clusters.

Also outside the E-ELT programme, technology developments are ongoing. The optical wave front error at cryogenic temperatures was measured for various materials in collaboration with TNO and ESA. This technology is expected to be used in e.g. the Euclid mission. Other technology development projects include an FP7 Opticon program to manufacture extreme aspheric active optics components. The idea is to adjust the shape of the optical component in operational condition (cryogenic / space) to meet challenging imaging requirements.

In 2013 both the Phase A study and Preliminary design review were passed successfully for BlackGEM. BlackGEM will consist of an array of small telescopes that can search for optical counterparts of gravitational waves, detected by VIRGO and LIGO. An NWO-M application was granted to manufacture the telescope structures out of carbon.

Two phase A reviews were successfully completed for multi object spectrographs 4MOST and MOONS. ESO decided to continue the development of both instruments, however NOVA choose to focus entirely on WEAVE. WEAVE is an optical multi object spectrograph for the ING William Herschel Telescope on La Palma. Its location on the Northern hemisphere is ideal for LOFAR and APERTIF follow up, as well as the GAIA follow up to complement the ESO instruments at the Southern hemisphere. NOVA is responsible for the design of the spectrograph. WEAVE passed the preliminary design review early 2013 and the optical final design review at the end of 2013.

A set of 4 ALMA band-5 mirror blocks was manufactured for the ALMA band-5 receivers that are integrated and tested by NOVA at SRON in Groningen. Before production this mirror block was redesigned from 43 components to a single component with easier tolerances. Another 70 mirror blocks will be produced in 2014.

MATISSE is the mid infrared interferometer for the ESO VLTI, combining the light of all four Very Large Telescopes at the same time, creating six baselines and micro-arcsecond angular accuracy in two wavelength domains (LM and N band). NOVA is responsible for the MATISSE Cryogenic Optical Bench (COB), MPIA (Heidelberg) for the Cryostats, MPIfR (Bonn) for the detectors and data reduction and OCA (Nice) for the warm optics, integration and overall management. ➔

MATISSE first light celebration with part of the MATISSE team at the NOVA optical infrared instrumentation group at ASTRON and Dutch Co-PI Watler Jaffe.

The MATISSE COB is a challenging design with many optical components and mechanisms for observation modes and alignment, all with extreme stability and accuracy requirements situated in a vacuum cryogenic environment. In October 2013 the fully integrated N-band COB has been delivered to MPIA for cryogenic testing. Just as last year, MATISSE is the most important project in 2012 in terms of staff effort.

Final integration step of the MATISSE N-band Cold Optics Bench. The insert shows the First Light image of 4 elongated telescope pupil images.

ZIMPOL is a high contrast imaging polarimeter for the SPHERE instrument on the ESO VLT, being developed by ETH (Zürich) and NOVA. ZIMPOL operates in the visual range and is based on differential comparison of two polarization images. The images are produced by polarization modulation at 1kHz using a Ferro-electric Liquid Crystal and a rapid phase shifting CCD. Both polarization directions are measured on the same pixel, allowing to reach a star to planet contrast ratio of 10-7. In ZIMPOL, planets become visible, when their reflected light is polarized (starlight is not polarized). In 2013, Sphere-ZIMPOL concluded the tests at the SPHERE test facility in Grenoble and was prepared for shipment to Paranal. First light on the VLT in Chile is expected first half of 2014. In 2012 the European MIRI consortium and ESA officially delivered the Mid InfraRed Instrument (MIRI) to NASA. In 2013 NASA has integrated MIRI in the instrument module of the James Webb Space Telescope (JWST) and the first set of tests have been performed, confirming the very good quality of the optical bench assembly. Progress on the telescope is as planned and the project is on schedule for launch in 2018.

iSPEX is a simple but clever extension piece for the camera of the iPhone, which allows people to measure the concentration of particles in the atmosphere by spectro-polarimetry. iSpex managed to produce 10.000 iSPEX extension pieces and gather 10.000 aerosol measurements over The Netherlands, performed by several thousand volunteers. This project generated a massive media attention around 2 national iSPEX measurement days.


iSPEX aerosol measurements during the national iSPEX measurement day in 2013.

JIVE staff enjoying the new coffee corner under the commemorative banner signaling the 20th anniversary of JIVE.

Joint Institute for VLBI in Europe

The Joint Institute for VLBI in Europe (JIVE) celebrated its 20th birthday during the last days of December 2013. After twenty years of operations, development and science with the EVN, JIVE is preparing a transition to become a European Research Infrastructure Consortium (ERIC). In view of this and the anticipated opening of the new building, a modest, internal party was organized on the occasion. Notable progress was made during 2013 with the submission of a first stage proposal by the summer, which is to be followed by the formal application in 2014.

The summer of 2013 had two other notable highlights, both taking advantage of the new building. The European Radio Interferometry School was held in Dwingeloo, organised by a joint ASTRON and JIVE team. In addition JIVE hosted the final review of the NEXPReS (Novel EXplorations Pushing Robust e-VLBI Services) project. After three years of good work, often based on collaborations started during its predecessor EXPReS, the EC and its expert panel visited Dwingeloo to evaluate the results. Starting with an ambitious demo that delivered 4 Gbps real-time fringes from EVN stations (see figure 1), staff from JIVE and partner institutes presented the deliverables and milestones produced in the project. The evaluation resulted in an excellent mark, thus concluding 7 years of e-VLBI pioneering on a high note.

In 2013, the EVN capabilities were further enhanced by new additions to the SFXC platform. The software correlator had already taken over processing of all EVN observations, also keeping up with the EVN e-VLBI experiments that require real-time processing. In addition some new modes were implemented, notably to deal with recording from a heterogeneous array with various digital backends. A lot of effort was spent on making the SFXC act as adding box for producing pulsar time series for multiple targets within the field. There is also a multiple phase centres mode for surveying a large number of targets in the telescope beams.

The same platform is also used for various space applications. It can both be used for observing spacecraft as well as space VLBI observations, with an antenna in orbit. The combination actually proved to be fruitful, as JIVE staff demonstrated they could derive the RadioAstron orbit elements to improve on the results from RadioAstron observations.

Of course JIVE scientists are also engaged in more classical VLBI science. A highlight this year was the paper demonstrating how a jet can clear out the environment of its hosting Galaxy (see figure 3 in the chapter 'Astronomy Group'). Among the authors were both JIVE and ASTRON staff, including a jointly supervised summer student.

Figure 1: EC experts inspecting the fringes between Metsahovi (Finland), Effelsberg (Germany), Yebes (Spain), Onsala (Sweden) and Hartebeesthoek (South-Africa) on J1800+3848, with JIVE staff in control.

On Sunday 8 December the science programme of VPRO (national tv), Labyrint, broadcast an episode on ‘Time’, featuring pulsar research with the Westerbork telescope.

In the 25-minute overview, our understanding of time was discussed, demonstrated, and even illustrated mid-air (as seen in the picture, above) by 5 experts: three (astro)physicists, including ASTRON’s Joeri van Leeuwen, highlighted the fundamental space-time perspective, while two experimental psychologists explain the human perception of time.

Outreach and education

The participants of the ASTRON/ JIVE Summer Student programme 2013.

Visitors

The 2013 ASTRON/JIVE Summer Student programme attracted a group of six enthusiastic students, from all over the world: Maria Grazia Blasi (University of Bologna, Italy), Peter Gentile (West Virginia University, USA), Minju Lee (Kagoshima University, Japan), Song Youn Park (Yonsei University, Republic of Korea), David Starkey (University of Leicester, UK), and Anna Williams (University of Wisconsin-Madison, USA).

The topics of their projects varied: from the relation between magnetic field and kinematics in VLBA 6.7 GHz methanol observations; to hunting for radio-loud gravitational lenses; detecting the origin of the radio emission in NGC 1277 and NGC 1270 – AGN jets or star formation; and polarisation properties and magnetic fields in nearby galaxies. Two projects involved observations with LOFAR: The 'LOFAR Tied-Array All-Sky Survey for Pulsars and Fast Transients'; and the 'Ionospheric effects and polarisation analysis of the LOFAR-EoR'.

Students followed the established lecture series on radio interferometry, the LOFAR telescope, and other scientific topics of research at ASTRON and JIVE. They also visited the LOFAR site in Exloo and the WSRT radio telescope in Westerbork. Apart from the scientific work they were doing with their supervisors, the students explored the surroundings by bike, and enjoyed the ASTRON BBQs, and other social activities.

In 2013 we welcomed three visitors under the 'Helena Kluyver' Female visitor programme. The first, in April, was Ivy Wong, who visited for a month. She is a Super Science Fellow of the Australian Research Council, and based at CSIRO in Sydney. Her focus was to work on WSRT observations of neutral hydrogen in blue early type galaxies. The purpose of this research is to understand better why star-formation is truncated as these galaxies evolve into post-starburst galaxies. ➔

Our second visitor in the Helena Kluyver programme, for a month during September and October, was Rosita Paladino. She is currently a member of the Italian ALMA Regional Center node in Bologna, Italy. Her work is on the role of magnetic fields in star-formation and the star-formation process in galaxies in general. During her visit to ASTRON she was involved with processing LOFAR observations for the LOFAR Magnetism KSP.

In November and December Natalia Lewandowska visited ASTRON. She is in the final stages of her PhD at the University of Würzburg. Natalia worked closely with several people in the pulsar group at ASTRON, analysing LOFAR data. Her focus is on the nature of giant pulses, such as observed in the Crab pulsar. She was also actively involved in several outreach activities.

Major group visits 2013

Every year, ASTRON welcomes a wide range of groups to the institute for tours at the facilities. Visitors include primary school kids and high school students, university students, scientific institutes, universities and commercial organizations ASTRON has ties with. Below you can see a selection of some of these visits.

February

06 February 2013

Workshop for the LOFAR guides of volunteer organisation the 'LOFAR tafel'.

LOFAR volunteer guides during a tour at ASTRON.

March

08 March 2013

Princess Day: female state members and councillors, clerks and City Counsel members of the province of Drenthe visited ASTRON..

April

15 April 2014

Pupils from the Harm Smeenge primary school visited the Milky Way path and the Westerbork telescope.

Children of the primary school Harm Smeenge won a contest and visited ASTRON. The picture shows the group on the Milky Way path on their way to the Westerbork telescope.

25 April 2013

Girlsday.

Artwork of the Girlsday-Girls as part of the Girlsday 2013. One of the activities was live chatting via Skype with a professional female astronomer. All questions were allowed: from work to hobbies. Part of the assignment was to draw their findings onto paper which resulted in this collage.

May

28 May 2013

Royal visit at De Brink, Dwingeloo, at the ASTRON stand. →

On May 28th 2013, King Willem Alexander and Queen Maxima of the Netherlands visited the province of Drenthe. ASTRON presented itself on the Brink of sunny Dwingeloo. On display were pictures of the many Royal Visits that mark the prominent Dutch role in radio astronomy: Queen Juliana opening the 25m Dwingeloo telescope in 1956 (left), and the 3km Westerbork telescope in 1970 (right), and Queen Beatrix opening the 1000km LOFAR telescope in 2010 in Exloo (middle).

29 May 2013

Symposium "Reinventing Radio-Astronomy: Technologies that made a Difference" in honour of Arnold van Ardenne and to commission the new Van de Hulst Auditorium.

September

18 September 2013
Radio communications agency 'Agentschap Telecom'.

19 September 2013
Province of Drenthe, department of Management and Communications.

October

03 October 2013
Young European Radio Astronomers Conference (YERAC).

05 October 2013
LOFAR Open day.

Students from primary school CSG Bogerman visited the Dwingeloo telescope during the Dwingeloo Live! Programme. This programme allows the kids to use the Dwingeloo telescope themselves to take data from a bright pulsar. See also: *http://www.astron.nl/onderwijs/index.html*

10 October 2013
Directors of regional radio and TV in the Netherlands.

November

4-7 November 2013
Conference 'The Radio Universe @ Ger's Wavelength' in honour of Ger de Bruyn, who has been a prominent radio astronomer in the last few decades. →

The LOFAR open day, organized in cooperation with the Discovery truck of the University of Groningen.

The LOFAR o On 10 October, directors of the regional radio and TV stations in the Netherlands visited ASTRON. Every year, one of these directors organises a visit for the others so they can meet to talk business but also to relax and do something fun and interesting. In 2013, it was 'Rtv Drenthe's' turn and the director, Dink Binnendijk, wanted to do something different for a change, instead of the typical Drenthe-visit to the 'hunebedden'.

To celebrate the scientific career and achievements of astronomer Ger de Bruyn, the University of Groningen and ASTRON organized an international conference: The Radio Universe @ Ger's wavelength in Groningen (4-7 Nov 2013) and a one-day mini-symposium Gerfest at ASTRON (8 Nov 2013).

12 November 2013
Students from the Roelof van Echtencollege, Hoogeveen, who follow the Technasium programme.

16 November2013
15-year anniversary of the Northern department of engineer society KIVI NIRIA.

29 November2013
Political party VVD Westerveld+ Second chamber.

Visit of the Board of the Netherlands Organisation for Scientific Research (NWO) to ASTRON and the Westerbork telescope. From left to right: Hans de Groene, Karel Gaemers, Franciska de Jong, Mike Garrett (ASTRON) and Jos Engelen (chair of the board).

Outreach activities

Crowd visits LOFAR telescope and multimedia Discovery truck

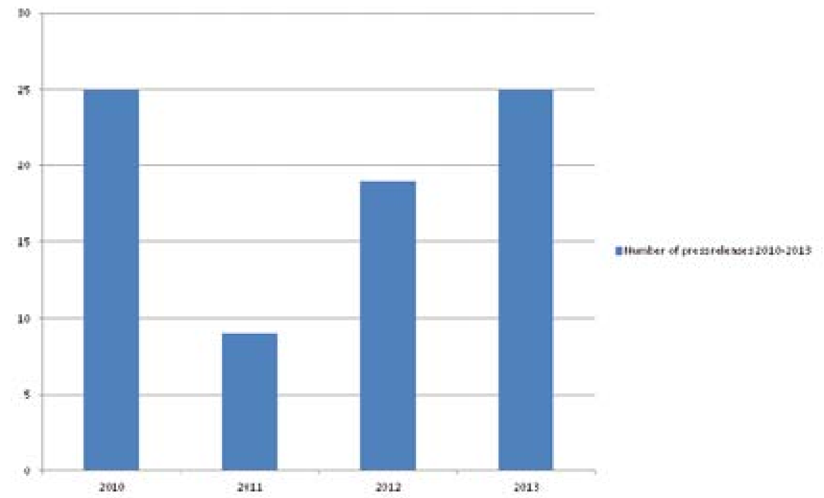
The LOFAR Open Day took place on Saturday 5 October and was again a success. It was organized by ASTRON and the multimedia Discovery Truck of the University of Groningen (RUG). The open day attracted about 260 visitors, of whom approximately 130 children of the ages 4-12. This was a bit of a contrast with 2012 when about 800-1000 visitors found their way to the activities. Nevertheless, the fact that less people visited, gave ASTRON and RUG scientists the chance to engage in interesting conversations with the visitors, and take the time to explain them about the wonders of the LOFAR telescope.

ASTRON scientists gave presentations in the high-tech Discovery Truck, with titles like ‘The Pulsar Mystery’, ‘Looking under the hood of LOFAR’ and ‘Looking back in time with LOFAR’. Many visitors, including kids, clung to the lips of the presenters and demanded more, which resulted in a bonus presentation at the end of the day.

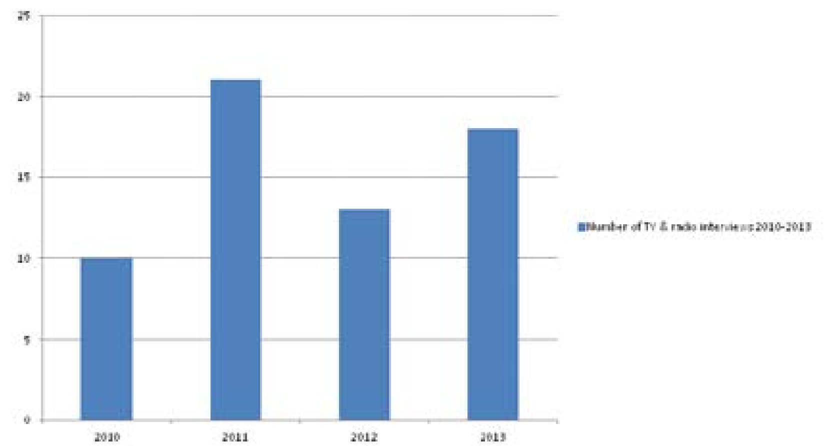
Besides this, there were tours to the LOFAR telescope, and many children’s activities: making a water rocket and shooting it into the sky (see bottom left in the compilation image on page 48), soldering together a small light or a dice, and making exploded stars. The icing on the cake was a treasure hunt for kids. With a mysterious map they could find a treasure (a multifunctional survival tool) hidden at different places on the premises.

The ‘LOFAR Expedition’ kicked off with Vincent Bijlo, Dutch comedian, and his ‘students’

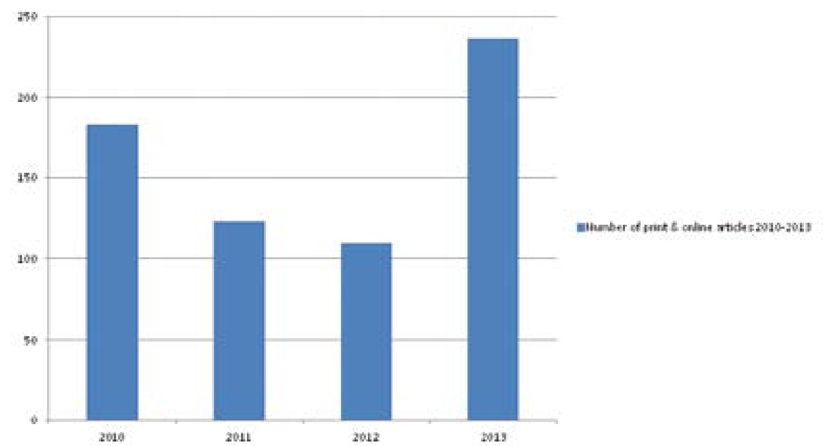
The LOFAR Expedition
On Thursday 25 July late at night, the first try-out of the theater production ‘The LOFAR Expedition’ kicked off. From 25 July to 25 August, the theater group ‘the PeerGroup’ played ‘the LOFAR Expedition’, a cosmic journey into the unknown, with Dutch astronaut/ comedian Vincent Bijlo as professional guide. The performances took place in the core of the LOFAR telescope and in the surrounding nature area of foundation ‘Het Drentse Lanschap’, between the villages of Exloo and Buinen. →



Number of press releases per year ASTRON issued nationally and internationally since 2010.



Number of times ASTRON astronomers and engineers featured in regional, national and international TV & radio interviews per year since 2010.



Estimated number of times ASTRON astronomers and engineers featured in regional, national and international print and online articles per year since 2010.

All summer, visitors enjoyed a fun and humourous show led by Vincent Bijlo and his 'students'. Bijlo thinks he has found the fastest route to the Big Bang. On the way, he made many exciting cosmic adventures that will shed new light on our existence. His ability to relate cosmic events to aspects in everyday life made the LOFAR Expedition an interesting, fun and fascinating experience. Accompanied by a live band, a light show and numerous cosmic 'props', visitors were left in awe of the universe and everything that surrounds them.

Media

The year 2013 was dominated by a wide range of news events, such as the first pulsars that were discovered by use of the LOFAR telescope, eight grants being awarded to ASTRON astronomers and engineers, the discovery of a new Giant Radio Galaxy and the joining of South Africa with the ASTRON and IBM DOME project. This generated much attention in the media, as you can see in the graphs to the left by the number of press releases and media appearances.

ASTRON in the media

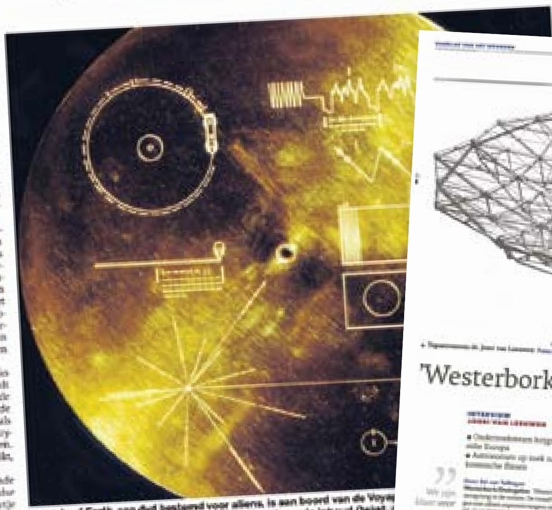
In 2013, ASTRON appeared in the media (online, newspaper articles, magazines, tv, radio etc.) roughly 230 times. Below is a small selection of these appearances in newspapers and magazines. →

Space artist wil beeld en geluid meegeven aan Pluto-sonde

Digitale flessenpost voor aliens

Van onze verslaggever
Govert Schilling

AMSTERDAM Instagrammen met aliens is er voorlopig nog even niet bij. Maar wat de Amerikaanse space artist Jon Lomberg van plan is, komt aardig in de buurt. Hij wil kiekjes van de aarde uploaden naar het computergeheugen van een ruimtesonde die in 2006 al werd gelanceerd in de richting van Pluto.



Sounds of Earth, een dvd bestemd voor aliens, is aan boord van de Voyager ... zonnestelsel. De markeringen geven de herkomst van de inhoud (telesk...

'Westerbork' stort zich op kosmische flitsen

VVD schrapt Drentse kandidaat

newsletter 2

IN THE SPOTLIGHTS

UniBoard: a high performance digital processing board for radio astronomy

Figure 1: UniBoards in their dedicated housing

ASTRON

ASTRON successfully finished their contribution to the UniBoard project (a Research Activity, led by JIVE, in the EC-funded RadioNet FP7 project) by designing and delivering a board integrated in an active cooled housing. The board, shown in Figure 1, will be used for a number of astronomical applications.

The target applications for UniBoard need a number of functionalities that are common in modern radio telescopes:

- Antenna based processing, such as filtering, delay tracking, fringe stopping
- Data routing to transport a part of the bandwidth (sub-band) for all antennas to the next stage of processing
- Sub-band based processing for all antennas, such as in a beam former or a correlator

The architecture of the board has been designed such that these functionalities can be optimally mapped on one or multiple boards. Two columns of four FPGAs each (Field Programmable Gate Arrays), named the front and the back node FPGAs (indicated as FN and BN in Figure 2) are interconnected by a semi-full high-speed mesh. The FPGA type is an Altera Stratix IV FPGA (EP4SGX230KF40C2N). All interfaces on the board are bi-directional. This enables applications to use the board in whatever direction is the most appropriate.

The architecture of UniBoard makes it possible to incorporate multiple UniBoards in a sub-... digital pro... the ... boards ca... via 10G ... backplane... plane ca... boards s...

In Table ... UniBoard ... low-up ... rently ... on the ... newest ... to inco... ing po...

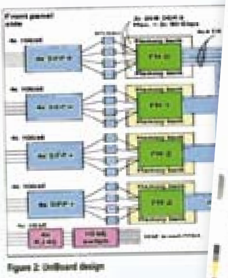


Figure 2: UniBoard design

* ASTRON, the Netherlands Institute for Radio Astronomy: www.astron.nl. JIVE, the ... for VLBI in Europe: www.jive.nl. UniBoard was a joint Research Activity in the EC-funded RadioNet FP7 programme, contract no. 283393.

6

High Tech & Innovatie special

DAGBLAD VAN HET NOORDEN Dinsdag 17 september 2013 AE 37

Astron: living lab voor ondernemend Noord-Nederland

ASTRON


ZOMER13

10 zaterdag 3 augustus 2013

De zoektocht naar buitenaardse leven is de kinderschoenen ontgroeid. Het is serieuze wetenschap waarin de megatelescoop Lofar een vooraanstaande rol gaat spelen. De Amerikaanse astronoom en researcher Andrew Siemion is kind aan huis bij Astron, aan de rand van het Dwingelderveld. Een verhaal over miljarden sterren, radioflitsen en exoplaneten. En vooral over buitenaardse intelligenties.

De 'ware' ontdekking van de hemel


KNOW HOW zoekt het uit

Op pad met Know How

Voor een passant lijkt het op een verscholen stukje afluistertechniek van het leger

LUISTEREN NAAR DE STERREN


DAGBLAD VAN HET NOORDEN

BEDACHT IN HET NOORDEN

Kijkje in de keuken van de wetenschap

Te weten komen of Einstein gelijk had

Meer dan een man in een witte jas in een lab


The ultimate in Big Data

Processing everything in the entire universe since time began

De ultieme Big Data:

Alles wat ooit in het hele universum is gebeurd sinds het begin

in de drie daaropvolgende jaren minimaal één trekje van een sigaret. Bij de controlegroep die niet deelnam aan het preventieprogramma was dit 12 procent; een onbeduidend verschil. Hiemstra vermoedt dat Rookvrije Kids zich richt op te jonge kinderen. Voor 12- en 13-jarigen is roken een relevantere verleiding.

ASTRONOMIE
LOFAR ZIET GEKNIPPER

De Europese radiotelescoop Lofar, waarvan het hart in het Drentse Exloo ligt, heeft voor het eerst twee pulsars gevonden. De knippersterren werden gevonden tijdens de 'warming up' van de telescoop. Lofar bestaat uit een netwerk van duizenden kleine antennes, waarbij opgepikte radiosignalen via een computernetwerk in samenhangend beeld worden omgezet. Pulsars zijn snel draaiende restanten van ontplofte sterren in ons Melkwegstelsel, waarvan straling als de bundel van een vuurtoren door het heelal zwiept. Lofar blijkt in staat duizend opnamen per seconde van een groot deel van de hemel te maken, genoeg om zulke snelle radioflitsen te onderscheiden.

Lofar in Exloo. Foto Harry Cock

BREIN
GOED GEHEUGEN FAALT

Ook mensen met een superieur geheugen zijn gevoelig voor valse herinneringen. Dit blijkt uit een onderzoeksverslag van de University of California in *PNAS*. De onderzoekers rekruteerden proefpersonen die allerlei details jarenlang onthouden; vraag hun wat er op 19 oktober 1987 in het nieuws was en ze weten het. De vrijwilligers zagen onder meer een video-opname van een diefstal. Even later volgde een geschreven weergave van de beelden, maar daar zaten stiekem foutjes in. In de tekst stond bijvoorbeeld 'linkerhand' terwijl de dief op de video toch echt zijn rechterhand gebruikte. Uit tests na afloop bleek dat de herinneringen van geheugenkampioenen net zo makkelijk te manipuleren zijn als die van proefpersonen met een gewoon geheugen. De ontdekking dat niemand immuun is voor valse herinneringen is onder meer relevant bij het beoordelen van verklaringen van ooggetuigen.

VK WETENSCHAP ZA 23/11/2013

Prijs voor het zoeken naar 'aliens'

• Prof. dr. Garrett ...buitenaards leven...

Van onze wetenschapsredactie

LEIDEN, woensdag

Zijn onverdroten zoektocht naar 'marsmannetjes' heeft astronoom prof. dr. Michael Garrett, directeur van het Nederlandse onderzoeksinstituut voor radioastronomie Astron en hoogleraar aan de Universiteit Leiden, een internationale onderscheiding opgeleverd.

De wetenschapper wordt geroemd om zijn onderzoek naar rekenmodellen die orde scheppen in de enorme hoeveelheid data afkomstig uit ons heelal. De professor ontvangt hiervoor vandaag de 'IBM Big Data and Analytics Faculty Award'.

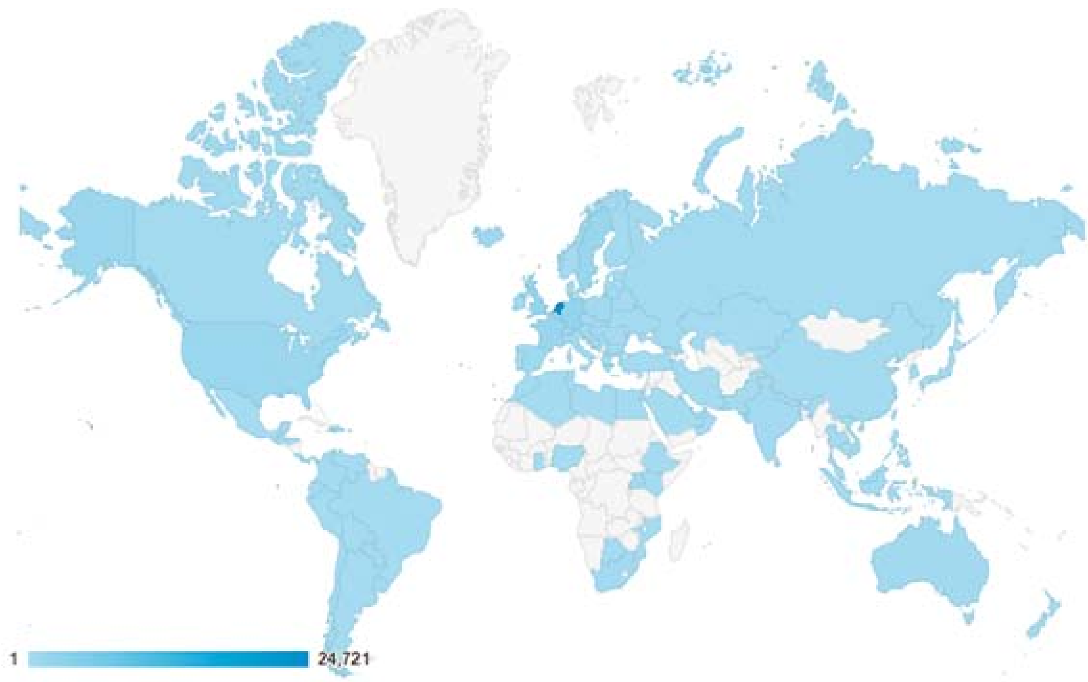
Met de juiste interpretatie van deze data kan gerichter worden gezocht naar buitenaards leven. Dit gebeurt binnen het SETI-project (Search for Extraterrestrial Intelligence). Hierbij zoeken gevoelige radiotelescopen naar radiosignalen in de ruimte die kenmerken hebben waaruit blijkt dat ze veroorzaakt zouden kunnen zijn door een buitenaardse beschaving. Binnen Astron heeft Garrett hiervoor de beschikking over de grootste radiotelescoop ter wereld, het – grotendeels Nederlandse – LOFAR-netwerk.

Het onderzoeksinstituut speelt een voortrekkersrol in de realisatie van de Square Kilometre Array. Deze radiotelescoop kan signalen ontvangen die nog aanzienlijk dieper in het heelal worden uitgezonden. Dit netwerk van antennes wordt gebouwd in Zuid-Afrika en Australië.

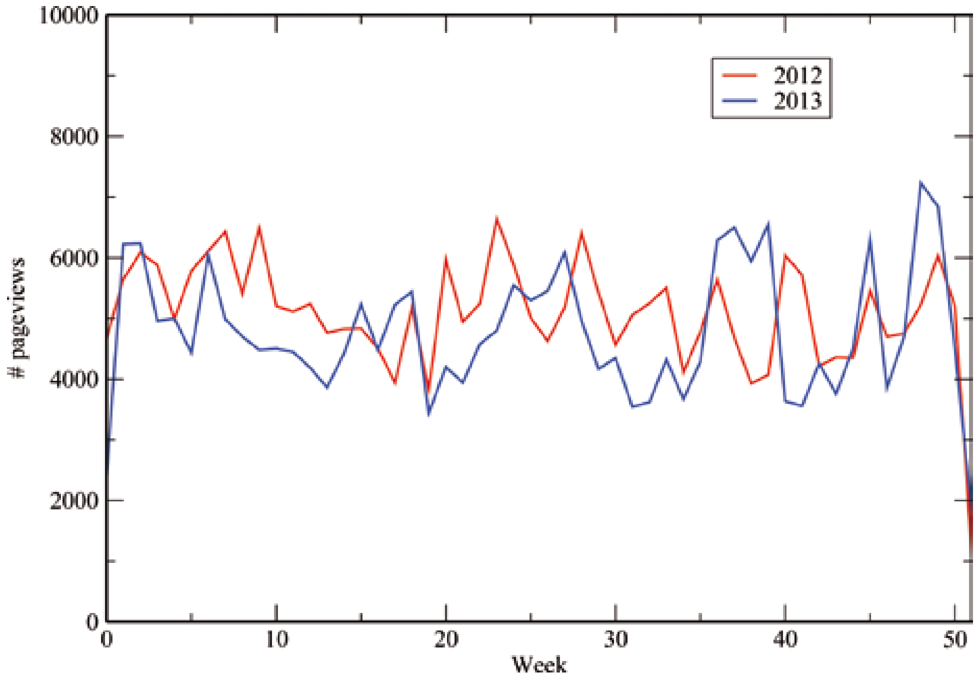
ASTRON/ JIVE Daily Image

In 2013, the web based ASTRON/ JIVE Daily Image *(http://www.astron.nl/dailyimage/)* counted 38,669 visits against 37,387 in 2012. A total of 9,628 of these are unique (against 7,957 in 2012). Total page views was 24,8511 against 26,5221 in 2012.

The visitors of the daily image originated from 113 different countries as opposed to 87 countries in 2012. Since measurements of the statistics began in 2009, the daily image stays unabatedly popular. →



This map shows the division of the number of people all over the world visiting the ASTRON/ JIVE Daily Image in 2013.



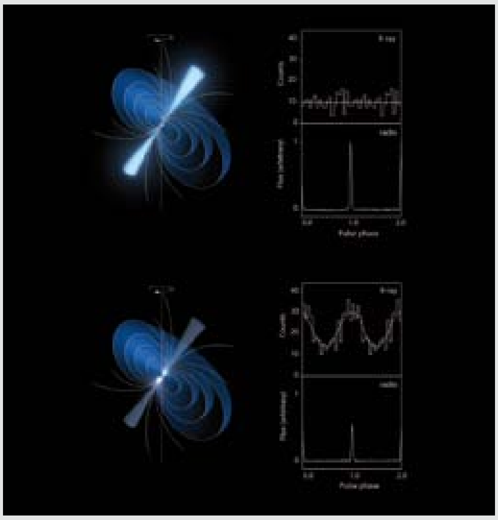
Number of page views per week of the ASTRON/ JIVE Daily Image in 2012 and 2013.

Press releases

In 2013, ASTRON issued 25 press releases. Below you can see an overview of them, month by month.

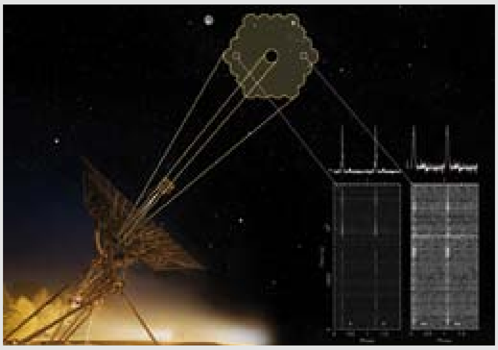
24 January 2013

Chameleon pulsar baffles astronomers



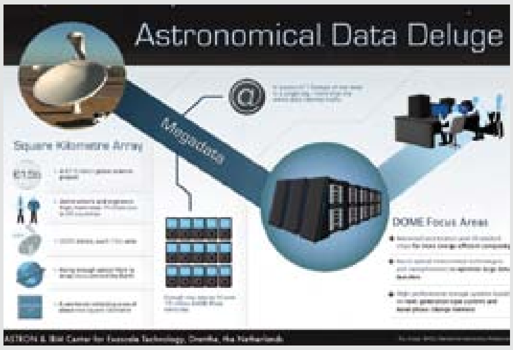
21 February 2013

Westerbork telescope hunts for cosmic flashes



11 March 2013

Big Bang meets Big Data

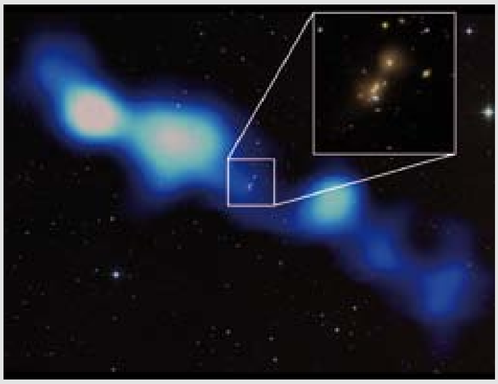


13 March 2013

LOFAR telescope open for business

19 March 2013

LOFAR discovers new giant galaxy in all-sky survey

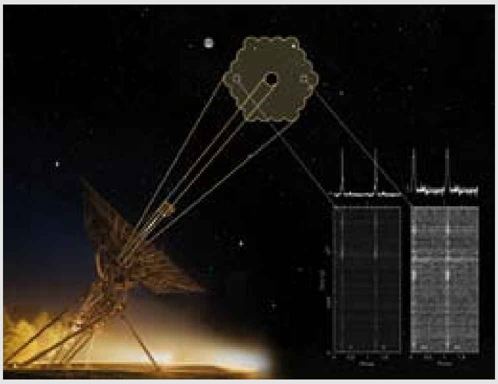


5 April 2013

ASTRON at Holland High Tech House, Hannover Messe 2013

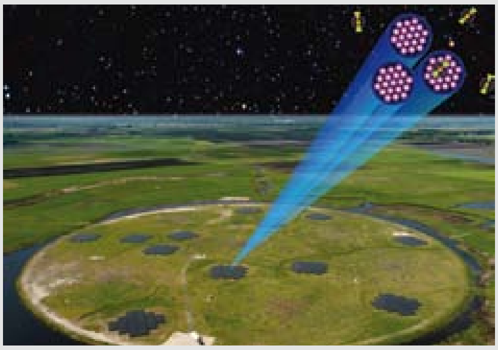
15 April 2013

New high-speed cameras for Westerbork telescope



22 May 2013

Vidi grant awarded to ASTRON astronomer

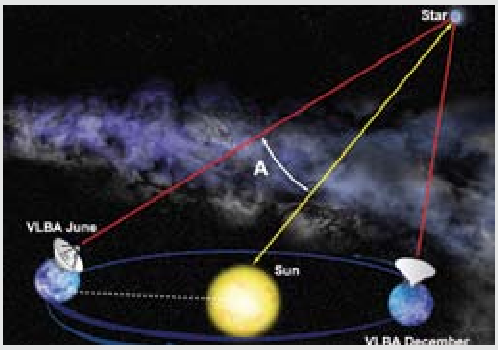


25 April 2013

Einstein was right – so far

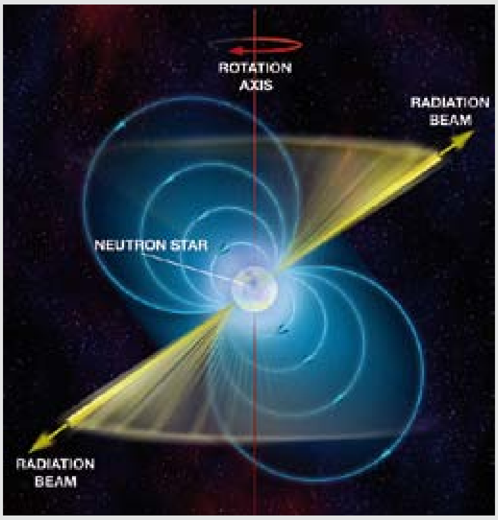
13 June 2013

Astronomers use precision pulsar positions to break record



2 May 2013

Neutron stars as laboratories

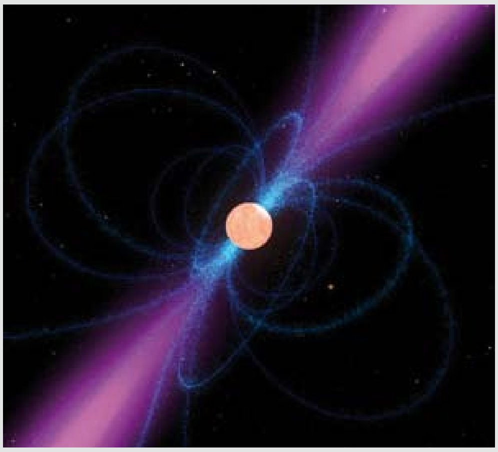


24 June 2013

ERC grant for astronomer Jason Hessels

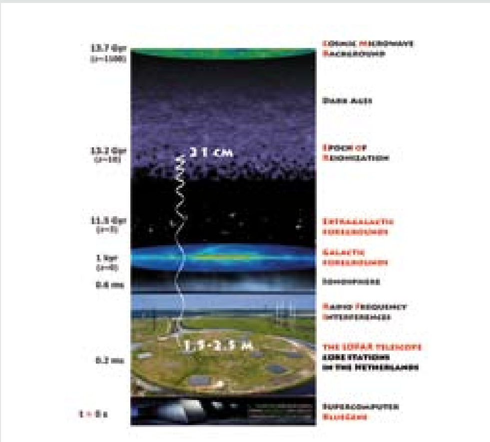
8 July 2013

Farewell greeting from a dying star



25 July 2013

Veni grant awarded to astronomer Vibor Jeliç



1 August 2013

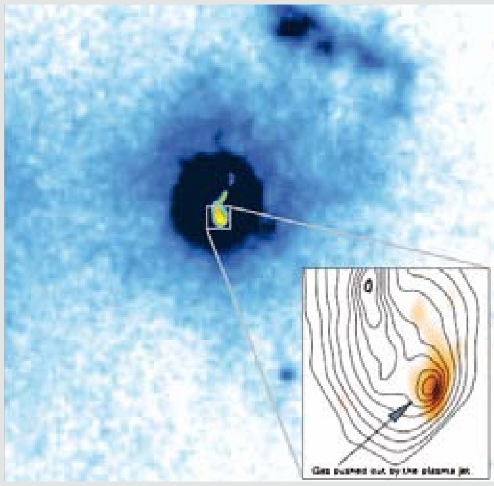
ERC Advanced grant for astronomer Ger de Bruyn

14 August 2013

New pulsar explores feeding habits of Milky Way's black hole

6 September 2013

Jets blow gas out of a galaxy

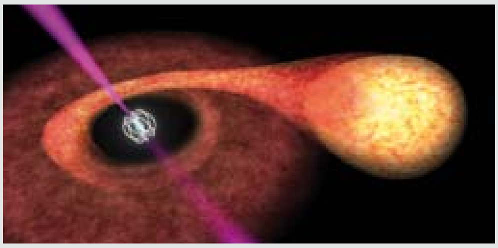


17 September 2013

Astronomer Michael Garrett wins IBM Faculty Award

25 September 2013

Astronomers observe pulsar switching in energy source



1 October 2013

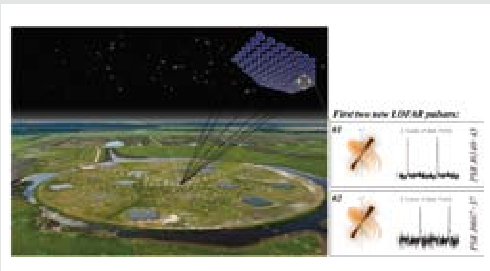
Open day this Saturday at LOFAR telescope

14 November 2013

Surprising image provides new tool for studying a galaxy

19 November 2013

Super-telescope LOFAR finds its first pulsars



26 November 2013

ERC grant for astronomer Joeri van Leeuwen

26 November 2013

Dwingeloo radio telescope supports satellite mission

17 December 2013

Synergy grant to image event horizon of black hole

Conferences and exhibitions

Below is a selection of conferences and exhibitions ASTRON participated in.

Hannover Messe 2013

Dutch companies and knowledge organizations in the national Top Sector HTSM (High Tech Systems and Materials) set themselves apart by their technological excellence, and are world leaders in their market segments. The HTSM ambition is to double the export from 32 billion euros in 2009 to 77 billion in 2020. This is why Holland High-Tech House, including ASTRON as part of the NWO-pavilion, presented itself at the Hannover Messe during 8-12 April 2013. The Messe is the largest industrial trade fair in the world. The HHTH was present in both Hall 2 with Research & Technology, and Hall 4 with the Dutch supply industry. This is an obvious platform for presenting the entire Dutch high-tech sector, to representatives of major companies and knowledge organizations.

The knowledge and expertise gained by research and development in radio astronomy has given ASTRON the capability to design and build extremely sensitive antenna systems, sensor technology, embedded computing, smart software, nano photonics, low noise amplifiers, low-power micro electronics and precision technology. Among other things, ASTRON showed the technology of the International LOFAR Telescope, which is also relevant for the SKA. For instance the water cooled UniBoard, which is the ultimate high-performance embedded processing platform that ASTRON has to offer. Another example was a photonic smart-antenna demonstrator.

The VIP-meeting at the Holland High Tech House held on Wednesday 10 April at the Hannover Messe 2013, with, among others: Mr Bertholt Leeftink, Director-General of Industries and Innovation of the Ministry of Economic Affairs (on the front left), Mrs Ineke Dezentje-Hamming. General Director of FME (front right) and NWO Director General Hans de Groene (left of the far table).

AAS 2013

For the past couple of years, ASTRON has traveled to the American Astronomical Society (AAS) meeting in January to strengthen our ties within the worldwide community. These trips have not only made ASTRON more visible to our international colleagues, but also allowed us to keep everyone up to date on the great advances made within the LOFAR project. 2013 was no exception, and as is becoming tradition, we and our trusty booth made the voyage across the Atlantic. This time the AAS meeting was held in sunny Long Beach, California (in the Greater Los Angeles Area). The ASTRON delegation this year consisted of George Heald and the four Mikes: Mike Sipior, Michael Wise, Michiel Brentjens, Mike Garrett, and guest participation by Charlotte Sobey from MPIfR (Bonn). As always the fantastic LOFAR station model (with its blinky lights) played its part, drawing the crowds to our booth to learn about ASTRON, LOFAR, and APERTIF. This year, we were also prepared with a couple of live demos: Michiel Brentjens's 'LOFAR Live!' (real-time all-sky LOFAR images) and Mike Sipior's postage stamp server extension to the MSSS web interface. We also thanked our guests for their visit by giving them a small ASTRON-themed gift, which was extremely popular. ➔

Compilation of the ASTRON booth photos at the AAS 2013 meeting in Long Beach, CA, USA.

Meetings and Schools

Second LOFAR Science Collaboration Workshop

The second LOFAR Science Collaboration Workshop was held at the Mooirivier conference center in Dalfsen on March 19th and 20th 2013. Presentations and discussion focused on developments in data analysis techniques as well as new scientific results from the commissioning programme. In total, 105 participants attended the event. It was followed by a face-to-face ILT Technical Operations Meeting on March 21st; an ILT Board meeting was also held at Dalfsen.

ERIS School 2013

The Fifth European Radio Interferometry School (ERIS) was hosted by ASTRON and JIVE between 9 and 13 September 2013 (co-chairs R. Pizzo and Z. Paragi). The event was sponsored by RadioNet, the host institutes, the DAGAL Network and the University of Groningen, as well as by the Leids Kerkhoven-Bosscha Fonds (LKBF). ERIS has provided a week of lectures and tutorials on how to achieve scientific results with radio interferometry. The topics ranged from low-frequency to mm radio astronomy, from connected element interferometers to very long baseline interferometry. The WSRT site was visited for the school barbecue event. 84 regular participants attended the event, as well as about sixteen in-house and community expert tutors and assistants.

ERIS school picture, taken on the first day of the school at the Westerbork Synthesis Radio Telescope.

Appendices

Appendix 1: financial summary

Financial report 2013

The financial report of 2013
compared with 2012

	2013 Budget	2013 Actual	2013 Difference	2012 Actual
REVENUES				
Government Grants-Ministry of Education, Culture & Science	11.683.273	12.011.530	-328.257	11.849.877
Subsidies / Contributions	6.220.067	5.025.345	1.194.722	5.988.853
Release to provision				10.348
Other Income	364.000	384.080	-20.080	440.044
Subtotal	*18.267.340*	*17.420.955*	*846.385*	*18.289.122*
EXPENDITURES				
Grants / Expenditures				
Operations	16.172.342	15.366.653	-805.689	15.161.801
Allocation to Projects	pm	-7.819.393	-7.819.393	-7.889.528
Projectcosts	1.200.000	9.543.762	8.343.762	12.123.396
Subtotal	*17.372.342*	*17.091.022*	*-281.320*	*19.395.669*
BALANCE	**894.998**	**329.933**	**565.065**	**-1.106.547**
Financial income and expenses	45.000	2.366.148	-2.321.148	32.675
Exceptional income and expenses		-267.029	267.029	245.935
Result	**939.998**	**2.429.052**	**-1.489.054**	**-827.937**
Results Subsidiaries				
Subsidiary ATH		6.250	-6.250	14.045
Net Result	**939.998**	**2.435.302**	**-1.495.304**	**-813.892**

Appendix 2: personnel highlights

Performance and development interview process

In 2013, ASTRON started to make several changes in the field of personnel management. Together with NWO the performance and development interview process was introduced. In this process we approach the performance and development of employees as an integral and continuous part of working at ASTRON. This means that instead of separate interviews discussing development, goals for the coming year and assessing the performance, we have incorporated all these interviews in one. At the beginning of the year, the targets are set, including what is needed to meet these targets. In the course of the year, progress is regularly discussed and monitored. At the end of the year, the agreed targets are formally evaluated and new targets for the new year are agreed. In 2013, we implemented this process. One of the advantages of this new set up is that employees and managers no longer mainly focus on tasks and projects but also on personal development.

Recruiting

Similar to 2012, we hired a number of new employees for various positions within ASTRON. These include both support for projects funded by personal grants as well as adding temporary staff or replacing current staff. In total, there were 21 procedures.

In 2013, we have started restyling our job advertisements to make them more appealing and attract a larger pool of applicants.

Absenteeism

In 2013, the absenteeism percentage was 3,0%. This is similar to previous years. In 2012, it was 2,9%; in 2011 2,8%. In comparison to 2009 and 2010, this percentage was 3,7% and 3,6% higher respectively.

Start of the renovations of the ASTRON and JIVE building.

Progress in the building project

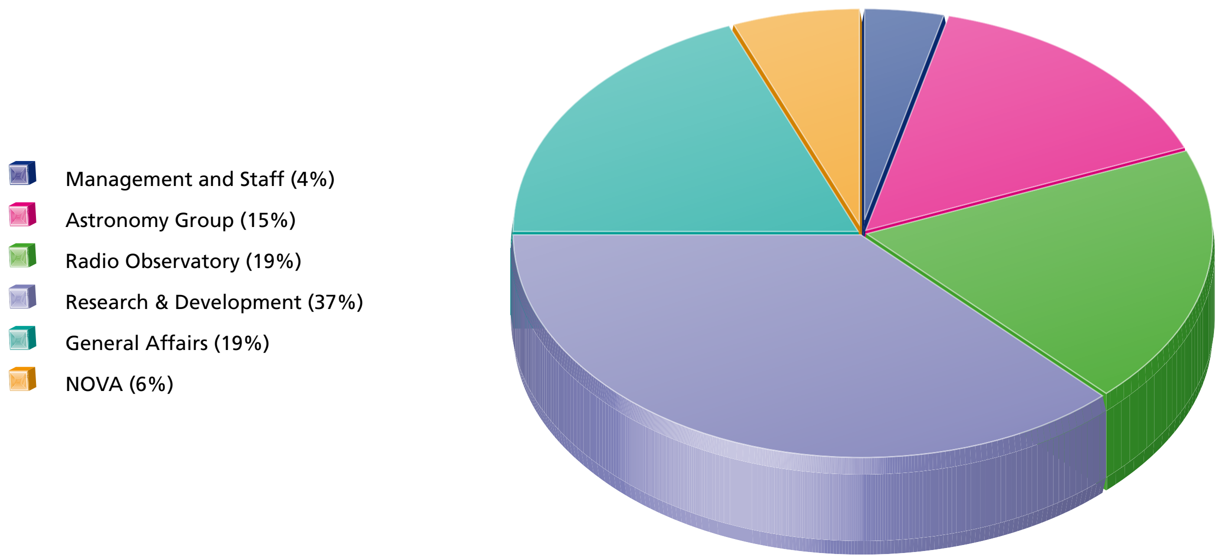
In 2013, the building process continued. In the beginning of 2013, the new wing was ready and people moved into their new offices. In the middle of 2013, wing '1980' was fully renovated. The modifications in the remaining wing ('1996') are expected to be finalised in 2014.

Renovated wing 1980

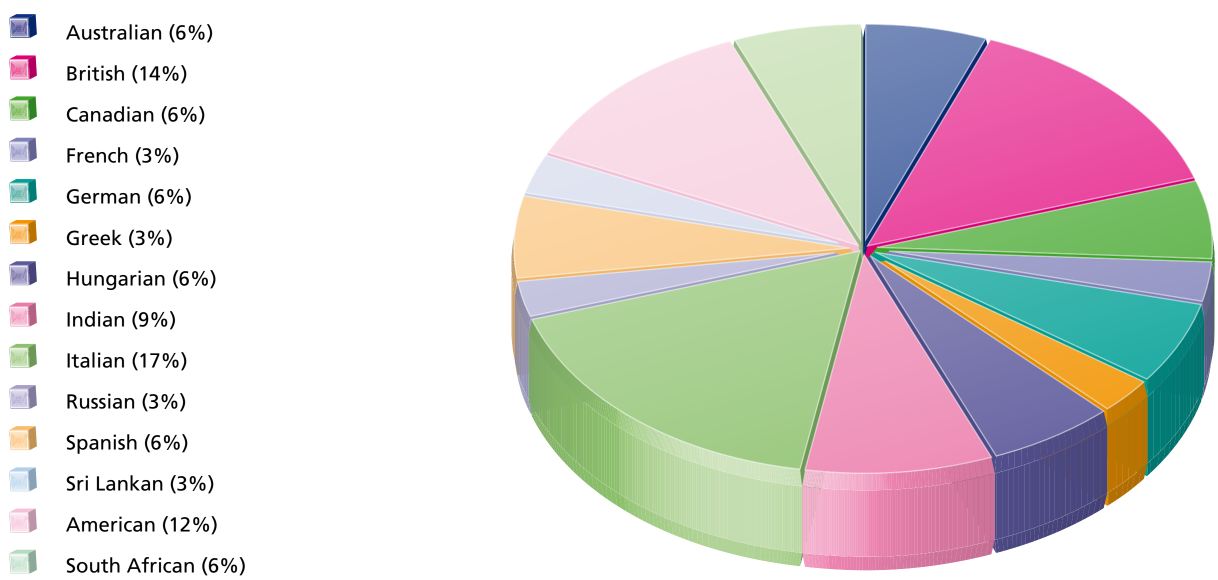
Number of employees at ASTRON in 2013

Department	Number of people
Management and Staff	7
Astronomy	24
Radio Observatory	31
Research & Development	60
General Affairs	31
NOVA	10
Total	**163**

Departments at ASTRON per 31 December 2013



Non-Dutch nationalities at ASTRON per 31 December 2013



Appendix 3: WSRT and LOFAR proposals in 2013

Table of proposals submitted to the WSRT in 2012 and accepted by the WSRT Programme Committee; rejected proposals are not shown.

Project-ID	Name of Project	Name of PI
Semester	**12A**	
R13A001	Ionization of ELDWIM, HII regions and Helium RRL from inner...	Raju Baddi
R13A002	Cyg X-3 in outburst: from gamma-ray to radio wavelengths	Valeriu Tudose
R13A003	HIJASS J1219+46 - a candidate galaxy or HI cloud/stream	Kathrin Wolfinger
R13A004	The mysterious WENSS source WB 1827+4914	Reinout van Weeren
R13A005	The galactic fountain in M101	Tom Oosterloo
R13A006	Unraveling the Physics of Gamma-Ray Burst Blast Waves	A. J. van der Horst
R13A007	A search for HI in spiral lens galaxies	Andy Biggs
R13A008	Who lost the longest HI tail?	Paolo Serra
R13A011	The polarization footprint of an extreme scattering screen on the d...	A. G de Bruyn
R13A013	Cosmic ray loss processes and magnetic fields in the archetypal starburst galaxy M82 at low frequencies	Bjoern Adebahr
R13A014	HI in the cores of cool-core clusters	Raymond Oonk
R13A015	Continued Daily WSRT Timing of a Pulsar in a Compact Triple-Star System	Jason Hessels
R13A016	Stacking HI absorption: a feasibility experiment in preparation of large surveys	Katinka Gereb
R13A017	A WSRT continuum legacy survey: Galactic foregrounds towards LOFAR-EoR windows	Vibor Jelic
R13A019	RadioAstron Space VLBI survey of AGN at the highest angular resolutions-continuation	Yuri Kovalev
R13A022	Completing the WSRT HALOGAS Survey	George Heald
R13A023	Multiwavelength Observations of Giant radio Pulses from the Crab Pulsar	Natalia Lewandowska
R13A024	Multi-frequency observations of giant radio pulse emission from pulsars	Natalia Lewandowska
R13A025	Precise pulsar Rotation Measures towards reconstructing the Large-S...	Charlotte Sobey
R13A026	LOFAR and WSRT Observations of Jupiter,Äôs Synchrotron Radiation	Imke de Pater
R13A027	New radio SN in NGC 891?	George Heald
R13A028	Transient radio source in NGC891 detected by LOFAR	David Mulcahy
S13A001	Resubmit for new semester - Timing the Crab pulsar during a large s...	Gemma Janssen
S13A002	A search for radio relics in the Musket Ball Cluster	Reinout van Weeren
S13A003	Investigating polarisation and time dependence of HI absorption	Raffaella Morganti
S13A004	Service proposal for simultaneous observations of the mode changing...	Charlotte Sobey
S13A006	Gas and restarted nuclear activity: the first LOFAR candidate to ex...	Raffaella Morganti
S13A007	Cas-A Radio Recombination Lines: Origin & Ionisation	Raymond Oonk
S13A008	A Search for Radio Recombination Lines towards Cygnus A	Raymond Oonk
S13A009	A search for broad HI absorption related to nuclear activity in NGC660	Ilse van Bemmel
Semester	**13B**	
R13B001	Extreme M_HI/L systems detected by ALFALFA	Elizabeth Adams
R13B002	Stacking HI absorption: a feasibility experiment in preparation of ...	Katinka Gereb
R13B003	Cyg X-3 in outburst: from gamma-ray to radio wavelengths	Valeriu Tudose
R13B004	Is GBT 1355+5439 a dark minihalo?	Tom Oosterloo
R13B005	OH Emission in NGC 891 - A New Tracer for the Molecular ISM	Tom Oosterloo
R13B006	Continued Near-Daily WSRT Timing of a Pulsar in a Compact Triple-St...	Jason Hessels
R13B007	Ultra-compact High Velocity Clouds: Local Group Minihalos?	Elizabeth Adams
R13B008	Resolving Faraday structures in nearby galaxies	George Heald
R13B009	On the creation of molecular clouds in the Milky Way Halo	Juergen Kerp
R13B010	Simultaneous X-ray/Radio observations of the mode-switching pulsar ...	Jason Hessels
R13B011	Revealing the Faraday rotation properties of intra-group medium: th...	Blazej Nikiel-Wroczynski
R13B012	Unveiling the absorption mechanism in the gamma-ray binary LS 5039	Benito Marcote
R13B013	Studies of Pulsars with RadioAstron and WSRT	Carl Gwinn

R13B014	Study of Giant Pulses from the Crab Pulsar on Earth-Space Baselines	Carl Gwinn
R13B015	RadioAstron-WSRT Space VLBI Survey of AGN at the Highest Angular Resolution	Yuri Kovalev
R13B016	Ultra-high resolution observations of hydroxyl masers with Space-VLBI	Alexey Alakoz
R13B017	Additional WSRT monitoring in support of RadioAstron VLBI observations	Giuseppe Cimo
R13B018	Global Timing Observations of PSR J1714+0747	Jason Hessels
R13B020	Does PSR J1023+0038 emit radio pulsations in its currently active X...	Gemma Janssen
R13B021	Hypothesis for the existence of an unknown particle	Elgin Ong
R13B022	RadioAstron-WSRT Space VLBI Survey of AGN at the Highest Angular Re...	Yuri Kovalev
S13B002	Copy of Abell 1835: the first cold gas outflow in a cluster	Raymond Oonk
S13B003	A search for broad HI absorption related to nuclear activity in NGC660	Ilse van Bemmel
S13B004	Imaging of MSSS GRG-1	George Heald
S13B006	Unraveling the deep HI absorption in NGC660	Ilse van Bemmel
S13B007	Observing gas accretion around NGC 2403	WJG de Blok
S13B008	A new method for identifying the most overdense protoclusters with Herschel and WSRT	Emma Rigby
S13B009	A new method for identifying the most overdense protoclusters with Herschel and WSRT	Emma Rigby
S13B010	Unveiling invisible galaxies: Confirming four DLA-strength interven...	Anant Tanna
S13B011	Studying giant pulses from the Crab pulsar in the radio and optical	Cees Bassa
S13B012	Abell 2069: New discoveries including a possible radio halo	Matthias Hoeft

Table of LOFAR proposals observed in 2013

Proposal code	PI	Title
LC0_002	O. Wucknitz	Location and motion of sources of Jupiter's magnetospheric/auroral decameter emissions
LC0_003	R. Fender	Wide field searches for image-plane radio transients
LC0_004	N. Jackson	Gravitational lenses at low frequencies
LC0_005	R. Courtin	A determination of the abundance of water in Saturn's deep atmosphere with LOFAR
LC0_006	I. de Pater	LOFAR Observations of Jupiter's Synchrotron Radiation
LC0_007	P. Zarka	Exoplanet radio search and characterization
LC0_008	B. Stappers	LOFAR studies of pulsars, fast transients and the interstellar medium
LC0_009	G. Miley	Particle acceleration and cold gas in high-redshift radio sources - long baseline and recombination line studies
LC0_010*	A. Karastergiou	ARTEMIS on LOFAR: real-time searches for fast transients with international LOFAR stations
LC0_011	J. Verbiest	Pulsar timing with LOFAR
LC0_012	R. Morganti	Using LOFAR for detailed studies of AGN, and AGN physics
LC0_013	R. Osten	Stellar Radio Astronomy with LOFAR
LC0_014*	M. Serylak	Studying pulsars and the interstellar medium using International LOFAR stations
LC0_015	P. Best	A deep and wide extragalactic survey at low frequencies: AGN evolution, star formation, and cosmology
LC0_016	E. OSullivan	Stephan's Quintet: the role of shocks in the formation of the hot intragroup medium
LC0_017	J. Lazio	A Search for radio emissions from HD 80606b near planetary periastron
LC0_019	A. G. de Bruyn	Studying the Epoch of Reionization and cosmic dawn of the Universe
LC0_020	D. Jones	Determining the origin and (magnetic) substructure of the Fermi bubbles
LC0_022	S. Ransom	LOFAR timing of pulsars and rotating radio transients discovered in GBT 350-MHz surveys
LC0_024	L. Gurvits	Atomic hydrogen at z>5
LC0_025	A. Scaife	Low Frequency Investigation of the Super-CLASS Super-cluster
LC0_026	J. Conway	Imaging compact SNR, Supernova and AGN emission in M82 and M81
LC0_027	G. Mann	Solar activity studies with LOFAR
LC0_028	R. Oonk	LOFAR Galactic Radio Recombination Line Survey (LG-RRLS)
LC0_029	J. P. Macquart	The polarization footprint of a nearby anomalously turbulent scattering screen
LC0_030	G. Mann	LOFAR studies of the evolution of coronal mass ejections in the heliosphere
LC0_031	B. McNamara	AGN outburst in MS0735.6+7421
LC0_032	G. White	LOFAR Survey of High Mass star forming regions in Galactic plane
LC0_034	J. Hessels	LOTAAS: The LOFAR Tied-Array All-Sky Survey for Pulsars and Fast Transients

LC0_035	J. van Leeuwen	Targeted searches for pulsars and fast transients
LC0_037	M. Brueggen	Exploitation of LOFAR surveys to study galaxy clusters
LC0_038**	S. Buitink	Cosmic ray detection using LORA triggers
LC0_039	J. Miller-Jones	Variable jet sources in the LOFAR band
LC0_040	J. Cordes	Using Diffractive Interstellar Scintillations (DISS) to Resolve Pulsar magnetospheres and the issue of potential DC emission
LC0_041	S. Buitink	Imaging of the Moon
LC0_042	N. Lewandowska	Multi-frequency observations of giant radio pulse emission from pulsars
LC0_043	R. Beck	LOFAR Survey of nearby galaxies
LC0_044*	J. Koehler	Studying large-scale polarization properties of the Milky Way ISM at low frequencies
DDT_003	P. Best	A joint LOFAR deep field: ELAIS-N1
DDT_004	J. Hessels	Global observations of pulsar J1713+0747
DDT_005	U. Pen	Pulsar VLBI observations
DDT_006	J. Hessels	Delving Deeper into the Mystery of Pulsar Mode Switching
DDT0001	R. Paladino	Low Frequency Properties of the Magnetized ISM in M33
DDT0002*	Aris Karastergiou	ARTEMIS on LOFAR: real-time searches for fast transients with international LOFAR stations
DDT0003	J. Verbiest	Pulsar Timing with LOFAR
DDT0004	J.M. Griessmeier	Measuring the energy of Saturn’s lightning with LOFAR
DDT0006	A. Shulevsky	Constraining the duty cycle of the cluster radio galaxy 4C35.06
DDT0007	R. Courtin	Supplementary observation of Saturn’s deep atmosphere with LOFAR for the determination of the abundance of water
DDT0010	G. de Bruyn	The LOFAR EoR window on the North Celestial Pole
DDT0011	L. Gurvits	HI absorption at z>5
DDT0012	G. Heald	Investigating the accretion state of the “missing link” pulsar J1023+0038
LC1_001	J. Eisloeffel	Low Frequency Observations of Jets from Young Stars in Taurus
LC1_002	I. Browne	HBA observations of the remarkable radio source in Abell 2626
LC1_006**	S. Buitink	Cosmic Ray Air Shower Detection
LC1_008	P. Best	LOFAR blank-field surveys: AGN, star-formation and cosmology
LC1_011	N. Jackson	Gravitational lenses at low frequencies
LC1_023	J. Miller-Jones	Variable jet sources in the LOFAR band
LC1_026*	A. Karastergiou	ARTEMIS on LOFAR: real-time searches for Fast Radio Bursts with international LOFAR stations
LC1_027	J. Verbiest	Pulsar Timing with LOFAR
LC1_028	G. Miley	LONG BASELINE STUDIES OF HIGH-REDSHIFT RADIO SOURCES: Constraining particle acceleration and cold gas
LC1_029	R. Oonk	Extragalactic Radio Recombination Lines: An LTA resource project.
LC1_032	P. Zarka	Exoplanet radio search and characterization
LC1_033	R. Fender	Wide field searches for image-plane radio transients
LC1_036	R. Oonk	Probing the Cold Interstellar Medium in the Milky Way.
LC1_038	D. Mulcahy	Detection of the extended disk of the nearly face-on galaxy NGC628
LC1_039	A. G. de Bruyn	The LOFAR EoR project
LC1_042*	J. Verbiest	Pulsar Monitoring with GLOW Stations
LC1_043	A. Miskolczi	Extended radio continuum halos in the edge-on galaxies NGC3432 and NGC5907
LC1_047	M. Brueggen	LOFAR surveys of galaxy clusters
LC1_048*	M. Serylak	Studying Pulsars and the Interstellar Medium using International LOFAR Stations
LC1_050	H. Vedantham	Lunar occultation: Towards measurement of the global redshifted 21-cm signal from cosmic dawn
LC1_052	J. Hessels	LOTAAS: The LOFAR Tied-Array All-Sky Survey for Pulsars and Fast Transients
LC1_055	G. White	LOFAR Survey of High Mass star forming regions in Galactic Plane - The Orion Nebula
DDT1_001	J. Broderick	LOFAR observations of the currently active transient XTE J1908+094
DDT1_002	L. Gurvits	HI absorption at z>5

* *observations for this project were performed in standalone mode*

** *observations for this project were performed in piggyback mode*

Appendix 4: board, committees and staff in 2013

Board members

Prof. K. Gaemers *(Chair of the Board)*
Prof. dr. ir. J.A.M. Bleeker
Prof. dr. J.T.M. de Hosson
Drs. S.B. Swierstra, Assen
Mw. Prof. dr. J.C.M. van Eijndhoven
Mw. Drs. J.P. Rijsdijk

Members of the Science Advisory Committee

Dr. S. Dougherty, *DRAO Canada*
Dr. L.V.E. Koopmans, *Kapteyn Institute*
Prof. dr. H.J.A. Röttgering, *Leiden Observatory*
Prof. dr. R.A.M.J. Wijers, *Amsterdam University*
Dr. S. Bhatnagar, *NRAO Socorro*
Prof. S. Tingay, *ICRAR Perth*
Dr. A. Loots, *SKA South Africa*
Dr. D. George, *Manchester University*

Members of the WSRT Program Committee

Isabella Prandoni *(Chair)*
Graham Woan
Carole Mundell
Marijke Haverkorn
Thijs van der Hulst
Tom Oosterloo
Andreas Brunthaler
Peter Biermann
Andrea Possenti
Jelle Kaastra

Directorate

Michael Garrett, *Scientific director/ Director General*
Marco de Vos, *Managing director/Deputy Director General*

Staff functions

Diana van Dijk, *Management assistant*
Truus van den Brink-Havinga, *Office manager*
Michiel van Haarlem, *Head of NL SKA Office*
Arnold van Ardenne, *Coordinator ASTRON SKA Program Office*
Femke Boekhorst, *PR & Communications officer*
Marja Carnal – v.d. Spek, *Secretary DOME*
André van Es, *Project manager European projects*
Arno Gregoor, *Employee general affairs*
Ina Lenten-Streutker, *Secretary*
Daniëla Mikkers, *Business development officer*
Rob Millenaar, *System engineer (SKA Project Office)*

Human Resources and Internal Communications

Diana Verweij, *Head HR&IC*
Carin Lubbers, *HR assistant*
Bastiaan Spijk, *Junior HR officer**
Erika Timmerman, *HR officer*
Marianne Wielink-Strating, *HR assistant*

Finance, Planning & Control

Janneke Wubs-Komdeur, *Head FP&C*
Ingrid Arling, *Assistant FP&C*
Emmy Boerma, *Project controller*
Anne Doek, *Assistant FP&C*
Bertine Kok-Winters, *Financial administrative assistant*
Anno Koster, *Purchasing administrative assistant*
Karin Spijkerman-Hogenkamp, *Project controller*

ICT support

Roelof Boesenkool, *Head of ICT*
Marc Luichjes, *System and network support*
Merijn Martens, *ICT assistant*
Jan Slagter, *System and network support*
Klaas Stuurwold, *Senior officer ICT*
Henk Vosmeijer, *Application and system administrator*

Facilities

Anne Veendijk, *Head of Facilities*
Alex Benjamins, *Technical support*
Henk Bokhorst, *Security*
Roelie Kremers, *Telephone operator/ receptionist*
Derk Kuipers, *Building and terrain*
Fritz Möller, *Facilities coordinator*
Miranda Vos, *Telephone operator/ receptionist*
Albert Wieringh, *Security*

Astronomy Group

Raffaella Morganti, *Head of Astronomy*
Besey Adams, *Postdoctoral research fellow**
Anne Archibald, *Postdoc in precision pulsar timing**
Ilse van Bemmel, *PostDoc*
Erwin de Blok, *Senior scientist*
Adam Deller, *Junior scientist*
Liesbet Elpenhof, *Secretary*
Brad Frank, *Postdoctoral research fellow**
Leith Godfrey, *Postdoctoral research fellow**
George Heald, *Junior scientist*
Jason Hessels, *Associate scientist*
Gemma Janssen, *Tenure track astronomer**
Vlad Kondratiev, *Pulsar PostDoc*
Joeri van Leeuwen, *Associate scientist*
Filippo Maccagni, *PhD researcher**
Elizabeth Mahoney, *Research assistant*
John McKean, *Junior scientist*
Raymond Oonk, *PostDoc*
Tom Oosterloo, *Senior scientist*
Maura Pilia, *PostDoc*
Charlotte Sobey, *Postdoctoral research fellow**
Mike Sipior, *Astronomical software support coordinator*
Marjan Tibbe, *Office manager*
Javier Moldón Vara, *PostDoc*
Nicolas Vilchez, *Software engineer**
Michael Wise, *Senior scientist*

Research and Development

Gert Kruithof, *Head of R&D**
Albert-Jan Boonstra, *Programme manager technical research/ Scientific director DOME*
Alexander van Amesfoort, *HPC software engineer*
Michel Arts, *Antenna Researcher*
Laurens Bakker, *RF System engineer*
Pieter Benthem, *Instrument engineer*
Mark Bentum, *Senior scientist DESP*
Jan Geralt Bij de Vaate, *Senior Project Manager*
Patricia Breman, *Office manager*
Raymond van den Brink, *Instrument engineer Mechanics*
Chris Broekema, *HPC Researcher*
Wim van Cappellen, *Head Antenna Group*
Arthur Coolen, *Software Design engineer*

Renate van Dalen-Bremer, *Secretary*
Sieds Damstra, *Design engineer*
Ger van Diepen, *Software System engineer*
Marco Drost, *Instrument engineer mechanics*
Tammo Jan Dijkema, *System Engineer**
Albert van Duin, *Support engineer*
Nico Ebbendorf, *Head of Technical support*
Benedetta Fiorelli, *Tenure track Antenna Design Engineer*
Marchel Gerbers, *Reliability engineer*
Lesley Goudbeek, *DOME electrical engineer**
Yan Grange, *Postdoc DOME*
André Gunst, *System engineer*
Ronald Halfwerk, *Technology Transfer Officer*
Hiddo Hanenburg, *Instrument engineer mechanics*
Boudewijn Hut, *Junior commissioning engineer**
Jan Idserda, *Head Mechanics Workshop*
Dion Kant, *Head System design & integration*
Koos Kegel, *Senior RF engineer*
Eric Kooistra, *System engineer DESP*
Anne Koster, *Project support engineer*
Sjouke Kuindersma, *Support engineer Mechanics*
Marcel Loose, *Software System engineer*
Peter Maat, *System researcher Photonics*
Agnes Mika, *DOME-SKA liaison engineer**
Jürgen Morawietz, *RF Instrument engineer*
Eim Mulder, *Support engineer*
Ronald Nijboer, *Head of Computing*
Ruud Overeem, *Instrument engineer software*
Vishambhar Nath Pandey, *Researcher*
Harm-Jan Pepping, *Design engineer DESP*
Johan Pragt, *Head of Mechanics*
Raj Thilak Rajan, *Digital signal processing engineer*
John Romein, *System researcher Software*
Mark Ruiter, *RF Instrument engineer*
Peeyush Prasad, *Postdoc**
Gijs Schoonderbeek, *Instrument engineer DESP*
David Smith, *PostDoc OLFAR*
Bas van der Tol, *Scientific software engineer**
Niels Tromp, *Instrument engineer Mechanics*
Lars Venema, *Senior researcher*
Klaas Visser, *RF Instrument engineer*
Erik van der Wal, *RF Instrument engineer*
Stefan Wijnholds, *Researcher*
Ronald de Wild, *Instrument engineer DESP*
Roel Witvers, *RF Instrument engineer*
Sarod Yatawatta, *Researcher Software*
Sjouke Zwier, *Design engineer DESP*

Radio Observatory

René Vermeulen, *Director Radio Observatory*
Cees Bassa, *Postdoctoral research assistant**
Michiel Brentjens, *Observatory astronomer*
Pieter Donker, *ICT/Software engineer*
Liesbet Elpenhof, *Secretary*
Richard Fallows, *Support scientist*
Wilfred Frieswijk, *Support scientist*
Teun Grit, *ICT/Software engineer*
Peter Gruppen, *Support engineer electronics*
Hanno Holties, *Head of software support*
Alwin de Jong, *ICT/Software engineer*
Gyula Józsa, *Support scientist*
Wouter Klijn, *Software engineer*
Geert Kuper, *Operator*
Hans van der Marel, *System engineer*
Henri Meulman, *Hardware engineer*
Jan David Mol, *ICT/Sofware engineer*
Harm Munk, *Head of Operations & Maintenance*
Menno Norden, *System engineer*
Emanuela Orrù, *Support scientist*
Roberto Pizzo, *Head of Science Support*
Antonis Polatidis, *Observatory Astronomer*
Jan-Pieter de Reijer, *Hardware engineer*
Adriaan Renting, *ICT/Software engineer*
Arno Schoenmakers, *ICT/Software engineer*
Jurjen Sluman, *Operator*
Roy Smits, *Support scientist*
Yuan Tang, *Operator*
Marjan Tibbe, *Office manager*
Carmen Toribio, *Support scientist*
Nico Vermaas, *ICT/Software engineer*

NOVA Optical/IR Instrumentation Group

Ramon Navarro Y Koren, *Group leader*
Tibor Agócs, *Instrument engineer*
Felix Bettonvil, *System engineer*
Eddy Elswijk, *Hardware engineer*
Menno de Haan, *Support engineer*
Rik ter Horst, *Instrument engineer*
Jan Kragt, *Design engineer*
Gabby Kroes, *Instrument engineer*
Ronald Roelfsema, *System engineer*
Menno Schuil, *Support engineer*

**New employee in 2013*

Appendix 5: publications

Astronomy Group and Radio Observatory

Journal Articles

1. A. J. van der Horst, ..[22 authors collapsed].., M. A. Garrett and [10 authors collapsed] : *Broad-band monitoring tracing the evolution of the jet and disc in the black hole candidate X-ray binary MAXI J1659-152*, 2013, *Monthly Notices of the Royal Astronomical Society, 436, 2625-2638*
2. C. Ramos Almeida, P. S. Bessiere, C. N. Tadhunter, K. J. Inskip, R. Morganti, D. Dicken, J. I. González-Serrano, J. Holt: *The environments of luminous radio galaxies and type-2 quasars*, 2013, *Monthly Notices of the Royal Astronomical Society, 436, 997-1016*
3. H. Falcke, S. B. Markoff: *Toward the event horizon---the supermassive black hole in the Galactic Center*, 2013, *Classical and Quantum Gravity, 30, 4003*
4. David L. Nidever, Trisha Ashley, Colin T. Slater, Jürgen Ott, Megan Johnson, Eric F. Bell, Snezana Stanimirovic, Mary Putman, Steven R. Majewski, Caroline E. Simpson, Eva Jütte, Tom A. Oosterloo, W. Butler Burton: *Evidence for an Interaction in the Nearest Starbursting Dwarf Irregular Galaxy IC 10*, 2013, *The Astrophysical Journal Letters, 779, L15*
5. G. Pivato, J. W. Hewitt, L. Tibaldo, F. Acero, J. Ballet, T. J. Brandt, F. de Palma, F. Giordano, G. H. Janssen, G. Jóhannesson, D. A. Smith: *Fermi LAT and WMAP Observations of the Supernova Remnant HB 21*, 2013, *The Astrophysical Journal, 779, 179*
6. Kristina Nyland, Katherine Alatalo, J. M. Wrobel, Lisa M. Young, Raffaella Morganti, Timothy A. Davis, P. T. de Zeeuw, Susana Deustua, Martin Bureau: *Detection of a High Brightness Temperature Radio Core in the Active-galactic-nucleus-driven Molecular Outflow Candidate NGC 1266*, 2013, *The Astrophysical Journal, 779, 173*
7. T. J. Johnson, L. Guillemot, M. Kerr, I. Cognard, P. S. Ray, M. T. Wolff, S. Bégin, G. H. Janssen and [22 authors collapsed] : Broadband Pulsations from PSR B1821-24: *Implications for Emission Models and the Pulsar Population of M28*, 2013, *The Astrophysical Journal, 778, 106*
8. P. Abreu, ..[125 authors collapsed].., H. Falcke and [378 authors collapsed]: *Identifying clouds over the Pierre Auger Observatory using infrared satellite data*, 2013, *Astroparticle Physics, 50, 92-101*
9. W. D. Apel, ..[15 authors collapsed].., H. Falcke and [39 authors collapsed]: *Comparing LOPES measurements of air-shower radio emission with REAS 3.11 and CoREAS simulations*, 2013, *Astroparticle Physics, 50, 76-91*
10. Judith Irwin, Marita Krause, Jayanne English, Rainer Beck, Eric Murphy, Theresa Wiegert, George Heald, Rene Walterbos, Richard J. Rand, Troy Porter: *CHANG-ES. III. UGC 10288---An Edge-on Galaxy with a Background Double-lobed Radio Source*, 2013, *The Astronomical Journal, 146, 164*
11. Anahi Caldú-Primo, Andreas Schruba, Fabian Walter, Adam Leroy, Karin Sandstrom, W. J. G. de Blok, R. Ianjamasimanana, K. M. Mogotsi: *A High-dispersion Molecular Gas Component in Nearby Galaxies*, 2013, *The Astronomical Journal, 146, 150*
12. P. Schellart, A. Nelles, S. Buitink, A. Corstanje, J. E. Enriquez, H. Falcke, W. Frieswijk, ..[21 authors collapsed].., M. Brentjens, ..[11 authors collapsed].., R. A. Fallows, C. Ferrari, M. A. Garrett, J. Grießmeier, T. Grit, J. P. Hamaker, T. E. Hassall, G. Heald, J. W. T. Hessels, M. Hoeft, H. A. Holties, M. Iacobelli, E. Juette, A. Karastergiou, W. Klijn, J. Kohler, V. I. Kondratiev, M. Kramer, M. Kuniyoshi, G. Kuper, P. Maat, G. Macario, G. Mann, S. Markoff, D. McKay-Bukowski, J. P. McKean, ..[11 authors collapsed].., R. Pizzo, A. G. Polatidis, A. Renting, J. W. Romein, H. Röttgering, A. Schoenmakers, D. Schwarz, J. Sluman, O. Smirnov, C. Sobey, B. W. Stappers, M. Steinmetz, J. Swinbank, Y. Tang, C. Tasse, C. Toribio, J. van Leeuwen, R. van Nieuwpoort, R. J. van Weeren, N. Vermaas, R. Vermeulen, C. Vocks, C. Vogt, R. A. M. J. Wijers, S. J. Wijnholds, M. W. Wise, O. Wucknitz, S. Yatawatta, P. Zarka, A. Zensus: *Detecting cosmic rays with the LOFAR radio telescope*, 2013, *Astronomy and Astrophysics, 560, 98*
13. G. A. Caliandro, A. B. Hill, D. F. Torres, D. Hadasch, P. Ray, A. Abdo, J. W. T. Hessels and [9 authors collapsed] : The missing GeV gamma-ray binary: *searching for HESS J0632+057 with Fermi-LAT*, 2013, *Monthly Notices of the Royal Astronomical Society, 436, 740-749*
14. D. Cseh, F. Grisé, P. Kaaret, S. Corbel, S. Scaringi, P. Groot, H. Falcke, E. Körding: Towards a dynamical mass of the ultraluminous X-ray source NGC 5408 X-1, 2013, *Monthly Notices of the Royal Astronomical Society, 435, 2896-2902*
15. J. Rhee, Martin A. Zwaan, Frank H. Briggs, Jayaram N. Chengalur, Philip Lah, Tom Oosterloo, Thijs van der Hulst: *Neutral atomic hydrogen (H I) gas evolution in field galaxies at z ˜ 0.1 and ˜0.2*, 2013, *Monthly Notices of the Royal Astronomical Society, 435, 2693-2706*
16. Richard Strom: Book Review: Our Enigmatic Universe: *One Astronomer's Reflections on the Human Condition in Tromsø 2012*, 2013, *Journal of Astronomical History and Heritage, 16, 339-340*
17. K. M. Sandstrom, ..[14 authors collapsed].., W. J. G. de Blok and [29 authors collapsed]: *The CO-to-H2 Conversion Factor and Dust-to-gas Ratio on Kiloparsec Scales in Nearby Galaxies*, 2013, *The Astrophysical Journal, 777, 5*
18. M. Bellazzini, T. Oosterloo, F. Fraternali, G. Beccari: *Dwarfs walking in a row. The filamentary nature of the NGC 3109 association*, 2013, *Astronomy and Astrophysics, 559, L11*

19. Monika Moscibrodzka, Heino Falcke: *Coupled jet-disk model for Sagittarius A*: explaining the flat-spectrum radio core with GRMHD simulations of jets*, 2013, *Astronomy and Astrophysics, 559, L3*
20. A. L. Chies-Santos, A. Cortesi, D. S. M. Fantin, M. R. Merrifield, S. Bamford, P. Serra: *The nature of faint fuzzies from the kinematics of NGC 1023*, 2013, *Astronomy and Astrophysics, 559, 67*
21. R. Gießübel, G. Heald, R. Beck, T. G. Arshakian: *Polarized synchrotron radiation from the Andromeda galaxy M 31 and background sources at 350 MHz*, 2013, *Astronomy and Astrophysics, 559, 27*
22. B. W. Holwerda, N. Pirzkal, W. J. G. de Blok, S.-L. Blyth: *Quantified H I morphology - VII. Star formation and tidal influence on local dwarf H I morphology*, 2013, *Monthly Notices of the Royal Astronomical Society, 435, 1020-1036*
23. A. R. Offringa, A. G. de Bruyn, ..[32 authors collapsed].., R. A. Fallows, C. Ferrari, W. Frieswijk, M. A. Garrett, ..[9 authors collapsed].., V. I. Kondratiev, J. van Leeuwen, M. Loose, P. Maat, G. Macario, G. Mann, J. P. McKean, H. Meulman, M. J. Norden, E. Orru, H. Paas, M. Pandey-Pommier, R. Pizzo, A. G. Polatidis, C. Sobey, ..[11 authors collapsed].., C. Toribio, R. Vermeulen, C. Vocks, R. J. van Weeren, M. W. Wise, O. Wucknitz: *The brightness and spatial distributions of terrestrial radio sources*, 2013, *Monthly Notices of the Royal Astronomical Society, 435, 584-596*
24. Noah Brosch, Ido Finkelman, Tom Oosterloo, Gyula Jozsa, Alexei Moiseev: H I in HO: *Hoag's Object revisited*, 2013, *Monthly Notices of the Royal Astronomical Society, 435, 475-481*
25. Hannes Jensen, Kanan K. Datta, Garrelt Mellema, Emma Chapman, Filipe B. Abdalla, Ilian T. Iliev, Yi Mao, Mario G. Santos, Paul R. Shapiro, Saleem Zaroubi, G. Bernardi, M. A. Brentjens, A. G. de Bruyn, B. Ciardi, G. J. A. Harker, V. Jelic, S. Kazemi, L. V. E. Koopmans, P. Labropoulos and [8 authors collapsed]: *Probing reionization with LOFAR using 21-cm redshift space distortions*, 2013, *Monthly Notices of the Royal Astronomical Society, 435, 460-474*
26. Tao An, Willem A. Baan, Jun-Yi Wang, Yu Wang, Xiao-Yu Hong: *Periodic radio variabilities in NRAO 530: a jet-disc connection?*, 2013, *Monthly Notices of the Royal Astronomical Society, 434, 3487-3496*
27. R. P. Deane, S. Rawlings, M. A. Garrett, I. Heywood, M. J. Jarvis, H.-R. Klöckner, P. J. Marshall, J. P. McKean: *The preferentially magnified active nucleus in IRAS F10214+4724 - III. VLBI observations of the radio core*, 2013, *Monthly Notices of the Royal Astronomical Society, 434, 3322-3336*
28. A. A. Abdo, ..[75 authors collapsed].., G. Godfrey, E. V. Gotthelf, I. A. Grenier, M.-H. Grondin, J. E. Grove, L. Guillemot, S. Guiriec, D. Hadasch, Y. Hanabata, A. K. Harding, M. Hayashida, E. Hays, J. Hessels, J. Hewitt, A. B. Hill, D. Horan, X. Hou, R. E. Hughes, M. S. Jackson, G. H. Janssen and [115 authors collapsed]: *The Second Fermi Large Area Telescope Catalog of Gamma-Ray Pulsars*, 2013, *The Astrophysical Journal Supplement Series, 208, 17*
29. Deidre A. Hunter, Bruce G. Elmegreen, Vera C. Rubin, Allison Ashburn, Teresa Wright, Gyula I. G. Józsa, Christian Struve: *Star Formation in Two Luminous Spiral Galaxies*, 2013, *The Astronomical Journal, 146, 92*
30. F. Verrecchia, ..[55 authors collapsed].., M. Pilia and [22 authors collapsed]: *An updated list of AGILE bright gamma-ray sources and their variability in pointing mode*, 2013, *Astronomy and Astrophysics, 558, 137*
31. N. Gupta, R. Srianand, P. Noterdaeme, P. Petitjean, S. Muzahid: *21-cm absorption from galaxies at z ~ 0.3*, 2013, *Astronomy and Astrophysics, 558, 84*
32. M. Iacobelli, M. Haverkorn, E. Orrú, R. F. Pizzo, J. Anderson, R. Beck, M. R. Bell, A. Bonafede, K. Chyzy, R.-J. Dettmar, T. A. Enßlin, G. Heald, C. Horellou, A. Horneffer, W. Jurusik, H. Junklewitz, M. Kuniyoshi, D. D. Mulcahy, R. Paladino, W. Reich, A. Scaife, C. Sobey, C. Sotomayor-Beltran, A. Alexov, A. Asgekar, I. M. Avruch, M. E. Bell, I. van Bemmel, M. J. Bentum, G. Bernardi, P. Best, L. Birzan, F. Breitling, J. Broderick, W. N. Brouw, M. Brüggen, H. R. Butcher, B. Ciardi, J. E. Conway, F. de Gasperin, E. de Geus, S. Duscha, J. Eislöffel, D. Engels, H. Falcke, R. A. Fallows, C. Ferrari, W. Frieswijk, M. A. Garrett, J. Grießmeier, A. W. Gunst, J. P. Hamaker, T. E. Hassall, J. W. T. Hessels, M. Hoeft, J. Hörandel, V. Jelic, A. Karastergiou, V. I. Kondratiev, L. V. E. Koopmans, M. Kramer, G. Kuper, J. van Leeuwen, G. Macario, G. Mann, J. P. McKean, H. Munk, M. Pandey-Pommier, A. G. Polatidis, H. Röttgering, D. Schwarz, J. Sluman, O. Smirnov, B. W. Stappers, M. Steinmetz, M. Tagger, Y. Tang, C. Tasse, C. Toribio, R. Vermeulen, C. Vocks, C. Vogt, R. J. van Weeren, M. W. Wise, O. Wucknitz, S. Yatawatta, P. Zarka, A. Zensus: *Studying Galactic interstellar turbulence through fluctuations in synchrotron emission. First LOFAR Galactic foreground detectio*n, 2013, *Astronomy and Astrophysics, 558, 72*
33. K. Geréb, R. Morganti, T. A. Oosterloo, G. Guglielmino, I. Prandoni: The Lockman Hole project: *gas and galaxy properties from a stacking experiment*, 2013, *Astronomy and Astrophysics, 558, 54*
34. A. W. Chen, ..[44 authors collapsed].., M. Pilia and [14 authors collapsed]: *Calibration of AGILE-GRID with in-flight data and Monte Carlo simulations*, 2013, *Astronomy and Astrophysics, 558, 37*
35. Raffaella Morganti, Judit Fogasy, Zsolt Paragi, Tom Oosterloo, Monica Orienti: *Radio Jets Clearing the Way Through a Galaxy: Watching Feedback in Action*, 2013, *Science, 341, 1082-1085*
36. A. Papitto, ..[11 authors collapsed].., J. W. T. Hessels and [10 authors collapsed]: *Swings between rotation and accretion power in a binary millisecond pulsar*, 2013, *Nature, 501, 517-520*
37. R. P. Eatough, H. Falcke, R. Karuppusamy, K. J. Lee, D. J. Champion, E. F. Keane, G. Desvignes, D. H. F. M. Schnitzeler, L. G. Spitler, M. Kramer, B. Klein, C. Bassa, G. C. Bower, A. Brunthaler, I. Cognard, A. T. Deller and [7 authors collapsed]: *A strong magnetic field around the supermassive black hole at the centre of the Galaxy*, 2013, *Nature, 501, 391-394*

38. P. Kamphuis, R. J. Rand, G. I. G. Józsa, L. K. Zschaechner, G. H. Heald, M. T. Patterson, G. Gentile, R. A. M. Walterbos, P. Serra, W. J. G. de Blok: *HALOGAS observations of NGC 5023 and UGC 2082: modelling of non-cylindrically symmetric gas distributions in edge-on galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 434, 2069-2093*
39. C. Carignan, B. S. Frank, K. M. Hess, D. M. Lucero, T. H. Randriamampandry, S. Goedhart, S. S. Passmoor: *KAT-7 Science Verification: Using H I Observations of NGC 3109 to Understand its Kinematics and Mass Distribution*, 2013, *The Astronomical Journal, 146, 48*
40. Sjoert van Velzen, Heino Falcke: *The contribution of spin to jet-disk coupling in black holes*, 2013, *Astronomy and Astrophysics, 557, L7*
41. E. K. Mahony, R. Morganti, B. H. C. Emonts, T. A. Oosterloo, C. Tadhunter: The location and impact of jet-driven outflows of cold gas: *the case of 3C 293*, 2013, *Monthly Notices of the Royal Astronomical Society, 435, L58-L62*
42. Davor Krajnovic, A. M. Karick, Roger L. Davies, Thorsten Naab, Marc Sarzi, Eric Emsellem, Michele Cappellari, Paolo Serra, P. T. de Zeeuw, Nicholas Scott, Richard M. McDermid, Anne-Marie Weijmans, Timothy A. Davis, Katherine Alatalo, Leo Blitz, Maxime Bois, Martin Bureau, Frederic Bournaud, Alison Crocker, Pierre-Alain Duc, Sadegh Khochfar, Harald Kuntschner, Raffaella Morganti, Tom Oosterloo, Lisa M. Young: *The ATLAS3D Project - XXIII. Angular momentum and nuclear surface brightness profiles*, 2013, *Monthly Notices of the Royal Astronomical Society, 433, 2812-2839*
43. T. An, Z. Paragi, S. Frey, T. Xiao, W. A. Baan, S. Komossa, K. É. Gabányi, Y.-H. Xu, X.-Y. Hong: *The radio structure of 3C 316, a galaxy with double-peaked narrow optical emission lines*, 2013, *Monthly Notices of the Royal Astronomical Society, 433, 1161-1171*
44. Kelsey E. Young, Matthijs C. Soest, Kip V. Hodges, E. Bruce Watson, Byron A. Adams, Pascal Lee: *Impact thermochronology and the age of Haughton impact structure, Canada*, 2013, *Geophysical Research Letters, 40, 3836-3840*
45. Garrelt Mellema, Léon V. E. Koopmans, Filipe A. Abdalla, Gianni Bernardi, Benedetta Ciardi, Soobash Daiboo, A. G. de Bruyn, Kanan K. Datta, Heino Falcke, Andrea Ferrara, Ilian T. Iliev, Fabio Iocco, Vibor Jelic and [14 authors collapsed]: *Reionization and the Cosmic Dawn with the Square Kilometre Array*, 2013, *Experimental Astronomy, 36, 235-318*
46. B. Allen, B. Knispel, J. M. Cordes, J. S. Deneva, J. W. T. Hessels, D. Anderson, C. Aulbert, O. Bock, A. Brazier, S. Chatterjee, P. B. Demorest, H. B. Eggenstein, H. Fehrmann, E. V. Gotthelf, D. Hammer, V. M. Kaspi, M. Kramer, A. G. Lyne, B. Machenschalk, M. A. McLaughlin, C. Messenger, H. J. Pletsch, S. M. Ransom, I. H. Stairs, B. W. Stappers, N. D. R. Bhat, S. Bogdanov, F. Camilo, D. J. Champion, F. Crawford, G. Desvignes, P. C. C. Freire, G. Heald, F. A. Jenet, P. Lazarus, K. J. Lee, J. van Leeuwen and [9 authors collapsed] : The Einstein@Home Search for Radio Pulsars and PSR J2007+2722 Discovery, 2013, *The Astrophysical Journal, 773, 91*
47. Junhua Gu, Haiguang Xu, Jingying Wang, Tao An, Wen Chen: *The Application of Continuous Wavelet Transform Based Foreground Subtraction Method in 21 cm Sky Surveys*, 2013, *The Astrophysical Journal, 773, 38*
48. J. Aleksic, ..[88 authors collapsed].., J. Moldón, A. Moralejo, P. Munar-Adrover, D. Nakajima, A. Niedzwiecki, D. Nieto, K. Nilsson, N. Nowak, R. Orito, S. Paiano, M. Palatiello, D. Paneque, R. Paoletti, J. M. Paredes, S. Partini, M. Persic, M. Pilia and [86 authors collapsed]: *The simultaneous low state spectral energy distribution of 1ES 2344+514 from radio to very high energies*, 2013, *Astronomy and Astrophysics, 556, 67*
49. M. P. van Haarlem, M. W. Wise, A. W. Gunst, G. Heald, J. P. McKean, J. W. T. Hessels, A. G. de Bruyn, .., R. Fallows, M. Brentjens, .., H. Falcke, ..[48 authors collapsed].., A. T. Deller, ..[12 authors collapsed].., W. Frieswijk, H. Gankema, M. A. Garrett, ..[24 authors collapsed].., V. Jelic, .., V. I. Kondratiev, ..[8 authors collapsed].., J. van Leeuwen, ..[14 authors collapsed].., R. Morganti, ..[12 authors collapsed].., R. Pizzo, A. Polatidis, ..[18 authors collapsed].., C. Sobey, H. Spreeuw, M. Steinmetz, C. G. M. Sterks, H.-J. Stiepel, K. Stuurwold, M. Tagger, Y. Tang, C. Tasse, I. Thomas, S. Thoudam, M. C. Toribio, .., R. Vermeulen and [19 authors collapsed]: *LOFAR: The LOw-Frequency ARray*, 2013, *Astronomy and Astrophysics, 556, 2*
50. Ming Xiong, J. A. Davies, M. M. Bisi, M. J. Owens, R. A. Fallows, G. D. Dorrian: Effects of Thomson-Scattering Geometry on White-Light Imaging of an Interplanetary Shock: *Synthetic Observations from Forward Magnetohydrodynamic Modelling*, 2013, *Solar Physics, 285, 369-389*
51. R. A. Fallows, A. Asgekar, M. M. Bisi, A. R. Breen, S. ter-Veen: The Dynamic Spectrum of Interplanetary Scintillation: *First Solar Wind Observations on LOFAR*, 2013, *Solar Physics, 285, 127-139*
52. S. A. Hardwick, M. M. Bisi, J. A. Davies, A. R. Breen, R. A. Fallows, R. A. Harrison, C. J. Davis: *Observations of Rapid Velocity Variations in the Slow Solar Wind*, 2013, *Solar Physics, 285, 111-126*
53. G. D. Dorrian, A. R. Breen, R. A. Fallows, M. M. Bisi: *Equatorwards Expansion of Unperturbed, High-Latitude Fast Solar Wind*, 2013, *Solar Physics, 285, 97-110*
54. K. J. Lee, ..[26 authors collapsed].., J. W. T. Hessels, R. Karuppusamy, V. M. Kaspi, B. Knispel, M. Kramer, P. Lazarus, R. Lynch, A. Lyne, M. McLaughlin, S. Ransom, P. Scholz, X. Siemens, L. Spitler, I. Stairs, M. Tan, J. van Leeuwen, W. W. Zhu: PEACE: *pulsar evaluation algorithm for candidate extraction - a software package for post-analysis processing of pulsar survey candidate*s, 2013, *Monthly Notices of the Royal Astronomical Society, 433, 688-694*
55. Jing Wang, Guinevere Kauffmann, Gyula I. G. Józsa, Paolo Serra, Thijs van der Hulst, Frank Bigiel, Jarle Brinchmann, M. A. W. Verheijen, Tom Oosterloo, Enci Wang, Cheng Li, Milan den Heijer, Jürgen Kerp: *The Bluedisks project, a study of unusually H I-rich galaxies - I. H I sizes and morphology*, 2013, *Monthly Notices of the Royal Astronomical Society, 433, 270-294*

56. R. P. C. Wiersma, B. Ciardi, R. M. Thomas, G. J. A. Harker, S. Zaroubi, G. Bernardi, M. Brentjens, A. G. de Bruyn, S. Daiboo, V. Jelic, S. Kazemi, L. V. E. Koopmans, P. Labropoulos and [8 authors collapsed]: *LOFAR insights into the epoch of reionization from the cross-power spectrum of 21 cm emission and galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 2615-2624*
57. Marie Martig, ..[18 authors collapsed].., Raffaella Morganti, Richard M. McDermid, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Nicholas Scott, Paolo Serra, Kristen Shapiro Griffin, Romain Teyssier, Anne-Marie Weijmans, Lisa M. Young: *The ATLAS3D project - XXII. Low-efficiency star formation in early-type galaxies: hydrodynamic models and observations*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1914-1927*
58. Nicholas Scott, ..[17 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Paolo Serra, Anne-Marie Weijmans, Lisa M. Young: *The ATLAS3D project - XXI. Correlations between gradients of local escape velocity and stellar populations in early-type galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1894-1913*
59. Michele Cappellari, ..[15 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Nicholas Scott, Paolo Serra, Anne-Marie Weijmans, Lisa M. Young: *The ATLAS3D project - XX. Mass-size and mass-sigma distributions of early-type galaxies: bulge fraction drives kinematics, mass-to-light ratio, molecular gas fraction and stellar initial mass function*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1862-1893*
60. Marc Sarzi, ..[17 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Nicholas Scott, Paolo Serra, Lisa M. Young, Anne-Marie Weijmans: *The ATLAS3D project - XIX. The hot gas content of early-type galaxies: fast versus slow rotators*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1845-1861*
61. Katherine Alatalo, ..[17 authors collapsed].., Raffaella Morganti, Richard M. McDermid, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Nicholas Scott, Paolo Serra, Anne-Marie Weijmans: *The ATLAS3D project - XVIII. CARMA CO imaging survey of early-type galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1796-1844*
62. Davor Krajnovic, ..[14 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Nicholas Scott, Paolo Serra, Anne-Marie Weijmans, Lisa M. Young: *The ATLAS3D project - XVII. Linking photometric and kinematic signatures of stellar discs in early-type galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1768-1795*
63. Estelle Bayet, ..[17 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Nicholas Scott, Paolo Serra, Anne-Marie Weijmans: *The ATLAS3D project - XVI. Physical parameters and spectral line energy distributions of the molecular gas in gas-rich early-type galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1742-1767*
64. Michele Cappellari, ..[16 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Paolo Serra, Anne-Marie Weijmans, Lisa M. Young: *The ATLAS3D project - XV. Benchmark for early-type galaxies scaling relations from 260 dynamical models: mass-to-light ratio, dark matter, Fundamental Plane and Mass Plane*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1709-1741*
65. D. J. Nice, E. Altiere, S. Bogdanov, J. M. Cordes, D. Farrington, J. W. T. Hessels, V. M. Kaspi, A. G. Lyne, L. Popa, S. M. Ransom, S. Sanpa-arsa, B. W. Stappers, Y. Wang, B. Allen, N. D. R. Bhat, A. Brazier, F. Camilo, D. J. Champion, S. Chatterjee, F. Crawford, J. S. Deneva, G. Desvignes, P. C. C. Freire, F. A. Jenet, B. Knispel, P. Lazarus, K. J. Lee, J. van Leeuwen and [9 authors collapsed]: *Timing and Interstellar Scattering of 35 Distant Pulsars Discovered in the PALFA Survey,* 2013, *The Astrophysical Journal, 772, 50*
66. B. D. Lehmer, D. R. Wik, A. E. Hornschemeier, A. Ptak, V. Antoniou, M. K. Argo and [13 authors collapsed]: *NuSTAR and Chandra Insight into the Nature of the 3-40 keV Nuclear Emission in NGC 253*, 2013, *The Astrophysical Journal, 771, 134*
67. T. A. Oosterloo, G. H. Heald, W. J. G. de Blok: *Is GBT 1355+5439 a dark galaxy?*, 2013, *Astronomy and Astrophysics, 555, L7*
68. Z. Paragi, A. J. van der Horst, T. Belloni, J. C. A. Miller-Jones, J. Linford, G. Taylor, J. Yang, M. A. Garrett, J. Granot, C. Kouveliotou, E. Kuulkers, R. A. M. J. Wijers: *VLBI observations of the shortest orbital period black hole binary, MAXI J1659-152*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1319-1329*
69. Leonid Petrov, Elizabeth K. Mahony, Philip G. Edwards, Elaine M. Sadler, Frank K. Schinzel, David McConnell: *Australia Telescope Compact Array observations of Fermi unassociated sources*, 2013, *Monthly Notices of the Royal Astronomical Society, 432, 1294-1302*
70. Ximena Fernández, J. H. van Gorkom, Kelley M. Hess, D. J. Pisano, Kathryn Kreckel, Emmanuel Momjian, Attila Popping, Tom Oosterloo and [7 authors collapsed]: *A Pilot for a Very Large Array H I Deep Field*, 2013, *The Astrophysical Journal Letters, 770, L29*
71. A. T. Deller, J. Boyles, D. R. Lorimer, V. M. Kaspi, M. A. McLaughlin, S. Ransom, I. H. Stairs, K. Stovall: *VLBI Astrometry of PSR J2222-0137: A Pulsar Distance Measured to 0.4% Accuracy*, 2013, *The Astrophysical Journal, 770, 145*
72. S. S. Shabala, L. E. H. Godfrey: *Size Dependence of the Radio-luminosity-Mechanical-power Correlation in Radio Galaxies*, 2013, *The Astrophysical Journal, 769, 129*
73. R. P. Breton, M. H. van Kerkwijk, M. S. E. Roberts, J. W. T. Hessels, F. Camilo, M. A. McLaughlin, S. M. Ransom, P. S. Ray, I. H. Stairs: *Discovery of the Optical Counterparts to Four Energetic Fermi Millisecond Pulsars*, 2013, *The Astrophysical Journal, 769, 108*

74. R. Beck, J. Anderson, G. Heald, A. Horneffer, M. Iacobelli, J. Köhler, D. Mulcahy, R. Pizzo, A. Scaife, O. Wucknitz: *The LOFAR view of cosmic magnetism*, 2013, *Astronomische Nachrichten, 334, 548-557*
75. A. S. Saburova, G. I. G. Józsa, A. V. Zasov, D. V. Bizyaev: *WSRT observations and surface photometry of two unusual spiral galaxies*, 2013, *Astronomy and Astrophysics, 554, 128*
76. G. Gentile, G. I. G. Józsa, P. Serra, G. H. Heald, W. J. G. de Blok, F. Fraternali, M. T. Patterson, R. A. M. Walterbos, T. Oosterloo: HALOGAS: *Extraplanar gas in NGC 3198*, 2013, *Astronomy and Astrophysics, 554, 125*
77. M. F. Bietenholz, V. Kondratiev, S. Ransom, P. Slane, N. Bartel, S. Buchner: *The proper motion of PSR J0205+6449 in 3C 58*, 2013, *Monthly Notices of the Royal Astronomical Society, 431, 2590-2598*
78. M. A. Gendre, D. M. Fenech, R. J. Beswick, T. W. B. Muxlow, M. K. Argo: *Flux density variations of radio sources in M82 over the last three decades*, 2013, *Monthly Notices of the Royal Astronomical Society, 431, 1107-1120*
79. R. Rosen, J. Swiggum, M. A. McLaughlin, D. R. Lorimer, M. Yun, S. A. Heatherly, J. Boyles, R. Lynch, V. I. Kondratiev and [62 authors collapsed]: *The Pulsar Search Collaboratory: Discovery and Timing of Five New Pulsars*, 2013, *The Astrophysical Journal, 768, 85*
80. John S. Morgan, Megan K. Argo, Cathryn M. Trott, Jean-Pierre Macquart, Adam Deller, Enno Middelberg, James Miller-Jones, Steven J. Tingay: Wide-field VLBI Observations of M31: *A Unique Probe of the Ionized Interstellar Medium of a Nearby Galaxy*, 2013, *The Astrophysical Journal, 768, 12*
81. John Antoniadis, Paulo C. C. Freire, Norbert Wex, Thomas M. Tauris, Ryan S. Lynch, Marten H. van Kerkwijk, Michael Kramer, Cees Bassa, Vik S. Dhillon, Thomas Driebe, Jason W. T. Hessels, Victoria M. Kaspi, Vladislav I. Kondratiev, Norbert Langer, Thomas R. Marsh, Maura A. McLaughlin, Timothy T. Pennucci, Scott M. Ransom, Ingrid H. Stairs, Joeri van Leeuwen, Joris P. W. Verbiest, David G. Whelan: *A Massive Pulsar in a Compact Relativistic Binary*, 2013, *Science, 340, 448*
82. M. K. Argo, Z. Paragi, H. Röttgering, H.-R. Klöckner, G. Miley, M. Mahmud: *Probing the nature of compact ultrasteep spectrum radio sources with the e-EVN and e-MERLIN*, 2013, *Monthly Notices of the Royal Astronomical Society, 431, L58-L62*
83. E. M. Ratti, T. F. J. van Grunsven, M. A. P. Torres, P. G. Jonker, J. C. A. Miller-Jones, J. W. T. Hessels, H. Van Winckel, M. van der Sluys, G. Nelemans: *IGR J19308+0530: Roche lobe overflow on to a compact object from a donor 1.8 times as massive*, 2013, *Monthly Notices of the Royal Astronomical Society, 431, L10-L14*
84. V. I. Zhuravlev, M. V. Popov, V. A. Soglasnov, V. I. Kondrat'ev, Y. Y. Kovalev, N. Bartel, F. Ghigo: *Statistical and polarization properties of giant pulses of the millisecond pulsar B1937+21*, 2013, *Monthly Notices of the Royal Astronomical Society, 430, 2815-2821*
85. R. G. Strom, R. Chen, J. Yang, B. Peng: *Structure and environment of the giant radio galaxy 4C 73.08*, 2013, *Monthly Notices of the Royal Astronomical Society, 430, 2090-2096*
86. M. Argo, R. Hollow: *Astronomy Outreach in the Remote Mid West Region of Western Australia*, 2013, *Communicating Astronomy with the Public Journal, 13, 16*
87. N. Werner, J. B. R. Oonk and [11 authors collapsed]: *The Nature of Filamentary Cold Gas in the Core of the Virgo Cluster*, 2013, *The Astrophysical Journal, 767, 153*
88. Andrew P. V. Siemion, Paul Demorest, Eric Korpela, Ron J. Maddalena, Dan Werthimer, Jeff Cobb, Andrew W. Howard, Glen Langston, Matt Lebofsky, Geoffrey W. Marcy, Jill Tarter: *A 1.1-1.9 GHz SETI Survey of the Kepler Field. I. A Search for Narrow-band Emission from Select Targets*, 2013, *The Astrophysical Journal, 767, 94*
89. J. Von Korff, P. Demorest, E. Heien, E. Korpela, D. Werthimer, J. Cobb, M. Lebofsky, D. Anderson, B. Bankay, A. Siemion: *Astropulse: A Search for Microsecond Transient Radio Signals Using Distributed Computing. I. Methodology*, 2013, *The Astrophysical Journal, 767, 40*
90. L. E. H. Godfrey, S. S. Shabala: *AGN Jet Kinetic Power and the Energy Budget of Radio Galaxy Lobes*, 2013, *The Astrophysical Journal, 767, 12*
91. Cathryn M. Trott, Steven J. Tingay, Randall B. Wayth, David R. Thompson, Adam T. Deller and [6 authors collapsed]: *A Framework for Interpreting Fast Radio Transients Search Experiments: Application to the V-FASTR Experiment,* 2013, *The Astrophysical Journal, 767, 4*
92. S. Sabatini, ..[17 authors collapsed].., M. Pilia, E. Striani, M. Trifoglio, S. Vercellone: *Gamma-Ray Observations of Cygnus X-1 above 100 MeV in the Hard and Soft States*, 2013, *The Astrophysical Journal, 766, 83*
93. A. C. Edge, J. B. R. Oonk, R. Mittal: *The Herschel view of clusters of galaxies*, 2013, *Astronomische Nachrichten, 334, 382*
94. H. Röttgering, ..[14 authors collapsed].., G. Heald, N. Jackson, M. Jarvis, M. Lehnert, G. Macario, G. Miley, E. Orrú, R. Pizzo, D. Rafferty, A. Stroe, C. Tasse, S. van der Tol, G. White, M. Wise: *The ``Sausage" and ``Toothbrush" clusters of galaxies and the prospects of LOFAR observations of clusters of galaxies*, 2013, *Astronomische Nachrichten, 334, 333*
95. R. Morganti, W. Frieswijk, R. J. B. Oonk, T. Oosterloo, C. Tadhunter: *Tracing the extreme interplay between radio jets and the ISM in IC 5063*, 2013, *Astronomy and Astrophysics, 552, L4*

96. J. Aleksic, ..[90 authors collapsed].., J. Moldón and [66 authors collapsed]: *Very high energy gamma-ray observation of the peculiar transient event Swift J1644+57 with the MAGIC telescopes and AGILE*, 2013, *Astronomy and Astrophysics, 552, 112*
97. S. Frey, Z. Paragi, K. É. Gabányi, T. An: *A compact radio source in the high-redshift soft gamma-ray blazar IGR J12319-0749*, 2013, *Astronomy and Astrophysics, 552, 109*
98. T. E. Hassall, B. W. Stappers, P. Weltevrede, J. W. T. Hessels, A. Alexov, T. Coenen, A. Karastergiou, M. Kramer, E. F. Keane, V. I. Kondratiev, J. van Leeuwen, A. Noutsos, M. Pilia, M. Serylak, C. Sobey, K. Zagkouris, R. Fender, M. E. Bell, J. Broderick, J. Eislöffel, H. Falcke, J.-M. Grießmeier, M. Kuniyoshi, J. C. A. Miller-Jones, M. W. Wise, O. Wucknitz, P. Zarka, A. Asgekar, F. Batejat, M. J. Bentum, G. Bernardi, P. Best, A. Bonafede, F. Breitling, M. Brüggen, H. R. Butcher, B. Ciardi, F. de Gasperin, J.-P. de Reijer, S. Duscha, R. A. Fallows, C. Ferrari, W. Frieswijk, M. A. Garrett, A. W. Gunst, G. Heald, M. Hoeft, E. Juette, P. Maat, J. P. McKean, M. J. Norden, M. Pandey-Pommier, R. Pizzo, A. G. Polatidis, W. Reich, H. Röttgering, J. Sluman, Y. Tang, C. Tasse, R. Vermeulen, R. J. van Weeren, S. J. Wijnholds, S. Yatawatta: *Differential frequency-dependent delay from the pulsar magnetosphere*, 2013, *Astronomy and Astrophysics, 552, 61*
99. C. Sotomayor-Beltran, C. Sobey, J. W. T. Hessels, G. de Bruyn, A. Noutsos, A. Alexov, J. Anderson, A. Asgekar, I. M. Avruch, R. Beck, M. E. Bell, M. R. Bell, M. J. Bentum, G. Bernardi, P. Best, L. Birzan, A. Bonafede, F. Breitling, J. Broderick, W. N. Brouw, M. Brüggen, B. Ciardi, F. de Gasperin, R.-J. Dettmar, A. van Duin, S. Duscha, J. Eislöffel, H. Falcke, R. A. Fallows, R. Fender, C. Ferrari, W. Frieswijk, M. A. Garrett, J. Grießmeier, T. Grit, A. W. Gunst, T. E. Hassall, G. Heald, M. Hoeft, A. Horneffer, M. Iacobelli, E. Juette, A. Karastergiou, E. Keane, J. Kohler, M. Kramer, V. I. Kondratiev, L. V. E. Koopmans, M. Kuniyoshi, G. Kuper, J. van Leeuwen, P. Maat, G. Macario, S. Markoff, J. P. McKean, D. D. Mulcahy, H. Munk, E. Orru, H. Paas, M. Pandey-Pommier, M. Pilia, R. Pizzo, A. G. Polatidis, W. Reich, H. Röttgering, M. Serylak, J. Sluman, B. W. Stappers, M. Tagger, Y. Tang, C. Tasse, S. ter Veen, R. Vermeulen, R. J. van Weeren, R. A. M. J. Wijers, S. J. Wijnholds, M. W. Wise, O. Wucknitz, S. Yatawatta, P. Zarka: *Calibrating high-precision Faraday rotation measurements for LOFAR and the next generation of low-frequency radio telescopes*, 2013, *Astronomy and Astrophysics, 552, 58*
100. A. T. Deller, J. Forbrich, L. Loinard: *A very long baseline interferometry detection of the class I protostar IRS 5 in Corona Australis*, 2013, *Astronomy and Astrophysics, 552, 51*
101. S. van Velzen, D. A. Frail, E. Körding, H. Falcke: *Constraints on off-axis jets from stellar tidal disruption flares*, 2013, *Astronomy and Astrophysics, 552, 5*
102. Ray P. Norris, ..[20 authors collapsed].., George Heald and [29 authors collapsed]: *Radio Continuum Surveys with Square Kilometre Array Pathfinders*, 2013, *Publications of the Astronomical Society of Australia, 30, 20*
103. C. M. Espinoza, L. Guillemot, Ö. Çelik, P. Weltevrede, B. W. Stappers, D. A. Smith, M. Kerr, V. E. Zavlin, I. Cognard, R. P. Eatough, P. C. C. Freire, G. H. Janssen and [14 authors collapsed]: *Six millisecond pulsars detected by the Fermi Large Area Telescope and the radio/gamma-ray connection of millisecond pulsars*, 2013, *Monthly Notices of the Royal Astronomical Society, 430, 571-587*
104. E. C. Elson, W. J. G. de Blok, R. C. Kraan-Korteweg: *H I synthesis observations of the blue compact dwarf NGC 1705*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 2550-2561*
105. Gerhardt R. Meurer, Zheng Zheng, W. J. G. de Blok: *Disc stability and neutral hydrogen as a tracer of dark matter*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 2537-2549*
106. Yogesh Chandola, Neeraj Gupta, D. J. Saikia: *Associated 21-cm absorption towards the cores of radio galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 2380-2391*
107. I. H. Whittam, J. M. Riley, D. A. Green, M. J. Jarvis, I. Prandoni, G. Guglielmino, R. Morganti, H. J. A. Röttgering, M. A. Garrett: *The faint source population at 15.7 GHz - I. The radio properties*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 2080-2097*
108. N. S. Kardashev, ..[11 authors collapsed].., W. Baan and [121 authors collapsed]: *"RadioAstron"-A telescope with a size of 300 000 km: Main parameters and first observational results*, 2013, *Astronomy Reports, 57, 153-194*
109. R. M. Shannon, J. M. Cordes, T. S. Metcalfe, T. J. W. Lazio, I. Cognard, G. Desvignes, G. H. Janssen and [6 authors collapsed]: *An Asteroid Belt Interpretation for the Timing Variations of the Millisecond Pulsar B1937+21*, 2013, *The Astrophysical Journal, 766, 5*
110. J.-P. Macquart, L. E. H. Godfrey, H. E. Bignall, J. A. Hodgson: *The Microarcsecond Structure of an Active Galactic Nucleus Jet via Interstellar Scintillation*, 2013, *The Astrophysical Journal, 765, 142*
111. J. M. Paredes, W. Bednarek, P. Bordas, V. Bosch-Ramon, E. De Cea del Pozo, G. Dubus, S. Funk, D. Hadasch, D. Khangulyan, S. Markoff, J. Moldón and [12 authors collapsed]: *Binaries with the eyes of CTA*, 2013, *Astroparticle Physics, 43, 301-316*
112. B. W. Holwerda, R. J. Allen, W. J. G. de Blok, A. Bouchard, R. A. González-Lópezlira, P. C. van der Kruit, A. Leroy: *The opacity of spiral galaxy disks: IX. Dust and gas surface densities*, 2013, *Astronomische Nachrichten, 334, 268-281*
113. A. Asgekar, J. B. R. Oonk, S. Yatawatta, R. J. van Weeren, J. P. McKean, G. White, N. Jackson, J. Anderson, I. M. Avruch, F. Batejat, R. Beck, M. E. Bell, M. R. Bell, I. van Bemmel, M. J. Bentum, G. Bernardi, P. Best, L. Bîrzan, A. Bonafede, R. Braun, F. Breitling, R. H. van de Brink, J. Broderick, W. N. Brouw, M. Brüggen, H. R. Butcher, W. van Cappellen, B. Ciardi, J. E. Conway, F. de Gasperin, E. de Geus, A. de Jong, M. de Vos, S. Duscha, J. Eislöffel, H. Falcke, R. A. Fallows, C. Ferrari, W. Frieswijk, M. A. Garrett, J.-M. Grießmeier, T. Grit, A. W. Gunst, T. E. Hassall, G. Heald, J. W. T. Hessels, M. Hoeft, M. Iacobelli, H. Intema, E. Juette, A. Karastergiou, J. Kohler, V. I. Kondratiev, M. Kuniyoshi, G. Kuper, C. Law, J. van Leeuwen, P. Maat, G. Macario, G. Mann, S. Markoff, D. McKay-Bukowski, M.

Mevius, J. C. A. Miller-Jones, J. D. Mol, R. Morganti, D. D. Mulcahy, H. Munk, M. J. Norden, E. Orru, H. Paas, M. Pandey-Pommier, V. N. Pandey, R. Pizzo, A. G. Polatidis, W. Reich, H. Röttgering, B. Scheers, A. Schoenmakers, J. Sluman, O. Smirnov, C. Sobey, M. Steinmetz, M. Tagger, Y. Tang, C. Tasse, R. Vermeulen, C. Vocks, R. A. M. J. Wijers, M. W. Wise, O. Wucknitz, P. Zarka: LOFAR detections of low-frequency radio recombination lines towards Cassiopeia A, 2013, *Astronomy and Astrophysics, 551, L11*

114. E. Middelberg, A. T. Deller and [7 authors collapsed]: *Mosaiced wide-field VLBI observations of the Lockman Hole/XMM*, 2013, *Astronomy and Astrophysics, 551, 97*
115. R. Kent Honeycutt, Brice R. Adams, George W. Turner, Jeff W. Robertson, Eric M. Ost, J. Edward Maxwell: *Light Curve of CR Bootis 1990-2012 from the Indiana Long-Term Monitoring Program*, 2013, *Publications of the Astronomical Society of the Pacific, 125, 126-142*
116. E. D. Barr, ..[12 authors collapsed].., G. H. Janssen and [9 authors collapsed]: *Pulsar searches of Fermi unassociated sources with the Effelsberg telescope*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 1633-1642*
117. Timothy A. Davis, ..[19 authors collapsed].., Raffaella Morganti, Thorsten Naab, Tom Oosterloo, Marc Sarzi, Paolo Serra, Anne-Marie Weijmans: *The ATLAS3D Project - XIV. The extent and kinematics of the molecular gas in early-type galaxies*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 534-555*
118. Emma Chapman, Filipe B. Abdalla, J. Bobin, J.-L. Starck, Geraint Harker, Vibor Jelic, Panagiotis Labropoulos, Saleem Zaroubi, Michiel A. Brentjens, A. G. de Bruyn, L. V. E. Koopmans: *The scale of the problem: recovering images of reionization with Generalized Morphological Component Analysis*, 2013, *Monthly Notices of the Royal Astronomical Society, 429, 165-176*
119. E. Rubio-Herrera, B. W. Stappers, J. W. T. Hessels, R. Braun: *A search for radio pulsars and fast transients in M31 using the Westerbork Synthesis Radio Telescope*, 2013, *Monthly Notices of the Royal Astronomical Society, 428, 2857-2873*
120. F. G. Schröder, ..[16 authors collapsed].., H. Falcke and [38 authors collapsed]: *Radio Measurements of Air Showers with LOPES*, 2013, *Journal of Physics Conference Series, 409, 2075*
121. Jingying Wang, Haiguang Xu, Tao An and [7 authors collapsed]: *Exploring the Cosmic Reionization Epoch in Frequency Space: An Improved Approach to Remove the Foreground in 21 cm Tomography*, 2013, *The Astrophysical Journal, 763, 90*
122. Ryan S. Lynch, Jason Boyles, Scott M. Ransom, Ingrid H. Stairs, Duncan R. Lorimer, Maura A. McLaughlin, Jason W. T. Hessels, Victoria M. Kaspi, Vladislav I. Kondratiev, Anne M. Archibald, Aaron Berndsen, Rogerio F. Cardoso, Angus Cherry, Courtney R. Epstein, Chen Karako-Argaman, Christie A. McPhee, Tim Pennucci, Mallory S. E. Roberts, Kevin Stovall, Joeri van Leeuwen: The Green Bank Telescope 350 MHz Drift-scan Survey II: *Data Analysis and the Timing of 10 New Pulsars, Including a Relativistic Binary*, 2013, *The Astrophysical Journal, 763, 81*
123. J. Boyles, R. S. Lynch, S. M. Ransom, I. H. Stairs, D. R. Lorimer, M. A. McLaughlin, J. W. T. Hessels, V. M. Kaspi, V. I. Kondratiev, A. Archibald, A. Berndsen, R. F. Cardoso, A. Cherry, C. R. Epstein, C. Karako-Argaman, C. A. McPhee, T. Pennucci, M. S. E. Roberts, K. Stovall, J. van Leeuwen: *The Green Bank Telescope 350 MHz Drift-scan survey. I. Survey Observations and the Discovery of 13 Pulsars*, 2013, *The Astrophysical Journal, 763, 80*
124. Alberto Accomazzi, Tamás Budavári, Christopher Fluke, Norman Gray, Robert G. Mann, William O'Mullane, Andreas Wicenec, Michael Wise: *Astronomy and Computing: A new journal for the astronomical computing community*, 2013, *Astronomy and Computing, 1, 1-4*
125. S. Yatawatta, A. G. de Bruyn, M. A. Brentjens, P. Labropoulos, V. N. Pandey, .., V. Jelic, ..[28 authors collapsed].., H. Falcke, R. A. Fallows, C. Ferrari, W. Frieswijk, M. A. Garrett, J. M. Griessmeier, A. W. Gunst, T. E. Hassall, J. W. T. Hessels, M. Hoeft, M. Iacobelli, E. Juette, A. Karastergiou, V. I. Kondratiev, M. Kramer, M. Kuniyoshi, G. Kuper, J. van Leeuwen, P. Maat, G. Mann, J. P. McKean, ..[12 authors collapsed].., R. Pizzo, A. G. Polatidis, ..[9 authors collapsed].., R. Vermeulen, R. J. van Weeren, M. Wise, O. Wucknitz, P. Zarka: *Initial deep LOFAR observations of epoch of reionization windows. I. The north celestial pole*, 2013, *Astronomy and Astrophysics, 550, 136*
126. F. Wu, T. An, W. A. Baan and [6 authors collapsed]: *Kinematics of the compact symmetric object OQ 208 revisited*, 2013, *Astronomy and Astrophysics, 550, 113*
127. S. Chi, P. D. Barthel, M. A. Garrett: *Deep, wide-field, global VLBI observations of the Hubble deep field north (HDF-N) and flanking fields (HFF)*, 2013, *Astronomy and Astrophysics, 550, 68*
128. W. Hermsen, J. W. T. Hessels, L. Kuiper, J. van Leeuwen, ..[12 authors collapsed].., V. I. Kondratiev, M. Kramer, M. Kuniyoshi, A. Noutsos, M. Serylak, M. Pilia, C. Sobey, P. Weltevrede, K. Zagkouris, A. Asgekar, ..[16 authors collapsed].., H. Falcke, R. Fender, C. Ferrari, W. Frieswijk, M. A. Garrett, F. de Gasperin, E. de Geus, A. W. Gunst, G. Heald, M. Hoeft, A. Horneffer, M. Iacobelli, G. Kuper, P. Maat, G. Macario, S. Markoff, J. P. McKean, M. Mevius, J. C. A. Miller-Jones, R. Morganti, H. Munk, E. Orrú, H. Paas, M. Pandey-Pommier, V. N. Pandey, R. Pizzo, A. G. Polatidis, S. Rawlings, W. Reich, H. Röttgering, A. M. M. Scaife, A. Schoenmakers, A. Shulevski, J. Sluman, M. Steinmetz, M. Tagger, Y. Tang, C. Tasse, S. ter Veen, R. Vermeulen, R. H. van de Brink, R. J. van Weeren, R. A. M. J. Wijers, M. W. Wise, O. Wucknitz, S. Yatawatta, P. Zarka: Synchronous X-ray and Radio Mode Switches: *A Rapid Global Transformation of the Pulsar Magnetosphere*, 2013, *Science, 339, 436-*
129. R. Srianand, N. Gupta, H. Rahmani, E. Momjian, P. Petitjean, P. Noterdaeme: *Parsec-scale structures and diffuse bands in a translucent interstellar medium at z~= 0.079*, 2013, *Monthly Notices of the Royal Astronomical Society, 428, 2198-2206*

130. B. Ciardi, P. Labropoulos, A. Maselli, R. Thomas, S. Zaroubi, L. Graziani, J. S. Bolton, G. Bernardi, M. Brentjens, A. G. de Bruyn, S. Daiboo, G. J. A. Harker, V. Jelic and [10 authors collapsed]: *Prospects for detecting the 21 cm forest from the diffuse intergalactic medium with LOFAR*, 2013, *Monthly Notices of the Royal Astronomical Society, 428, 1755-1765*
131. J. I. Davies, ..[11 authors collapsed].., P. Serra and [8 authors collapsed]: *The Herschel Fornax Cluster Survey - I. The bright galaxy sample*, 2013, *Monthly Notices of the Royal Astronomical Society, 428, 834-844*
132. Paolo Serra, Bärbel Koribalski, Pierre-Alain Duc, Tom Oosterloo, ..[17 authors collapsed].., Raffaella Morganti, and [6 authors collapsed]: *Discovery of a giant HI tail in the galaxy group HCG 44*, 2013, *Monthly Notices of the Royal Astronomical Society, 428, 370-380*
133. D. A. Rafferty, L. Bîrzan, P. E. J. Nulsen, B. R. McNamara, W. N. Brandt, M. W. Wise, H. J. A. Röttgering: *A deep Chandra observation of the active galactic nucleus outburst and merger in Hickson compact group 62*, 2013, *Monthly Notices of the Royal Astronomical Society, 428, 58-70*
134. P. Abreu, ..[135 authors collapsed].., H. Falcke and [376 authors collapsed]: *Constraints on the Origin of Cosmic Rays above 1018 eV from Large-scale Anisotropy Searches in Data of the Pierre Auger Observatory*, 2013, *The Astrophysical Journal Letters, 762, L13*
135. A. Del Moro, D. M. Alexander, J. R. Mullaney, E. Daddi, M. Pannella, F. E. Bauer, A. Pope, M. Dickinson, D. Elbaz, P. D. Barthel, M. A. Garrett and [15 authors collapsed]: *GOODS-Herschel: radio-excess signature of hidden AGN activity in distant star-forming galaxies*, 2013, *Astronomy and Astrophysics, 549, 59*
136. A. Labiano, S. García-Burillo, F. Combes, A. Usero, R. Soria-Ruiz, G. Tremblay, R. Neri, A. Fuente, R. Morganti, T. Oosterloo: *Fueling the central engine of radio galaxies. II. The footprints of AGN feedback on the ISM of 3C 236*, 2013, *Astronomy and Astrophysics, 549, 58*
137. J. Aleksic, ..[87 authors collapsed].., J. Moldón, A. Moralejo, P. Munar-Adrover, A. Niedzwiecki, D. Nieto, K. Nilsson, N. Nowak, R. Orito, S. Paiano, M. Palatiello, D. Paneque, R. Paoletti, J. M. Paredes, S. Partini, M. Persic, M. Pilia and [53 authors collapsed]: *Observations of the magnetars 4U 0142+61 and 1E 2259+586 with the MAGIC telescopes*, 2013, *Astronomy and Astrophysics, 549, 23*
138. A. R. Offringa, A. G. de Bruyn, S. Zaroubi, G. van Diepen, O. Martinez-Ruby, P. Labropoulos, M. A. Brentjens, B. Ciardi, S. Daiboo, G. Harker, V. Jelic, S. Kazemi, L. V. E. Koopmans, G. Mellema, V. N. Pandey, R. F. Pizzo, ..[19 authors collapsed].., H. Falcke, R. Fender, W. Frieswijk, M. Gerbers, J. M. Griessmeier, A. W. Gunst, T. E. Hassall, G. Heald, J. Hessels, M. Hoeft, A. Horneffer, A. Karastergiou, V. Kondratiev, Y. Koopman, M. Kuniyoshi, G. Kuper, P. Maat, G. Mann, J. McKean, H. Meulman, M. Mevius, J. D. Mol, R. Nijboer, J. Noordam, M. Norden, H. Paas, M. Pandey, R. Pizzo, A. Polatidis, D. Rafferty, S. Rawlings, W. Reich, H. J. A. Röttgering, A. P. Schoenmakers, C. Sobey, ..[12 authors collapsed].., J. van Leeuwen, R. J. van Weeren, R. Vermeulen, C. Vocks, R. A. M. J. Wijers, M. Wise, O. Wucknitz: *The LOFAR radio environment*, 2013, *Astronomy and Astrophysics, 549, 11*

Electronic Articles

1. L. M. Young, N. Scott, P. Serra, K. Alatalo, E. Bayet, L. Blitz, M. Bois, F. Bournaud, M. Bureau, A. F. Crocker, M. Cappellari, R. L. Davies, T. A. Davis, P. T. de Zeeuw, P.-A. Duc, E. Emsellem, S. Khochfar, D. Krajnovic, H. Kuntschner, R. M. McDermid, R. Morganti, T. Naab, T. Oosterloo, M. Sarzi, A.-M. Weijmans: *The Atlas3D project -- XXVII. Cold Gas and the Colours and Ages of Early-type Galaxies*, 2013, *ArXiv e-prints, 1312.6318*
2. B. W. Stappers, A. M. Archibald, J. W. T. Hessels, C. G. Bassa, S. Bogdanov, G. H. Janssen and [6 authors collapsed]: *A state change in the missing link binary pulsar system PSR J1023+0038*, 2013, *ArXiv e-prints, 1311.7506*
3. A. López-Oramas, O. Blanch Bigas, J. Cortina, D. Hadasch, A. Herrero, B. Marcote, P. Munar-Adrover, J. Moldón and [6 authors collapsed]: *Observations of VHE gamma-ray binaries with the MAGIC Telescopes*, 2013, *ArXiv e-prints, 1311.5711*
4. Anne M. Archibald, Victoria M. Kaspi, Jason W. T. Hessels, Ben Stappers, Gemma Janssen, Andrew Lyne: *Long-Term Radio Timing Observations of the Transition Millisecond Pulsar PSR~J1023+0038*, 2013, *ArXiv e-prints, 1311.5161*
5. Jayanth Chennamangalam, Andrew P. V. Siemion, D. R. Lorimer, Dan Werthimer: Jumping the energetics queue: *Modulation of pulsar signals by extraterrestrial civilizations*, 2013, *ArXiv e-prints, 1311.4608*
6. T. Naab, ..[20 authors collapsed].., R. Morganti, T. Oosterloo, M. Sarzi, N. Scott, P. Serra, G. van de Ven, A. Weijmans, L. M. Young: The ATLAS$^{\rm{3D}}$ project - XXV: *Two-dimensional kinematic analysis of simulated galaxies and the cosmological origin of fast and slow rotators*, 2013, *ArXiv e-prints, 1311.0284*
7. Antoine Letessier-Selvon, ..[123 authors collapsed].., H. Falcke and [372 authors collapsed]: *Highlights from the Pierre Auger Observatory*, 2013, *ArXiv e-prints, 1310.4620*
8. The Telescope Array, ..[246 authors collapsed].., H. Falcke and [373 authors collapsed]: *Pierre Auger Observatory and Telescope Array: Joint Contributions to the 33rd International Cosmic Ray Conference (ICRC 2013)*, 2013, *ArXiv e-prints, 1310.0647*
9. Vincent Fish, ..[11 authors collapsed].., Heino Falcke and [56 authors collapsed]: *High-Angular-Resolution and High-Sensitivity Science Enabled by Beamformed ALMA*, 2013, *ArXiv e-prints, 1309.3519*
10. N. Palmieri, ..[15 authors collapsed].., H. Falcke and [37 authors collapsed]: *Investigation on the energy and mass composition of cosmic rays using LOPES radio data*, 2013, *ArXiv e-prints, 1309.2410*
11. P. A. R. Ade, ..[203 authors collapsed].., P. Serra and [35 authors collapsed]: *Planck 2013 results. XXX. Cosmic infrared background measurements and implications for star formation*, 2013, *ArXiv e-prints, 1309.0382*

12. B. R. McNamara, ..[16 authors collapsed].., J. B. R. Oonk, G. Tremblay, G. M. Voit: *A Ten Billion Solar Mass Outflow of Molecular Gas Launched by Radio Bubbles in the Abell 1835 Brightest Cluster Galaxy*, 2013, *ArXiv e-prints, 1309.013*
13. R. J. Nijboer, M. Pandey-Pommier, A. G. de Bruyn: *LOFAR imaging capabilities and system sensitivity*, 2013, *ArXiv e-prints, 1308.4267*
14. K. Link, ..[16 authors collapsed].., H. Falcke and [38 authors collapsed]: *Comparison of LOPES data and CoREAS simulations using a full detector simulation (ICRC2013)*, 2013, *ArXiv e-prints, 1308.2523*
15. D. Huber, ..[15 authors collapsed].., H. Falcke and [39 authors collapsed]: *Vectorial Radio Interferometry with LOPES 3D*, 2013, *ArXiv e-prints, 1308.2512*
16. W. D. Apel, ..[16 authors collapsed].., H. Falcke and [41 authors collapsed]: *Mass sensitivity in the radio lateral distribution function*, 2013, *ArXiv e-prints, 1308.046*
17. Alexander Aab, ..[120 authors collapsed].., Heino Falcke and [375 authors collapsed]: *The Pierre Auger Observatory: Contributions to the 33rd International Cosmic Ray Conference (ICRC 2013)*, 2013, *ArXiv e-prints, 1307.5059*
18. J. M. Paredes, W. Bednarek, P. Bordas, V. Bosch-Ramon, E. De Cea del Pozo, G. Dubus, S. Funk, D. Hadasch, D. Khangulyan, S. Markoff, J. Moldon and [13 authors collapsed]: *Exploring high-energy processes in binary systems with the Cherenkov Telescope Array*, 2013, *ArXiv e-prints, 1307.3048*
19. M. A. Garrett: Radio Astronomy transformed: *Aperture Arrays - Past, Present and Future*, 2013, *ArXiv e-prints, 1307.0386*
20. Javier Moldón, Marc Ribó, Josep M. Paredes: *Periodic radio morphology of gamma-ray binaries*, 2013, *ArXiv e-prints, 1306.2830*
21. J. H. Croston, ..[26 authors collapsed].., M. Wise: *The Hot and Energetic Universe: AGN feedback in galaxy clusters and groups*, 2013, *ArXiv e-prints, 1306.2323*
22. Kirpal Nandra, ..[230 authors collapsed].., Michael Wise and [8 authors collapsed]: *The Hot and Energetic Universe: A White Paper presenting the science theme motivating the Athena+ mission*, 2013, *ArXiv e-prints, 1306.2307*
23. W. D. Apel, ..[14 authors collapsed].., H. Falcke and [39 authors collapsed]: *LOPES 3D - vectorial measurements of radio emission from cosmic ray induced air showers*, 2013, *ArXiv e-prints, 1303.7080*
24. D. Huber, ..[17 authors collapsed].., H. Falcke and [40 authors collapsed]: *LOPES 3D reconfiguration and first measurements*, 2013, *ArXiv e-prints, 1303.7070*
25. P. A. R. Ade, ..[192 authors collapsed].., P. Serra and [31 authors collapsed]: *Planck 2013 results. XVIII. Gravitational lensing-infrared background correlation*, 2013, *ArXiv e-prints, 1303.5078*
26. Ximena Fernández, J. H. van Gorkom, Kelley M. Hess, D. J. Pisano, Kathryn Kreckel, Emmanuel Momjian, Attila Popping, Tom Oosterloo and [7 authors collapsed]: *A Pilot for a VLA HI Deep Field*, 2013, *ArXiv e-prints, 1303.2659*
27. David R. Thompson, Sarah Burke-Spolaor, Adam T. Deller, Walid A. Majid, Divya Palaniswamy, Steven J. Tingay, Kiri L. Wagstaff, Randall B. Wayth: *Real Time Event Detection in Astronomical Data Streams: Lessons from the VLBA*, 2013, *ArXiv e-prints, 1301.6290*
28. Megan K. Argo, Rob J. Beswick, Tom W. B. Muxlow, Danielle Fenech, Huib Jan van Langevelde, Melanie Gendre, Alan Pedlar: *Resolving the masers in M82*, 2013, *ArXiv e-prints, 1301.4820*
29. M. A. de Avillez, D. Breitschwerdt, A. Asgekar, E. Spitoni: *ISM Simulations: An Overview of Models*, 2013, *ArXiv e-prints, 1301.2890*

Conference Papers

1. M. Bois, ..[14 authors collapsed].., R. Morganti, T. Naab, T. Oosterloo, M. Sarzi, N. Scott, P. Serra, A.-M. Weijmans, L. M. Young, C. K. Xu, N. Z. Scoville, D. B. Sanders: *Simulations of Binary Galaxy Mergers and the Link with Fast Rotators, Slow Rotators, and Kinematically Distinct Cores*, 2013, *Astronomical Society of the Pacific Conference Series, 477, 97*
2. O. Martinez-Rubi, V. K. Veligatla, A. G. de Bruyn, P. Lampropoulos, A. R. Offringa, V. Jelic, S. Yatawatta, L. V. E. Koopmans, S. Zaroubi: *LEDDB: LOFAR Epoch of Reionization Diagnostic Database*, 2013, *Astronomical Data Analysis Software and Systems XXII, 475, 377*
3. R. G. Mann, A. Accomazzi, T. Budavári, C. Fluke, N. Gray, W. O'Mullane, A. Wicenec, M. Wise: *Astronomy and Computing: A New Journal for the Astronomical Computing Community*, 2013, *Astronomical Data Analysis Software and Systems XXII, 475, 7*
4. P.-A. Duc, ..[21 authors collapsed].., R. Morganti, T. Naab, T. Oosterloo, M. Sarzi, N. Scott, P. Serra, A. Weijmans, L. M. Young, Anna Pasquali, Ignacio Ferreras: *Probing the mass assembly of massive nearby galaxies with deep imaging*, 2013, *IAU Symposium, 295, 358-361*
5. T. A. Davis, ..[19 authors collapsed].., R. Morganti, T. Naab, M. Sarzi, N. Scott, P. Serra, A. Weijmans, Anna Pasquali, Ignacio Ferreras: *Revealing the origin of the cold ISM in massive early-type galaxies*, 2013, *IAU Symposium, 295, 324-327*
6. D. Krajnovic, ..[13 authors collapsed].., R. Morganti, T. Naab, M. Sarzi, N. Scott, P. Serra, A. Weijmans, L. M. Young, Anna Pasquali, Ignacio Ferreras: *Stellar discs in massive galaxies*, 2013, *IAU Symposium, 295, 314-314*
7. S. van Velzen, H. Falcke, Anna Pasquali, Ignacio Ferreras: *All-sky catalog of local radio galaxies*, 2013, *IAU Symposium, 295, 271-271*
8. Anna Nelles, Stijn Buitink, Arthur Corstanje, Emilio Enriquez, Heino Falcke, Wilfred Frieswijk and [13 authors collapsed]: *Detecting radio emission from air showers with LOFAR*, 2013, *American Institute of Physics Conference Series, 1535, 105-110*

9. N. Palmieri, ..[15 authors collapsed].., H. Falcke and [44 authors collapsed]: *Reconstructing energy and Xmax of cosmic ray air showers using the radio lateral distribution measured with LOPES*, 2013, *American Institute of Physics Conference Series, 1535, 89-93*
10. F. G. Schröder, ..[15 authors collapsed].., H. Falcke and [44 authors collapsed]: *Cosmic ray measurements with LOPES: Status and recent results*, 2013, *American Institute of Physics Conference Series, 1535, 78-83*
11. Stijn Buitink, Arthur Corstanje, Emilio Enriquez, Heino Falcke, Wilfred Frieswijk and [14 authors collapsed]: *Searching for neutrino radio flashes from the Moon with LOFAR*, 2013, *American Institute of Physics Conference Series, 1535, 27-31*
12. Michael W. Wise, D. A. Rafferty, J. P. McKean: Feedback at the Working Surface: *A Joint X-ray and Low-Frequency Radio Spectral Study of the Cocoon Shock in Cygnus A*, 2013, *AAS/High Energy Astrophysics Division, 13,*
13. Ann E. Hornschemeier, B. Lehmer, D. R. Wik, M. Argo and [12 authors collapsed]: *A Hard X-ray View of Star Formation: NGC 253 in Focus*, 2013, *AAS/High Energy Astrophysics Division, 13,*
14. Andrew Ptak, M. Argo and [15 authors collapsed]: *Getting a Good, Hard X-ray Look at Starburst Galaxies with NuSTAR*, 2013, *AAS/High Energy Astrophysics Division, 13,*
15. Willem A. Baan, Richard Fallows: *SURO-LC and LOFAR, observing the space environment*, 2013, *EGU General Assembly Conference Abstracts, 15, 7438*
16. Ann Hornschemeier, Megan Argo and [15 authors collapsed]: *Hard X-ray emission from Starburst Galaxies with the NuSTAR Mission*, 2013, *APS Meeting Abstracts, , 14007*
17. S. C. Mest, N. G. Barlow, J. M. Boyce, L. R. Gaddis, T. M. Hare, R. G. Strom: *The Lunar Impact Crater Database: Update From the Polar Regions*, 2013, *Lunar and Planetary Science Conference, 44, 2368*
18. A. Labiano, S. García-Burillo, F. Combes, A. Usero, R. Soria-Ruiz, G. Tremblay, R. Neri, A. Fuente, R. Morganti, T. Oosterloo, Jürgen Ott: *AGN feedback on the ISM of 3C 236*, 2013, *IAU Symposium, 292, 374-374*
19. K. Alatalo, ..[19 authors collapsed].., R. Morganti, T. Naab, T. Oosterloo, M. Sarzi, N. Scott, P. Serra, A. Weijmans, Jürgen Ott: *Quenching of Star Formation in Molecular Outflow Host NGC 1266*, 2013, *IAU Symposium, 292, 371-371*
20. Willem A. Baan, Edo Loenen, Xiaoli Lian, Jürgen Ott: *Diagnostics of the ISM in star formation regions*, 2013, *IAU Symposium, 292, 215-218*
21. Vladislav Kondratiev, Duncan Lorimer, Maura McLaughlin, Scott Ransom: *A pulsar census of the Local Group*, 2013, *IAU Symposium, 291, 431-431*
22. P. Gentile, M. McLaughlin, M. Roberts, F. Camilo, J. Hessels, M. Kerr, S. Ransom, P. Ray, I. Stairs: *Chandra observations of black widow pulsars*, 2013, *IAU Symposium, 291, 389-391*
23. Joeri van Leeuwen, Wim Hermsen, Jason Hessels, Lucien Kuiper, Dipanjan Mitra, Joanna Rankin, Ben Stappers, Geoff Wright: *``An X-Raydio Switcheroo" - The detection of correlated mode changes in radio and X-ray*, 2013, *IAU Symposium, 291, 321-321*
24. Vladislav Kondratiev: *Pulsar emission at the bottom end of the electromagnetic spectrum*, 2013, *IAU Symposium, 291, 317-320*
25. Heino Falcke: *FRATs: Searching for fast radio transient in real-time with LOFAR*, 2013, *IAU Symposium, 291, 233-233*
26. Gregory Desvignes, Michael Kramer, Ismaël Cognard, Laura Kasian, Joeri van Leeuwen, Ingrid Stairs, Gilles Theureau: *PSR J1906+0746: From relativistic spin-precession to beam modeling*, 2013, *IAU Symposium, 291, 199-202*
27. Andrew Siemion, Matthew Bailes, Geoff Bower, Jayanth Chennamangalam, Jim Cordes, Paul Demorest, Julia Deneva, Gregory Desvignes, John Ford, Dale Frail, Glenn Jones, Michael Kramer, Joseph Lazio, Duncan Lorimer, Maura McLaughlin, Scott Ransom, Anish Roshi, Mark Wagner, Dan Werthimer, Robert Wharton: *A search for pulsars in the central parsecs of the Galactic center*, 2013, *IAU Symposium, 291, 57-57*
28. Vladislav Kondratiev, Ben Stappers: *New results from LOFAR*, 2013, *IAU Symposium, 291, 47-52*
29. Ryan S. Lynch: *The hunt for new pulsars with the Green Bank Telescope*, 2013, *IAU Symposium, 291, 41-46*
30. K. Alatalo, ..[20 authors collapsed].., R. Morganti, T. Naab, M. Sarzi, N. Scott, P. Serra, A. Weijmans, T. Belloni, M. Méndez, S. N. Zhang: *AGN Feedback Driven Molecular Outflow in NGC 1266*, 2013, *IAU Symposium, 290, 175-176*
31. Megan Argo, P. Roggemans: *Sir Bernard Lovell (1913-2012), 2013, Proceedings of the International Meteor Conference, 31st IMC, La Palma, Canary Islands, Spain*, 2012, *, 60*
32. Laura Zschaechner, R. J. Rand, G. Heald, G. Gentile, P. Kamphuis, G. Jozsa: *Observations and Kinematic Modeling of Extra-Planar HI in Several Nearby Spiral Galaxies*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
33. Bret Lehmer, D. R. Wik, M. Argo and [14 authors collapsed]: *NuSTAR, Chandra, and VLBA Monitoring of the X-ray Binary Population in NGC 253*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
34. Andrew Ptak, M. Argo and [15 authors collapsed]: *Getting a Good, Hard X-ray Look at Starburst Galaxies with NuSTAR*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
35. Michael W. Wise, D. A. Rafferty, J. P. McKean: *Evidence for Merger-Induced Outburst Activity in Cygnus A*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
36. George Heald: The LOFAR Multifrequency Snapshot Sky Survey (MSSS): *Status and Results*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
37. Eric Bellm, S. G. Djorgovski, A. J. Drake, J. Hessels and [9 authors collapsed]: *The Optical Counterpart of the Redback Pulsar J2129-0428*, 2013, *American Astronomical Society Meeting Abstracts, 221,*

38. Abhimat Gautam, S. Chatterjee, J. M. Cordes, A. T. Deller, J. LAZIO: *Multiple Epoch Analysis of the Guitar Nebula and B2224+65 at Optical, X-Ray, and Radio Wavelengths*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
39. Catharine J. Wu, R. A. Walterbos, R. J. Rand, G. Heald: *Ionized Gas Velocities from Multi-Slit Spectroscopy for Nearby, Edge-on Galaxies*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
40. Christopher Stockdale, T. A. Pritchard, W. P. Blair, J. J. Cowan, L. Godfrey and [8 authors collapsed]: *A Multiwavelength Exploration of the Grand Design Spiral M83: A VLA L and C Band Survey of Historical Supernovae*, 2013, *American Astronomical Society Meeting Abstracts, 221,*
41. Knox S. Long, W. P. Blair, L. Godfrey and [6 authors collapsed]: *A Multiwavelength Exploration of the Grand Design Spiral M83: The X-ray Point Source Population*, 2013, *American Astronomical Society Meeting Abstracts, 221,*

Astronomer's Telegrams and CGNs

1. E. Striani, ..[38 authors collapsed].., M. Pilia and [14 authors collapsed]: *Confirmation by AGILE of increased gamma-ray emission from the blazar 3C 279*, 2013, *The Astronomer's Telegram, 5682, 1*
2. C. G. Bassa, A. Patruno, J. W. T. Hessels, A. M. Archibald, E. K. Mahony, B. Monard, E. F. Keane, S. Bogdanov, B. W. Stappers, G. H. Janssen, S. Tendulkar: *A possible state transition in the low-mass X-ray binary XSS J12270-4859*, 2013, *The Astronomer's Telegram, 5647, 1*
3. M. Perez-Torres, M. Argo and [8 authors collapsed]: *5.0 GHz Continuum MERLIN Observations of the Type Ia SN 2013dy*, 2013, *The Astronomer's Telegram, 5619, 1*
4. A. Patruno, A. Archibald, S. Bogdanov, V. Kaspi, S. Tendulkar, C. Bassa, G. Janssen, B. Stappers, A. Lyne: *X-Ray and UV/Optical Variability of the Missing Link Binary Pulsar PSR J1023+0038*, 2013, *The Astronomer's Telegram, 5516, 1*
5. B. W. Stappers, A. Archibald, C. Bassa, J. Hessels, G. Janssen, V. Kaspi, A. Lyne, A. Patruno, A. B. Hill: *State-change in the "transition" binary millisecond pulsar J1023+0038*, 2013, *The Astronomer's Telegram, 5513, 1*
6. F. Verrecchia, ..[37 authors collapsed].., M. Pilia and [15 authors collapsed]: *After a gamma-ray flare, AGILE detects the Crab Nebula returning to the normal flux level*, 2013, *The Astronomer's Telegram, 5506, 1*
7. V. Fioretti, ..[37 authors collapsed].., M. Pilia and [15 authors collapsed]: *AGILE detection of increasing gamma-ray emission from the blazar PKS 1510-089 following an optical/near-infrared flare*, 2013, *The Astronomer's Telegram, 5422, 1*
8. James C. A. Miller-Jones, Gregory R. Sivakoff, Tom J. Maccarone, Adam T. Deller and [6 authors collapsed]: *ATCA radio detection of GX 339-4 in the rising hard state*, 2013, *The Astronomer's Telegram, 5285, 1*
9. F. Lucarelli, ..[37 authors collapsed].., M. Pilia and [15 authors collapsed]: *AGILE confirmation of the increasing gamma-ray activity from 4C +38.41 (BZQ J1635+3808)*, 2013, *The Astronomer's Telegram, 5234, 1*
10. Andreas Brunthaler, Heino Falcke: *Limits on Low Frequency Radio Flux Density Changes for Sgr A**, 2013, *The Astronomer's Telegram, 5159, 1*
11. V. Tudose, Z. Paragi, J. Yang, J. C. A. Miller-Jones, R. Fender, M. Garrett, A. Rushton, R. Spencer: *e-EVN radio detection of Aql X-1 in outburst*, 2013, *The Astronomer's Telegram, 5158, 1*
12. J. Yang, Z. Paragi, S. Komossa, I. van Bemmel, R. Oonk: *e-EVN detection of AGN activity in NGC 2617*, 2013, *The Astronomer's Telegram, 5125, 1*
13. A. Papitto, J. W. T. Hessels and [7 authors collapsed]: *The transient low-mass X-ray binary IGR J18245-2452 is again active as a radio pulsar*, 2013, *The Astronomer's Telegram, 5069, 1*
14. K. J. Lee, ..[19 authors collapsed].., Heino Falcke: *Polarisation profiles and rotation measure of PSR J1745-2900 measured at Effelsberg*, 2013, *The Astronomer's Telegram, 5064, 1*
15. Ralph Eatough, ..[17 authors collapsed].., Heino Falcke: *On-going radio observations of PSR J1745-2900 at Effelsberg, Nancay, and Jodrell Bank: flux density estimates, polarisation properties, spin-down measurement, and the highest dispersion measure measured.*, 2013, *The Astronomer's Telegram, 5058, 1*
16. Ralph Eatough, ..[12 authors collapsed].., Heino Falcke, Laura Spitler, Ben Stappers: *Further radio pulsations from the direction of the NuSTAR 3.76-second X-ray pulsar, and a dispersion measure estimate.*, 2013, *The Astronomer's Telegram, 5043, 1*
17. Ralph Eatough, ..[12 authors collapsed].., Heino Falcke: *Detection of radio pulsations from the direction of the NuSTAR 3.76 second X-ray pulsar at 8.35 GHz*, 2013, *The Astronomer's Telegram, 5040, 1*
18. Ralph Eatough, Ramesh Karuppusamy, Michael Kramer, Alex Kraus, Bernd Klein, David Champion, Joris Verbiest, Patrick Lazarus, Paulo Freire, Andreas Brunthaler, Heino Falcke: *Searches for radio pulsations from the 3.76 second NuSTAR X-ray pulsar in the Galactic centre*, 2013, *The Astronomer's Telegram, 5027, 1*
19. Geoffrey C. Bower, Andreas Brunthaler, Heino Falcke: *Limits on Radio Frequency Flux Density Changes in Sgr A**, 2013, *The Astronomer's Telegram, 5025, 1*
20. A. Brunthaler, H. Falcke, G. C. Bower, J. Ott, M. J. Reid: *Brightening of Sgr A* at 32 GHz from VLA observations*, 2013, *The Astronomer's Telegram, 5014, 1*
21. F. Verrecchia, ..[37 authors collapsed].., M. Pilia and [15 authors collapsed]: *Sustained high-flux emission above 100 MeV from the Crab Nebula source*, 2013, *The Astronomer's Telegram, 4867, 1*

22. E. Striani, ..[37 authors collapsed].., M. Pilia and [15 authors collapsed]: *Enhanced gamma-ray emission from the Crab Nebula region detected by AGILE*, 2013, *The Astronomer's Telegram, 4856, 1*
23. A. Bulgarelli, ..[38 authors collapsed].., M. Pilia and [15 authors collapsed]: *AGILE detection of a new gamma-ray source at high Galactic latitude, AGLJ1647+5107*, 2013, *The Astronomer's Telegram, 4842, 1*
24. Sandor Frey, Zsolt Paragi, Krisztina Gabanyi, Tao An: *EVN detection of a compact radio source as a counterpart to Fermi J1418+3541*, 2013, *The Astronomer's Telegram, 4750, 1*
25. A. Giuliani, ..[38 authors collapsed].., M. Pilia and [11 authors collapsed]: *GRB 131108A: AGILE/GRID observation*, 2013, *GRB Coordinates Network, 1547,*
26. M. Marisaldi, ..[38 authors collapsed].., M. Pilia and [12 authors collapsed]: *GRB 130606B: AGILE-MCAL observation*, 2013, *GRB Coordinates Network, 1482,*
27. F. Verrecchia, ..[38 authors collapsed].., M. Pilia and [12 authors collapsed]: *GRB 130427A: high energy gamma-ray detection by AGILE*, 2013, *GRB Coordinates Network, 1451,*
28. F. Longo, ..[33 authors collapsed].., M. Pilia and [16 authors collapsed]: *GRB 130327B: gamma-ray detection by AGILE*, 2013, *GRB Coordinates Network, 1434,*

Books

1. Joeri van Leeuwen: *Neutron Stars and Pulsars (IAU S291), 2013, Neutron Stars and Pulsars (IAU S291), by Joeri van Leeuwen, Cambridge, UK: Cambridge University Press*, 2013

Non-refereed Publications

1. P. Schmidt, G. I. G. Jozsa and [6 authors collapsed]: *WSRT HI data cubes of the dwarf galaxy UGCA 105 (Schmidt+, 2014)*, 2013, *VizieR Online Data Catalog, 356, 19028*
2. F. Verrecchia, ..[55 authors collapsed].., M. Pilia and [21 authors collapsed]: *AGILE bright gamma-ray sources updated list (Verrecchia+, 2013)*, 2013, *VizieR Online Data Catalog, 355, 89137*
3. A. A. Abdo, ..[75 authors collapsed].., G. Godfrey, E. V. Gotthelf, I. A. Grenier, M.-H. Grondin, J. E. Grove, L. Guillemot, S. Guiriec, D. Hadasch, Y. Hanabata, A. K. Harding, M. Hayashida, E. Hays, J. Hessels, J. Hewitt, A. B. Hill, D. Horan, X. Hou, R. E. Hughes, M. S. Jackson, G. H. Janssen and [114 authors collapsed]: *2nd Fermi LAT cat. of gamma-ray pulsars (2PC) (Abdo+, 2013)*, 2013, *VizieR Online Data Catalog, 220, 80017*
4. H. Falcke: Landing Site Requirements for Astrophysics and Astroparticle Physics on the Moon, 2013, *LPI Contributions, 1769, 6036*
5. R. Giessubel, G. Heald, R. Beck, T. G. Arshakian: *RM Synthesis of 33 sources around M31 (Giessubel+, 2013)*, 2013, *VizieR Online Data Catalog, 355, 99027*
6. E. Middelberg, A. T. Deller and [7 authors collapsed]: *Lockman Hole/XMM VLBI observations (Middelberg+, 2013)*, 2013, *VizieR Online Data Catalog, 355, 19097*
7. I. H. Whittam, J. M. Riley, D. A. Green, M. J. Jarvis, I. Prandoni, G. Guglielmino, R. Morganti, H. J. A. Rottgering, M. A. Garrett: *Lockman Hole 10C sources radio spectral indices (Whittam+ 2013)*, 2013, *VizieR Online Data Catalog, 742, 92080*
8. M. T. Doyle, ..[17 authors collapsed].., W. J. G. de Blok, M. J. Disney, R. D. Ekers, K. C. Freeman, D. A. Garcia, B. K. Gibson, J. Harnett, P. A. Henning, H. Jerjen, M. J. Kesteven, P. M. Knezek, S. Mader, M. Marquarding, R. F. Minchin, J. O'Brien, T. Oosterloo and [7 authors collapsed]: *HIPASS catalogue. III. (Doyle+, 2005)*, 2013, *VizieR Online Data Catalog, 736, 10034*
9. A. S. Saburova, G. I. G. Jozsa, A. V. Zasov, D. V. Bizyaev: *NGC 6824 and UGC 11919 data cubes (Saburova+, 2013)*, 2013, *VizieR Online Data Catalog, 355, 49128*
10. R. K. Honeycutt, B. R. Adams, G. W. Turner, J. W. Robertson, E. M. Ost, J. E. Maxwell: *Light curve of CR Boo over 1990-2012 (Honeycutt+, 2013)*, 2013, *VizieR Online Data Catalog, 612, 50126*

Miscellaneous

1. C. Sotomayor-Beltran, C. Sobey, J. W. T. Hessels, G. de Bruyn, A. Noutsos, A. Alexov, J. Anderson, A. Asgekar, I. M. Avruch, R. Beck, M. E. Bell, M. R. Bell, M. J. Bentum, G. Bernardi, P. Best, L. Birzan, A. Bonafede, F. Breitling, J. Broderick, W. N. Brouw, M. Brueggen, B. Ciardi, F. de Gasperin, R.-J. Dettmar, A. van Duin, S. Duscha, J. Eisloeffel, H. Falcke, R. A. Fallows, R. Fender, C. Ferrari, W. Frieswijk, M. A. Garrett, J. Griessmeier, T. Grit, A. W. Gunst, T. E. Hassall, G. Heald, M. Hoeft, A. Horneffer, M. Iacobelli, E. Juette, A. Karastergiou, E. Keane, J. Kohler, M. Kramer, V. I. Kondratiev, L. V. E. Koopmans, M. Kuniyoshi, G. Kuper, J. van Leeuwen, P. Maat, G. Macario, S. Markoff, J. P. McKean, D. D. Mulcahy, H. Munk, E. Orru, H. Paas, M. Pandey-Pommier, M. Pilia, R. Pizzo, A. G. Polatidis, W. Reich, H. Roettgering, M. Serylak, J. Sluman, B. W. Stappers, M. Tagger, Y. Tang, C. Tasse, S. ter Veen, R. Vermeulen, R. J. van Weeren, R. A. M. J. Wijers, S. J. Wijnholds, M. W. Wise, O. Wucknitz, S. Yatawatta, P. Zarka: *ionFR: Ionospheric Faraday rotation*, 2013, *Astrophysics Source Code Library, , 03022*
2. Michael W. Wise, John E. Davis, David P. Huenemoerder, John C. Houck, Dan Dewey: MARX: Model of AXAF Response to X-rays, 2013, *Astrophysics Source Code Library, , 02001*

Research & Development

Refereed journal publications

1. Asgekar, A., Oonk, J.B.R., Yatawatta, S., et al., *"LOFAR detections of low-frequency radio recombination lines towards Cassiopeia A"*, *Astronomy & Astrophysics, Vol. 551, pp. L11:1-L11:5*, February 2013.
2. Ciardi, B., Labropoulos, P., Pandey, V.N., et. al., *"Prospects for detecting the 21 cm forest from the diffuse intergalactic medium with LOFAR"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 428, Issue 2, pp. 1755-1765*, January 2013.
3. Cao, H.S., Witvers, R.H., Vanapalli, S., Holland, H.J., Brake, H.J.M. ter, *"Cooling a low noise amplifier with a micromachined cryogenic cooler"*, *Review of Scientific Instruments, Vol. 84, Issue 10*, 2013.
4. Chepuri, S.P., Rajan, R.T.,Leus, G., Veen, A.J. van der, *"Joint Clock Synchronization and Ranging: Asymmetrical Time-Stamping and Passive Listening"*, *Signal Processing Letters, IEEE, Vol. 20, no.1, pp. 51,54*, Jan. 2013.
5. Haarlem, M.P. van, Wise, M.W., Gunst, A.W., Ardenne, A. van, et. al., *"LOFAR: The LOw-Frequency Array"*, *Astronomy & Astrophysics, arXiv:1305.35550v2, Vol. 556, pp. 1-53*, August 2013. DOI: 10.1051/0004-6361/201220873.
6. Hassall, T.E., et al., *"Differential Frequency-dependent Delay from the Pulsar Magnetosphere"*, *Astronomy & Astrophysics, Volume 552, id. A61, April*, 2013.
7. Hermsen, W. et al., *"Synchronous X-ray and Radio Mode Switches: A Rapid Global Transformation of the Pulsar Magnetosphere"*, *Science 339 (6118), pp. 436-439*, 2013.
8. Iacobelli, M. et al., *"Studying Galactic interstellar turbulence through fluctuations in synchrotron emission - First LOFAR Galactic foreground detection"*, *Astronomy & Astrophysics, Volume 558, A72*, October 2013. DOI: 10.1051/0004-6361/201322013.
9. Jensen, H. et al., *"Probing reionization with LOFAR using 21-cm redshift space distortions"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 435, pp. 460-474*, Oct. 11, 2013. DOI: 10.1093/mnras/stt1341.
10. Juan Ovelar, M. de, Snik, F., Keller, C.U., Venema, L.B., *"Instrumental Polarisation at the Nasmyth focus of the E-ELT"*, *Astronomy & Astrophysics*, December 20, 2013, arXiv:1312.6148.
11. Kazemi, S., Yatawatta, S., *"Robust radio interferometric calibration using the t-distribution"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 435 (1), pp. 597-605*, Oct. 11, 2013. DOI: 10.1093/mnras/stt1347.
12. Kazemi, S., Yatawatta, S., Zaroubi, S., *"Radio interferometric calibration via ordered-subsets algorithms: OS-LS and OS-SAGE calibrations"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 434 (4), pp. 3130-3141*, Oct. 1, 2013. DOI: 10.1093/mnras/stt1229.
13. Kazemi, S., Yatawatta, S., Zaroubi, S., *"Clustered calibration: an improvement to radio interferometric direction-dependent self-calibration"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 430 (2), pp. 1457-1472*, April 1, 2013. DOI: 10.1093/mnras/stt018.
14. Mellema, G., Koopmans, L.V.E., Abdalla, F.A., Bernardi, G., Ciardi, B., Daiboo, S., Bruyn, A.G. de, Datta, K.K., Falcke, H., Ferrara, A., Iliev, I.T., Iocco, F., Jelic, V., Jensen, H., Joseph, R., Labroupoulos, P., Meiksin, A., Mesinger, A., Offringa, A.R., Pandey, V.N., Pritchard, J.R., Santos, M.G., Schwarz, D.J., Semelin, B., Vedantham, H., Yatawatta, S., Zaroubi, S., *"Reionization and the Cosmic Dawn with the Square Kilometre Array"*, *Experimental Astronomy, Vol. 36 (1-2), pp. 235-318*, August 2013.
15. Milli, J., Mouillet, D., Mawet, D., Schmid, H.M., Bazzon, A., Girard, J.H., Dohlen, K., Roelfsema, R., *"Prospects of detecting the polarimetric signature of the Earth-mass planet alpha Centauri B with SPHERE/ZIMPOL"*, *Astronomy & Astrophysics*, 06/2013, arXiv: 1306.1006.
16. Offringa, A.R., Bruyn, A.G. de, Haarlem, M.P. van, et al. *"The LOFAR radio environment"*, *Astronomy & Astrophysics, Vol. 549, no. A11, pp. 1-15*, January 2013. DOI: 10.1051/0004-6361/201220293.
17. Offringa, A.R. et al., *"The brightness and spatial distribution of terrestrial radio sources"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 435 (1), pp. 584-596*, October 2013, DOI: 10.1093/mnras/stt1337.
18. Prasad, P., Wijnholds, S.J., *"Amsterdam-ASTRON radio transients facility and analysis centre: towards a 24x7 all-sky monitor for the Low Frequency Array (LOFAR)"*, *Philosophical Transactions of the Royal Society A, Vol. 371, no. 1992 20120234*, June 13, 2013, DOI: 10.1098/rsta.2012.0234.
19. Schellart, P., et al., *"Detecting Cosmic Rays with the LOFAR Radio Telescope"*, *Astronomy & Astrophysics, Vol. 560 no. A98, 560A no. 98S*, December 2013. DOI: 10.1051/0004.6361/201322683.
20. Smith, D.M.P., Bakker, L., Witvers, R.H., Woestenburg, E.E.M., Palmer, K.D., *"Low Noise Amplifiers for Radio Astronomy,"* *International Journal of Microwave and Wireless Technologies, Vol. 5, no. 4, pp. 453-461*, August, 2013. DOI: 10.1017/S1759078712000840.
21. Smith, D.M.P., Woestenburg, E.E.M., *"Technique for Reduction of Noise Resistance in a Balanced Low-Noise Amplifier for Beam-Steering Applications,"* *International Journal of Microwave and Wireless Technologies, Vol. 5, no. 5, pp. 561-565*, October, 2013. DOI: 10.1017/A1759078713000676.
22. Sotomayor-Beltran, C. et al., *"Calibrating high-precision Faraday rotation measurements for LOFAR and the next generation of low-frequency radio telescopes"*, Astronomy & Astrophysics, Vol. 552, no. A58, April 2013, DOI: 10.1051/0004-6361/201220728.

23. Tasse, C., Tol, B. van der, Zwieten, J. van, Diepen, G. van, Bhatnagar, S., *"Applying full polarization A-Projection to very wide field of view instruments: An imager for LOFAR"*, *Astronomy & Astrophysics, Vol. 553, no. A105*, May, 2013. DOI: 10.1051/0004-6361/201220882.
24. Wiersma, R.P.C. et al., *"LOFAR insights into the epoch of reionization from the cross power spectrum of 21cm emission and galaxies"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 432 (3), pp. 2615-2624*, July 1, 2013. DOI: 10.1093/mnras/stt624.
25. Wijnholds, S.J., Cappellen, W.A. van, Vaate, J.G. Bij de, Ardenne, A. van, *"Phased Array Antenna System Development for Radio-Astronomy Applications"*, *IEEE Antennas and Propagation Magazine, Vol. 55, no. 6, pp. 293-308*, December 2013.
26. Yatawatta, S. et al., *"Initial deep LOFAR observations of Epoch of Reionization windows: I. The North Celestial Pole"*, *Astronomy & Astrophysics, Vol. 550, no. A136, pp. 1-17*, February 2013. DOI: 10.1051/0004-6361/201220874.
27. Yatawatta, S., *"On the interpolation of calibration solutions obtained in radio interferometry"*, *Monthly Notices of the Royal Astronomical Society (MNRAS), Vol. 428 (1), pp. 828-833*, Jan. 1, 2013. DOI: 10.1093/mnras/sts069.
28. Yatawatta, S., *"Estimation of radio interferometer beam shapes using Riemannian optimization"*, *Experimental Astronomy, Vol. 35, no. 3, pp. 469-487*, April 2013. arXiv: 1209.4236. DOI: 10.1007/s10686-012-9318-x.

Chapters in books

1. Veen, A.J. van der, Wijnholds, S.J., *"Signal Processing Tools for Radio Astronomy"*. In: *"Handbook of Signal Processing Systems", 2nd Edition, Springer, eds.: Shuvra S. Bhattacharyya, Ed F. Deprettere, Rainer Leupers and Jarno Takala.*

Theses

1. Lambrecht, K., *"Continuous Doppler Blood Flow Monitoring"*, *submitted to Hanze University of Applied Science Groningen / Hanze Institute of Technology in partial fulfilment of the requirements for the degree of Fulltime Honours Bachelor Advanced Sensor Applications, Assen*, June 16, 2013.

Conference papers

1. Apituley, A., Snik, F., Keller, C., Volten, H., Heinsbroek, R., Harten, G. van, Heikamp, S., Boer, J. de, Zeegers, E., Einarsen, L., Rietjens, J., Hasekamp, O., Smit, M., di Noia, A., Mijling, B., Hendriks, E., Stammes, P., Vonk, J., Berkhout, S., Haaima, M., Hoff, R. van der, Stam, D., Navarro, R., Bettonvil, F.C.M., *"iSPEX: First Results of Aerosols Measured by Smartphones in The Netherlands"*, *Proc. of the European Aerosol Conference*, Sept. 2013. http://www.knmi.nl/publications/fulltexts/eac2013_abstract_apituley_ispex.pdf
2. Ardenne, A. van, "*Calibration and Performance of Large Antenna Arrays for Radio Astronomy" (Invited)*, *Progress in Electromagnetics Research Symposium (PIERS), Stockholm, Sweden, p.1003*, August, 2013.
3. Ardenne, A. van, Vaate, J.G. Bij de, Fiorelli, B., Wijnholds, S.J., *"Wideband Array Developments for Planned and Future Radio Astronomy Antennas"*, *Proc. EUCAP 2013 (European Conference on Antennas and Propagation), pp. 667-671, Gothenborg, Sweden*, April 8-12, 2013. ISBN: 978-88-907018-1-8.
4. Arts, M.J., Fiorelli, B., *"Polarization studies of Vivaldi aperture arrays for the Square Kilometre Array"*, *Electromagnetics in Advanced Applications (ICEAA), 2013 International Conference on, Turin, Italy*, Sept. 2013, pp. 356-359, ISBN: 978-146735707-4.
5. Barbosa, D., Márquez, G.L., Ruiz, V., Silva, M., Verdes-Montenegro, L., Santander-Vela, J., Maia, D., Antón, S., Ardenne, A. van, Vetter, M., Kramer, M., Keller, R., Pereira, N., Silva, V., *"The BIOSTIRLING Consortium; Power Challenges of Large Scale Research Infrastructures: the Square Kilometer Array and Solar Energy Integration; Towards a zero-carbon footprint next generation telescope"*, *Proc. 2nd Int. Workshop on Integration of Solar Power into Power Systems, 2012arXiv1210.4972B*, November 12-13, Lisbon, Portugal (2012), ISBN: 978-3-9813870-4-9.
6. Barbosa, D., Bergano, M., Ardenne, A. van, et.al., *"Design, Environmental and Sustainability Constraints of newAfrican Observatories: The example of the Mozambique Radio Astronomy Observatory"*, *URSI-BEJ, IEEE-Africon 2013, Mauritius*, Sept. 2013.
7. Bettonvil, F.C.M., Weiland, T., *"The 2011 Eta-Aquariids observing campaign from La Palma"*, *Proc. of the International Meteor Conference, La Palma, Canary Islands, Spain*, Sept. 20-23, 2012, Eds.: Gyssens, M., Roggemans, P., International Meteor Organization, ISBN 978-2-87355-024-4, pp. 115-117, Publ. date January 2013.
8. Bettonvil, F.C.M., *"Digital all-sky cameras VII: Putting the camera into operation"*, *Proc. of the International Meteor Conference, La Palma, Canary Islands, Span*, Sept. 20-23, 2012, Eds.: Gyssens, M., Roggemans, P., International Meteor Organization, ISBN 978-2-87355-024-4, pp. 34-37, Publ. date January 2013.
9. Bettonvil, F.C.M., *"Utrecht and the European Solar Telescope"*, *Proceedings of a conference held 2-5 April 2012 at Hotel Leeuwenhorst, Noordwijkerhout, The Netherlands. ASP Conference Series, Vol. 470, 370 Years of Astronomy in Utrecht. San Francisco: Astronomical Society of the Pacific*, 2013, p.389, Publ. date January 2013. http://aspbooks.org/custom/publications/paper/470-0389.html.

10. Blott, R., Baan, W.A., Boonstra, A.J., Bergman, J., Robinson, D., Liddle, D., Navarathinam, N., Eves, S., Bridges, C., Gao, S., Bentum, M.J., Forbes, A., Humphreys, D., Harroch, C.G., *"Space-based ultra-long wavelength radio observatory (low cost) – SURO-LC"*, *European Planetary Science Congress 2013, University College London*, September 8-13, 2013, London, United Kingdom.
11. Budianu, A., Willink Castro, T.J., Meijerink, A., Bentum, M.J., *"Inter-satellite links for cubesats"*, *IEEE Aerospace Conference, Montana, US*, March 2-9, 2013.
12. Budianu, A., Meijerink, A., Bentum, M.J., *"Swarm to earth Communications in OLFAR"*, *IAC2013, Beijing, China,* September 23-27, 2013.
13. Collados, M., Bettonvil, F.C.M., Cavaller, L., Ermolli, I., Gelly, B., Pérez, A., Socas-Navarro, H., Soltau, D., Volkmer, R., EST Team, *"The European Solar Telescope"*, *Memorie della Societa Astronomica Italiana, Vol. 84, p. 379*, 2013.
14. Collados, M., Bettonvil, F.C.M., Cavaller, L., Ermolli, I., Gelly, B., Pérez, A., Socas-Navarro, H., Soltau, D., Volkmer, R., EST Team, *"EST: the largest and most sensitive spectropolarimeter"*, *published in Highlights of Spanish Astrophysics VII, Proceedings of the X Scientific Meeting of the Spanish Astronomical Society (SEA), held in Valencia, July 9-13, 2012, pp. 808-819*, Publ. date May 2013. http://www.sea-astromania.es/drupal/sites/default/files/archivos/ proceedings10/instrumentacion/INVIT ADAS/colladosm.pdf.
15. Engelen, S., Quillien, K., Smith, D.M.P., Budianu, A., Rajan, R.T., Boonstra, A.J., Gill, E.K.A., Bentum, M.J., Veen, A.J. van der, Verhoeven, C., Meijerink, A., Sundaramoorthy, P., Noroozi, A., "*The Road to OLFAR – A Roadmap to Interferometric Long-wavelenght Radio Astronomy using Miniaturized Distributed Space Systems"*, *IAC2013, Beijing, China*, September 23-27, 2013.
16. Faulkner, A.J., Vaate, J.G. Bij de, *"SKA Low Frequency Aperture Array Design"*, *IEEE International Symposium on Phased Array Systems, Boston, USA*, Oct. 15-18, 2013.
17. Fiorelli B., De Lera Acedo E., Arts M.J., Virone G., Vaate J.G. Bij De, *"Polarization Performances and Antenna Misalignment for Aperture Arrays: SKA-Low AAVS 0.5 case"*, *Electromagnetics in Advanced Applications (ICEAA), 2013 International Conference on, Turin, Italy*, Sept. 2013, pp. 972-975, ISBN: 978-146735707-4.
18. Fiorelli B., Arts M.J., Virone, G., De Lera Acedo, E., Cappellen, W.A. van, *"Polarization Analysis and Evaluation for Radio Astronomy Aperture Array Antennas"*, *7th European Conference on Antennas and Propagation (EuCAP 2013), Gothenborg, Sweden, pp. 461-465*, April 8-12, 2013, ISBN: 978-88-907018-1-8.
19. Grootjans, R., Bentum, M.J., Brethouwer, M., Grootjans, R., Langen, S.K. van, Vries, R. de, Dijk, P. van, *"Inter-satellite Communication Link for a Space Based Interferometer"*, *IAC2013, Beijing, China*, September 23-27, 2013.
20. Hall, P.J., Sutinjo, A.T., Lera Acedo, E. de, Wayth, R.B., Razavi-Ghods, N., Colegate, T.M., Faulkner, A.J., Juswardy, B., Fiorelli, B., Booler, T., Vaate, J.G. Bij de, Waterson, M., Tingay, S.J., *"First Results from AAVS 0.5: A Prototype Array for Next-Generation Radio Astronomy"*, *Electromagnetics in Advanced Applications (ICEAA), 2013 International Conference on, Turin, Italy*, Sept. 2013, pp. 340-343, ISBN: 978-146735707-4.
21. Kazemi, S., Yatawatta, S., Zaroubi, S., *"Ordered-Subsets Acceleration of Radio Interferometric Calibration: OS-SAGE calibration algorithm"*, *Proc. 2013, of IEEE International Symposium on Signal Processing and Information Technology (ISSPIT) 2012*, December 12-15, Ho Chi Minh City, Vietnam.
22. Klein, M., Engelen, S., Verhoeven, C., Bentum, M.J., Budianu, A., *"Design of an Electric Power Design with Incorporation of a Phased Array Antenna for OLFAR"*, *IAC2013, Beijing, China*, September 23-27, 2013.
23. Langen, S.K. van, Bentum, M.J., Brethouwer, M., Grootjans, R., Grootjans, R., Vries, R. de, Dijk, P. van, *"Perceived Value of Students Participation in the Field of Aerospace Engineering from a Student's Perspective"*, *IAC2013, Beijing, China*, September 23-27, 2013.
24. Maat, D.H.P., Broekema, P.C., Schoonderbeek, G.W., Weiss, J., *"Multi-Tb/s data transport system for the square kilometre array radio telescope"*, *Photonics Society Summer Topical Meeting Series*, 2013 IEEE, pp. 221-222.
25. Navarro, R., Venema, L.B., Davies, R., *"MICADO, the E-ELT first-light imaging camera"*, *presentation on Workshop Shaping E-ELT Science and Instrumentation*, Febr. 25-March 1, 2013.
26. Navarro, R., Venema, L.B., Brandl, B., *"METIS, Science case and instrument specification"*, *presentation on Workshop Shaping E-ELT Science and Instrumentation*, Febr. 25-March 1, 2013.
27. Navarro, R., Venema, L.B., Kaper, L., *"A high-multiplex fibre-fed MOS for the E-ELT"*, *presentation on Workshop Shaping E-ELT Science and Instrumentation*, Febr. 25-March 1, 2013.
28. Nijboer, R.J., Pandey-Pommier, M., Bruyn, A.G. de, *"LOFAR imaging capabilities and system sensitivity"*, 2013, *ArXiv e-prints, 1308.4267.*
29. Quillien, K.A., Engelen, S., Gill, E.K.A., Smith, D.M.P., Arts, M.J., Boonsta, A.J., *"Astronomical Antenna for a Space Based Low Frequency Radio Telescope"*, *in 27th AIAA/USU Conference on Small Satellites, Logan, Utah, USA*, August 10-15, 2013, pp. 1-7. http://digitalcommons.usu.edu/smallsat/2013/all2013/86/.
30. Rajan, R.T., Bentum, M.J., Gunst, A.W., Boonstra, A.J., *"Distributed Correlators for Interferometery in Space"*, *IEEE Aerospace Conference, Montana, US*, March 2-9, 2013.
31. Rajan, R.T., Bentum, M.J., Boonstra, A.J., *"Synchronization for space based ultra low frequency interferometery"*, *IEEE Aerospace Conference, Montana, US*, March 2-9, 2013.

32. Rajan, R.T., Veen, A.J. van der, *"Joint Non-Linear Ranging and Affine Synchronization Basis for a Network of Mobile Nodes"*, *in Proc. 21st European Signal Processing Conference (EUSIPCO), Marrakech (Marokko)*, September 2013.
33. Rajan, R.T., Leus, G.J.T., Veen, A.J. van der, *"Relative velocity estimation using Multidimensional Scaling"*, *in Proc. 5th IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP 2013), St. Maarten (Dutch Antilles)*, December 2013.
34. Roelfsema, R., Pragt, J., Elswijk, E., Haan, M. de, et al., *"SPHERE-ZIMPOL system testing: status report on polarimetric high contrast results"*, *Proc. SPIE Vol. 8864, Techniques and Instrumentation for Detection of Exoplanets VI, 88640C*, September 26, 2013, DOI:10.1117/12.2023600.
35. Martinez-Rubi, O., Veligatla, V.K., Bruyn, A. G. de, Lampropoulos, P., Offringa, A.R., Jelic, V., Yatawatta, S., Koopmans, L.V.E., Zaroubi, S., *"LEDDB: LOFAR Epoch of Reionization Diagnostic Database*", 2013, *Astronomical Data Analysis Software and Systems XXII, 475.*
36. Sauvage, J.F., Pragt, J., Roelfsema, R., *"Sphere: complete laboratory performance and prediction for on-sky first light"*, *Proc. SPIE Vol. 8864*, October 2013.
37. Smith, D.M.P., Arts, M.J., Boonstra, A.J., Wijnholds, S.J., *"Characterisation of astronomical antenna for space based low frequency radio telescope"*, *IEEE Aerospace Conference, Big Sky, Montana, USA, pp.1-9*, March 2-9, 2013. DOI: 10.1109/AERO.2013.6496908.
38. Snellen, I., Stuik, R., Otten, G., Bettonvil, F.C.M., Navarro, R., Kenworthy, M., Mooij, E. de, Horst, R. ter, Le Poole, R., Lesage, A., Spronck, J., *"MASCARA: The Multi-site All-Sky CameRA"*, *EPJ Web of Conferences, Vol. 47*, 2013, Hot Planets and Cool Stars, http://arxiv.org/ftp/arxiv/papers/1208/1208.4116.pdf.
39. Vaate, J.G. Bij de, Faulkner, A.J., Gunst, A.W., Hall, P.J., *"Aperture Arrays for the Square Kilometre Array"*, *IEEE AFRICON 2013, URSI BEJ session*, Sept. 9-12, 2013, Mauritius.
40. Verhoeven, C.J.M., Engelen, S., Rajan, R.T., Bentum, M.J., Budianu, A., Smith, D.M.P., *"Swarm radio for nano satellites - Radio needs for nano-satellites"*, *invited paper PAR4CR Workshop, Stockholm, Sweden*, 18-19 June, 2013.
41. Vries, R. de, Bentum, M.J., Brethouwer, M., Grootjans, R., Grootjans, R., Langen, S.K. van, Dijk, P. van, "*Determining Position, Rotation and Orientation for Tethered Twin Nano Satellite to Map Data from a Interferometer"*, *IAC2013, Beijing, China*, September 23-27, 2013.
42. Weber, R., Hellbourg, G., Dumez-Viou, C., Boonstra, A.J., Torchinsky, S., Capdessus, C., Abed-Meraim, K., *"RFI Mitigation in Radio Astronomy: an Overview"*, *L' électromagnétisme, Une science en pleine action, URSI France, Journées Scientifiques, CNAM, Paris, France*, March 26-27, 2013.
43. Wise, M., Nijboer, R.J., Holties, H., *"The LOFAR Data System: An integrated Observing, Processing and Archiving Facility"*, *Proc. 2013 of The 22nd annual Astronomical Data Analysis Software and Systems (ADASS XXII) Conference*, 2012, November 4-8, Champaign, Illinois, USA.
44. Wijnholds, S.J., Sardarabadi, A.M., Veen, A.J. van der, *"Factor Analysis as a Tool for Signal Processing"*, *Biomedical and Astronomical Signal Processing (BASP) Frontiers Workshop, Villars-sur-Ollon (Switzerland)*, January 27-February 1, 2013.
45. Wijnholds, S.J., *"Blind Self-Calibration of Sensor Arrays"*, *Biomedical and Astronomical Signal Processing (BASP) Frontiers Workshop, Villars-sur-Ollon (Switzerland)*, January 27-February 1, 2013.
46. Wijnholds, S.J., Cappellen, W.A. van, Vaate, J.G. Bij de, *"Advances in Phased Array Systems for Radio Astronomy"*, *IEEE International Symposium on Antennas and Propagation (APS), Orlando, Florida (USA)*, July 7-13, 2013.
47. Wijnholds, S.J., Jongerius, R., *"Computing Cost of Sensitivity and Survey Speed for Aperture Array and Phased Array Feed Systems"*, *IEEE AfriCon and URSI BEJ meeting, Pointe-Aux-Piments (Mauritius)*, September 9-12, 2013.
48. Yatawatta, S., *"Radio Interferometric Calibration Using a Riemannian Manifold"*, *IEEE ICASSP, Vancouver, Canada*, June, 2013.
49. Yatawatta, S., Kazemi, S., Zaroubi, S., *"Robust Radio Interferometric Calibration Using the t-Distribution"*, *Proc. 2013 of IEEE International Symposium on Signal Processing and Information Technology (ISSPIT)* 2012, December 12-15, Ho Chi Minh City, Vietnam.

Professional publications

1. Bettonvil, F.C.M., *"MATISSE mid-infrarood interferometrie op de VLTI"*, *Fotonica Magazine, 38e jaargang nr. 1, maart 2013. Presentation on Photonica Event, Veldhoven, The Netherlands April 24-25*, 2013.
2. Bentum, M.J., *"OLFAR – Orbiting Low Frequency Antennas for Radio Astronomy"*, *invited talk seminar Queens University Belfast, Ireland, January 22*, 2013.
3. Bentum, M.J., *"OLFAR - a radio telescope swarm around the Moon"*, *invited talk URSI-Benelux Forum, Eindhoven, The Netherlands*, April 19, 2013.
4. Bentum, M.J., *"A Large Ultra-long Wavelength Radio Astronomy Instrument in Space"*, *invited talk AFRICON 2013, URSI-BEJ special session, Mauritius*, September 11, 2013.
5. Bentum, M.J., *"Dark-ages explorer – opening up a new unexplored window to the universe"*, *invited talk China Academy of Space Technology (CAST), Beijing, China*, September 26, 2013.

6. Bentum, M.J., *"OLFAR – Orbiting Low Frequency Antennas for Radio Astronomy"*, *invited talk STW jaarcongres, Nieuwegein,The Netherlands*, October 3, 2013.
7. Boonstra, A.J., Praktijkcase: *"Big Data in de radioastronomie"*, *Big Data conference Almere, The Netherlands*, January 22, 2013.
8. Boonstra, A.J., *"Approaches to Tackle the Signal Processing Challenges of the SKA Radio Telescope"*, *ICT.Open 2013, Eindhoven, The Netherlands November 27-28*, 2013.
9. Fiorelli, B., *"Antenna Polarization Performance"*, *presentation at AADC LFAA consortium All-hands meeting, Dwingeloo, The Netherlands*, Dec. 2013.
10. Gerbers, M., *"Management Tools and Rules"*, *presentation at AADC LFAA consortium All-hands meeting, Dwingeloo, The Netherlands*, Dec. 2013.
11. Jiwani, A., Colgate, T., Razavi-Ghods, N., Hall, P.J., Padhi, S., Vaate, J.G. Bij de, "*Square Kilometre Array station configuration using two stage beamforming"*, *Publications of the Astronomical Society of Australi*a, March 2013.
12. Jongerius, R., Wijnholds, S.J., Nijboer, R.J., Corporaal, H.,*"End-to-end Compute Model of the Square Kilometre Array"*, *IBM Research Report RZ-3860*.
13. Navarro, R., *"The Netherlands Instrumentation Program for the European Extremely Large Telescope"*, *presentation for Optics group prof. P. Urbach, TU Delft, The Netherlands*, January 28, 2013.
14. Roelfsema, R., Pragt, J., *"De ZIMPOL hoog contrast polarimeter voor SPHERE"*, *Fotonica Magazine, 38e jaargang nr. 1*, maart 2013.
15. Romein, J.W., *"From Uni-Core to Many-Core, the Splendor of DAS-1 to 4"*, *presentation at DAS-4 workshop, TU Delft, The Netherlands*, February, 2013.
16. Romein, J.W., *"Signal Processing on GPUs for Radio Telescopes"*, *presentation at GPU Technology Conference, San Jose, Californa*, March 2013.
17. Vaate, J.G. Bij de, *"Aperture Array Design and Construction Consortium: AADC"*, *presentation at SKA Engineering meeting, Manchester, United Kingdom*, Oct. 2013.
18. Vaate, J.G. Bij de, *"Aperture Array MID Consortium: AAMID"*, *presentation at SKA Engineering meeting, Manchester, United Kingdom*, Oct. 2013.
19. Vaate, J.G. Bij de, *"Goals of the Meeting"*, *presentation at AADC LFAA consortium All-hands meeting, Dwingeloo, The Netherlands*, Dec. 2013.
20. Venema, L.B., *"The Instrumentation Program for the European Extremely Large Telescope"*, *presentation on Astronomical Instrumentation for AMOLF during visit to ASTRON, Dwingeloo, The Netherlands*, October 18, 2013.
21. Wijnholds, S.J., *"Comparative Analysis of Performance and Computing for MFAA*", *presentation at SKA Engineering meeting, Manchester, United Kingdom*, Oct. 2013.
22. Yatawatta, S., *"Calibration and Imaging, Going deeper than ever before"*, *presentation at SKA science workshop in Nagoya, Japan*, June 2013.
23. Yatawatta, S., *"EoR NCP observations"*, *presentation at LOFAR science workshop, Dalfsen, The Netherlands*, March 2013.
24. Yatawatta, S., *"Deep widefield interferometry of the NCP"*, *presentation at Symposium for University of Groningen*, November 2013.

Publications for general audience

1. Bettonvil, F.C.M., *"De European Solar Telescope"*, *Zenit, pp. 26,* July/Aug. 2013.
2. Bentum, M.J., et. al., *"Een zwerm nanosatellieten aan het praten krijgen"*, *Bits & Chips*, October 2013. http://www.bits-chips.nl/artikel/een-zwerm-nanosatellieten-aan-het-praten-krijgen.html.
3. Bentum, M.J., et. al., *"Radiotelescoop zwermt uit rond de maan"*, *Bits & Chips, pp. 54-55*, March, 2013. http://www.bits-chips.nl/artikel/radiotelescoop-zwermt-uit-rond-de-maan.html.
4. Gunst, A.W., Szomoru, A., *"UniBoard: a high performance digital processing board for radio astronomy"*, *DSP valley newsletter 2*, April- May 2013.

Other research output

1. Alexander, P., Broekema, P.C., Ratcliffe, S., Bolton, R., Nikolic, B., *"SDP Element Concept SKA"*, *Manchester, United Kingdom*, June 6, 2013.
2. Baan, W.A., *"SURO-LC"*, *Netherlands Low-frequency radio Astronomy Platform (NLAP), First NLAP Organizational and Technical Meeting, Dwingeloo, The Netherlands*, November 19-20, 2013.
3. Bentum, M.J., Budianu, A., Meijerink, A., Rajan, R.T., Engelen, S., Smith, D.M.P., *"OLFAR – Orbiting Low Frequency Antennas for Radio Astronomy"*, *2013 Interplanetary Small Satellite Conference, Caltech, Pasadena, California*, June 20-21, 2013.
4. Boonstra, A.J., et al, *CEBIT DOME presentation, Hannover, Germany*, March 2013.

5. Boonstra, A.J., *"4 pi Sr imaging with 3D arrays"*, *Netherlands Low-frequency radio Astronomy Platform (NLAP), First NLAP Organizational and Technical Meeting, Dwingeloo, The Netherlands*, November 19-20, 2013.
6. Broekema, P.C., *"The Square Kilometer Array - Exascale I/O personified"*, *Exascale10 workshop invited talk, Leipzig, Germany*, June 6, 2013.
7. Broekema, P.C., *"Cobalt, a new correlator for LOFAR"*, *presentation for Hanzehoogeschool, Groningen, The Netherlands*, Oct. 31, 2013.
8. Broekema, P.C., *"Cobalt, a new correlator for LOFAR"*, *presentation at Nvidia booth on Exhibition Supercomputing '13, Denver, Colorado, USA,* November 20, 2013.
9. Budianu, A., Willink Castro, T.J., Smith, D.M.P., Meijerink, A., Bentum, M.J., *"Data Distribution in the OLFAR Satellite Swarm"*, *Sense of Contact workshop, Soesterberg, The Netherlands*, April 10, 2013.
10. Budianu, A., Willink Castro, T.J., Smith, D.M.P., Meijerink, A., Bentum, M.J., *"Data Distribution in the OLFAR Satellite Swarm"*, *URSI Benelux Forum, Eindhoven, The Netherlands*, April 19, 2013.
11. Budianu, A., Willink Castro, T.J., Smith, D.M.P., Meijerink, A., Bentum, M.J., *"Data Distribution in the OLFAR Satellite Swarm"*, *CTIT workshop poster, Enschede*, The Netherlands, June 4, 2013.
12. Cappellen, W.A. van, Fiorelli, B., *"Focal Plane Arrays for Radio Astronomy"*, *presentation at TU Eindhoven, The Netherlands*, November 1, 2013.
13. Engelen, S., Budianu, A., Verhoeven, C.J.M., Smith, D.M.P., Quillien, K.A., Bentum, M.J., Klein, J.M., Rajan, R.T., *"A first glimpse at the OLFAR satellites"*, *Sense of Contact workshop, Soesterberg, The Netherlands*, April 10, 2013.
14. Gerbers, M., *"Galileo Signal Monitoring Facility (SMF) Close out report"*, *Doc.nr. GAL-RPT-ASTRON-SMF-A-00034*, May 21, 2013.
15. Gerbers, M., *"Galileo Signal Monitoring Facility (SMF) Lessons learned"*, *Doc.nr. GAL-RPT-ASTRON-SMF-A-0003*5, May 3, 2013.
16. Gerbers, M., *"SKA LFAA Quality Assurance and Product Assurance plan"*, *Doc.nr. AADC-LFAA.MGT.QAPA-AADC-QA-001*, June 8, 2013.
17. Gerbers, M., *"SKA LFAA Configuration and Documentation Mangement Plan"*, *Doc.nr. AADC-TEL.LFAA.MGT.CC-AADC-PL-001*, June 8, 2013.
18. Gerbers, M., *"SKA MFAA Quality Assurance and Product Assurance plan"*, *Doc.nr. AAMID-MFAA.MGT.QAPA-AAMID-QA-001*, June 8, 2013.
19. Gerbers, M., *"SKA MFAA Configuration and Documentation Mangement Plan"*, *Doc.nr. AAMID-TEL.MFAA.MGT.CC-AAMID-PL-001*, June 8, 2013.
20. Grange, Y.G., Holties, H.A., Hinrich, P., Trompert, H., Hil, A. van den, Boven, P., Deliverable D6.4 of the work package 6 of the EU FP7 project: NEXPReS, *"BoD scheduling interface for LTA"*, January 11, 2013.
21. Grange, Y.G., Holties, H.A., Boven, P., Deliverable D6.5 of the work package 6 of the EU FP7 project: NEXPReS, *"Demonstration of BoD for an operational LTA"*, April 2, 2013.
22. Grange, Y.G., Holties, H.A., Paas, H., Deliverable D 8.9 of the work package 8 of the EU FP7 project: NEXPReS, *"Integration test report of LTA and pipeline integration"*, June 28, 2013.
23. Gunst, A.W., *"UniBoard Systems"*, *Digital Platform Study Group meeting, Vancouver, Canada*, March 6-8, 2013.
24. Gunst, A.W., *"Signal Processing in Radio Astronomy"*, *College at University of Twente, Enschede, The Netherlands*, October 1, 2013.
25. Halfwerk, R.G.B, *"SKA en DOME Users platform"*, *presentation for Big Science Industriemiddag (NWO Industrial Liaison Officers network), Woerden, The Netherlands*, October 2013. http://www.bigscience4business.com/presentatie/BSI2013/08-ASTRON-ILO.pdf.
26. Halfwerk, R.G.B, *"ASTRON Connecting science to industry*", *presentation for delegates of the Netherlands Space Office, Dwingeloo, The Netherlands*, April 5, 2013.
27. Luis, H.J., Drost, M., Graduation report *"SKA-MFAA Radome Design Parameters"*, June 21, 2013.
28. Navarro, R., *NWO evenement Bessensap*, *Radio performance in Hoe?Zo! Radio, interview with winner Lucas Ellerbroek of the Bessensap Masterclasses*, June 10, 2013.
29. Jongerius, R., Schmatz, M., Engbersen, T., Luijten, R., Weiss, J., Dittmann, G., Boonstra, A.J., Nijboer, R.J., Gunst, A.W., Vaate, J.G. Bij de, *"DOME Project: SKA Front – End Brainstorm!"*, *presented at the SKA Digital Platform Study Group meeting; Vancouver, Canada*, March 6-8, 2013.
30. Kegel, K.,*"PAASAR"*, *Netherlands Low-frequency radio Astronomy Platform (NLAP), First NLAP Organizational and Technical Meeting, Dwingeloo, The Netherlands*, November 19-20, 2013.
31. Pepping, H.J., *"DSP Applications @ Astron"*, *College at Hogeschool Windesheim, Zwolle, The Netherlands*, November 14, 2013.
32. Pragt, J.H. et al, *"4MOST Low-Resolution Spectrograph B"*, *Doc.nr. VLT-SPE-TRE-14625-3200, Input for the Phase a Review at ESO, Garching, Germany*, March 5, 2013.
33. Pragt, J.H., *"WEAVE Spectrograph system PDR Document"*, *Doc.nr. WEAVE-SPE-001, Phase B review for the William Herschel Telescope of ING, Madrid, Spain*, March 19, 2013.

34. Rajan, R.T., *"Synchronization for space based ultra low frequency interferometery"*, *Netherlands Low-frequency radio Astronomy Platform (NLAP), First NLAP Organizational and Technical Meeting, Dwingeloo, The Netherlands*, November 19-20, 2013.
35. Romein, J.W., *"From Uni-Core to Many-Core, the Splendor of DAS-1 to 4"*, *presentation at DAS-4 workshop, TU Delft, The Netherlands*, February, 2013.
36. Romein, J.W., *"Signal Processing on GPUs for Radio Telescopes"*, *presentation at GPU Technology Conference, San Jose, California*, March, 2013.
37. Schoonderbeek, G.W., *UniBoard2*, *PowerMX Design/Standards Meeting #1*, August 28, 2013.
38. Schoonderbeek, G.W., *UniBoard*, *visit of KIVI region Noord at ASTRON*, November 16, 2013.
39. Schoonderbeek, G.W., Engbersen, T., Döring, A. Luijten, R., Boonstra, A.J., *"Microservers, An Essential element of the DOME Project"*, *Bits & Chips 2013 Embedded Systems*, November 7, 2013.
40. Schnetler, H., Pragt, J.H., *"MOONS Technical Report"*, *Doc.nr. VLT-TRE-MON-14620-0002, Input for the Phase a Review at ESO, Garching, Germany*, March 6, 2013.
41. Sotomayor-Beltran, C., Sobey, C., Hessels, J.W.T., Bruyn, A.G. de, Noutsos, A., Alexov, A., *"ionFR: Ionospheric Faraday rotation"*, *Astrophysics Source Code Library 1, 03022.*
42. Vos, C.M., Pragt, J.H., Drost, M., Gunst, A.W., Kant, G.W., Nijboer, R., Cappellen, W.A. van et al., *"Proeftuin SKA Noord-Nederland"*, *deliverable of: Environmental Tiles in South Africa; LFAA High speed processing in Australia and UK; MFAA test station, LOFAR advanced imaging and Focal Plane Array at Westerbork, The Netherlands*, Q1 2013.
43. Yatawatta, S., Editor: *The Scientific World Journal (Hindawi).*

Colofon

Editor:
Femke Boekhorst
(pr@astron.nl)

Contributors:
Gert Kruithof
Mike Garrett
Huib-Jan van Langevelde
Joeri van Leeuwen
Carin Lubbers
Raffaella Morganti
Ramon Navarro
René Vermeulen
Diana Verweij
Marco de Vos
Janneke Wubs

Print:
Ruigrokmedia, Hoogeveen

Pictures:
Credits ASTRON, unless otherwise specified.

ASTRON is part of the Netherlands Organisation for Scientific Research (NWO).

ASTRON is the Netherlands Institute for Radio Astronomy. Its mission is to make discoveries in radio astronomy happen, via the development of novel and innovative technologies, the operation of world-class radio astronomy facilities, and the pursuit of fundamental astronomical research.

Office address:
Oude Hoogeveensedijk 4
7991 PD Dwingeloo
The Netherlands

Postal address:
P.O.Box 2
7990 AA Dwingeloo
The Netherlands

Phone: +31 521 59 51 00
Fax: +31 521 59 51 01

www.astron.nl

June 2014

ASTRON

Netherlands Institute for Radio Astronomy