# Effelsberg Newsletter

May 2017

# Call for Proposals

## Deadline: June 1, 2017, 15:00 UT

Observing proposals are invited for the Effelsberg 100-meter Radio Telescope of the Max Planck Institute for Radio Astronomy (MPIfR). The Effelsberg telescope is one of the World's largest fully steerable instruments. This extreme-precision antenna is used exclusively for research in radio astronomy, both as a stand-alone instrument as well as for Very Long Baseline Interferometry (VLBI) experiments. Access to the telescope is open to all qualified astronomers. Use of the instrument by scientists from outside the MPIfR is strongly encouraged. The institute can provide support and advice on project preparation, observation, and data analysis. The directors of the institute make observing time available to applicants based on the recommendations of the Program Committee for Effelsberg (PKE), which judges the scientific merit (and technical feasibility) of the observing requests.

Information about the telescope, its receivers and backends and the Program Committee can be found at http://www.mpifr-bonn.mpg.de/effelsberg/astronomers (potential observers are especially encouraged to visit the wiki pages!).

**Observing modes**

Possible observing modes include spectral line, continuum, and pulsar observations as well as VLBI. Available backends are several FFT spectrometers (with up to 65536 channels per subband/polarization), a digital continuum backend, a number of polarimeters, several pulsar systems (coherent and incoherent dedispersion), and two VLBI terminals (dBBC and RDBE type with MK5 recorders). Receiving systems cover the frequency range from 0.3 to 96 GHz. The actual availability of the receivers depends on technical circumstances and proposal pressure. For a description of the receivers see the web pages.

**How to submit**

Applicants should use the NorthStar proposal tool for preparation and submission of their observing requests. North Star is reachable at

https://northstar.mpifr-bonn.mpg.de/

For VLBI proposals special rules apply. For proposals which request Effelsberg as part of the European VLBI Network (EVN) see:

http://www.evlbi.org/proposals/.

Information on proposals for the Global mm-VLBI network can be found at

http://www3.mpifr-bonn.mpg.de/div/vlbi/globalmm/index.html.

Other proposals which ask for Effelsberg plus (an)other antenna(s) should be submitted twice, one to the MPIfR and a second to the institute(s) operating the other telescope(s) (eg. to NRAO for the VLBA).

After June, the next deadline will be on Oct 4, 2017, 15:00 UT.

by Alex Kraus

## RadioNet Transnational Access Programme

RadioNet (see http://www.radionet-org.eu/ ) includes a coherent set of Transnational Access (TA) programs aimed at significantly improving the access of European astronomers to the major radio astronomical infrastructures that exist in, or are owned and run by, European organizations.

Astronomers who are based in the EU and the Associated States but are not affiliated to a German astronomical institute, may also receive additional aid from the Transnational Access (TA) Program of "RadioNet". This will entail free access to the telescope, as well as financial support of travel and accommodation expenses for one of the proposal team members to visit the Effelsberg telescope for observations.

The Transnational Access program is one of the activities of "RadioNet", an Integrated Infrastructure Initiative (I3) funded under the ECs Framework Program Horizon2020, that has pulled together all of Europe's leading astronomy facilities to produce a focused, coherent and integrated project that will significantly enhance the quality and quantity of science performed by European astronomers.

One - in exceptional cases more - scientists who are going to Effelsberg for observations can be supported, if the User Group Leader (i.e., the PI - a User Group is a team of one or more researchers) and the majority of the users work in (a) country(ies) other than the country where the installation is located. Only user groups that are allowed to disseminate the results they have generated under this program may benefit from the access.

For more details see http://www.radionet-org.eu/ .

After completion of their observations, TNA supported scientists are required to submit their feedback through the TNA web pages.

*by Alex Kraus*

# News in Brief

The Phased-Array-Feed for the 100-m telescope which has been constructed by the ATNF (see issue 2/2016) and tested in the Parkes telescope, arrived in Effelsberg in February. It has been adapted for the usage with the 100-m telescope since then and is - at the time of writing this - being installed in the telescope. Stay tuned for the report on first light in the next issue of this newsletter.

# Workshop invitation:

# "Science with the Effelsberg 100-m Telescope"

# at MPIfR, Bonn Germany November 6-7, 2017

The Max-Planck-Institute for Radio Astronomy is happy to invite you to the workshop: "Science with the Effelsberg 100-m telescope", which will be held on Nov 6 & 7, 2017 at the MPIfR in Bonn.

Even more than 40 years after its inauguration, the 100-m telescope is still one of the two largest fully-steerable radio telescopes in the world, and – due to continuous efforts by the institute and the Max-Planck-Society – in an excellent shape. It is heavily used for astronomical observations and accessible by users from all over the world due to its "Open Skies" policy.

This meeting is intended to bring together various user groups of the 100-m telescope with the support staff of the observatory and the technical developers. We are looking forward to the opportunity to discuss recent observational results and technical developments with the users of the 100-m telescope. Furthermore, this meeting will give us the possibility to learn about new ideas for observing projects and will allow us to plan technical and software development for the next years.

More information about the meeting and the registration process could be found on our meeting webpage

https://events.mpifr-bonn.mpg.de/indico/event/48/overview

*We hope to meet you in Bonn in November!*

**SOC:**

Matthias Kadler (University of Würzburg, Chair), Andreas Brunthaler (MPIfR), Paulo Freire (MPIfR), Fabrice Herpin (University of Bordeaux, France), Gemma Janssen (ASTRON, Netherlands), Alexander Karim (University of Bonn, Germany), Alex Kraus (MPIfR), Thomas Krichbaum (MPIfR), John McKean (University of Groningen & ASTRON, Netherlands).

**LOC:**

Olaf Wucknitz, Kira Kühn and Rainer Beck

# News in Brief (continued)

During May 3-5, 2017 MPIfR hosted the 60th meeting of the Committee on Radio Astronomy Frequencies (CRAF, see: https://www.craf.eu/).

During these days more than 20 CRAF members as well as experts from the German Federal Network Agency, the ESA and the DLR discussed recent developments in spectrum management and interference issues.

CRAF is an Expert Committee of the European Science Foundation acting on frequency issues for European radio astronomy and related sciences. The mission of CRAF is:

- to keep the frequency bands used for radio astronomical observations free from interference;
- to argue the scientific needs of the European research community for continued access to and availability of the radio spectrum for radio astronomy;
- to support related science communities in their needs concerning interference-free radio frequency bands for passive use.

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As in the last two years, we offered „public observations“ in the visitors pavillon on the “Day of Astronomy” in Germany, which happened to be on March 25. At Effelsberg, a team of scientists (E. Fürst, N. Junkes, P. Müller, L. Spitler, B. Winkel) presented observations at 21cm wavelength, ranging from pulsar signals to scans through a supernova remnant and neutral hydrogen in the M81 galaxy system. About 100 interested viewers followed the observations as well as the subsequent data analysis and used the opportunity to ask many questions about the presentations and other astronomical topics.

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On Sep 9 this year, the observatory will open its doors for the public. Members of the scientific and technical staff of the institute will present their work to all interested persons. Based on the experience of former „Open Doors“, we expect to have between 2000-3000 guests at the observatory on this day.

*The provisional repair with the fitting piece.*

## Track repair at the 100-m telescope

As mentioned in the last issue of this newsletter (3/2016), some major repair work is currently undergoing at the track of the 100-m telescope.

The reason for this activity goes back to 2009. After the second fissure of the track in this year, we decided not to do the "standard" repair procedure, instead, a ~20 x 20 $cm^2$ part was milled out of the track (at the position of the crack) and a fitting piece was inserted which was connected to one side of the track only (see picture).

*Result of the arc gouging of the track.*

*The welding is nearly completed.*

Over the years this provisional repair worked well, but we noticed that the foundation did sink at the place of the fissure (due to one-sided loads) by up to few tenths of a mm.

Therefore, it was decided to perform a "regular" repair of the track. The work started on April 5 (immediately after the GMVA session). First task was the removal of the concrete and the core iron. After that the steel around the crack was removed by arc gouging before both ends of the track were welded together again. By the time this was written, these activities were finished successfully and in time. Currently, the welded track will be milled and grinded, before we could start to rebuild the core iron and the concrete around the track. It is expected that regular observations will restart on May 12.

*Milling of the track.*

# Science Highlights

## Giant Magnetic Fields in the Universe

*By Norbert Junkes*

*MPIfR Press Release, March 22, 2017:* [http://www.mpifr-bonn.mpg.de/pressreleases/2017/4](http://www.mpifr-bonn.mpg.de/pressreleases/2017/4)

*The research team comprises of Maja Kierdorf, Rainer Beck, Matthias Hoeft, Uli Klein, Reinout van Weeren, William Forman, and Christine Jones. First author Maja Kierdorf and Rainer Beck are MPIfR employees.*

Astronomers from Bonn and Tautenburg in Thuringia (Germany) used the 100-m radio telescope at Effelsberg to observe several galaxy clusters. At the edges of these large accumulations of dark matter, stellar systems (galaxies), hot gas, and charged particles, they found magnetic fields that are exceptionally ordered over distances of many million light years. This makes them the most extended magnetic fields in the universe known so far. The results were published in the journal „Astronomy & Astrophysics“ in March 2017.

Galaxy clusters are the largest gravitationally bound structures in the universe. With a typical extent of about 10 million light years, i.e. 100 times the diameter of the Milky Way, they host a large number of such stellar systems, along with hot gas, magnetic fields, charged particles, embedded in large haloes of dark matter, the composition of which is unknown. Collision of galaxy clusters leads to a shock compression of the hot cluster gas and of the magnetic fields. The resulting arc-like features are called

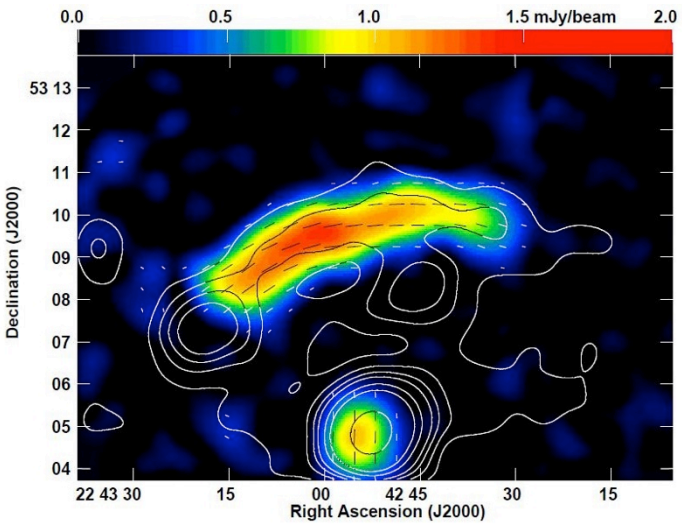



*Fig. 1: The relic at the outskirts of the galaxy cluster CIZA J2242+53, named „Sausage“ because of its shape, is located at a distance of about two billion light years from us. The contour lines show the intensity of the radio emission at a wavelength of 3 cm, observed with the 100-m Effelsberg radio telescope. The colors represent the distribution of linearly polarized radio intensity at the chosen wavelength, in units of Milli-Jansky per telescope beam. The short dashes indicate the orientation of the magnetic field. The bright source at the bottom is a radio galaxy that belongs to the same galaxy cluster.*

*Image: M. Kierdorf et al., 2017, A&A 600, A18*

"relics" and stand out by their radio and X-ray emission. Since their discovery in 1970 with a radio telescope near Cambridge/UK, relics were found in about 70 galaxy clusters so far, but many more are likely to exist. They are messengers of huge gas flows that continuously shape the structure of the universe.

Radio waves are excellent tracers of relics. The compression of magnetic fields orders the field lines, which also affects the emitted radio waves. More precisely, the emission becomes linearly polarized. This effect was detected in four galaxy clusters using the MPIfR's 100-m radio telescope near Bad Münstereifel-Effelsberg in the Eifel hills at wavelengths of 3 cm and 6 cm. Such short wavelengths are advantageous because the polarized emission is not diminished when passing through the galaxy cluster and our Milky Way. Fig.1 shows the most spectacular case.

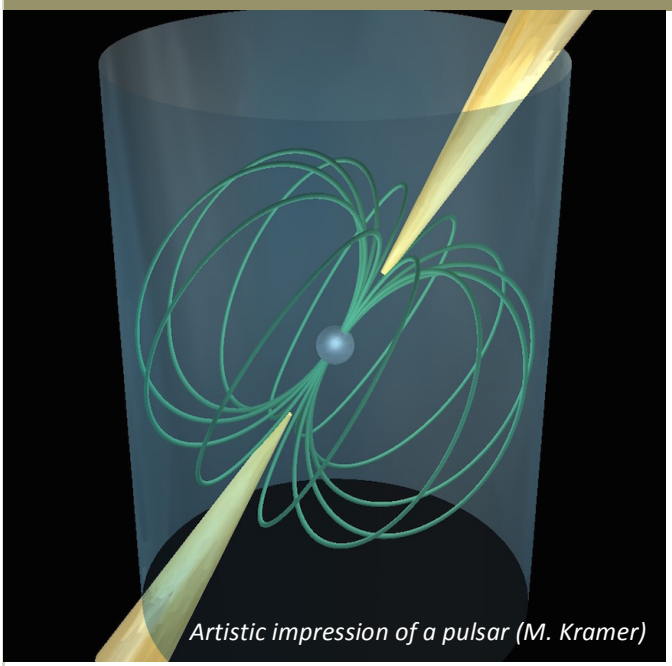
Linearly polarized relics were found in the four galaxy clusters observed, in one case for the first time. The magnetic fields are of similar strength as in our Milky Way, while the measured degrees of polarization of up to 50% are exceptionally high, indicating that the emission originates in an extremely ordered magnetic field. "We discovered the so far largest ordered magnetic fields in the universe, extending over 5-6 million light years", says Maja Kierdorf from MPIfR Bonn, the project leader and first author of the publication. She also wrote her Master Thesis at Bonn University on this subject. For this project, co-author Matthias Hoeft from TLS Tautenburg developed a method that permits to determine the "Mach number", i.e. the ratio of the relative velocity between the colliding gas clouds and the local sound speed, using the observed degree of polarization. The resulting Mach numbers of about two tell us that the galaxy clusters collide with velocities of about 2000 km/s, which is faster than previously derived from measurements of the X-ray emission.

The new Effelsberg telescope observations show that the polarization plane of the radio emission from the relics turns with wavelength. This "Faraday rotation effect", named after the English physicist Michael Faraday, indicates that ordered magnetic fields also exist between the clusters and, together with hot gas, cause the rotation of the polarization plane. Such magnetic fields may be even larger than the clusters themselves.

"The Effelsberg radio telescope proved again to be an ideal instrument to detect magnetic fields in the universe", emphasizes co-author Rainer Beck from MPIfR who works on this topic for more than 40 years. "Now we can systematically search for ordered magnetic fields in galaxy clusters using polarized radio waves."

# 50 Years of Pulsars - Beginnings at Effelsberg

*By Richard Wielebinski*



*Artistic impression of a pulsar (M. Kramer)*

After completing my PhD in Cambridge in May 1963 I was in Sydney at the Electrical Engineering Department of the University of Sydney from August 1963 until December 1969. In August I966 I was invited to come to the Bonn University by Professor Otto Hachenberg for a period of six months. During this time I worked at the Stockert telescope starting observations with a cryogenically cooled parametric amplifier at 11cm wavelength. During this short stay I travelled to Cambridge, to meet my old friends and to get the latest news. In fact in 1967 I was told by John Shakeshaft that a big discovery will be announced.

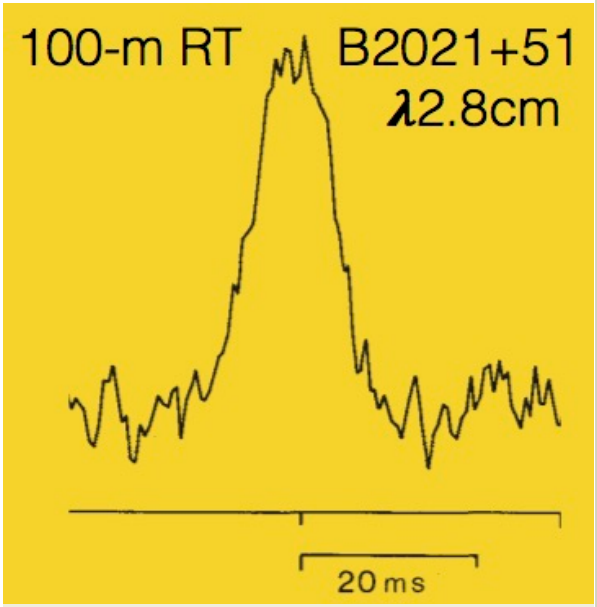
I returned to Sydney and proceeded to observe in Parkes at 150 MHz trying to make a complete all sky map of continuum radiation (Landecker & Wielebinski 1970, Australian Journal of Physics Supplement, Vol. 16, p. 1). We built a receiver (in fact for 85 and 150 MHz) and took it to Parkes. I had two students at that time: Warren Yates and Tom Landecker. We had a week of observing time and at the end we packed our receiver and drove back to Sydney. On arrival in my home I was told that a John Bolton was phoning wanting me to return to Parkes with my receiver: pulsars were discovered and the 'big boys' (CSIRO staff) had no low frequency receiver. Next day I was in Parkes installing my receiver. Some dramatic observations were made of PSR B1919+21 – a record of this first pulsar observation in Parkes ended up on an Australian $50 banknote.


*An old Australian 50$ bank note showing the Parkes observations of PSR B1910+21 by Richard Wielebinski (on the left).*

The following two years were full of pulsar research. We had access to the Molonglo radio telescope where some 30 new pulsars were discovered (e.g. Vaughan et al., 1969, Nature 222, 963). The galactic distribution of pulsars was confirmed and the pulsar-SNR association found. In this time I was asked to come to the Max Planck Institute in Bonn to the new Effelsberg radio telescope.

On arrival in Bonn in January 1970 I found good progress with the 100-m dish construction but hardly any receivers. I also found a student: Wolfgang Sieber, who was keen to work on pulsars. So in addition to managing of the Electronics for Effelsberg I went with Wolfgang to Stockert and started pulsar observations there. Stockert had a good 21cm receiver and we surveyed the known pulsars. My idea was that the pulsar data logger could be transferred to Effelsberg once the telescope construction was finished. We had the official opening of the 100-m telescope in May 1971. The first pulsar observations in Effelsberg were made at 11cm but in November 1972, a 2.8cm receiver became available leading to intense use for pulsars at this frequency. This was to be the highest frequency for pulsar observations at that time. In fact the first Effelsberg paper published in Nature in December 1972 was on the detection of six pulsars at 2.8cm. (Wielebinski et al., 1972, Nature, 240, 131-132). Effelsberg kept on setting records for the highest frequency of pulsar studies, including the first detection of pulsars at mm wavelength (Wielebinski et al. 1993. Astron. & Astrophys, 272, L13-L17).

The pulsar group was always very popular by young PhD students. Also young post-docs came from various countries. Later we even had senior visitors from Australia, the Soviet Union, Poland and Jodrell Bank/UK. Pulsar software had to be implemented by the pulsar researchers themselves leading to some disputes with the standard software developers who wanted to protect the security of their drive program. A lively research group was build up over the years. The 100-m radio telescope allowed the observations of a large sample of pulsars at many frequencies. At first these were the 'normal' objects but later a survey of millisecond pulsars was carried out. These surveys remain to this day basis information about pulsar characteristics. Also pulsar timing was introduced which led to international collaborations. Pulsars were used to probe the Galactic magnetic fields and the electron distribution in the Galaxy. A

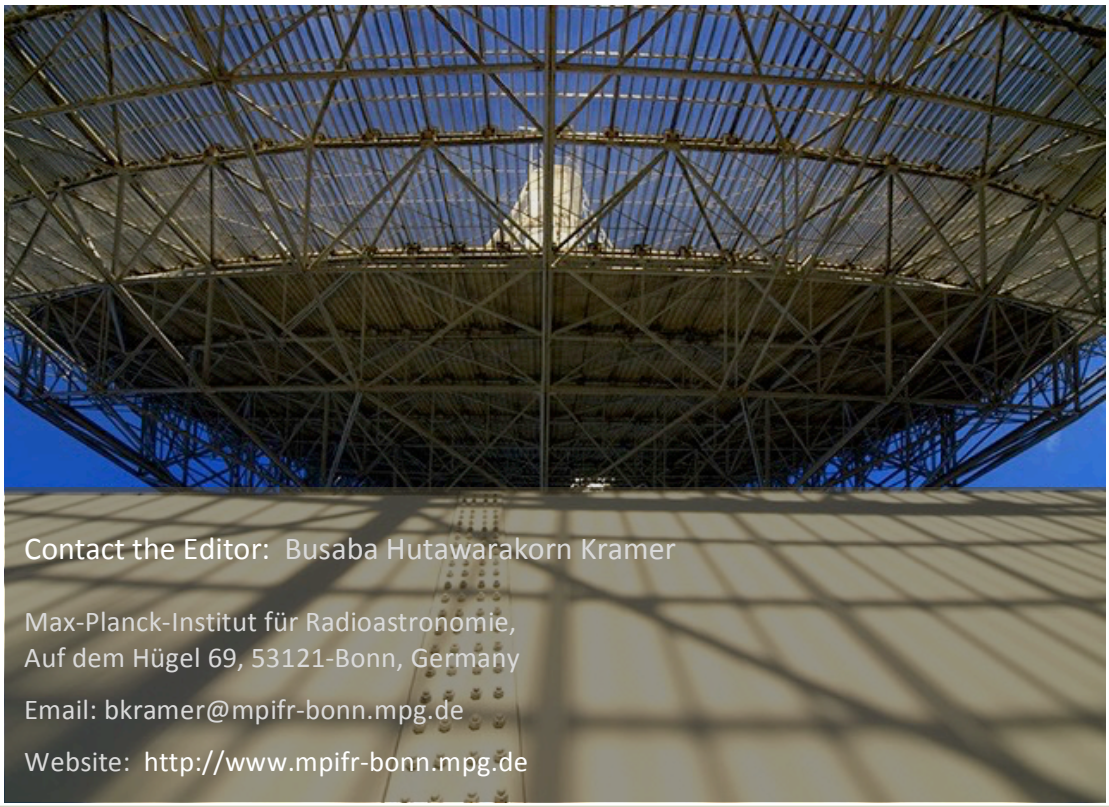



*An observation of PSR B2021+51 by Richard Wielebinski et al. in 1972.*

search for new pulsars was not intensely followed but occasional special search programs were implemented.

The MPIfR hosted two major international pulsar conferences with such people as Tony Hewish, Jocelyn Bell-Burnell and Joe Taylor and many others attending. We were supported by the European Union to organize the European Pulsar Network (EPN).

The MPIfR pulsar group has made a good international impression. The group has become one of the major pillars of radio astronomy research at the MPIfR. One of the three directors of the MPIfR, Michael Kramer, is a pulsar researcher, heading the "Fundamental Physics in Radio Astronomy" research department (http://www.mpifr-bonn.mpg.de/research/fundamental).



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