Effelsberg Newsletter

January 2013

Call for Proposals:

Call for proposals. The deadline is February 6, 2013, 13.00 UT.

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Greetings from the Director

A Happy New 2013! Since we survived the end of the world, it is appropriate to look ahead into a year that is going to be exciting, again. But before we do this, lets reflect on a remarkable 2012. We have completed our 40-year anniversary celebrations, which were a huge success – thanks to, in particular, the staff at Effelsberg. They went more than the extra mile and we are very grateful to them! We also achieved first light with the ultra-broad band (UBB) receiver, which will become routinely available after refitting it with additional RFI protection. This year will also see first light with the new high-resolution K-band system, and the new UBB backend, which will allow us to coherently de-disperse 3 GHz of bandwidth. Exciting times ahead! Join us in producing great science like that about the non-variability of fundamental constants published in SCIENCE, which is summarized in the following pages. Enjoy a wonderful new year – *Michael Kramer*

Content

HAPPY NEW YEAR 2013

Icon Images: Norbert Tacken

Call for Proposals:

Deadline February 6, 2013, 13.00 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/for_astronomers

Observing modes

Possible observing modes include spectral line, continuum, pulsar, and VLBI. Available backends are a FFT spectrometer (with 32768 channels), a digital continuum backend, a pulsar system (coherent and incoherent dedispersion), and two VLBI terminals (MK4/5 and VLBA/RDBE type).

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 new NorthStar proposal tool for preparation and submission of their observing requests. NorthStar 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/proposals.html

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

http://www.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) (e.g. to NRAO for the VLBA).

After February, the next deadline will be on June 5, 2013, 13.00 UT.

by Alex Kraus

Key Science Projects

The MPIfR invites scientists to submit Key Science Proposals (KSPs) for the 100-m telescope at Effelsberg. This kind of proposals should obey the following rules:

1. The proposed project should address high-quality and high-impact science that requires significant observing efforts.
2. The observations should utilize the core strength of the 100-m telescope.
3. KSPs should be large projects that cannot be realized (or only with difficulties) with standard observing proposals, i.e. projects requiring between 150 and 500 hours of observing time per year. (The exact amount of time available for KSPs may be limited depending on proposal pressure and requested observing frequency).
4. The project should also have a strong potential for outreach.

Key Science Projects can only be submitted to the February proposal deadline for the 100-m telescope.

They should be submitted using the NorthStar Tool as normal proposals accompanied by a more extensive justification (up to 10 pages) explaining the

- Scientific background
- Observing procedure
- Data analysis plan and data release policy
- Publication strategy

The proposals will be judged by the Effelsberg PC (PKE) and by the directors of the MPIfR who might consult external referees. The MPIfR expects progress reports periodically and a quick publication of the data (preferably online).

In case absentee-observations are desired, clear instructions for the execution of the project (observing strategy, acceptable weather conditions, etc.) have to be given.

by Alex Kraus

RadioNet Transnational Access Programme

RadioNet (see http://www.radionet-eu.org) includes a coherent set of Transnational Access programmes 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. Observing time at Effelsberg is available to astronomers from EU Member States (except Germany) and Associated States that meet certain criteria of eligibility. For more information:

http://www.radionet-eu.org/transnational-access

Time on these facilities is awarded following standard selection procedures for each TNA site, mainly based on scientific merits and feasibility. New users, young researchers and users from countries with no similar research infrastructure, are specially encouraged to apply. User groups who are awarded observing time under this contract, following the selection procedures and meeting the criteria of eligibility, will gain free access to the awarded facility, including infrastructure and logistical support, scientific and technical support usually provided to internal users and travel and subsistence grants for one of the members of the research team.

by Alex Kraus

Science & Technology News

Geodesist measure paraboloid deformations of the Effelsberg telescope with a laser scanner

Axel Nothnagel, Institute of Geodesy and Geoinformation, University of Bonn
Alex Kraus, Max-Planck-Institut für Radioastronomie

The Leica terrestrial laser scanner in the prime focus of the 100-meter-telescope. It was mounted in an empty receiver box.

It was quite a strange type of receiver which had been mounted on a prime focus receiver box on two days in June and July 2010 appearing so different from what a feed horn normally looks like. And indeed, it had nothing to do with radio astronomy but, as can be seen in the pictures, it was a surveying instrument fixed to the bottom of an empty receiver box. Geodesists of the Institute of Geodäsie and Geoinformation of the University of Bonn had embarked on a new type of paraboloid deformation measurements.

Although the shape of the paraboloid can be determined by holography quite reliably, the results are limited to a narrow range of elevation angles depending on the geostationary satellites serving as signal sources. The basic questions to be solved are how the focal length changes with elevation and how the deformation patterns look at other elevation angles.

Terrestrial laser scanning is a technique which has become quite common for surveying and other geometrical applications. It is a fast way of getting a huge number of points measured in 3D polar coordinates in fixed angular increments. Afterwards the individual data points have to be linked by sophisticated methods to generate surfaces and other design primitives.

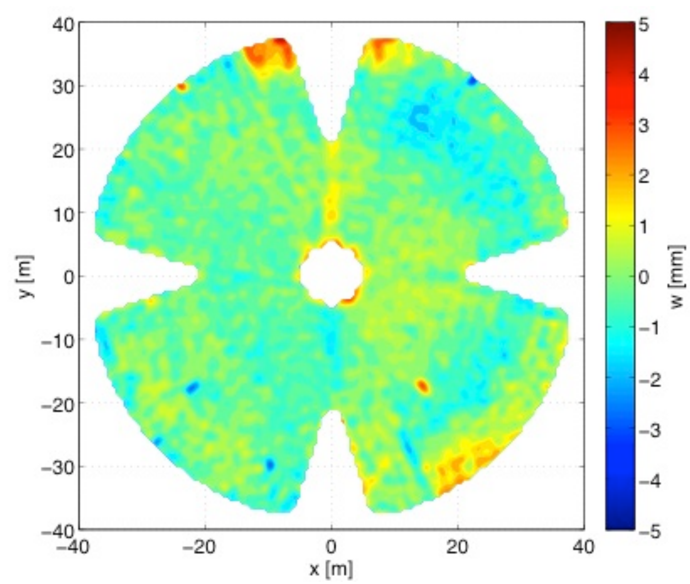
For a large structure like the Effelsberg paraboloid, terrestrial laser scanning, thus, seemed to be the method of choice. However, the questions were where to mount the scanner with minimal shadowing and how to cope with different elevation angles. In the course of planning the measurements, the idea developed to mount the scanner head-down to an empty prime focus receiver box. Putting the receiver box in place gave the scanner an almost unobstructed view of the main paraboloid.

The paraboloid was then scanned with a Leica HDS 6100 terrestrial Laser scanner which was (unofficially) qualified for the extreme tilt of the instrument at the low elevation angles of the telescope. To control the operation, the scanner was linked to a laptop computer located in the prime focus cabin by cable. Scans were repeated in various telescope elevation angles down to 7.5° with each data set consisting of 370 million points with three polar components each. This is equivalent to one data point every 64 mm^2.

The sheer number of observations required the development of a dedicated C++ program which had to run on a computer cluster. Proprietary software of the instrument's manufacturer was not able to handle this large amount of data. In 2012, Malvin Eichborn developed the program and analyzed the data in a geodetic master's project. As a first result, the estimated focal length variations agree very well with the empirical model for the sub-reflector displacement corrections.

Since the accuracy of the individual distance measurements of the scanner is only a few millimeters at a distance of 50 m, the ultimate insight into the deformations cannot be achieved from individual data points but from a surface fitting procedure to the residuals. The figure below shows the smoothed surface of the solid part of the paraboloid at 30° elevation after a best fit paraboloid has been subtracted. In the second and third quadrant, two reflector panels can be identified which had been displaced on purpose by plus and minus 3 mm for a holography survey some time ago validating the correctness of the whole procedure. The second blue spot at the third quadrant persists at other elevation angles as well und must, thus, be a real local deformation.

The result presented here resembles very well the outcome of the last holography campaign – the latter one, however, is restricted to a single observation at 32 deg elevation.



Shape of the main dish as measured at 30 deg elevation. Clearly visible are two (for calibration purposes deliberately) displaced panels.

Further work is in progress to iron out remaining difficulties including other elevations and the outer perforated ring of the reflector. The results will then prove whether the theoretical deformation model of the manufacturer is still valid and will show where some of the panels might need adjustment.

Physical constant passes the alcohol test

The proton-to-electron mass ratio has not changed during the past seven billion years

Christian Henkel, Norbert Junkes & Alex Kraus, MPIfR

The mass ratio of protons and electrons is deemed to be a universal constant. However, the Standard Model of particle physics does not prohibit that the fundamental constants have a different value in different regions of the universe or at different times in its history. In contrast, Einstein's Equivalence Principle assumes that the laws of nature (and hence also the fundamental constants) are independent of a local reference system.

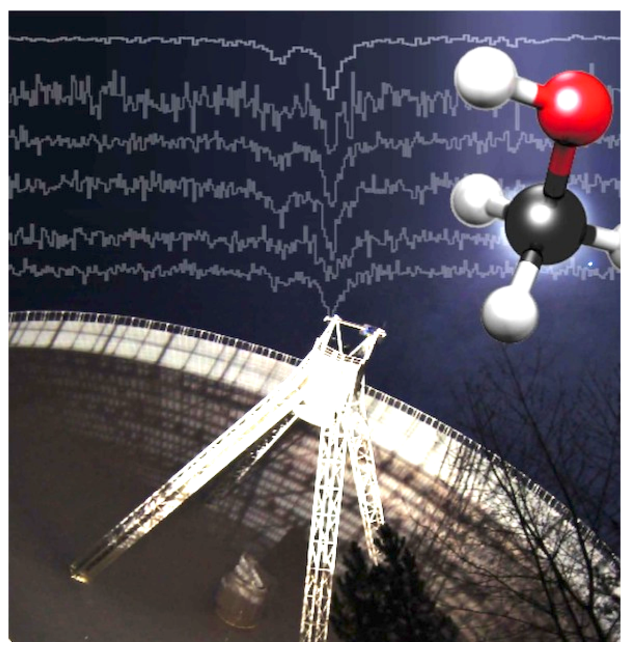
A group of researchers of the Vrije Universiteit (VU) Amsterdam and the Max-Planck-Institut für Radioastronomie used the 100-meter telescope to determine a stringent limit of the variability of the proton-to-electron mass ratio.

For this, they observed the simplest alcohol – methanol (CH_3OH) – in absorption against the high redshift ($z = 2.507$) blazar PKS 1830-211. This source is gravitationally lensed by an intervening spiral galaxy. The redshift of the absorption lines is 0.88582, corresponding to a look-back time of 7.2 billion years.

Various rotational and torsional transitions of the methanol molecule were observed with the 5cm, 1.3cm, and 1cm receivers of the 100-meter telescope. By analyzing the quantum structure of the methanol molecule the researchers were able to deduce that two of its spectral lines, which they observed at frequencies around 25 GHz, were influenced hardly at all by a change in the proton-to-electron mass ratio. The other two lines reacted much more sensitively to a modification of this parameter.

By the comparison of the measured velocity offsets, an unprecedented limit of $\Delta\mu/\mu = (0.0 \pm 1.0) \times 10^{-7}$ could be reached. This result can be interpreted as follows: the structure of the molecular matter agrees very accurately with the structure seven billion years ago. Possible deviations amount to a mere one hundred thousandth of a percent or even less.

Original publication: J. Bagdonaite et al.: "A Stringent Limit on a Drifting Proton-to-Electron Mass Ratio from Alcohol in the Early Universe", Science 339, pg. 46-48 (2013)



Observer's View

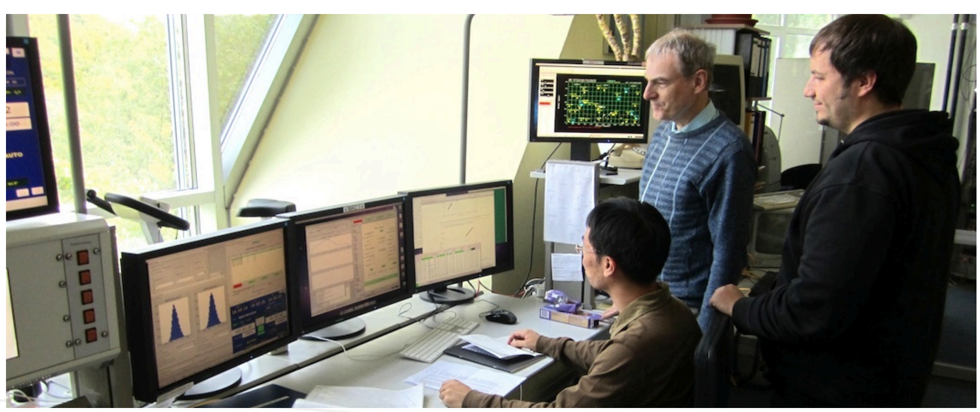
Bosco Yung

I am a PhD candidate in The University of Hong Kong, working under the supervision of Jun-ichi Nakashima and Sun Kwok. My current research focus has been on the kinematics of the circumstellar envelope of AGB and post-AGB stars, and one study approach is to analyze the spectra of various molecular masers like OH, H_2O and SiO. I am in particular interested in the high velocity stellar jets form in the late-AGB phase, which play an important role in the shaping process of planetary nebulae. These jets can be revealed by maser observations. However, since they are expected to have short lives (maybe about 100 years), it is not easy find them. I have recently completed two observing projects with the Effelsberg 100m Telescope, and have been successful in finding new candidates for objects associated with such jets.

I observed in 22 GHz in an H_2O maser survey. The large 100m dish allowed me to reveal some weak emission features, which have been slipped away from previous major surveys. In fact, one of the high velocity sources that I mentioned above was an extremely weak one, with a peak flux only about 0.2 Jy. Under good weather here, one might be able to achieve an RMS noise down to the order of 10^{-2}Jy upon a 5-minute on-source integration. The good sensitivity makes this telescope an excellent choice for doing large scale surveys in similar frequency ranges. In addition, we have a smaller beam (~40") at 22 GHz, and that was essential especially when I would like to do pointed-observations toward some specific sources in a relatively dense region (e.g. close to the Galactic Centre).

In my personal experience, this telescope is surely one of the best radio telescopes that I have ever used. This year marks its 40-year anniversary, but the site and all the system are well maintained, and the control interface is very user friendly for visiting observers. My projects were a little bit exhausting, as I have to observe continuously for about 15 hours a day. Nonetheless it was a very enjoyable experience, and all the staff here were very friendly and helpful.

Bonn is a very beautiful and historical city as well. It was unfortunate that I did not have time to stay longer after my projects. As a classical music lover, I am honoured to work in the city where the maestro Ludwig van Beethoven was born. I wish I will have another chance to visit Bonn and Effelsberg in the near future.



Who is Who in Effelsberg ?

Alexander Hochgürtel

Alexander Hochgürtel joined the staff of Effelsberg observatory in June 2012.

After some specialist trainings in the field of medical-/electro- and information technology, he decides to study an entirely different field, namely human biology, for about one year.

There he quickly became aware of the fact that human biology is very interesting but not compatible with his expectations. He came back on the path of technology and applied at the MPIfR's computer division in Bonn for an apprenticeship as a computer specialist. From September 2011 till the end of May 2012 he worked at the Rechenzentrum.

After a four-week speed course "How to become an operator", he started to take regular shifts as telescope operator in July 2012. But even after this intensive course and about seven months of work, he says that there is so much more to learn. Some things at the telescope are changing daily, and almost every little change is affecting the operator's work.

Alexander has to keep his private hobbies clear. Alongside the job as operator he studies information technology at the Fernuniversität Hagen (a distance learning university) and he even wants to participate at the examination of the IT-specialist training at the IHK in Bonn, to complete his education which he started in 2011. If there is enough time he likes to walk few hours with his dog around a small village near Bad Münstereifel, where he lives.

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