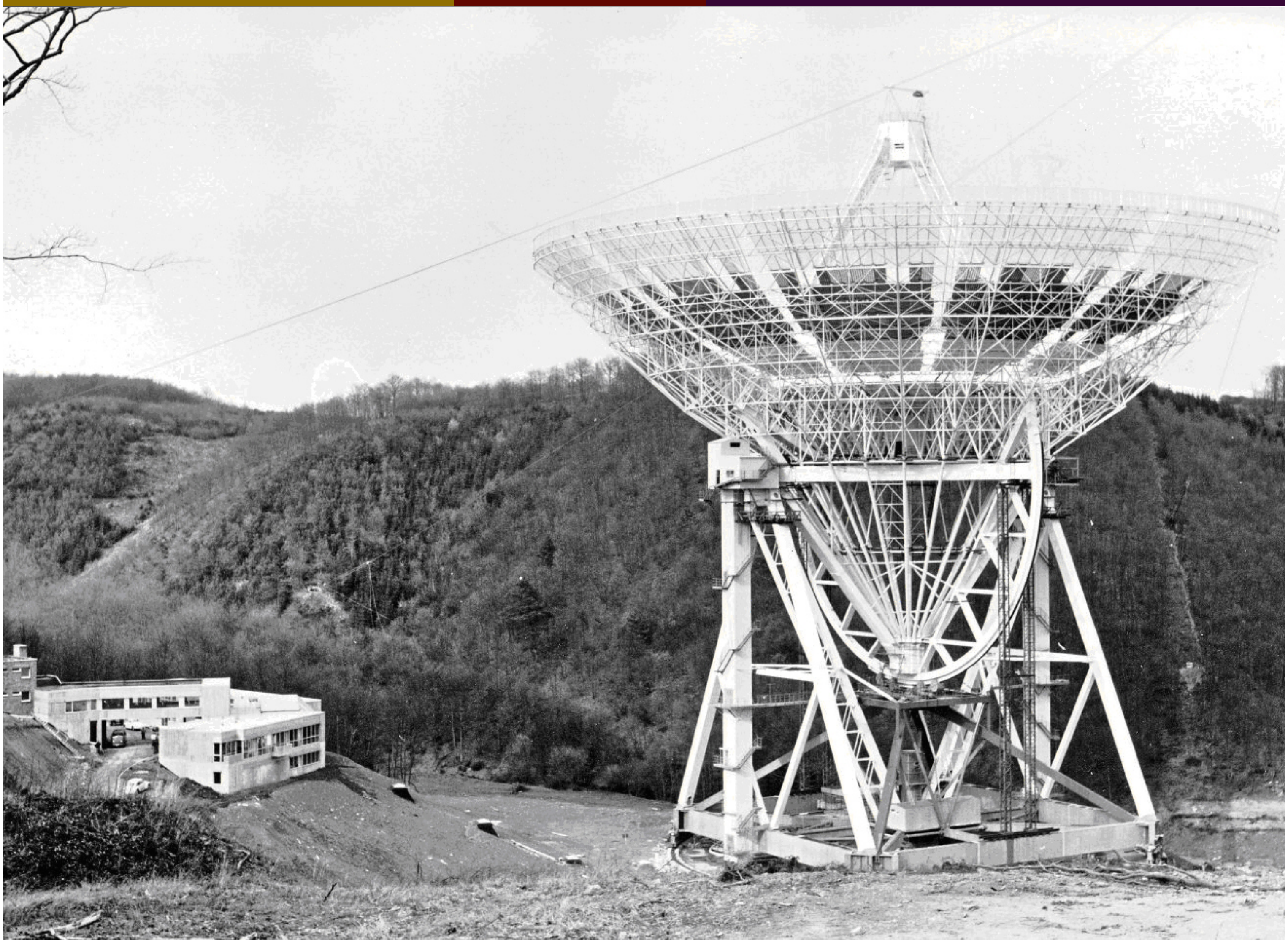
Effelsberg

NEWSLETTER May 2011



Max-Planck-Institut für Radioastronomie

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/english/radiotelescope/index.html

Observing modes >> Possible observing modes include spectral line, continuum, pulsar, and VLBI. Available backends are a FFT spectrometer (with 16384 channels), a digital continuum backend, a pulsar system (coherent and incoherent dedispersion), and two VLBI terminals (MK4 and VLBA type).

Receiving systems cover the frequency range from 0.6 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. North Star is reachable at https://proposal.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/prop.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).

by Alex Kraus

RadioNet Transnational Access Programme

RadioNet (see http://www.radionet-eu.org) includes a coherent set of Transnational Access programme 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

Technical News: The DBBC, a new VLBI backend for Effelsberg

By Uwe Bach

In January 2011 a new VLBI backend, the DBBC (Digital Base Band Converter, the black box in the middle of the photo), was installed in the Faraday room at Effelsberg. The DBBC is an EVN (European VLBI Network) development to replace the existing VLBI terminal with a complete and compact system to be used with any VSI compliant recorder or data transport. It is fully compatible with the existing terminals and correlators.

At Effelsberg the DBBC will replace the old MKIV terminal that is in operation since many years for EVN and Global 3mm VLBI observations. The main features of the new backend are

- 4x4 RF/IF Inputs for 1-512MHz and 512-1024 MHz with automatic gain control
- Four polarizations or bands available for a single group of 64 output data channels (2 VSI output connectors with at present 2 Gb/s each)
- 1024 MHz sampling clock frequency
- Variable channel bandwidth ranging between 500 KHz and 16 MHz, upper and lower side band, in the base-band-converter mode
- Tuning step less than 1 Hz
- Wider channel bandwidth based on a poly-phase-filter-bank mode with direct sampling of the IF on 16x32 MHz channels
- Multiple architecture using fully re-configurable FPGA CoreBoards

The new system is completed with a Mark5B+ disk recorder (top of the photo) and a new Field System PC (bottom). To allow a smooth switch over, the new equipment can be used in parallel to the old MKIV and VLBA terminals. In the previous month the DBBC was successfully tested in various VLBI observations, including disk recording and e-VLBI at 1024 Mbps. During e-VLBI the data is send directly via optical fibres to the EVN correlator at JIVE, NL. The Feb/Mar EVN Session 2011 was recorded on both the MKIV and the DBBC and the performance of the DBBC was equal to that of the old equipment. Therefore, it is planned to use the DBBC as the standard VLBI terminal in the May/June EVN Session 2011. As soon as more stations within the EVN will have DBBCs installed an increase of the current maximum data rate of 1024 Mbps to 2 Gbps or even 4 Gbps will be possible.

To replace the VLBA terminal and to stay fully compatible with the VLBA in the US an RDBE produced by NRAO arrived in Bonn. After some initial testing it will be installed at Effelsberg together with another Mark 5C recorder. Observations with the RDBE are planned for this summer.

The Construction of the Effelsberg 100-m Radio Telescope

>> Part II

by Richard Wielebinski & Bernd Grahl

Continued from previous issue >>

The mounting of the reflecting panels was partly done on the ground before lifting. The ‘orange slice’ sections were inserted alternatively on opposite sides of the central dish structure (see figure 5). For this purpose the azimuth drive had to be installed in the earliest construction stage. The final section of the reflector was hoisted in 1970, having less than 0.5-cm gap in the final assembly. This was a remarkable achievement in steel construction accuracy. Final surface adjustment could only be made after all the panels were in place.

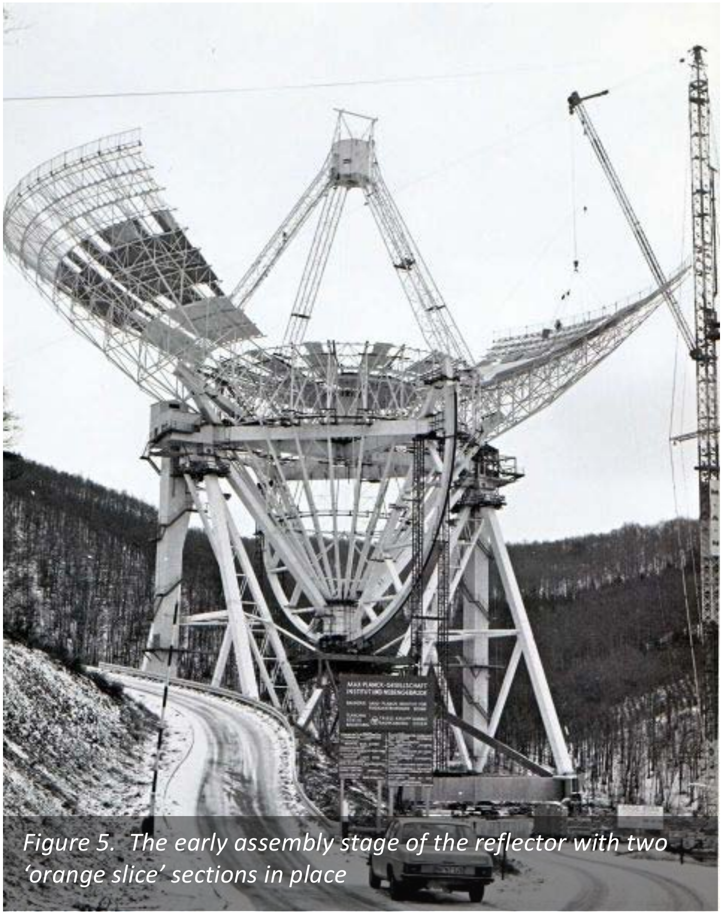


Figure 5. The early assembly stage of the reflector with two ‘orange slice’ sections in place

Several additional major components of the telescope require special mention. The telescope was an azimuth-elevation construction. The rotation of the dish was on a steel track of a special construction. The 64-m diameter ring track embedded in the ring foundation (rail cross-

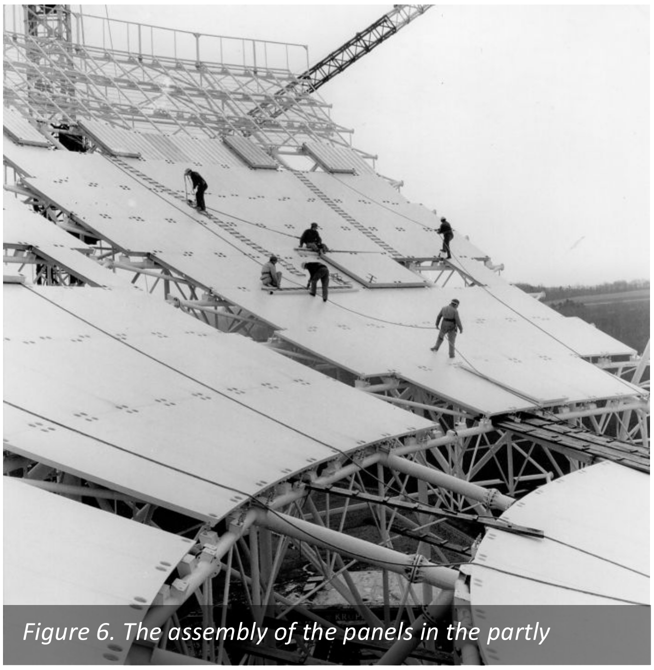


Figure 6. The assembly of the panels in the partly

section 29-cm x 14-cm) was delivered in sections that were welded on site by the thermite process. The adjustment of the track required high accuracy, some 0.1-mm level was finally reached. The axes of the telescope were leveled to an accuracy of 0.2-mm. The reflecting panels were another crucial component of the construction. The inner ring up to 60-m diameter had honeycomb panels (aluminium) delivered by the Dornier Company.

The next section of the reflector from 60-m to 80-m diameter had aluminium frame panels that were delivered by the MAN Company. The final rings of panels out to 100-m diameter were mesh reflecting surface on steel frames made by Aviolanda in the Netherlands. The surface accuracy of the honeycomb panels was better than 0.2-mm. The aluminium frame panels came with ~0.3-mm accuracy. In addition a 1.0-m high ‘collar’ was added on the periphery of the 100-m reflector, a series of reflecting mesh sections that were to reduce the sidelobes and hence man-made interference.

The geometry of the 100-m dish was a Gregorian system with the possibility to insert a receiver into the prime focus. The Gregorian sub-reflector was 6.5-m in diameter. Considerable effort was needed in the design of both the prime focus and secondary focus cabins. This was an in-house effort.

The telescope electric drive system was a concept of the AEG-Telefunken company. In azimuth half of the 16 motors were driving while the other half were braking to ensure a smooth movement. In elevation the two motor-gear systems were also controlled in a similar manner. The telescope drive was planned to be computer controlled from the very beginning. Preliminary experience of controlling an elevation-azimuth instrument by computer (not by a master equatorial) was made at the Stockert telescope. The design for positioning of the telescope with the high accuracy of better than ~ 10 arcsec needed special effort. The incremental encoders for the telescope axes came from the Heidenhain Company, capable of 2 arc sec readout. Incremental encoders from this company proved accurate and safe in operation. For control of the drive system a Ferranti ARGUS 500 computer was chosen. The astronomical drive system was an in-house effort of the MPIfR computer division. A clear interface was planned between the astronomical system and the electric drive system of the AEG. The astronomical drive program incorporated many novel features, allowing great flexibility in the drive modes. The electronic receivers were state of art, again an in-house effort of the MPIfR electronic division. First light was received at 11-cm wavelength on 23.04.1971. The telescope was driven, while observing a 408 MHz radio continuum survey for the official opening on 12th May 1971.

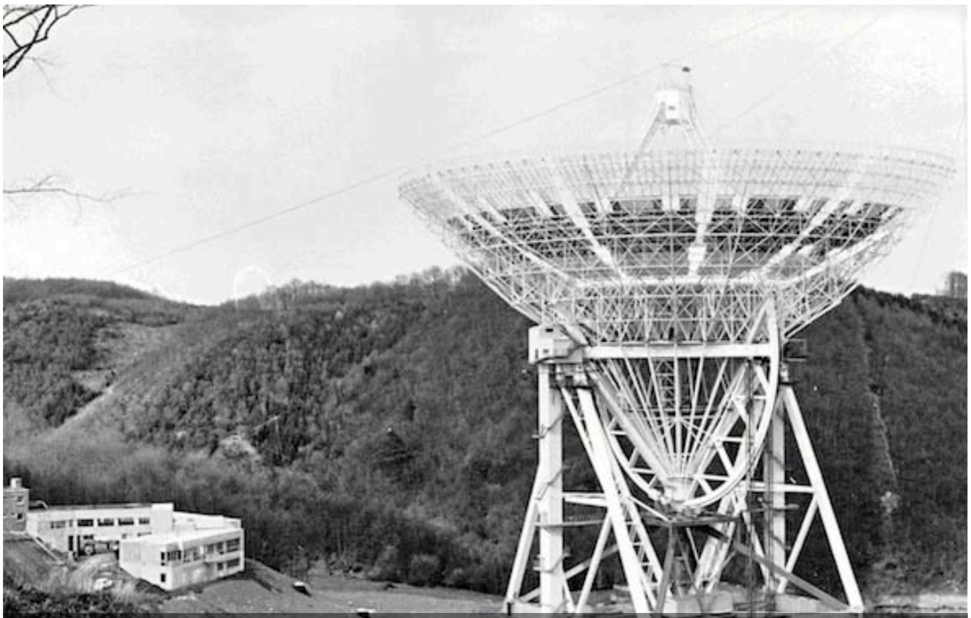


Figure 7. The view of the near-final assembled telescope – early 1971. The control building is seen on the left.

Many measurements had to be made of crucial parameters to optimize the telescope performance. In the early stage of the telescope operations drive oscillations were experienced in the elevation motors. This had to be changed by removing every second drive and reinforcing the brakes. This problem was solved by the consultations of Ing. Bernard G. Hooghoudt. The surface was measured by tape and theodolite showing that the design specification of 1-mm r.m.s. was met. The predicted focus changes of some 90-mm in the elevation direction and 20-mm in the vertical direction during a full elevation tipping agreed with the computed predictions and were incorporated as correction in the drive program. Furthermore the change of the reflector from one parabolic shape to another with elevation change was confirmed. The pointing of the telescope was found to be some 5” absolute with deviations of ± 1” in the tracking mode. In fact the overall telescope performance exceeded all the original specifications. Astronomical observations could be made at 11cm and later at 2.8-cm wavelength in 1972. The first astronomical papers that used the 100-m radio telescope for observations were published in December 1972. The 408 MHz observations that were made in the construction phase of the telescope led ultimately to a very important all sky radio continuum survey, in a way the logo of the MPIfR.

The 100-m radio telescope has served two generations of radio astronomers and produced thousands of research papers. Careful maintenance by the operating staff of the telescope ensured regular operations. Continuous improvements have been added in the time of 40 years. In particular the surface accuracy was improved and the secondary sub-reflector was changed to a unit with active surface adjustment. A whole array of receivers was developed both for the prime and the secondary focus to cover all the radio frequency bands in the cm wavelength range. The 100-m Effelsberg telescope has been used to observe even at 86 GHz, 3-mm wavelength. The 100-m radio telescope Effelsberg is a tribute to the ingenuity of a few dedicated people who made this accurate machine possible.

1971-2011

40 Years of the 100-m Effelsberg Radio Telescope

Who is Who in Effelsberg ?

Willi Schmitz >> Telescope Operator

Willi Schmitz joined the MPIFR in 2007. After school he became a technician in electronics, but soon moved in the media industry. He has a Diploma in audio engineering and is also a skilled worker in media design. Willi worked for several years as a product specialist and audio engineer by different companies in the TV, multimedia and IT environment.

At the radio telescope he is member of the team of telescope operators. He is competent for questions about the computer systems in the control room and also for general problems with Windows or Mac OS X.

Willi and his family are living on a small farm not too far away from the observatory. In his spare time Willi is making and producing a lot of music and working on multimedia projects. He´s playing several instruments and owns a little project studio at home. Willi made music in a rock band for more than 15 years. So if there is any need for a birthday CD or a new soundtrack for your home video feel free to ask him!.

Public Outreach

April 09, 2011 >> Astronomy Day at the Visitor's Pavilion of the Effelsberg Radio Telescope

The visitor's pavilion with the Effelsberg 100-m Radio Telescope in the background. At the right side the final destination of the planetary walk with a concrete model of the sun and its description on an information panel is shown.

On Saturday, April 09, the annual "Astronomy Day" took place with a large number of events all over Germany. The Max-Planck-Institut für Radioastronomie participated as in previous years with a program of talks presented in the visitor's pavilion at Effelsberg Radio Observatory. The topics included "40 years of Effelsberg Radio Observatory", "Observations of Artificial Radio Signals" (man-made interference) with the 100-m radio telescope, and the recently completed ensemble of "Astronomical Walks at the Radio Observatory". A total of 180 visitors were attending the talks, there was also plenty of time for discussion and questions between the talks.

Karl Grypstra, Dipl.-Ing, head of the receiver group at Effelsberg Radio Observatory, presenting his talk on artificial radio signals in the pavilion. At the left side of the image an early construction model of the 100m telescope is shown, outlined for a somewhat smaller dish of 80 m diameter.

March 26, 2011 >> Inauguration of the Galaxy Walk, the third astronomical walk at Effelsberg Radio Observatory

Right: Information panel of the Galaxy Walk, presenting the complete walk in an aerial view, and also information to all 14 targets of the walk, ranging from the Milky Way as starting point to the radio galaxy J1148+5251 at redshift 6.4. This panel is installed at two places, the start of the Galaxy Walk directly behind the 100-m-Telescope, and its terminal point after 2.6 km at the Martinshütte, the "hut at the end of the Universe".

Image Credits: Andreas Schmickler

On Saturday, March 26, the third astronomical walk at Effelsberg Radio Observatory, labelled "Galaxy Walk" was inaugurated. This walk with a distance scale of 1 to 5 x 1022 (corresponding to 5 billion light years per kilometre) complements the two already existing walks, the Planetary Walk and the Milky Way Walk, to the largest distance scales in the Universe. It starts with two members of the local group, the Milky Way and the Andromeda Galaxy M31 (only 50 cm apart at the scale of the Galaxy Walk) and is continued with well-known objects like the starburst galaxy M82, the central galaxy of the Virgo Cluster, M87, and the central galaxy of the Perseus cluster, NGC 1275 or Perseus A. Next comes Cygnus A in a distance of 750 million light years (or 150 m in the scale of the Galaxy Walk).

The following stations with 3C 273, 3C 48, 3C 295 and 3C 286 assemble a number of well-known calibration sources for the 100-m radio telescope, ranging to a distance of 7 billion light years (or 1420 m) in case of 3C 286. Objects like B0218+367 (universal proton-electron mass ratio), 0917+62 (intra-day variability) and MG J0414+0534 (water maser emission) characterize different research areas based upon observations with the Effelsberg Radio Telescope. The final station of the Galaxy walk presents J1148+5254, a quasar at redshift 6.4, corresponding to a light travel distance of almost 13 billion light years. Observers at the Effelsberg station might recognize a number of targets of the Galaxy Walk from their own research work.

Description (in German): http://www.mpifr-bonn.mpg.de/public/galweg.html

Left: Starting point of the Galaxy Walk with the first two panels, depicting the Milky Way and its neighbour, the Andromeda Galaxy M31. Their distance of 2.5 million light years shrinks to only 50 cm in the scale of the Galaxy Walk. Some participants are about to start the walk.

Right: Information panel of the Galaxy Walk, with Martinshütte in the background. The hut was the final destination of the inaugural walk. About 150 guests were present at the day of the inauguration.

Celebrating the 40th Year Anniversary

Images taken on 19th May, 2011, in Effelsberg during the celebration for the 40th anniversary of the 100-m Effelsberg Radio Telescope. Besides a number of special guests, the festivities were a wonderful occasion for friends and former colleagues to meet.

Addresses and speeches were given by the Executive Director of MPIfR, Prof. Karl Menten (top left), the Vice-President of the MPG, Prof. Martin Stratmann (bottom left), Prof. Richard Wielebinski (top middle) and Ministerialdirigentin Annette Storsberg (top right). Between the speeches, the audience (bottom) was entertained by the Duo Conflux.

1971-2011

40 Years of the 100-m Effelsberg Radio Telescope

Celebrating the 40th Year Anniversary

One of the celebration highlights was the lecture by Prof. Harald Lesch. Harald did his PhD at the MPIfR in theoretical astrophysics and is now professor for physics and philosophy at the Ludwig Maximilians University of Munich. His main areas of research are cosmic plasma physics, black holes, and neutron stars, but he is also known to the general public in Germany as an author and television presenter. As such he is presenting Germany's best known science magazine "Abenteuer Forschung". Harald's well known art to capture the audience's attention and to explain difficult concepts in

an easy way also worked for the guests in Effelsberg! His lecture on what radio astronomers really do was outstanding!

The images show impressions from the reception following the formal part of the celebration. The atmosphere was friendly and warm, bringing together members of the institute, former colleagues and national and international guests. These images show Karl Menten (MPIfR), Arno Witzel (formerly MPIfR), Pierre Cox (IRAM), Bernd Grahl (formerly MPIfR), Michael Grewing (formerly IRAM), Mayor Alexander Büttner (Bad Muenstereifel), Harald Lesch (LMU) and Axel Jessner (MPIfR).

The telescope was not the only one that celebrated its birthday. Also Station Head, Dr. Alex Kraus, happened to celebrate his birthday on the very same day! Happy birthday, Alex - happy birthday, 100-m telescope!!!

Effelsberg Newsletter

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