Effelsberg Newsletter

May 2015

Credit: Norbert Junkes

Call for Proposals

Deadline: June 3, 2015, 15:00 UT


Credit: Norbert Tacken

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) (e.g. to NRAO for the VLBA).

After June, the next deadline will be on October 1, 2015, 15:00 UT.

by Alex Kraus

RadioNet Transnational Access Programme

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

TECHNICAL NEWS

A new broad-band receiver for the 100-m telescope

By Alex Kraus

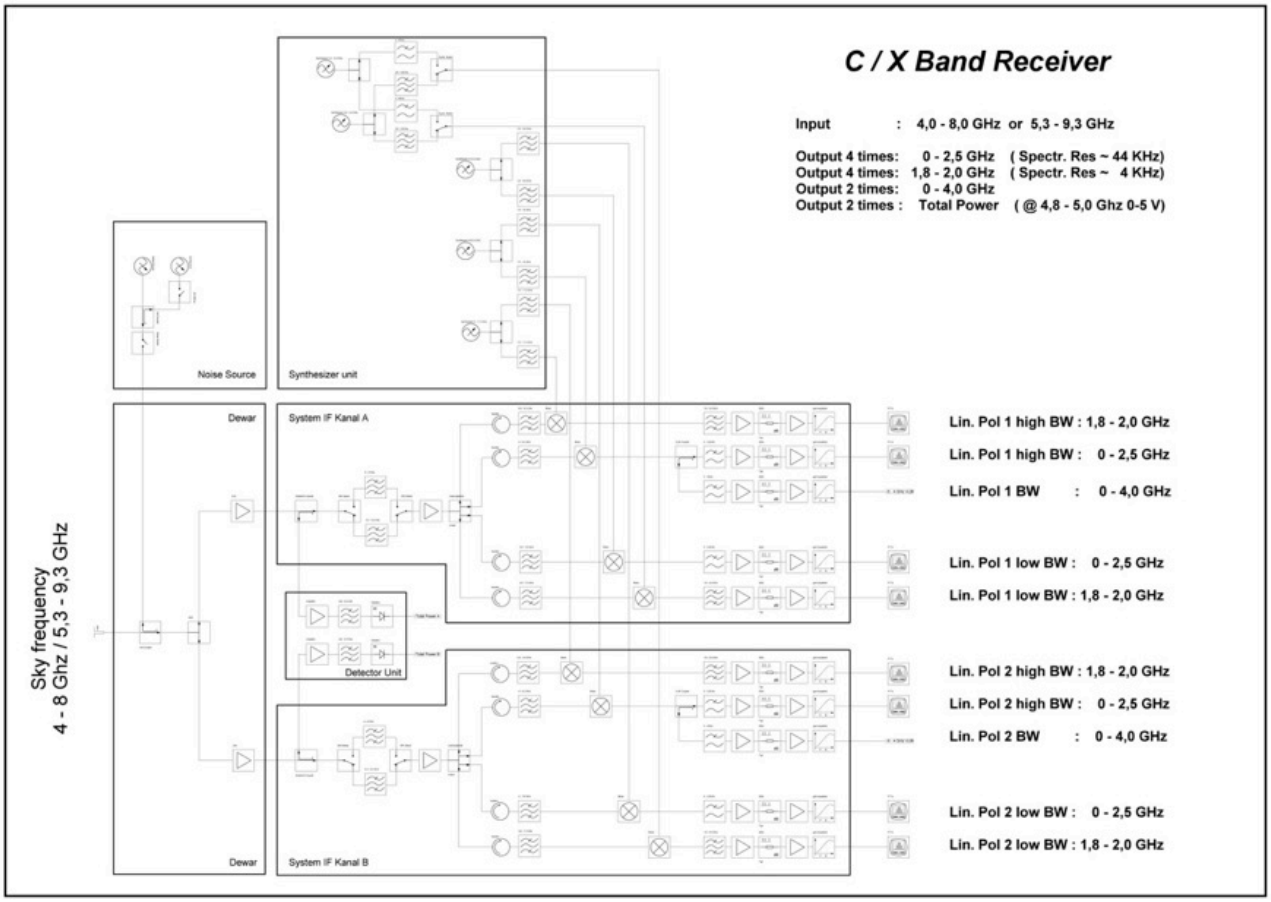
On April 15, a new broad-band receiver (called „C+“), covering the frequency range from 4-9.3 GHz was brought into operation at the 100-m telescope. The single horn receiver is mounted in the secondary focus of the telescope and has two orthogonal linear polarizations.

It will allow to observe either the band of 4-8 GHz or 5.3-9.3 GHz instantaneously. Measurements in the lab showed a receiver temperature of about 10 K over the full band. First tests in the telescope confirmed this: the system temperature was about 25

K. Detailed tests are still ongoing - we will report on these in the next issues of this newsletter.

The main science driver for the new receiver is a Galactic plane survey (PI: Karl Menten). Covering the 4-8 GHz range, the survey will observe the continuum emission in total power and linear polarization with high sensitivity. For this purpose, also a special multi-channel continuum backend is currently under development. At the same time, molecular transitions like Formaldehyde and Methanol as well as Radio Recombination Lines will be studied.

Finally, the data will be combined with similar data from the Jansky Very Large Array, providing the important „zero-spacings“ for the analogous survey performed there.



Science Highlights

A Line Survey of the Prototypcal Carbon Star IRC+10216

By Christian Henkel

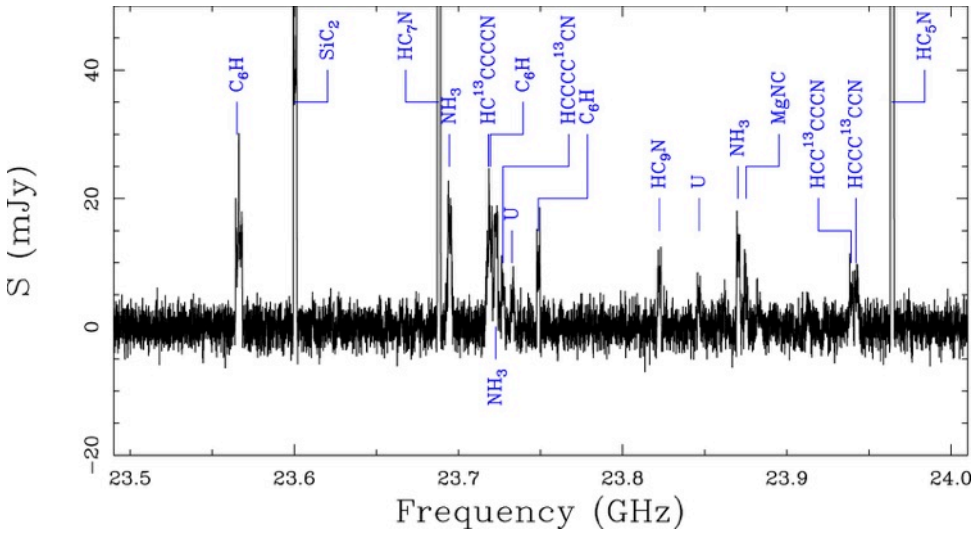


Fig. 1: A 0.5 GHz wide section of the 1.3 cm line survey covering a total of 8GHz toward IRC+10216, with strong lines marked (U = unidentified spectral feature).

Molecular line surveys are a powerful tool to analyze the physical as well as the chemical parameters of astronomical objects. In fact, they are the only means to obtain a complete unbiased view of the molecular inventory of a given source. However, despite the long history of powerful large radio telescopes, only very few such surveys have been conducted in the centimeter wave regime.

With the intrinsic bandwidth of 2 GHz provided by the X-FFT spectrometer at Effelsberg and allowing for some frequency overlap, the 8 GHz bandwidth of the primary focus 1.3 cm PFK receiver could be covered with only five frequency setups. The frequency resolution of ~ 1 km s^{-1}, provided by the backend, is sufficient for a large number of sources, including sites of massive star formation and late type stars with high mass loss and dense circumstellar shells.

IRC+10216, also known as CW Leonis, is found to be the brightest object outside the solar system at 5µm. It is by far the brightest asymptotic giant branch (AGB) carbon star, showing a high mass loss rate (2.0×10^{-5} $M_{\odot}yr^{-1}$) at a distance of only ~ 130 pc. This leads to a dense circumstellar envelope (CSE). The CSE is the ideal target to study gas-phase chemistry in a peculiar, namely carbon-rich (C/O > 1) environment.

Over a bandwidth of only 8 GHz, 78 spectral lines (including 8 tentative spectral features) have been detected (see Fig. 1 for a 0.5 GHz wide section), among which 12 (15%) still remain unidentified and will motivate future studies. The identified lines are assigned to 18 different molecules and radicals. 19 transitions were detected for the first time outside the solar system.

Figs. 1 and 2 show the enormous potential of such surveys at Effelsberg, where many molecules can be detected in more than one transition even within a single 8 GHz band, allowing for a detailed analysis of excitation and abundance. The spectrum is dominated by the strong profiles from six species: SiS, HC_3N, HC_5N, HC_7N, cyclic C_3H_2, and SiC_2. Several

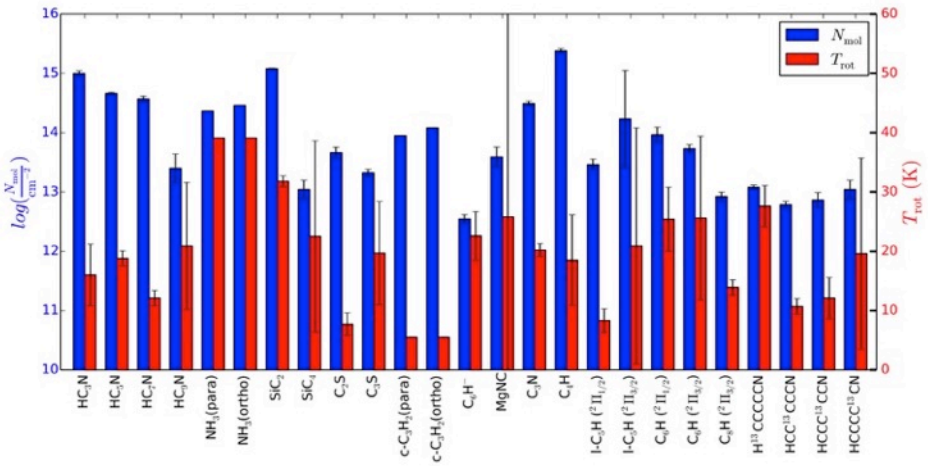


Fig. 2: Comparison of the column densities and rotational temperatures of different molecules. The labels for column density are blue colored on the left, while those for rotational temperatures are red colored on the right hand side.

lines of ammonia serve to analyze the temperature stratification in the circumstellar envelope with the line with highest excitation either arising from a region with a kinetic temperature larger than 300 K or representing maser emission. Chemical fractionation of 13 C bearing species has also been studied, in this case using HC_3N and HC_5N, yielding $^{12}C/^{13}C$ ~ 50, much less than in the solar system or in the nearby interstellar medium, emphasizing effects of stellar burning in the interior of IRC+10216.

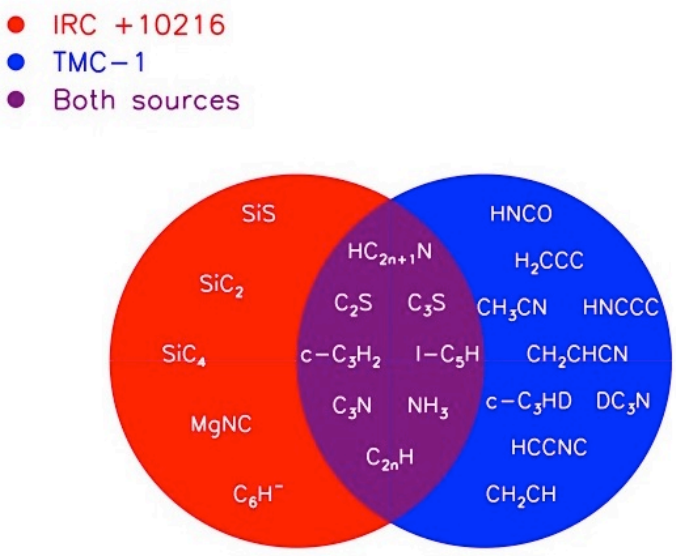


Fig. 3: Schematic diagram of detected molecules in the same 1.3 cm spectral range toward IRC +10216 and the dark cloud TMC-1. Molecules in the red, blue and purple regions indicate that they are detected in IRC +10216, TMC-1 and both sources, respectively.

Fig. 3 shows a comparison with the most prominent nearby dark cloud, TMC-1, a site of low mass star formation, being famous for hosting like IRC+10216 a large number of long chain carbon molecules (HC_5N or HC_7N are among the most prominent ones). Our IRC+10216 project can be viewed as the starting point into systematic spectroscopic studies of exemplary prominent celestial targets with the Effelsberg 100-m telescope. Before the end of this year, the new K-band (18–26 GHz) secondary focus receiver will get equipped with backends simultaneously covering its entire 8 GHz bandpass. The consequence will be that observations will become five times more effective than so far in the case of IRC+10216. Furthermore, the spectral resolution will become so good that not only late type stars and high mass star formation sites but also low mass star formation regions with their comparatively narrow lines will become accessible. This will likely set up a new "spectroscopic industry" at the 100-m that will possibly also lead to the detection of new interstellar molecular species.

For a publication of the IRC+10216 data, see Y. Gong et al. 2015, A&A 574, A56

Who is Who in Effelsberg?

Reinhard Keller

Leader of The Systems Group

Born in Ulm at the Danube river in the very south of Germany I made my first business travels as a baby together with my family following the different employments of my father as car mechanic. Obviously, my love to cars and engineering began in those days. After my relatively steady schooldays, I joined the military service as a sailor on the Baltic Sea. After that very interesting time, I started to study Electrical Engineering at the Friedrich Alexander University in Erlangen with foci on Microwaves and Power Grids.

After finishing the university with my Diploma of Engineering (now called MS) I started to work at ANT Telecommunications, where I already did my Diploma Thesis in 1985, to do real stuff and make real money. At this time I decided to study in particular microwaves, which I also concentrated on for my PhD at the University of Bremen, while I was still working for the company. At the end of the 1990 when globalization made an end to Telecom Industry in Germany, I looked for a new challenge which I found in radio astronomy instrumentation.

In 1999 I started at the institute leading the receiver group of the Electronic Department in Bonn. Together with the colleagues of the group we realized many challenging receiver projects for the Effelsberg 100m Radio Telescope, many of them are still in daily operation today. In 2006 I also headed the Electronics Department, until in 2009 Christoph Kasemann took over the head of the receiver group. Besides concentrating on administrative and management issues of the department, I also had the opportunity to make big plans to renew the 100-m telescope's IF and control infrastructure. Two years ago I stepped back from management to concentrate on technical issues again by taking the lead of the Systems Group in Effelsberg. Here I'm now working on the realization of the plans made before.

During my studies and later professional career, I had the chance to work on a wide field of radio frequency topics such as field theory, monolithic integrated circuits and cryo-cooled radiometers for radio astronomy. Teamwork was always a fundamental issue in my work and assured the success we had. As a technical project leader in industry as well as group leader and head of the electronics department of the Max-Planck-Institute for Radio Astronomy I had the chance to collect a rich experience in management tasks and internal and external representation of the respective group. This again forced me traveling around the world and most of all in Europe which I enjoyed. I still very much enjoy chairing a special forum for engineering issues in the EU funded RadioNet consortium, where people from all European observatories come together to talk and to exchange experience about technical issues that we all are struggling with.

Public Outreach

Live Observations with the 100m Radio Telescope - Astronomy Day 2015

By Norbert Junkes

Fig. 1: Effelsberg Radio Observatory: Visitors' pavilion with 100m radio telescope in the background. The observations with the 100m telescope were shown at the pavilion.

Once a year (public) astronomical institutions in Germany are celebrating an "Astronomy Day" with a number of specific events like Open Days, special observations, public talks etc. In 2015 we participated with a program of special observations which were displayed on screen at the Effelsberg visitors' pavilion.

The program took place in the afternoon of Saturday, March 21, and was outlined for two consecutive groups of 60 participants each in the pavilion. The schedule included an introductory talk about the telescope and its observing capabilities, calibration observations (pointing and flux calibration) followed by a continuum map of Tycho's supernova remnant (3C10) at 2.8 cm wavelength and finally a sequence of pulsar timing observations.

The continuum maps of Tycho are regularly performed as demonstration observations at e.g. Open Days, resulting in a range of maps over a time period of almost 20 years which clearly show the expansion of the supernova shell. The time coverage corresponds to more than 4 % of the time since the supernova exploded in 1572.

The event was organised in collaboration with the friends' association of the institute ("Freunde und Förderer des Max-Planck-Instituts für Radioastronomie e.V.") and will probably be repeated at next year's "Astronomy Day" in Germany.

Links:

http://www.mpifr-bonn.mpg.de/mitteilungen/2015/5

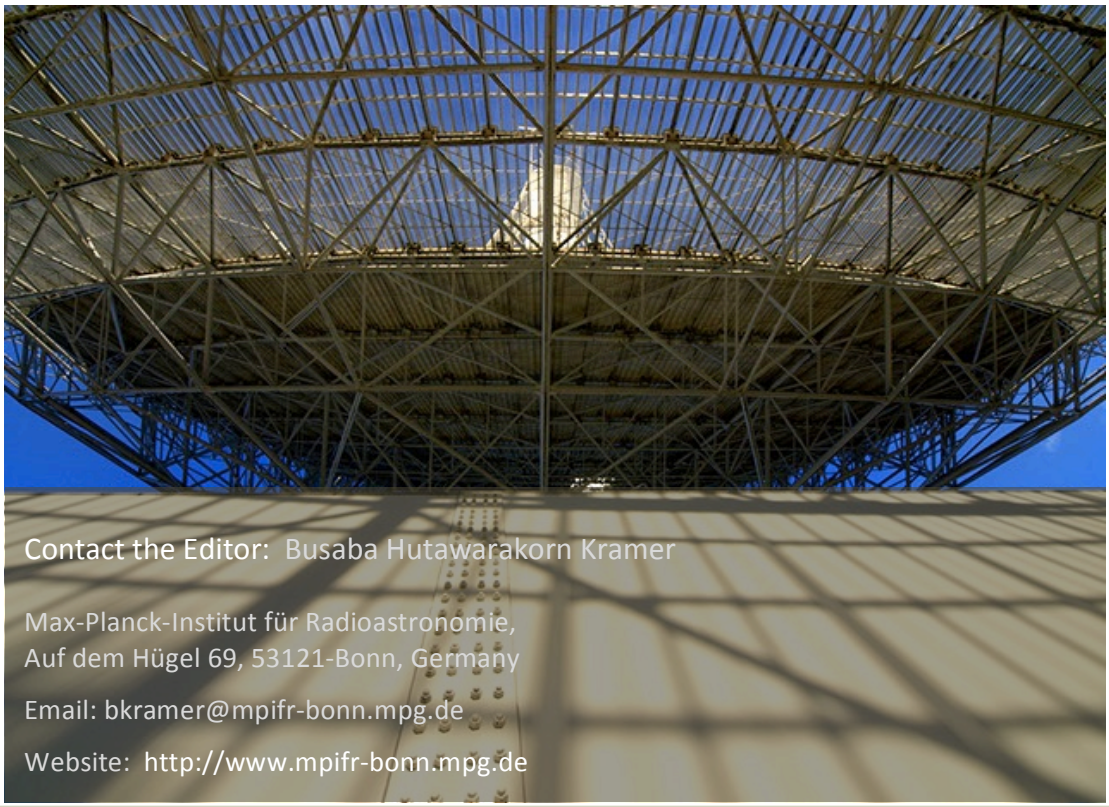
http://www.mpifr-bonn.mpg.de/supporters

Fig. 2: Ernst Fürst explaining data acquisition and processing for a radio continuum map of supernova remnant Tycho at 2.8 cm wavelength.

Fig. 3: David Champion explaining pulsar observing programs with the Effelsberg 100m radio telescope.

Fig. 4: Alex Kraus and Ernst Fürst presenting a map of the complete Effelsberg Galactic Plane Survey at 11 cm wavelength. The remnant of Tycho's supernova from 1572 shows up at 120 degrees Galactic latitude.

All Photos: Norbert Junkes



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