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Call for proposals – Deadline June 3, 2021, UT 15:00

by Alex Kraus

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 (including a spectro-polarimeter), several pulsar systems (coherent and incoherent dedispersion), and two VLBI terminals (dBBC and RDBE type with MK6 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.

Please note, that observing proposals for the new **Phased-Array-Feed** cannot yet be accepted – the system is still under test.

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).

The following deadline will be October 5, 2021, 15:00 UT.

Opticon-RadioNet-Pilot Transnational Access Programme

by Alex Kraus

The new Opticon-RadioNet-Pilot (ORP) project (see http://www.orp-h2020.eu) includes a coherent set of Transnational Access (TA) programs aimed at significantly improving the access of European astronomers to the major 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 personal aid from the Transnational Access (TA) Program of the ORP. 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.

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.orp-h2020.eu/TA-VA .

After completion of their observations, TA supported scientists are required to submit their feedback to the ORP project management and the EU. Publications based on these observations should be acknowledged accordingly:

The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004719 [ORP].

The Effelsberg Radio Telescope turns 50

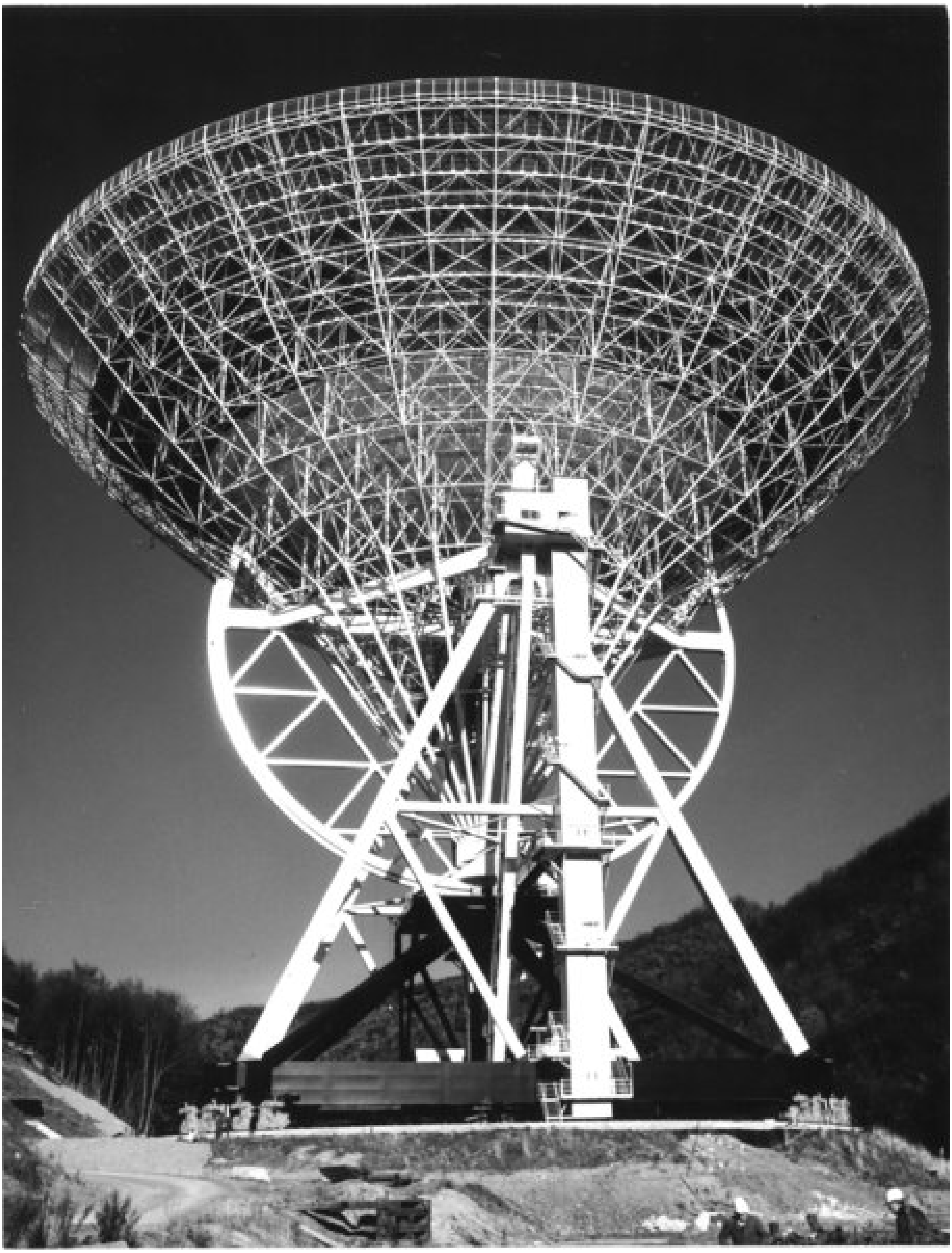
by Norbert Junkes and Alex Kraus

The 100-m radio telescope of the Max Planck Institute for Radio Astronomy in Bonn celebrates its 50th anniversary in 2021. The construction of the telescope in an Eifel valley about 40 km southwest of Bonn started in 1967. On May 12, 1971, the official inauguration was celebrated at the telescope site, close to the two Eifel villages named Effelsberg and Lethert, which are now districts of the town of Bad Münstereifel. A number of guests from research and politics were welcomed on site for the opening.

Starting from August 01, 1972, the Effelsberg telescope became fully operational. During the last five decades, the instrument underwent continuous technical upgrades, so that it is still the second largest and one of the most powerful radio telescopes on Earth today and a central part of the scientific work of the institute.

The picture below shows the 100-m radio telescope shortly before its opening in 1971. In this picture it can be seen very nicely that the lower elements of the supporting structure do not appear in white, but rather dark. In fact, this part of the telescope was initially painted in blue. However, the resulting bad temperature behavior very quickly led to re-painting this part of the telescope in white as well.

The other two pictures were taken during and after the inauguration ceremony on May 12, 1971.



The 100-m radio telescope Effelsberg shortly before its opening in May 1971. The first scientific observation ("First Light") already took place on April 23, 1971.

Guests of honor at the inauguration ceremony of the Effelsberg 100-m radio telescope on May 12, 1971. Front row, far left: Reimar Lüst, chairman of the Science Council. Second from left: Otto Hachenberg, Founding Director of the MPIfR. Fourth from left: Johannes Rau, NRW Minister of Science. Fifth from left: Hans Leussink, Federal Minister of Research. Eighth from left: Richard Wielebinski, member of the MPIfR Board of Directors. In the seat between Mr. Rau and Mr. Leussink: MPG President Adolf Butenandt, who gave a ceremonial address while this photo was taken. The third director at the MPIfR, Professor Peter G. Mezger, is not visible in this photo.

Today, the MPIfR is still conducted by three directors who pursue different aspects of radio astronomy in their respective research departments.

Professor Michael Kramer is head of the department "Fundamental Physics in Radio Astronomy", which investigates questions of fundamental physics, from cosmic magnetic fields to gravitation. Observations with the Effelsberg radio telescope are carried out, for example, in large collaborations such as the "European Pulsar Timing Array" (EPTA) or the "High Time Resolution Universe" (HTRU), in which the department is significantly involved.

Professor J. Anton Zensus is head of the research department "Radio Astronomy/VLBI", which usually performs observations with the 100 m radio telescope not in a single dish mode, but connected to an interferometer in various continental and global networks of radio telescopes, thus enabling observations at the highest angular resolution. These include, for example, the "European VLBI Network" (eVLBI), the "Global Millimeter-VLBI Array" (GMVA), and the new "M2FINDERS" project, for which Anton Zensus was recently awarded one of the prestigious "Advanced Research Grants" of the European Research Council (ERC).

Professor Karl M. Menten is head of the research department "Millimeter and Submillimeter Astronomy" at the MPIfR. Collaborations within the research work in this department using the 100-m telescope include "The Bar and Spiral Structure Legacy (BeSSeL) Survey" and the "Megamaser Cosmology Project."

However, a larger part of the research work in the "Millimeter and Submillimeter Astronomy" department takes place at higher radio frequencies in the millimeter and submillimeter wavelength ranges, using radio telescopes such as APEX in Chile and the flying observatory SOFIA. In these wavelength ranges, the 100-m telescope with its cutoff frequency of 96 GHz (3.1 mm wavelength) is no longer used.

Currently, the observing program with the 100-m radio telescope Effelsberg is dominated, as usual in this time of the year, by observations within international networks (Very Long Baseline Interferometry, VLBI), in which the 100-m radio telescope is connected with other radio telescopes on Earth in order to form virtual radio telescopes across continents and oceans to achieve the highest angular resolution. The Effelsberg radio telescope is in demand for this kind of observations because of its large collecting area (even after five decades of operation it is still the second largest fully steerable radio telescope in the world).

In a recent release of the MPIfR, the contribution of the Effelsberg radio telescope to the investigation of the central region of the galaxy M87 (M87*) was acknowledged. In the center of this galaxy, a “photo” of the shadow of a black hole could be taken for the first time (“*Multi-frequency observations of M87**”, issued April 14, 2021).

Another focus of the observing program for the 100-m radio telescope is on pulsars and fast radio bursts (FRBs). These observations require very high time resolution in the range of microseconds. The importance of the 100-m telescope for this type of observations was described in another press release last month ("*In pursuit of a famous radio burst*", issued April 19, 2021).

"Even after 50 years, our radio telescope is a top-class astronomical instrument. Over the past decades, apart from the basic structure, almost all components have been constantly renewed and improved. The demand for observing time remains high, and observation requests come from scientists all over the world," says Dr. Alex Kraus, station manager of the Effelsberg Radio Observatory.

"Effelsberg has repeatedly shown its versatility in the past. The ability to keep using new, specially developed cutting-edge technology for the receiver systems will keep the Effelsberg radio telescope at the top of the world for the foreseeable future," concludes Professor Michael Kramer, director at the MPIfR and responsible for the radio observatory with the 100-m telescope.

Control room of the Effelsberg radio telescope: Otto Hachenberg, the Founding Director of the MPIfR (left side), talking to Hans Leussink, the Federal Science Minister in 1971.

As a retrospective of 50 years of successful research work with the 100-m radio telescope Effelsberg, a new hiking trail, the "Time Travel Trail", will be opened in the neighbourhood of the Effelsberg telescope these days – see the contribution at the end of this newsletter.

In honour of the telescope, the German ministry of finance (which is responsible for the release of new stamps) issued a dedicated stamp on April 1st.

The special issue stamp "50 Years of the Effelsberg 100-m Radio Telescope" was issued on April 1, 2021.

That is already the second German stamp with the telescope on it; the first one was issued in 1976 in a special series “Industry and Technics”.

Design: Beat Knoblauch

Additionally, two stamps which present radio continuum maps observed with the 100-meter telescope were released in 1999. The first one shows a part of the Cygnus region taken from the 11cm Galactic plane survey, the second one a map of the Andromeda galaxy at a wavelength of 6cm.

Design: Benjamin Blase

Effelsberg provides the last brick for the GLObal View on STAR Formation (GLOSTAR) survey

by the GLOSTAR Team

Stars with more than about ten solar masses dominate galactic ecosystems. Understanding the circumstances of their formation is one of the great challenges of modern astronomy. In the last years, our view of massive star formation regions (SFRs) has been dramatically changed by Galactic plane surveys covering centimeter to infrared wavelengths (e.g., CORNISH, MAGPIS, BGPS, ATLASGAL, Hi-GAL, MIPSGAL, and GLIMPSE). These surveys enable us for the first time to study ALL evolutionary stages of massive star formation (MSF) in an unbiased way.

With the exciting results of the submm/FIR surveys from the ground (ATLASGAL) and space (Hi-GAL) the massive and cold dust clumps from which massive clusters form are now detected galaxy wide. Complementary to these surveys, the cm studies using the VLA allow very powerful and comprehensive radio wavelength surveys of, both, the ionized and the molecular tracers of star formation in the Galactic plane. Our team has completed the new VLA C band galactic plane survey, which is the most sensitive VLA galactic plane surveys at this band so far. However, the important large-scale emission is missing in the VLA observations because this interferometer cannot detect extended structures. Hence, Effelsberg observations are indispensable to complement the VLA observations at large spatial scales.

Thanks to the advent of the extremely wideband (4--8 GHz) new C/X-band (or S45mm) receiver at Effelsberg, we are able to complement significantly our VLA survey of the Galactic plane in the Milky Way. The full survey aims to cover the Galactic Plane in the range from -2° < l < 60° and |b| < 1°, as well as the Cygnus X star forming complex at a range from 76° < l < 83° and -1° < b < 2°, or 145 square degrees in total.

The S45mm receiver is a 4.5 cm broad-band receiver with two orthogonal linear polarizations. With the help of Effelsberg staff, we are able to use two different kinds of backends, i.e., SPEctro-POLarimeter (SPECPOL) and fast Fourier trans- form spectrometers, simultaneously. SPECPOL is used to obtain the full Stokes parameters (I, Q, U, V). SPECPOL delivers two bands covering 4–6 GHz and 6–8 GHz, respectively. Each band provides 1024 channels, resulting in a channel width of 1.95 MHz. FFTSs deliver two low-spectral resolution bands and two high-spectral resolution bands that are used for spectral studies. The two low-spectral resolution bands cover 4–6.5 GHz and 5.5–8 GHz, respectively. Each band provides 65536 channels, resulting in a channel width of 38.1 kHz, corresponding to a velocity spacing of 2.2 km/s at 5.25 GHz. The two high-spectral resolution bands are designed to study H_2CO ($1_{1,0} – 1_{1,1}$) and CH_3OH ($5_1 – 6_0$ A^+). These two bands have bandwidths of 200 MHz. Each band provides 65536 channels, resulting in a channel width of 3.1 kHz, corresponding to a velocity spacing of 0.14 km/s at 6.7 GHz. This allows us to investigate free-free emission, synchrotron emission, rotation measures, radio recombination line, H_2CO, CH_3OH, and OH spectral line emission with only one setup. This fascinating setup becomes a cornerstone of the Effelsberg observations.

After initial tests of the new receiver and backends, we were able to start proper observations in January 2019. So far, we have made about 700 hours of successful observations. These efforts have already covered about 75 square degree, including many famous regions, e.g., Cygnus X, W43, W44, W51, and the Galactic centre. This is nearly half the whole survey, and the rest of the survey is still ongoing.

Shortly before the 50th birthday of the Effelsberg radio telescope, a series of papers based on the GLOSTAR data have been accepted or under review by Astronomy & Astrophysics (Brunthaler et al. 2021, Dokara et al. 2021, Nguyen et al. 2021, Ortiz-León et al. 2021, Medina et al. 2019). More progress based on the Effelsberg continuum and spectroscopic observations is being made. One spectacular result is the radio continuum image in the galactic longitude range of 28—36° from the combination of the VLA D configuration and the Effelsberg single dish images (see Figure 1, taken from Brunthaler et al. 2021). We can see that the extended emission missed in the VLA image is largely recovered by adding the Effelsberg data, nearly perfectly resolving the zero-spacing issue. These images not only provide high dynamical ranges, but also cover all spatial scales down to 18 arcsec.

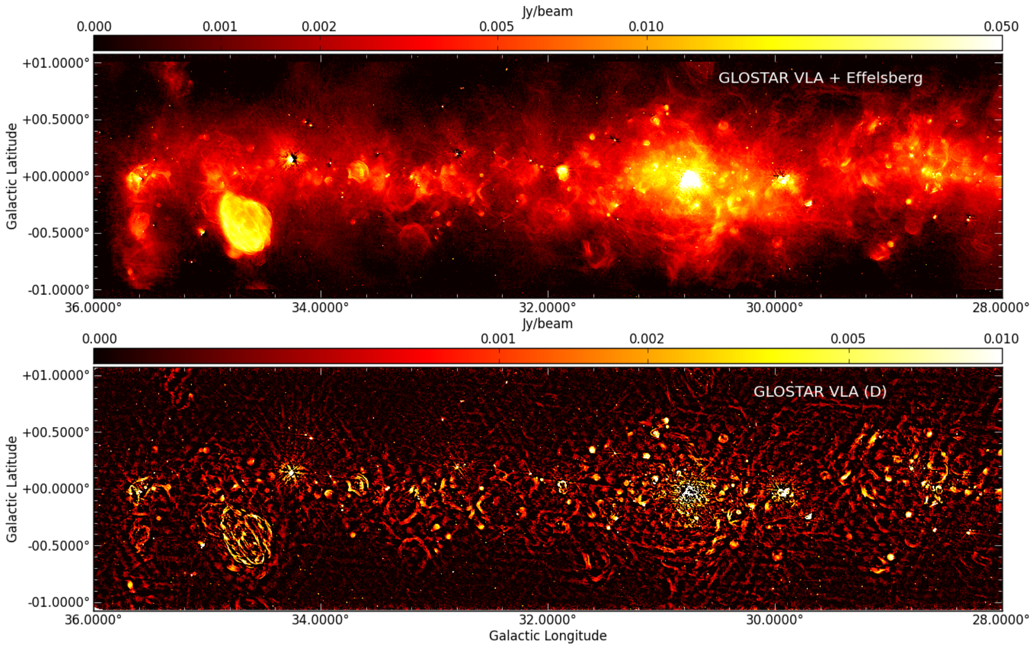


Figure 1: Top: Continuum radio image of the pilot region in the range 28° < l <36° from the combination of the VLA D-configuration and the Effelsberg single dish images.
Bottom: D-configuration VLA image of the full continuum of the same longitude range which was already presented in Medina et al. (2019).

With Effelsberg contributions, the GLOSTAR survey will become the first survey at 4--8 GHz that can rival with space IR mission in terms of spatial scales and dynamical ranges. The GLOSTAR survey will therefore provide a unique dataset with true legacy vale for a global perspective on star formation in our Galaxy.

References

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- Dokara, R., Brunthaler, A., Menten, K. M., et al.\ 2021, arXiv:2103.06267
- Medina, S. N. X., Urquhart, J. S., Dzib, S. A., et al. 2019, A&A, 627, A1
- Nguyen, H., Rugel, M. R., Menten, K. M., et al.\ 2021, A&A, accepted
- Ortiz-León, G. N., Menten, K. M., Brunthaler, A., et al. 2021, A&A, submitted

The Time Travel Trail – A new astronomical walk around the Effelsberg 100-m radio telescope

by Norbert Junkes

As a retrospective of 50 years of successful research work with the 100-m radio telescope Effelsberg, a new hiking trail, the "Time Travel Trail", will be opened in the neighbourhood of the Effelsberg telescope in these days. It starts at the visitors' pavilion in the direct vicinity of the 100-m radio telescope and leads on a distance of a bit more than 5 km around the telescope, finishing at the viewing spot directly in front of the giant dish. From there, a short zigzag path leads directly back to the pavilion.

The Time Travel Trail describes a range of specific events from five decades in a total of 20 stations, from the official opening of the radio telescope in 1971 to the 50-year anniversary in the current year 2021.

They include both, scientific and technical milestones, from the first discovery of the molecules water and ammonia outside the boundaries of our Milky Way in 1977/79 to a world record in angular resolution of only 11 micro-arcseconds (equivalent to the diameter of a 1-cent coin on the surface of the Moon) by Space VLBI observations including the 100-m telescope. It also features technical milestones such as the installation of a new subreflector with active-surface elements in 2006 and the commissioning of a second radio telescope on site, the Effelsberg station of the European LOFAR telescope network.

In the following, a short description of all 20 stations of the Time Travel Trail (see also table in Figure 1) is given:

1. The first station of the trail represents the inauguration of the radio telescope after about three years of construction on May 12, 1971. Already on April 23, the supernova remnant HB21 was observed as the first successful measurement ("First Light") with the Effelsberg radio telescope.
2. Station no. 2 marks the start of full operations for the Effelsberg radio telescope and its receiver systems on August 01, 1972. In the same year, first pulsar measurements were made at a wavelength of 2.8 cm, which was the shortest wavelength used for pulsar observations to this time.
3. In 1973, the Effelsberg radio telescope was integrated into a worldwide network of radio telescopes ("Very Long Baseline Interferometry", VLBI), already at a very early stage of its operation. The first measurements with transatlantic baselines took place, enabled by the connection of the 100-m telescope with radio telescopes in the U.S.
4. One year later, in 1974, the Effelsberg radio telescope was used as a receiving station for the HELIOS solar probe for six months during daytime. HELIOS was the first major project of German spaceflight. In the same year, the first complete map of the radio emission of the Andromeda galaxy M31 at 11 cm wavelength was published.

5. Due to its high sensitivity, the Effelsberg radio telescope is ideally suited for measurements of extremely weak radio signals. Though, spectral lines of water H_2O (1977 in M33) and ammonia NH_3 (1979 in IC342) could be detected for the first time in other galaxies several million light-years away.
6. After about ten years of measurements with the three largest fully steerable radio telescopes on earth at that time (Effelsberg: 100-m, Jodrell Bank: 76 m, Parkes: 64 m diameter), the most accurate map of the radio emission of the complete sky at 73 cm wavelength was published in 1982.
7. Observations of a whole range of spectroscopic lines of the ammonia molecule NH_3 with the Effelsberg radio telescope led to the introduction of a cosmic thermometer to derive the temperature of molecular clouds.
8. The Effelsberg radio telescope was essential for the discovery of short-term variability in the cores of extragalactic radio sources. In the central regions of extremely distant active galaxies (e.g. 0917+624, nine billion light-years away), one finds brightness variations within a few hours and can thus detect structures as small as the size of our solar system.
9. The Zeeman effect is the splitting of spectral lines in magnetic fields (Nobel Prize for Pieter Zeeman 1902). The verification of this effect in space was first demonstrated with the radio telescope Effelsberg for the water molecule H_2O. This enables the investigation of magnetic fields in molecular clouds.
10. A circular rail of 64 m diameter carries the complete weight of the Effelsberg radio telescope. After 25 years of operation, this rail had to be completely replaced. For this purpose, the telescope with its total weight of 3200 tons had to be "jacked up" for the time of the rail replacement.
11. Einstein's general theory of relativity predicts a continuous change in the direction of a pulsar's rotation axis (geodetic precession) when it moves in the gravitational field of a companion star. With the Effelsberg radio telescope, this effect could be proven for the first time in case of the pulsar PSR 1913+16.
12. The systematic study of the magnetic fields of galaxies and of our Milky Way was started by observations of polarized radio emission with the Effelsberg radio telescope. A nice example is presented in a detailed map to study the magnetic field of our neighbour galaxy M31 at 6 cm wavelength.
13. The subreflector of the Effelsberg radio telescope with a diameter of 6.50 m is located near the focal point at the tip of the four support legs. On October 5, 2006, a new, improved mirror with 100 motor-controlled active surface elements was installed, further increasing the performance of the radio telescope.
14. The first German station of the European low-frequency radio telescope LOFAR was built at the site of the Effelsberg Radio Observatory. LOFAR stations are distributed over several countries in Europe and are directly connected via fast data line connections.
15. Special measurement programs to find new pulsars are running at the Effelsberg radio telescope. PSR J1745+10 is the first millisecond pulsar discovered at Effelsberg. It is a

so-called "black widow pulsar", where the pulsar's high-energy radiation is almost completely vaporizing its partner over time.

16. A pulsar with an extremely strong magnetic field, a so-called magnetar, was detected with the Effelsberg radio telescope in the immediate vicinity of the center of the Milky Way. It moves in an orbital period of about 500 years around the supermassive black hole in the centre (Sgr A* with more than 4 million solar masses).
17. Within the project "Effelsberg-Bonn-HI-Survey" (EBHIS), the complete northern sky was observed in the light of the 21-cm spectral line of neutral hydrogen (HI) with the radio telescope Effelsberg.
18. Studying the spectral lines of water masers in the galaxy NGC 4258 in a Space-VLBI network connecting the RadioAstron space telescope with a number of Earth-based radio telescopes including the 100-m telescope, the highest angular resolution in astronomy with 11 microarcseconds only could be achieved.
19. The "Global Millimeter VLBI Array" (GMVA) is used to investigate details within the central regions of galaxies like Perseus A, Cygnus A, M87 and Sgr A* (center of the Milky Way) at very high angular resolution. At a wavelength of 3.5 mm only, the participating 100-m radio Effelsberg is pushed to its limits.
20. In 2021, the Effelsberg radio telescope has completed the first 50 years of its life. To mark the occasion, the German postal service issued an anniversary stamp “50 Jahre 100-m-Radioteleskop Effelsberg”. Observations and research programs with the 100-m telescope will be continued.

After a total of 50 years corresponding to a distance of 5 km, the final station of the Time Travel Trail has been reached (Figure 3).

Figure 2 shows a map of the complete course of the trail with a total length of a bit more than 5 km around the Effelsberg 100-m radio telescope. The 20 stations have been mounted in time for the 50th anniversary of the telescope. The smaller signs for orientation on the trail (“black telescope on yellow ground”) will follow soon.

The Time Travel Trail complements the three already existing astronomical trails at the Effelsberg site, the Planetary, Milky Way and Galaxy Trails, which show the almost complete cosmic distance scale from our solar system to the most distant galaxies at the edge of the Universe. It completes the set of the three spatial trails at different scales with a dimension in time, thus creating a four-dimensional space-time😊.

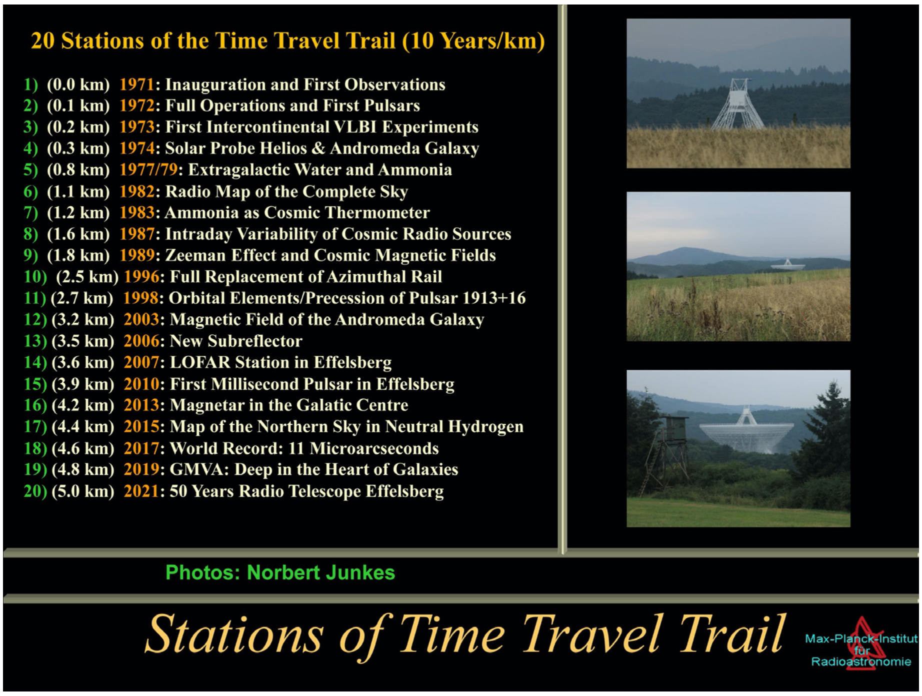

Figure 1: List of the 20 stations of the Time Travel Trail at the Effelsberg radio telescope (Credit: Norbert Junkes/MPIfR).

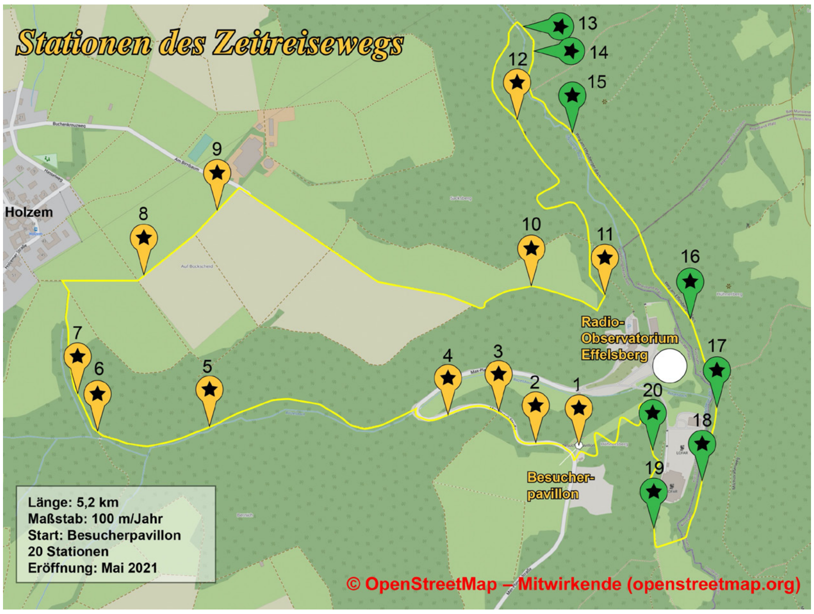

Figure 2: Map of the area around the Effelsberg radio telescope. The positions of the 20 plaques of the Time Travel Trail are marked. The first 11 plaques are mounted in the state of Northrhine-Westfalia, no. 13 to 18 are within the area of Rhineland-Palatinate (Credit: OpenStreetMap – Contributors, openstreetmap.org).

Figure 3: Station no. 20 of the Time Travel Trail at Effelsberg radio telescope. This plaque is mounted at the viewing spot directly in front of the 100-m telescope and marks the finish of the trail after 5 kilometers (Photo: Norbert Junkes/MPIfR).

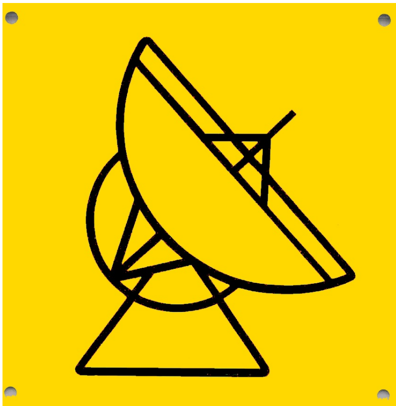

Figure 4: Sign to identify the course of the Time Travel Trail around the telescope ("black telescope on yellow ground").

Link for the Time Travel Trail:
https://www.mpifr-bonn.mpg.de/effelsberg/visitors/timetravelwalk

Links for the three other astronomy trails at the Effelsberg telescope:
https://www.mpifr-bonn.mpg.de/effelsberg/visitors/planetarywalk
https://www.mpifr-bonn.mpg.de/effelsberg/visitors/milkywaywalk
https://www.mpifr-bonn.mpg.de/effelsberg/visitors/galaxywalk