Contents

Greetings from the Director

Happy New Year, Everyone!

It is a pleasure to wish everyone involved with the Effelsberg Observatory a happy, healthy and productive New Year 2020. These wishes are directed to our superb staff at the observatory, the users of the 100-telescope and the LOFAR station, and everyone who just wants to learn more about the exciting instrumentation and science done with this telescope.

As many of you will remember, a little time ago we encouraged all of you to provide us with a list of wishes for new instrumentation and software that you would like to see at the 100-m telescope. The result was a very productive workshop in Bonn and a task list for our technical departments and their engineers. I am happy to say that many of these wishes have now been installed and produce already excellent science. A few more projects will be completed this year, and I will refer to this in upcoming newsletters, and of course the resulting journal publications, for more details. An example of the science done with the new Q-band receiver can be found in this newsletter. In future issues we will report on the first science runs with the Phased-Array-Feed and describe our efforts for the new signal digitization and processing („Effelsberg Direct Digitization – EDD“) – stay tuned!

I encourage everyone to submit an observing proposal and to join the many publications per months that the telescope keeps on producing.

Happy 2020, and happy observing,

Michael Kramer

Call for proposals – Deadline February 3, 2020, 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 https://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 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 be accepted yet – the system is still being commissioned. The new 20mm receiver is fully usable, however.

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 June 3, 2020, 15:00 UT.

RadioNet Transnational Access Programme

by Alex Kraus

RadioNet (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.

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

A Repeating Fast Radio Burst from a Spiral Galaxy

Localization of a new, recurring source of radio flashes deepens the mystery of their origins

by Norbert Junkes

The Effelsberg 100-m radio telescope participated in the European VLBI Network (EVN) to observe a repeating Fast Radio Burst (FRB) and helped to pinpoint the FRB to a spiral galaxy similar to our own. Crucial to this work was the sensitivity of the Effelsberg telescope and its flexible pulsar instrument that aided the quick radio localization. This FRB is the closest to Earth ever localized and was found in a radically different environment to previous studies. The discovery, once again, changes researchers' assumptions on the origins of these mysterious extragalactic events.

The results are reported in the current issue of the journal Nature by an international team of scientists including Ramesh Karuppusamy from the Max Planck Institute for Radio Astronomy in Bonn, Germany.

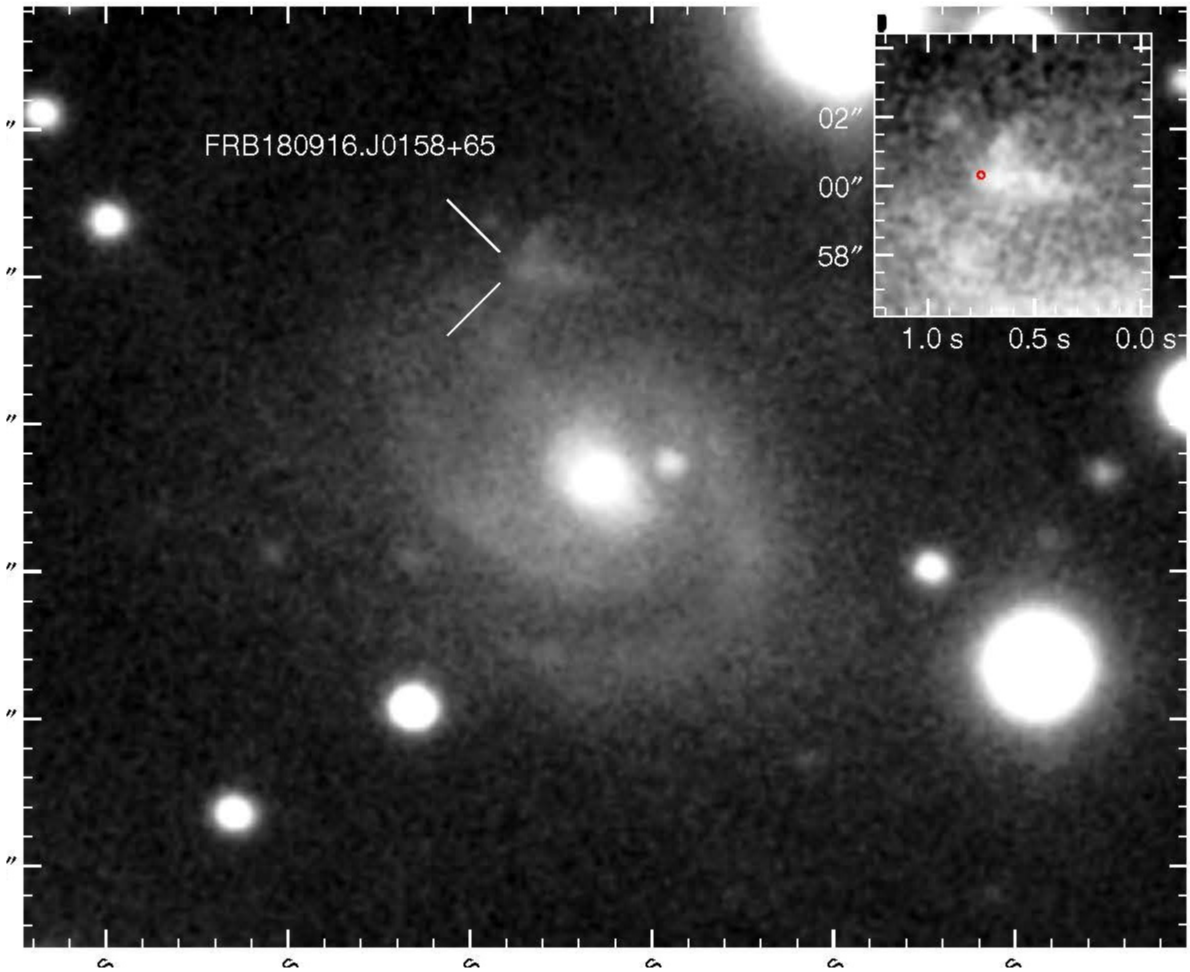


Image of the host galaxy of the Fast Radio Burst (FRB) 180916.J0158+65 as seen with the Gemini-North telescope. The position of the FRB is marked. The inset is a higher-contrast zoom-in of the star-forming region containing the FRB (marked by the red circle).
Credit: B. Marcote et al, Nature 2020.

One of the greatest mysteries in astronomy right now is the origin of short, dramatic bursts of radio light seen across the universe, known as Fast Radio Bursts or FRBs. Although they last for only a thousandth of a second, there are now hundreds of records of these enigmatic sources. However, from these records, the precise location is known for just four FRBs - they are said to be 'localized'.

In 2016, one of these four sources was observed to repeat, with bursts originating from the same region in the sky in a non-predictable way. This resulted in researchers drawing distinctions between FRBs where only a single burst of light was observed ('non-repeating') and those where multiple bursts of light were observed ('repeating').

"The multiple flashes that we witnessed in the first repeating FRB arose from very particular and extreme conditions inside a very tiny (dwarf) galaxy", says Benito Marcote, from the Joint Institute for VLBI ERIC, the lead author of the current study. "This discovery represented the first piece of the puzzle but it also raised more questions than it solved, such as whether there was a fundamental difference between repeating and non-repeating FRBs. Now, we have localized a second repeating FRB, which challenges our previous ideas on what the source of these bursts could be."

On 19th June 2019, eight telescopes from the European VLBI Network (EVN) simultaneously observed a radio source known as FRB 180916.J0158+65. This source was originally discovered in 2018 by the CHIME telescope in Canada, which enabled the team to conduct a very high-resolution observation with the EVN in the direction of FRB 180916.J0158+65. During five hours of observations the researchers detected four bursts, each lasting for less than two thousandths of a second. The resolution reached through the combination of the telescopes across the globe, using a technique known as Very Long Baseline Interferometry (VLBI), meant that the bursts could be precisely localized to a region of approximately only seven light years across. This localization is comparable to an individual on Earth being able to distinguish a person on the Moon.

The Effelsberg 100-m radio telescope of the Max Planck institute for Radio Astronomy (MPIfR) played a crucial role in these observations in two ways. With the flexible instruments at this telescope one could record data amenable to rapid identification of radio bursts and a form of data suitable for high resolution radio imaging. Secondly the large collecting area of the telescope makes it an indispensable element in the coordinated interferometric observations of weak sources like this FRB.

With the precise position of the radio source the team was able to conduct observations with one of the world's largest optical telescopes, the 8-m Gemini North on Mauna Kea in Hawaii. Examining the environment around the source revealed that the bursts originated from a spiral galaxy named SDSS J015800.28+654253.0, located half a billion light years from Earth. The bursts come from a region of that galaxy where star formation is prominent.

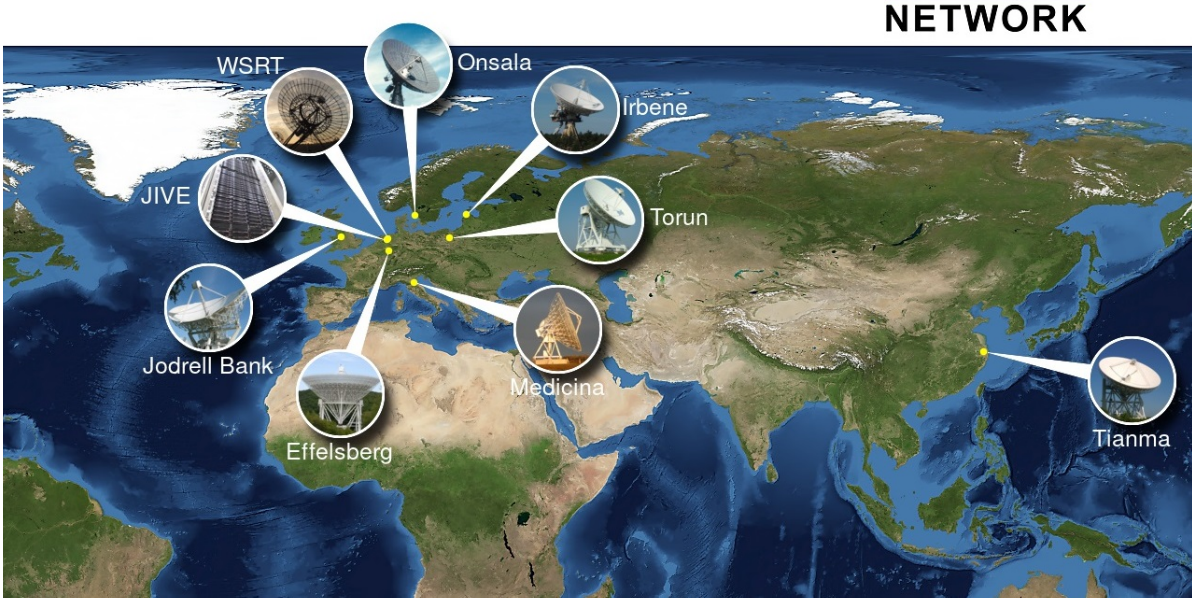
"The found location is radically different from the previously located repeating FRB, but also different from all previously studied FRBs", explains Kenzie Nimmo, PhD student at the University of Amsterdam. "The differences between repeating and non-repeating fast radio bursts are thus less clear and we think that these events may not be linked to a particular type of galaxy or environment. It may be that FRBs are produced in a large zoo of locations across the Universe and just require some specific conditions to be visible."

"With the characterization of this source, the argument against pulsar-like emission as origin for repeating FRBs is gaining strength", says Ramesh Karuppusamy of the MPIfR, a co-author of the study. "We are at the verge of more such localizations brought about by the upcoming newer telescopes. These will finally allow us to establish the true nature of these sources", he adds.

While the current study casts doubt on previous assumptions, this FRB is the closest to Earth ever localized, allowing astronomers to study these events in unparalleled detail.

"We hope that continued studies will unveil the conditions that result in the production of these mysterious flashes. Our aim is to precisely localize more FRBs and, ultimately, understand their origin", concludes Jason Hessels, corresponding author on the study, from the Netherlands Institute for Radio Astronomy (ASTRON) and the University of Amsterdam.

EUROPEAN vlbi NETWORK



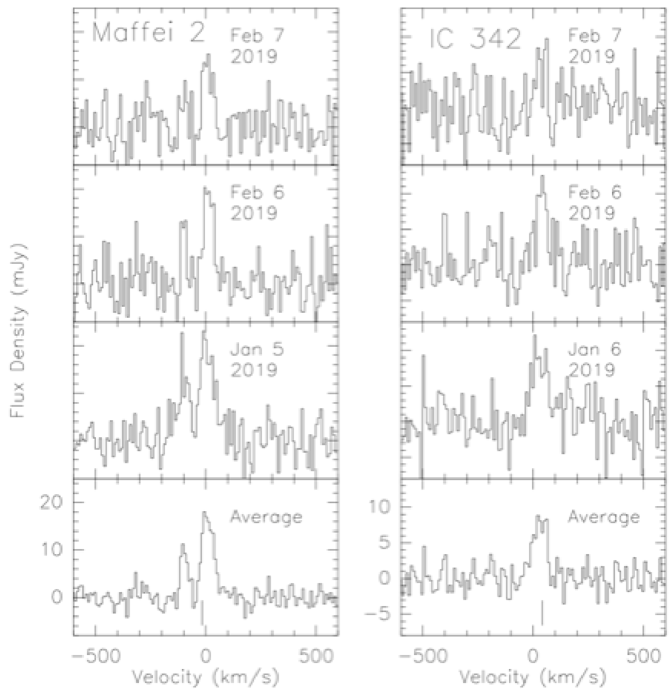
Map of the European VLBI Network (EVN) telescopes used in the observation, showing the positions of the eight participating radio telescopes and also JIVE in The Netherlands.
Credit: Paul Boven (JIVE). Satellite image: Blue Marble Next Generation, courtesy of NASA Visible Earth (visibleearth.nasa.gov).

36 GHz Methanol Lines from Nearby Galaxies

by Alex Kraus

The 100-m telescope was used to observe the 36 GHz methanol transition in several nearby galaxies. With the recently installed Q-band receiver (33-50 GHz, see the newsletter issue of September 2018, https://www.mpifr-bonn.mpg.de/4334693/Eff-news-sep2018.pdf), Humire et al. detected the class I 36 GHz CH3OH 4(-1) - 3(0) E line emission in Maffei2 and IC342 (see figure). The 36 GHz methanol line of Maffei2 is the second most luminous among the sources detected with certainty outside the Local Group of galaxies. Upper limits were found in M82, NGC4388, NGC5728 and Arp220. In contrast to the previously detected 36GHz CH3OH emission in NGC253 and NGC4945, the 36 GHz profiles towards Maffei2 and IC342 resemble those of non-masing lines from other molecular species, making a clear distinction between maser and thermal lines difficult. As in our Galactic center region, it may well be possible that these lines are composed of a large number of faint and narrow maser features that remain spatially unresolved and appear like a single thermal line. More observations would be needed to answer this question.

The paper could be found at: https://arxiv.org/pdf/1911.06776.pdf and in Astronomy and Astrophysics **633**, A106 (2020).



Methanol lines at 36.169261 GHz observed with the 100-m telescope. Credit: P.K. Humire, C. Henkel (MPIfR)