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Greetings from the director

Dear Astronomers, dear Colleagues,

I wish you a very happy new year 2023. In many respects, we were hoping for a return to normality after the COVID pandemic, but other factors are nowadays impacting our lives. Still, the observatory is performing in an excellent fashion, as ever.

Looking back at the last year, it is very gratifying to see that the very large number and quality of publications resulting from observations with the 100-m telescope have not only kept up but even increased, and that the remaining effects of the flooding in July 2021 have mostly been removed by now. This includes the repairs to the LOFAR LBA field, which is now fully operational again. Here, I take the opportunity to thank the Max-Planck-Society for its continuous support! This support also allows us to start the renewal of the axis control units of the 100-m telescope this year. This is a major project which will renew a crucial piece of hardware, making the telescope better and better still.

We are looking to your new results with the 100-m telescopes for 2023, and we wish you a happy new year and happy observing.

Best wishes, Michael Kramer

Call for proposals

Deadline Feb 02, 2023, UT 15.00

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 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.

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) (eg. to NRAO for the VLBA).

Important Remarks

Please note, that the Effelsberg Programme Committee (PKE) is composed of several scientist with different backgrounds. It is hence advisable to write the proposals in a way that they could be understood by readers who are not working in the particular field.
Furthermore, it should be noted that all proposals are treated confidentially. Therefore, it is not necessary to withhold or obscure information, which on the contrary might lead to a downgrading of the proposal.

The following deadlines will be on Jun 1st, 2023 and on Sep 28th, 2023.

Opticon-RadioNet-Pilot Transnational Access Programme

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.

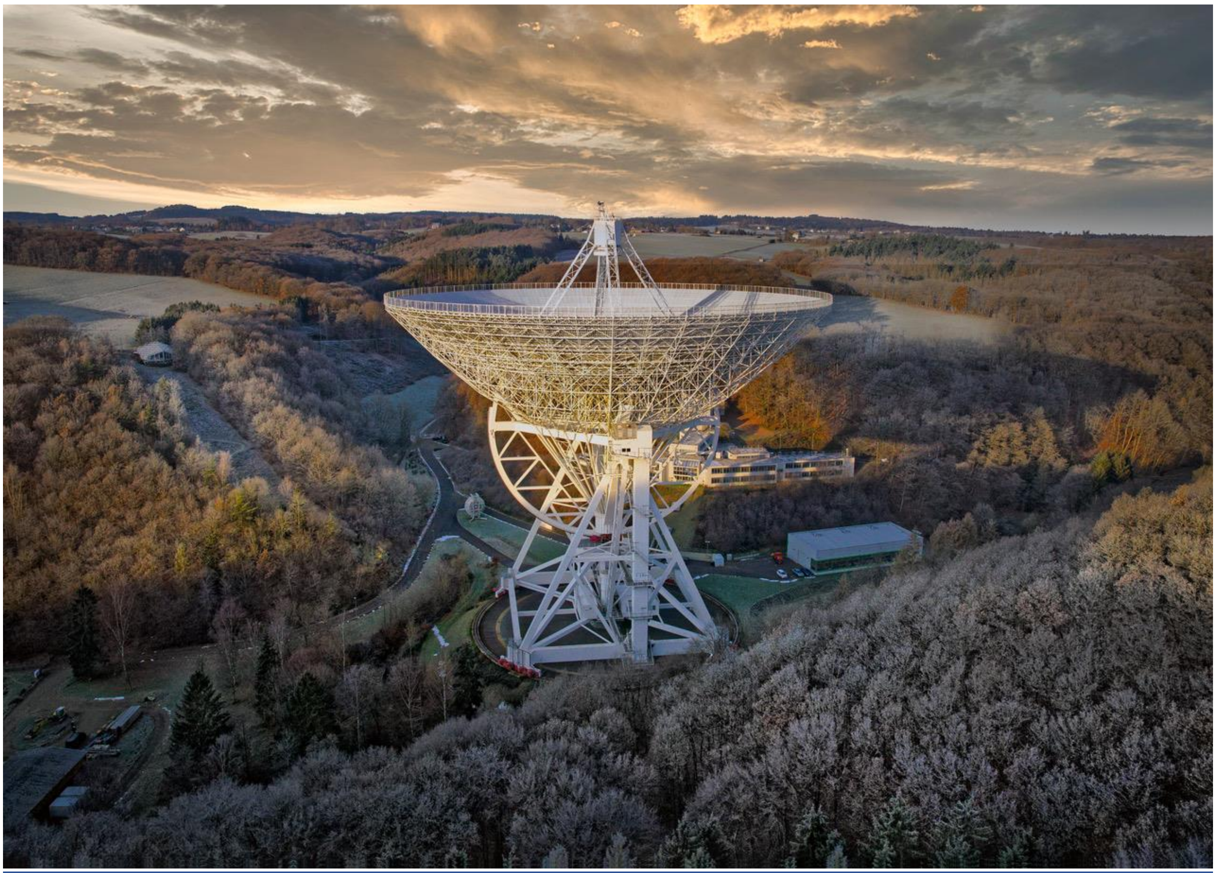
One – in exceptional cases more – scientists who are going to Effelsberg for observations can be supported, if the User Group Leader (i.e., the PI – a User Group is a team of one or more researchers) and the majority of the users work in (a) country(ies) other than the country where the installation 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].

by Alex Kraus



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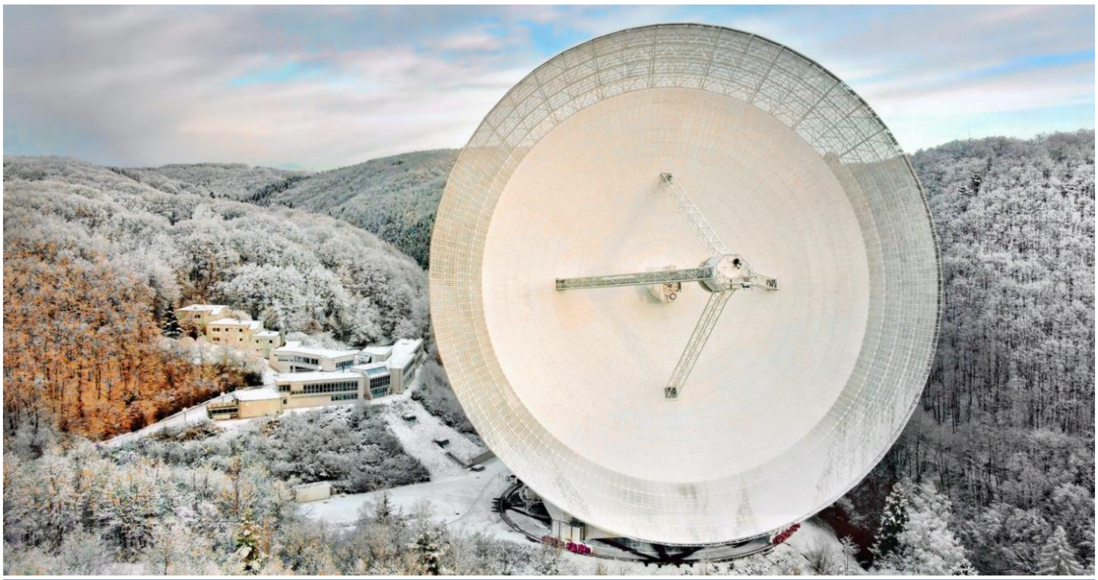
News from the observatory

Project to renew the main axes drive control started

Even more than 50 years after its inauguration, the telescope is still going strong and we make a lot of efforts to maintain and improve the hard- and software. In this context, some time ago we started a project to renovate the main axes drives, including the power units and the corresponding control systems.
This project passed now an important milestone with the signature of a contract for the work with an external company. First discussions have already been held to fix details and the timeline of the project. We hope to have the new hard- and software installed in summer 2024. Not surprisingly, that will lead to an interruption of the operations. However, we expect to have this break outside the planned VLBI sessions and for not longer than a few weeks.

Repair of the damages from the flooding in July 2021 continues

As reported (see the issue of November 2021, Vol. 12, Issue 3), the observatory was hit by the flooding of July 14, 2021. Although observations with the 100-m telescope could be re-started after five days, there was quite some damage in the compound of the observatory, including the low-band antennas of the local LOFAR station. While these could be repaired by the colleagues from ASTRON in summer last year, some other work still remains to be done, e.g., the restoration of the beds of the *Effelsberger Bach* and the *Rötzelbach*. We are happy to notice that the latter work packages started recently, and hope that all traces of the catastrophe will be cleaned up by summer this year.



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To the Heart of 3C 273

International Team Observes Innermost Structure of a Quasar Jet

At the heart of nearly every galaxy lurks a supermassive black hole. But not all supermassive black holes are alike: there are many types. Quasars (or quasi-stellar objects) are one of the brightest and most active types of galaxies that host supermassive black holes. An international group of scientists including astronomers at the Max Planck Institute for Radio Astronomy presents new observations of the first quasar ever identified. Its name is 3C273 and it is located at a distance of approx. 1.9 Billion light years in the Virgo constellation. The new high-resolution radio images trace the jet down to the jet formation region and show how the width of the jet varies with distance from the central black hole. The results were published in the November issue of the "Astrophysical Journal".

Active supermassive black holes emit narrow, incredibly powerful jets of plasma that escape at nearly the speed of light. Thomas Krichbaum, astronomer at the Max Planck Institute for Radio Astronomy (MPIfR) in Bonn, Germany, one of the leading authors of the work, says: "*These jets have been studied over many decades, yet the details of jet formation are not well understood and a topic of ongoing research. An unresolved issue has been how and where the jets are collimated into a narrow beam, which allows them to propagate to extreme distances beyond their host galaxy. Astronomers now realize that these far outreaching jets may even affect galactic evolution. These new radio observations are probing as deep as 0.5 light years into the heart of the black hole in 3C273 into the region, where the jet plasma flow is collimated into a narrow beam.*"

This new study, published in The Astrophysical Journal in November 2022, includes observations of the 3C 273 jet at the highest angular resolution to date. The ground-breaking work was made possible by using a closely coordinated set of radio antennas around the globe, a combination of the Global Millimeter VLBI Array (GMVA) and the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile. In addition, coordinated observations were also made with the High Sensitivity Array (HSA) to extend the study of 3C 273 to larger scales, in order to also measure the global shape of the jet. The 100-m telescope at Effelsberg participated in both observations.

The MPIfR is the leading institution of the GMVA. Data are processed at the correlator center in the institute, and the observations are coordinated from the institute.

"*3C 273 has been studied for decades as the ideal closest laboratory for quasar jets*," says Hiroki Okino, lead author of this paper and a PhD student at the University of Tokyo and National Astronomical Observatory of Japan. "*However, even though the quasar is a close neighbor, until recently, we didn't have an eye sharp enough to see where this narrow powerful flow of plasma is shaped.*"

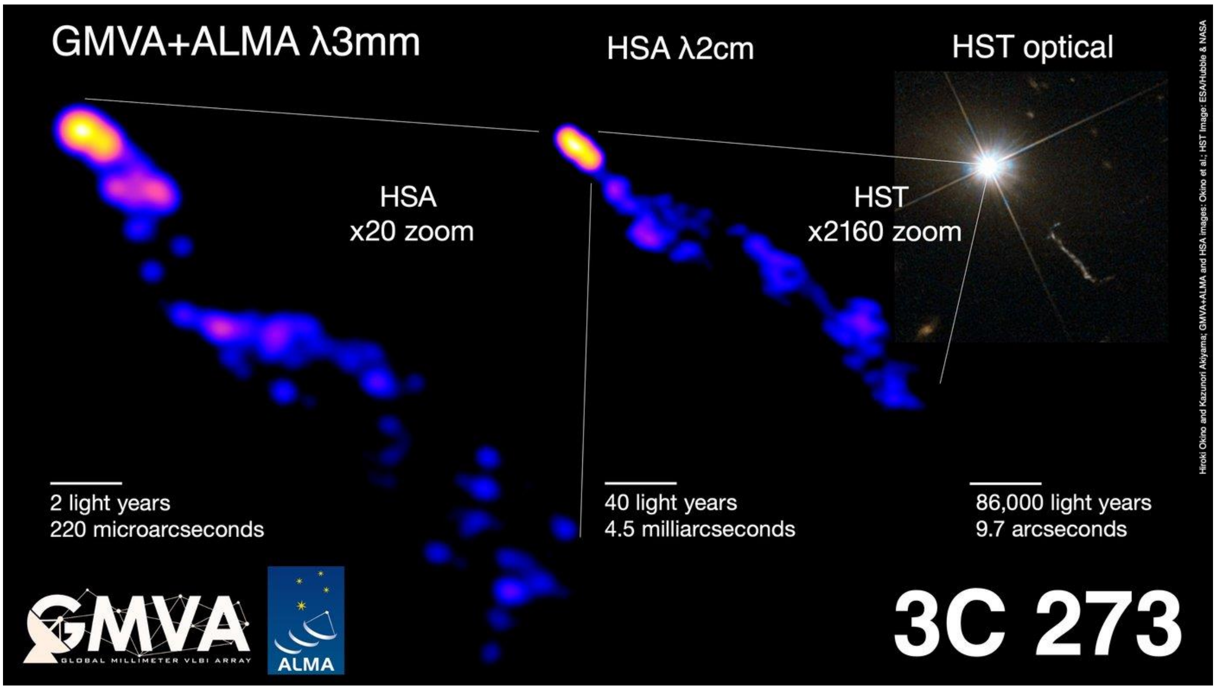


Fig. 1: *The views of the 3C 273 jet from the deepest to farthest ends. The left image shows the deepest look yet into the plasma jet of the quasar 3C 273, which will allow scientists to further study how quasar jets are collimated, or narrowed. The powerful, collimated jet extends for hundreds of thousands of light-years beyond the host galaxy, as seen in the right panel optical image taken by the Hubble Space Telescope. Scientists use radio images at different scales to measure the shape of the entire jet. The radio interferometer arrays used are the Global Millimeter VLBI Array (GMVA) joined by the Atacama Large Millimeter/submillimeter Array (ALMA) and the High Sensitivity Array (HSA). The 100-m telescope was part of both the GMVA and the HSA.*

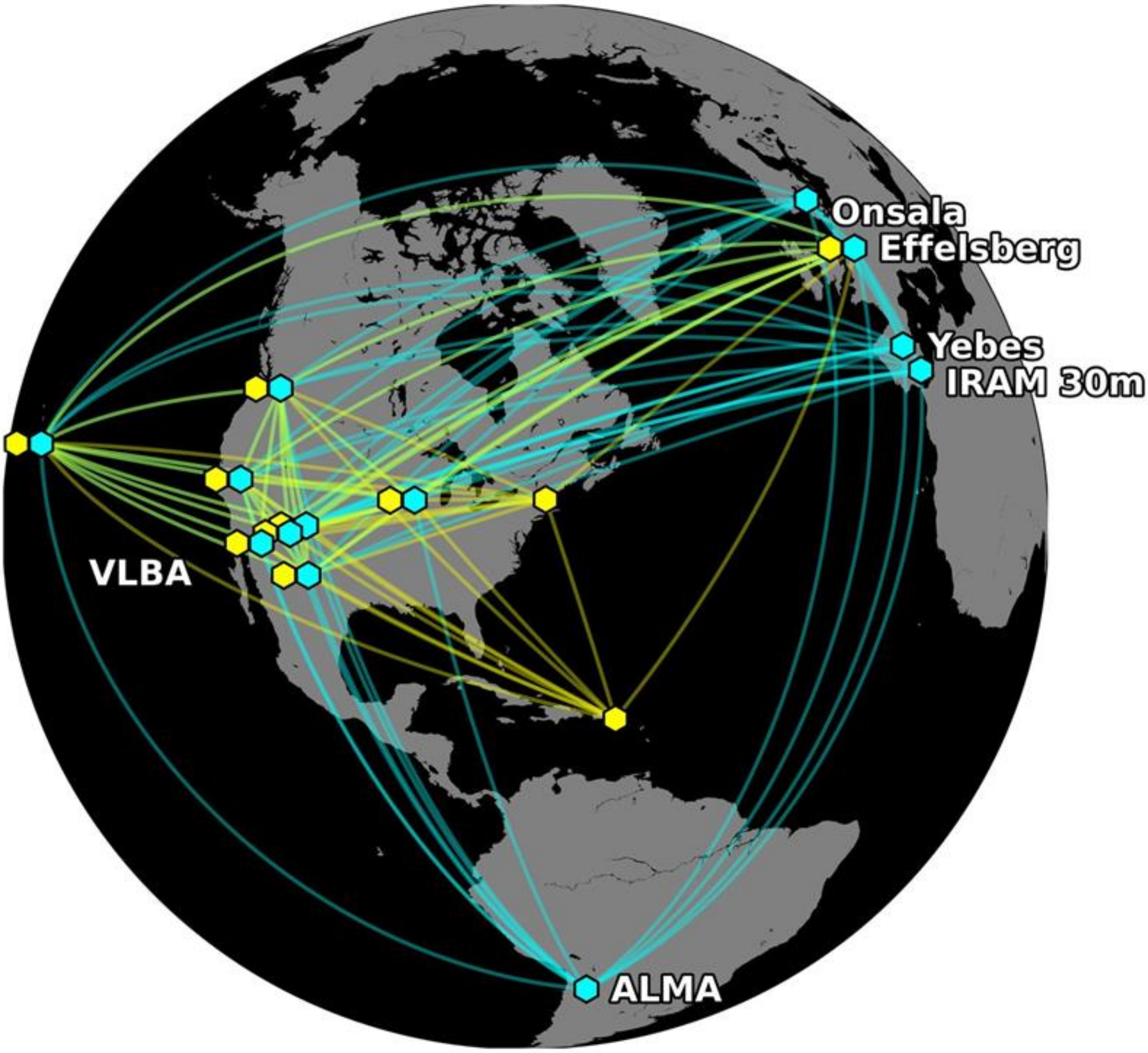
The image of the 3C 273 jet gives scientists the very first view of the innermost part of the jet in a quasar, where the collimation or narrowing of the beam occurs. The team further found that the angle of the plasma stream flowing away from the black hole is tightened up over a very long distance. This narrowing part of the jet continues incredibly far, well beyond the area where the black hole's gravity rules.

"*It is striking to see that the shape of the powerful stream is slowly formed over a long distance in an extremely active quasar. This has also been discovered nearby in much fainter and less active supermassive black holes*," says Kazunori Akiyama, research scientist at MIT Haystack Observatory and project lead.

"*The results pose a new question: how does the jet collimation happen so consistently across such varied black hole systems?*"

The new, extremely sharp images of the 3C 273 jet were made possible by the inclusion of the ALMA interferometer, which was phased-up to act as a single big radio-telescope. The GMVA and ALMA were connected across continents using a technique called very long baseline interferometry (VLBI) to obtain highly detailed information about distant astronomical sources. The remarkable VLBI capability of ALMA was enabled by the ALMA Phasing Project (APP) team. The international APP team, led by MIT Haystack Observatory and the MPIfR, developed the hardware and software to turn ALMA, an array of sixty-six telescopes, into the world's most sensitive astronomical interferometry station. Collecting data at these wavelengths greatly increases the resolution and sensitivity of the VLBI array. This capability was fundamental not only to the GMVA but also to the EHT's black hole imaging work.

Anton Zensus, director at the MPIfR and coauthor of the present work, concludes: "*ALMA joining the global VLBI networks is a complete game-changer for black hole science. With this breakthrough, we obtained the first-ever images of supermassive black holes, and now in cases like 3C 273 it is helping us to see for the first time incredible new details about how black holes power their jets also in such more distant objects.*"



Radio telescope networks used in this project. The blue points are the telescopes of the Global Millimeter VLBI Array (GMVA) joined by ALMA. The yellow points are the telescopes of the High Sensitivity Array (HSA) used in this project. Green lines indicate baselines where both networks were used. *© Kazunori Akiyam*

Original Paper:

[Collimation of the Relativistic Jet in the Quasar 3C273]

H. Okino et al., The Astrophysical Journal Vol. 940, Number 1, 22 Nov 2022, DOI:10.3847/1538-4357/ac97e5.