From the Director:

Just over two weeks ago VR-RFI announced the results of the latest proposal cycle for infrastructure funding. The proposal for future full Swedish participation in the Square Kilometre Array (SKA) obtained an excellent scientific evaluation and conditional approval. This VR-RFI decision is a key milestone in the process of Sweden joining the new SKA Observatory international organisation - further steps however remain before Sweden commits to contributing to the SKA construction and operations phases. These steps include successfully completing a proposal negotiation phase with VR and achieving final agreement on a package for funding Swedish industrial participation. Assuming these final steps are successful we can look forward to Sweden signing the international convention to join the SKA-Observatory during 2020. Full participation in SKA will ensure that Swedish astronomers continue to have access to the world's largest telescopes across the electromagnetic spectrum; with SKA taking its place alongside ESO's Optical-IR telescopes, ALMA at mm wavelengths and other major international telescopes located both on the ground and in space.

Sincerely, John Conway
**Call for Proposals**

Proposals are invited for observations with the APEX telescope, the Onsala Space Observatory 20 m telescope, and the Swedish LOFAR station in stand-alone mode. **Deadline for proposals: Friday 18 October 2019.** More details on these instruments are given below.

**APEX**, the Atacama Pathfinder EXperiment, is a 12 m diameter submillimetre telescope at 5100 m altitude on Llano Chajnantor in Chile. The receivers offered in this Call are the heterodyne receivers SEPIA (ALMA band 5, 159-211 GHz; band 7, 272-376 GHz; and band 9, 578-738 GHz) and nFLASH (ALMA band 6, 200-270 GHz; and band 8, 385-500 GHz), and the bolometer arrays ArTeMiS (350 and 450 µm) and LABOCA (870 µm). In general, proposals for Swedish time on APEX must have at least one co-I with a Swedish affiliation; however a maximum of 20% of the observing time will be open to international proposals (i.e. those without a PI or co-I with a Swedish affiliation) - to be scheduled based purely on scientific merit.

The Onsala 20 m diameter telescope in Sweden is equipped with receivers which provide continuous frequency coverage in the ranges 18-50, 67-87 and 85-116 GHz with 4 GHz IF bandpass, dual polarisations and full mutual sideband rejection (<−13 dB). We welcome proposals for Large programmes, i.e. spanning more than one semester and/or require a large number of hours (> 500 h).

The Swedish LOFAR station at OSO is an array of antennas for the frequency bands 10–90 MHz and 110–240 MHz. It is part of the International LOFAR Telescope (ILT), but is offered here in stand-alone mode.

The European VLBI Network (EVN) is a collaboration of the major radio astronomical institutes in Europe (including OSO), Asia and South Africa. **The next deadline for EVN proposals is 1 February 2019.**

For more detailed information: see [OSO web page](#).

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**Support at OSO**

The National Facility offers a wide variety of support to Swedish astronomers. For example, we host one of the European ALMA regional nodes, supporting ALMA users throughout the Nordic region. We also offer support in several other areas.

**Data Reduction:** We support the reduction of all types of radio/(sub-)mm interferometric and single-dish observations. We welcome visitors who need reduction support and offer them the use of our National Facility Computing Infrastructure (NaFCI) for reduction of large data sets.

**Specialised Courses:** We will be able to assist with specialised lectures on for example, interferometry, radio/(sub-)mm data analysis and/or the use of National Facility instruments.

**Student projects:** We also encourage visits by students who want to learn how to reduce and analyse their radio/(sub-)mm observations.

**Workshop/School support:** Similarly, we can assist in planning and lecturing at schools or workshops, when these include topics related to National Facility activities and instruments. This includes but is not limited to, for example, radio/(sub-)mm interferometry and single dish observing and analysis, ALMA, APEX, LOFAR, SKA and EVN.

**Seminars:** National facility staff are also available for scientific and technical seminars on the aforementioned instruments.

**Interested in SKA/LOFAR news?**

Please sign up to the [LOFAR/SKA mailing list](#).

**More Information:** Contact [Michael Lindqvist](mailto:Michael.Lindqvist@onsa.se), Head of Astronomy User Support.
We would like to introduce you to a few of the recent science highlights produced using the instruments at, and supported by, OSO. We especially welcome short contributions by you, the users of our telescopes, so please do not hesitate to contact us if you have results you would like to share in future newsletters.

Swedish SKA proposal

On September 26th VR announced the conditional approval of the infrastructure proposal submitted for full Swedish participation in the Square Kilometre Array (SKA) project. Still remaining, before a final decision for Swedish participation in SKA is made, is the successful completion of a negotiation phase and approval of a package for Sweden’s industrial contributions to the project. Assuming these final steps are successful then Sweden will during 2020 sign the international convention to join the new SKA Observatory international organisation.

The SKA is planned to impact many important areas of astrophysics ranging from observations of the Epoch of Reionization and the epoch of galaxy formation, to pulsar observations as tests of fundamental physics, to observations of forming planetary systems. More details on SKA science goals can found in the SKA Science Book (see Science Case). Construction of SKA is planned to begin in 2021 with the low frequency part of the array being built in Australia (see Fig. 1, left), and the high frequency antennas located in South Africa (see Fig. 1, right). The SKA will incorporate the infrastructure of the existing SKA precursor arrays at the two sites, i.e. the MWA in Australia and the 64 dish MeerKAT in South Africa. The global headquarters of the SKA project are at a third site, in Jodrell Bank, near Manchester in the UK.

Figure 1. Left - Simulated image of SKA1-low in Australia showing in the foreground one its 512 dipole stations, with other stations in the background (and dishes of the ASKAP SKA precursor array). Right: Simulated image showing a small fraction of the 197 dishes that will comprise SKA1-mid in South Africa.

Interested in SKA/LOFAR news? Please sign up to the Swedish LOFAR SKA mailing list.
Cycle 7 proposal review results and the ACA Supplemental Call

The number of proposals submitted for Cycle 7 was 1773, for the first time a number that didn't surpass the previous cycle (63 proposals less than last year). Of the 1773 proposals submitted, 634 were accepted (128 received the highest priority of Grade A, 270 received Grade B, and 236 received Grade C). Four Large Programs were also accepted. There were 54 proposals with PIs from the Nordic regions, out of which 26 were allocated observing time.

The ALMA Phase2 process proceeded smoothly and Cycle 7 started successfully on October 1st. The main array will be moved to the most compact configuration (C-1) around December this year and later on, around summer 2020, it will be expanded to its largest configuration (C-10). This will be the last time the telescopes visits all configurations within a cycle. Configurations with baselines longer than 13 km (C-9 and C-10) are scheduled for Cycle 7 and 9 but not Cycle 8.

The Atacama Compact Array (ACA) still continues operating with a high efficiency. For this reason, there has been a Supplemental Call for ACA-standalone proposals. The call closed on October 1st with a total of 257 proposals. The reviewing process will be in the mode of peer-to-peer for the first time. In addition, the recent review by Carpenter (2019) on systematics related to the ALMA Proposal Review process has information that you may find relevant.

As always, the Nordic ARC node will continue supporting the ALMA user community in proposal preparation, data reduction, advanced analysis and archival research. We strongly encourage users to contact the Node to get support for their project. We can arrange a face-to-face visit to the node or your institution or assist you remotely. You can contact us at contact@nordic-alma.se or visit nordic-alma.se to request support.
Stringent limits on the magnetic field in a proto-planetary disk

Magnetic fields likely play an important role during the evolution of planet forming disks. But only very limited information exists on the magnetic field strength in such disks. So far, most observations have relied on dust polarisation, but unfortunately recent observations have shown that dust self-scattering at (sub-)millimeter wavelengths significantly complicates the dust observation interpretation. This leaves direct magnetic field measurements using the Zeeman effect of the CN radical as one of the most promising ways to determine the magnetic field strength.

In a recent paper by Vlemmings et al. (2019), some of the first ALMA Zeeman observations were used to provide the so-far most stringent limit on the vertical magnetic field component of the proto-planetary disk around the T Tauri star TW Hya, Fig. 2. Stacking a number of CN hyperfine components, a limit of |Bz|<0.8 mG was reached. This limit rules out several disk models and provides the first constraints to be compared with magneto-hydrodynamic simulations.

Figure 2. (left) An integrated intensity map of one of the CN hyperfine components in the disk around TW Hya. The dashed line is the line of nodes and the cross indicates the peak of the CN emission. (right) The stacked CN total intensity and circular polarisation spectrum after azimuthal averaging. The red line indicates a model for magnetic field strength of 0.8 mG.

Wouter Vlemmings, Chalmers

The above result is published in Vlemmings et al. (2019).
Combining ALMA data to produce high-fidelity images of B335

In a forthcoming A&A paper, the kinematics and morphological properties of the region around the protostar B335 are studied in great detail by combining multiple ALMA data sets of different angular resolutions. B335 is perhaps one of the youngest known protostars, and does not yet show evidence of a rotationally supported accretion disk. To investigate the relationship between outflow launching and formation of any disk-like structure, a wide range of spatial scales need to be covered. With dedicated support from the Nordic ARC node in Onsala, Bjerkeli et al. (2019) managed to produce a high-fidelity $^{12}$CO image, covering an impressive range of structures scaling from 3 au (0.03") to 700 au (7"), Fig. 3. The image was produced by combining data acquired between 2013 and 2017, and reveals unprecedented details of the environment of B335.

**Figure 3.** Moment 0 map of the $^{12}$CO emission (colour contours), overlaid on the continuum (grayscale) in the combined dataset (excerpt from Bjerkeli et al., 2019; their Fig. 5). The emission is integrated from 2.0 to 6.0 km s$^{-1}$ with respect to the source velocity, 8.3 km s$^{-1}$ w.r.t. v$_{LSR}$. Selected mean spectra, averaged over circular regions of 10 au radius, are indicated by the coloured points and the corresponding coloured spectral line profiles.
The X-shaped outflow shows no signs of rotation at distances larger than 30 au from the protostar, which suggests that most of the $^{12}$CO emitting gas originates at the edge of the surrounding envelope. Since most of the outflow emission is recovered, the combined data cube reveals the scales over which entrainment takes place.

Within ~10 au of the protostar, a clear rotation signature is observed in CH$_3$OH and one line of SO$_2$. Using high-velocity $^{12}$CO features in the vicinity of the protostar, the launching radius is estimated to be less than 0.1 au from the centre of the continuum peak source, but no rotationally-supported disk can be seen. The dynamical time-scale of these knots are less than a few years.

*Per Bjerkeli, Chalmers*

*The above result is accepted for publication in A&A, see Bjerkeli et al. (2019).*

**An ‘orphan’ gamma-ray burst afterglow**

A radio source that has been decaying for the last 30 years, known as FIRST J1419+3940, is potentially linked to fast radio bursts and/or long gamma-ray bursts. The source is actually located in an environment that resembles FRB 121102. European VLBI Network (EVN) observations, including the 25 m telescope at Onsala, of the source have revealed an expansion, which suggests that the source is the orphan afterglow of a long gamma-ray burst.

When the biggest stars in the Universe reach the end of their lives, they collapse due to their own gravity and produce a supernova explosion. In some cases, they also emit a long gamma-ray burst (GRB) lasting seconds or minutes. This GRB is only visible if pointing directly towards the Earth. There is, however, a long-lived afterglow that expands at relativistic velocities and, after isotropization, can be visible at radio frequencies even if the gamma-ray emission was not observed, Fig. 4. This is termed an ‘orphan’ GRB afterglow, but so far there were no solid detections of such objects.

The team conducted observations of FIRST J1419+3940 with the EVN in September 2018 to study the source on milliarcsecond scales and search for Fast Radio Bursts (FRBs) with the Effelsberg single-dish telescope. They detected FIRST J1419+3940 as a compact radio source with a size of 3.9 ± 0.7 mas (1.6 ± 0.3 pc given the angular diameter distance of 83 Mpc). These results confirm that the radio emission is nonthermal and imply an average expansion velocity of (0.10 ± 0.02)c, which is consistent with a GRB jet expansion. Although no FRBs were detected during these observations, FIRST J1419+3940 could still be a potential source of this kind of bursts.
Figure 4. Artist’s impression of the time evolution of the observed event: from the original massive star, and the explosion during its death that produced a hidden gamma-ray burst, to the afterglow that was finally observed. Credit: Benito Marcote, JIVE, The Netherlands.

Benito Marcote, JIVE, The Netherlands

The above results are published in Marcote et al. (2019).
Other News

A new visitor center for space technology and astronomy

Chalmers is building a new visitor center for space technology and astronomy, located on the Onsala site between the 25-metre and Twin telescopes. A groundbreaking ceremony for the new building was held on September 19, marking the start of what is planned to be a uniquely climate-friendly building project, Fig 5.

– For over 50 years, Onsala Space Observatory has increased our understanding of our universe and has led Chalmers to an ever greater commitment to space research and its applications. In the new visitor centre, the public will have a better opportunity to experience the universe and our space activities, said Stefan Bengtsson, Chalmers President.

Figure 5. First spade in the ground for the new visitor centre: Lena Sommestad, county governor for Halland region, and behind her Lisbeth Schultze, county administrator for Västra Götaland region, shared the most important task at the groundbreaking ceremony.
European Radio Interferometry School 2019

The eight European Radio Interferometry School (ERIS) was organised by Onsala Space Observatory, Chalmers, in Gothenburg October 7-11, 2019. It is a bi-annual graduate level school that forms a fundamental part of the training and development of young radio astronomers primarily from Europe, but also from RadioNet partner countries throughout the world. The school has both lectures and practical tutorials that are given by invited specialists in interferometry who have the expertise and experience in using the main European radio astronomy facilities, which include the Atacama Large Millimetre/Sub-millimetre Array (ALMA), the e-Multi-Element Remotely Linked Interferometry Network (e-MERLIN), the European VLBI Network (EVN), the Low Frequency Array (LOFAR) and the Northern Extended Millimetre Array (NOEMA).

ERIS is open to all regardless of their ethnicity, gender and academic position. In total, 72 participants attended the school from 28 countries, Fig. 6. The vast majority of the participants were at graduate level (Masters/PhD). The gender ratio (females vs males) for both students and lectures/tutors were close to 50:50.

The event received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 730562 RadioNet.

Figure 6. Participants in the ERIS 2019. Photo taken during a visit to Onsala Space Observatory. Credit: Magnus Thomasson, Chalmers.
The APEX 12 m submillimeter telescope, jointly operated by Max Planck Institute for Radio Astronomy, European Southern Observatory and Onsala, has been significantly upgraded over the last two years. The APEX workshop, APEX2020, held at Ringberg Castle outside Munich on February 2-5 2020, invites new and old APEX users and interested scientists to become acquainted with the new set of submillimeter receivers which will be taken into operation in 2020. The conference is a very good opportunity for scientists to present their new results as well as to get ideas for future science projects with APEX.

For more information and registration please visit
https://events.mpifr-bonn.mpg.de/indico/event/134/