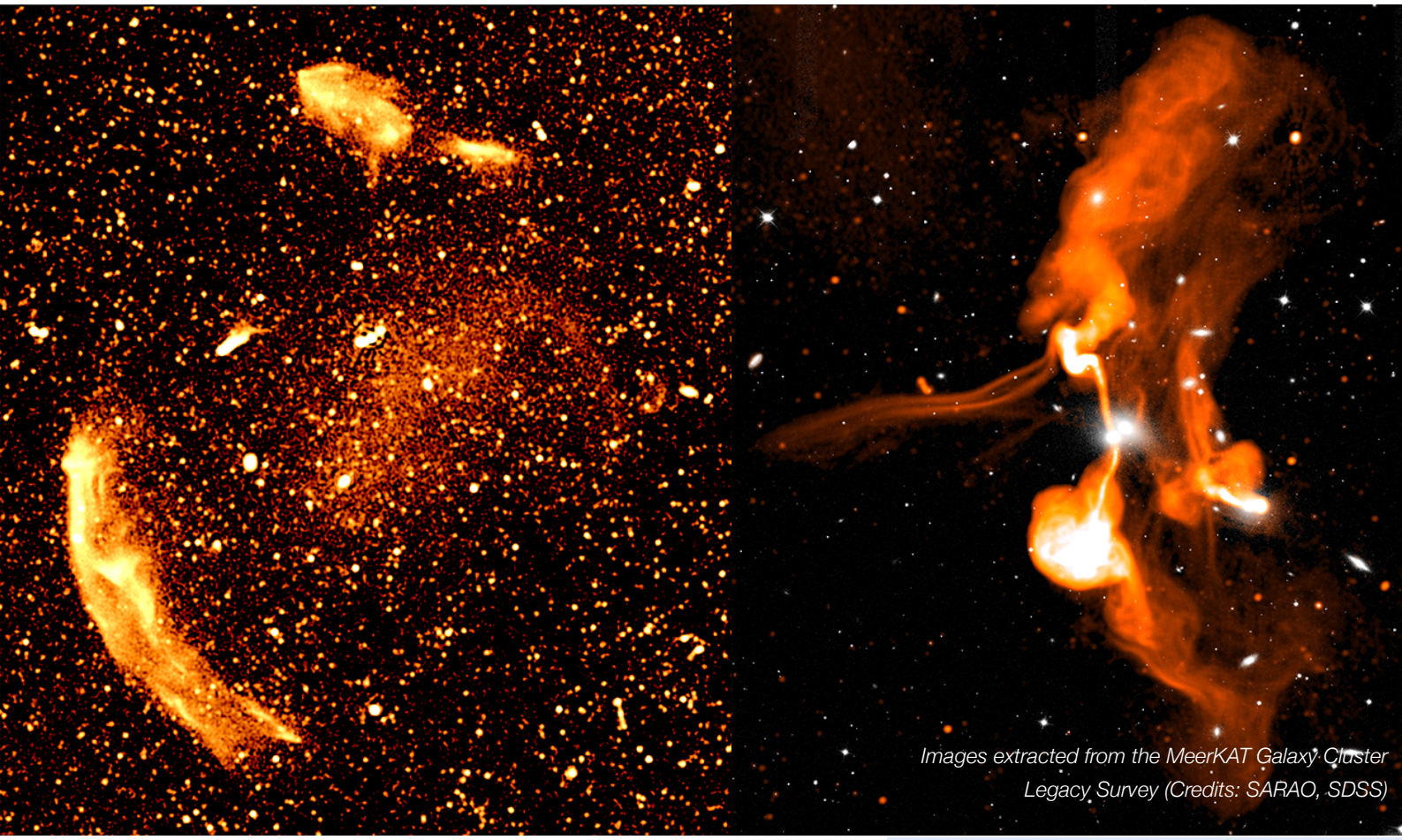
NOV. – DEC. 2021, ISSUE 54

News from SKA-France

BIMONTHLY BULLETIN



Images extracted from the MeerKAT Galaxy Cluster Legacy Survey (Credits: SARAO, SDSS)

PROJECT

Development of the SKA project

After the official start of construction on July 1st, 2021, the SKA project is progressing rapidly in different areas.

Already 27 contracts, worthing approximately €90 million in total, have been signed with all seven current members of the SKA Observatory (SKAO), mostly for software development and early contract awards for professional services contracts. As explained by J. McMullin (SKAO Programme Director and Deputy Director-General) at SKAO webpage, "Adversity is the biggest driver of innovation", and SKAO has been able to quickly adjust to consequences of COVID-19 pandemic. To name a few, a global shortage of semiconductors and shipping issues. More information about contracting and procurement are available on-line.

WHAT'S INSIDE THIS ISSUE

Edited by C. Ferrari (SKA-France Director) in collaboration with the Scientific Council of AS SKA-LOFAR

The SKAO keeps progressing also in terms of the official participations to the project. On November 29, 2021, a two-years cooperation agreement has been signed between the SKAO and the National Research Council of Canada (NRC). This step allows the federal government of Canada giving membership of the SKAO full consideration, while the Canadian community keeps participating in the project from the technical, scientific and socio-economic point of view.

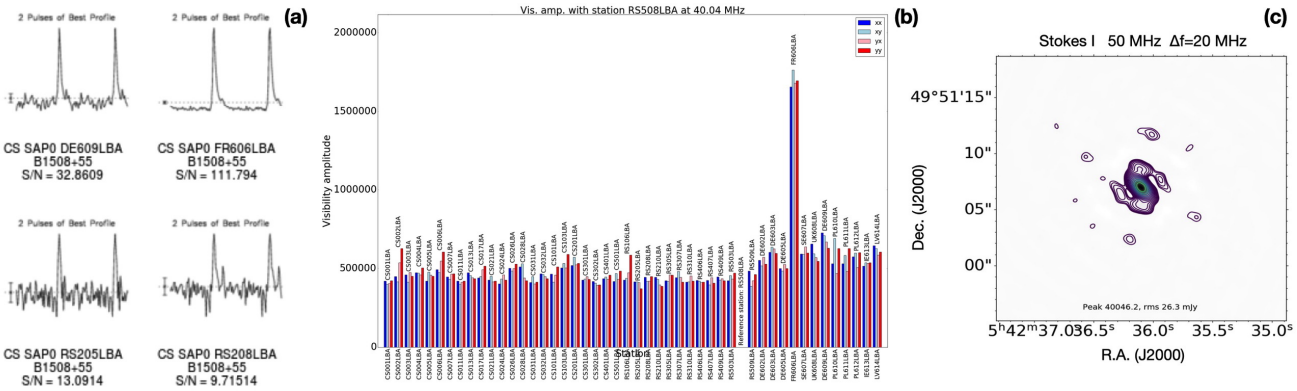
Sustainability is one of the SKAO's foundational values (see e.g. the SKA Session at the virtual conference "Science Digital" around the 75th United Nations General Assembly and a dedicated section of the SKA Phase 1 Construction Proposal). On December 14, 2021, the initiative of the United Nations General Assembly that promulgated 2022 as the International Year of Basic Sciences for Sustainable Development (IYBSSD) has been therefore officially backed by SKAO. As detailed at SKAO webpage, the IYBSSD will be officially launched at UNESCO's headquarters in Paris in mid-2022 and SKAO plans a series of activities in line with the international year.

SCIENCE

NenuFAR becomes a LOFAR super station

Following recent successful tests (coordinated by J.-M. Grießmeier, Orléans University) that demonstrated the feasibility of using NenuFAR (New Extension in Nançay Upgrading LOFAR) as a giant LOFAR low-frequency station (cf. Figure), the International LOFAR Telescope (ILT) Board endorsed on December 14, 2021 the connection of NenuFAR to LOFAR as a Super-Station (LSS mode).

This will increase by a factor 4 to 5 the sensitivity of the baselines connecting Nançay to all the other LOFAR stations, in the Netherlands as well as in the rest of Europe. The gain will likely be higher below 40 MHz and above 70 MHz, where the sensitivity of LOFAR LBA antennas is limited. Giving access to more calibrators, the LSS will greatly increase the sensitivity



(a) Detection of a pulsar by 4 international stations including the LSS/FR606 with a much better SNR (top right) (b) Amplitude of visibilities between 1 Dutch station (RS508) and all other LOFAR stations: the amplitude is >4 times higher with FR606/LSS, as expected (c) Preliminary image of 3C147 in LSS mode, at sub-arcsecond resolution. Residual artefacts require more cleaning to obtain a final image

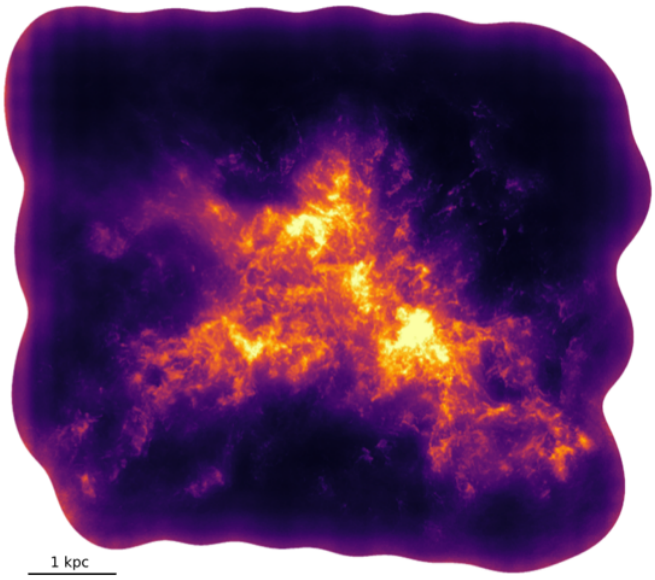
(Credits: J.-M. Grießmeier and collaborators)

of LOFAR 2.0's very high angular resolution low-frequency observations. This will be beneficial for several programs under consideration for LOFAR 2.0, especially its low-frequency survey. NenuFAR standalone observations will also complement LOFAR 2.0 observations, e.g. for the follow-up of candidate radio-emitting exoplanets.

Established in very constructive discussions, the decision officially makes the LSS mode connection a part of the LOFAR 2.0 development. This agreement strengthens the international partnership around LOFAR, recognises NenuFAR's contribution and validates the initial ambition of this project, as well as the result of the efforts of all those who made it possible. In the immediate future, a solution is being sought for the permanent connection of the NenuFAR mini-arrays to the FR606 station at its present standard (i.e. before its 2.0 upgrade), which will allow the LSS mode to be operated with LOFAR as soon as possible (and before the 2025 solar maximum).

First results of the GASKAP project : 21 cm observations of the Small Magellanic Cloud and the Milky Way

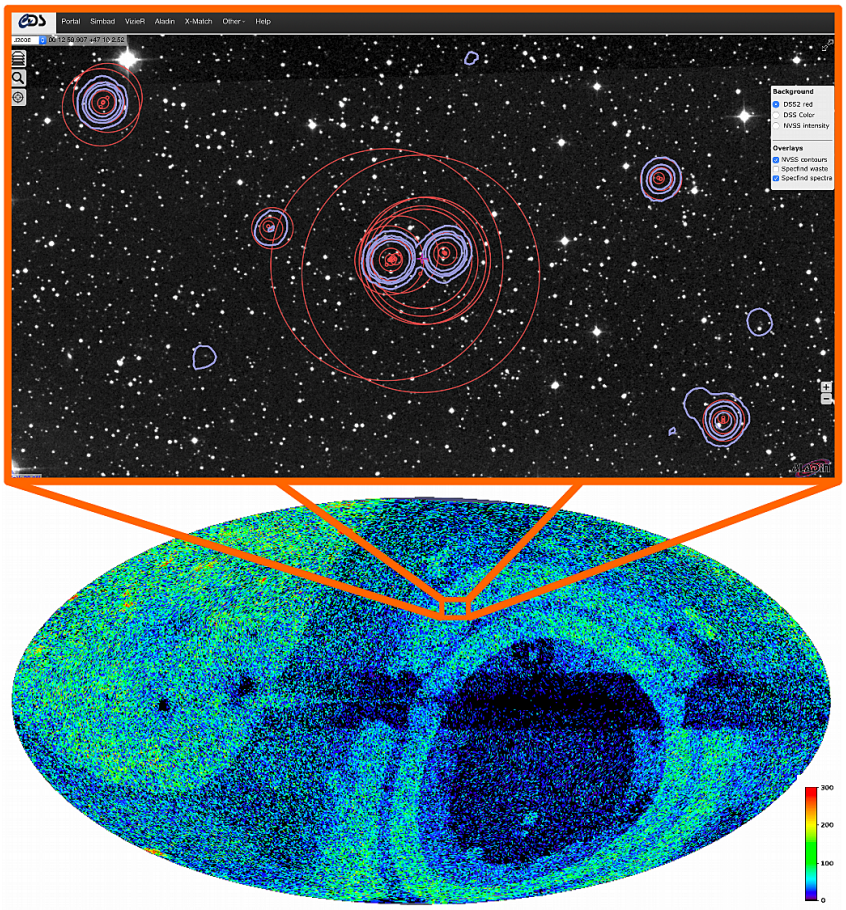
The GASKAP collaboration, including french partrens, has published its first two papers based on 21 cm observations obtained with the Australian Square Kilometre Array Pathfinder ASKAP telescope. The first study, "GASKAP-HI Pilot Survey Science I: ASKAP Zoom Observations of HI Emission in the Small Magellanic Cloud" (Pingel et al. 2021) presents the most sensitive and detailed view of the neutral hydrogen (HI) emission associated with the Small Magellanic Cloud. At 30 arcsec resolution, these data reveal the first view of the atomic gas of the SMC at scales



The peak 21 cm intensity along each line-of-sight for the combined ASKAP and Parkes image cube of the Small Magellanic Cloud
(Credits: Pingel et al. 2021)

comparable to dust and molecular tracers. The paper describes the custom data imaging procedure that had to be designed to account for the specificity of the ASKAP interferometer and for the large data size, and in order to accurately recover the diffuse emission of the entire 25 square degrees field.

The second study, "GASKAP Pilot Survey Science II: ASKAP Zoom Observations of Galactic 21-cm Absorption" (Dickey et al.. 2021) uses the largest density of 21-cm absorption measurements in a region of the Galactic plane, to reveal the properties of the cool HI in the disk. With a significantly larger data sample density than what previous instruments could provide, the authors were able to reliably estimate the scale height of the cool HI in the inner part of the disk, and found an almost constant cool gas fraction of about 1/3 in the outer disk out to about 15 kpc in Galacto-centric radius.



Sky coverage of the 1.6 million radio sources of the SPECFIND V3.0 catalogue (bottom) and zoom on a small region with radio contours overlaid on the optical DSS2 red image of the field

(Credits: Y. Stein et al., CDS)

SPECFIND V3.0 catalogue

Using the VizieR catalogue access tool developed by the Strasbourg astronomical Data Center (CDS), researchers of Strasbourg Astronomical Observatory and University have published a new version (V3.0) of the "SPECFIND" catalogue.

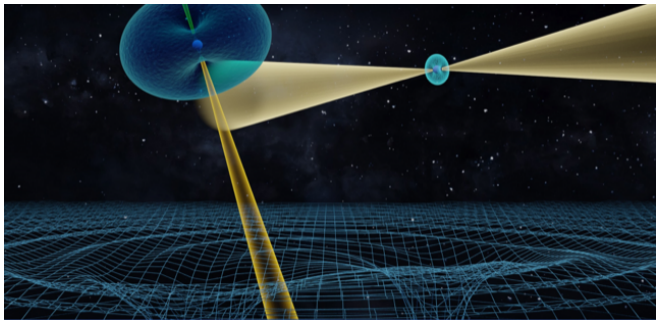
Since its first version, SPECFIND provides cross-identification of radio sources from heterogeneous catalogues and, when possible, radio spectra for each of them.

The paper associated to this third release (SPECFIND V3.0) has been published on Astronomy and Astrophysics in November 2021 (Stein et al. 2021). This release contains the cross-identification of 1.6 million radio sources obtained using more than two hundreds radio continuum input catalogue tables from VizieR at CDS.

By including many radio continuum surveys of the last 50 years, the SPECFIND V3.0 catalogue is not only a useful resource for radio astronomers, but also a beautiful example of how powerful the use of state-of-the-art open access tools developed at CDS can be. As stressed in the CDS press release, SPECFIND 3.0 will be included in the SIMBAD astronomical database, providing more radio continuum data and serving the needs for future projects, such as the SKA and its precursor and pathfinder instruments.

Pulsars: once more excellent probes for fundamental physics

On December 13, 2021, an international team lead by M. Kramer (Max Planck Institute for Radio Astronomy - MPIfR - in Bonn) and including French researchers from CNRS, Orléans University and Paris Observatory-PSL, has published new relevant results about fundamental physics studies based on pulsar observations. The



Artist impression of the Double Pulsar system. Pulsars are neutron stars (the densest celestial objects after black holes) emitting beams of radiation out of their magnetic poles

(Credits: Michael Kramer/MPIfR)

article appeared in Physical Review X (Kramer et al. 2021).

The international team has monitored PSR J0737−3039A/B - a unique system discovered in 2003 and composed of two pulsars in orbit around each other - for 16 years and using seven different telescopes all over the world, including the Nançay Radio Telescope (NRT) in France (over the 900.000 times of arrival measurements, 177.000 are from the NRT).

These observations have allowed the team to conduct several tests of general relativity. One of the most relevant is based on the fact that, as the two pulsars revolve around each other, gravitational waves are emitted. Extremely precise measurements of time intervals between subsequent approaches of the periastron (the point when the orbiting pulsars are nearest to each other) has allowed Kramer and collaborators to test energy carried by gravitational waves with a precision that is 25 times better than similar tests performed by Nobel-Prize winners Hulse-Taylor (using the first known stellar binary containing a pulsar), and 1000 times better than currently possible with gravitational wave detectors. Results agrees with the prediction of general relativity within 0.013%!

For more detailed information about all the tests that have been reported in this publication confirming the validity of Einstein's theory of general relativity at an unprecedented level (e.g. the delay and deflection of light due to a strong curvature of spacetime, or the effect of time dilation that makes clocks run slower in gravitational fields), interesting readers can refer to press releases in English (from MPIfR) and in French (from CNRS).

A wealth of information available thanks to the MeerKAT observations of galaxy clusters

The cover image of this SKA-France bulletin shows spectacular examples of extragalactic radio sources within galaxy clusters and is extracted from the recent announcement (November 11, 2021) of the publication of the MeerKAT Galaxy Cluster Legacy Survey (MGCLS) first data release (Knowles et al. 2021).

Galaxy clusters are huge concentrations of thousands of galaxies. Radio observations are extremely powerful tools to study a wide range of astrophysical processes, such as processes driving the evolution of galaxies within clusters (including their star formation rate, hydrogen gas content, presence of active massive black holes, …), as well as large scale particle acceleration that, interacting with ubiquitous but weak magnetic fields, produce spectacular extended and diffuse radio emission not associated to a specific galaxy, but rather to the intracluster medium.

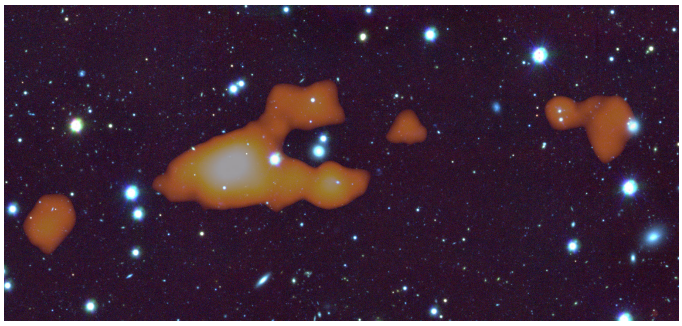
The MGCLS is a programme of long track MeerKAT observations of 115 galaxy clusters, observed between 900 MHz and

1670 MHz for 6-10 hours each. This allowed the authors to get astrophysical information from the continuum radio emission associated to the the cluster (e.g. over the whole frequency range covered in the observations) as well as from narrow frequency channels centred around the neutral hydrogen gas emission line.

The scientific paper, to be published soon in Astronomy & Astrophysics, provides an overview of the survey, its data products and, very importantly, caveats for their usage. The quantity of information that astronomers can use is impressive: a catalogue of more than 600 hundreds compact radio sources, as well as nearly one hundred new extended and diffuse cluster sources, among which more than half were unknown before these observations.

More information about the survey and its initial scientific results are available in the SARAO press-release.

MeerKAT discovery of a mysterious chain of hydrogen gas clouds



Overlay of the neutral hydrogen gas observed by MeerKAT (orange/red colours) on a deep optical image in bands g, r, i of the electromagnetic spectrum (blue/white colours on black background)

(Credits: SARAO)

On December 9, 2021, an international team leading the "MeerKAT Habitat of Galaxies Survey" (MeerHOGS) has announced the discovery of a chain of hydrogen gas (HI) clouds whose physical origin is still unknown (Józsa et al. 2021).

As declared by the first author of this paper, "cosmic filaments are the highways along which mass concentrations come together under the action of gravity". We therefore expect that gas-rich galaxies, using their neutral hydrogen as fuel for star formation and growth, are associated with these structures. MeerHOGS has been conceived to map the radio emission associated to local large scale structures.

The newly discovered HI cloud has been detected at the edge of a relatively massive group of galaxies. The cloud, characterised by seven HI peak concentrations interconnected by a tenuous chain structure, has a total gas mass extraordinarily large (equivalent to 10 billion of our Sun's mass) and it extends over a distance of 1.3 million light years. Its most puzzling property is the fact that this gas chain is extremely dark, since the comparison with radio continuum, ultraviolet, optical and infrared observations do not show any association to emission from stars or to ongoing star formation. As stressed in the SARAO press-release, the accumulation of so much elemental hydrogen without associated stellar components is the largest yet discovered.

The origin of this HI cloud is still unknown. It could be gas associated to smaller clouds that have merged and being accreted by the nearby galaxy group, or, vice versa, it could be a ripped-apart detritus from a tidal event that happened in the past between gas rich galaxies within the group. Answering to these questions is not only interesting to

understand the nature of this particular object, but it can also provide important observational constraints to galaxy formation models.

EVENTS

SKA Regional Centre Training Event Series - Hands-on Containerization

27 Janvier-14 Février 2022 - Virtual Event

The Science User Engagement group of the SKA Regional Centre Steering Committee is glad to announce the "SKA Regional Centre Training Event Series - Hands-on Containerization".

This is the first event of a series that will drive the attendants to understand the basics and dig into more advanced knowledge of the technologies and instruments that will be useful to approach the SKA data. The event will be fully virtual, and it will consist of lectures, tutorials and practicals spread over 3-hour sessions twice a week for three weeks. The format will allow participation and engagement across different time zones.

Format: Lessons and Tutorials on sessions of 3h maximum on Mondays and Thursdays

Preliminary program and registration are now available on-line. Registrations will close on 15th January 2022. Questions can be sent by email.

URSI Atlantic / Asia-Pacific Radio Science Meeting

29 May-3 June 2022 - Gran Canaria

The next URSI (Union radio-scientifique internationale) Atlantic / Asia-Pacific Radio Science Meeting (AT-AP-RASC 2022) will be held in Gran Canaria with a hybrid format.

The full list of sessions and workshops, as well as their descriptions, are now available on-line, together with the call for papers (deadline, January 15, 2022),

We stress here in particular specific sessions organised by the Commission J - Radio Astronomy, including:

- J01: New Telescopes
- J02: VLBI
- J03: Time-domain astronomy - observations and instrumentation
- J04: Cosmological HI - observations and instrumentation
- J05: Wide-field radio astronomy
- J06: Space-based radio astronomy
- J07: Calibration and instrumentation
- J08: CEM method for radio astronomy
- J09: Receiving systems and their components
- J10: Big Data and AI in radio interferometry
- J11: Latest new and observatory reports (open session)
- JE: EMC issues in integration of digital and analog electronics
- JG: Mutual Benefit between radio astronomy and ionospheric science
- JH: Solar, heliospheric and planetary physics

Key dates:

- 15 January 2022 - Paper submission
- 21 February 2022 - Notification
- 24 March 2022 - Authors' and Early bird registration

News from the second NenuFAR Users Workshop

The very low-frequency (10-85 MHz) SKA pathfinder NenuFAR is in the last stage of its deployment at the Nançay Radioastronomy Observatory.

The last set of 16 Mini-Arrays (hexagonal tiles of 19 analog-phased dipole antennas), out of 96, is to be deployed soon, but the instrument has been used for scientific observations since mid-2019 in the so-called 'Early Science' phase. Thanks to the development of dedicated receivers, such as UnDySPuTeD for beamforming observations and NICKEL (the dedicated correlator based on its LOFAR-equivalent COBALT2.0) for imaging observations, researchers from a dozen Key Science Programs are collecting and analysing NenuFAR data to address various scientific questions.

The First NenuFAR Users Workshop, which took place at the Nançay Radio Observatory in March 2019, led to the formation of the "Early Science" Key Projects. The Second NenuFAR Users Workshop was held at the same venue on November 17-19, 2021. Due to the global pandemic context, it took place in hybrid mode, with half of the participants attending remotely.

44 scientists from 19 institutes/countries were given thorough up-to-date presentations of NenuFAR. The recent deployment of 24 additional Mini-Arrays in its 'core' increased the instrument sensitivity, while the first 4 'remote' Mini-Arrays and the NICKEL correlator enabled NenuFAR imaging capabilities since 2020. The various receivers and observing modes were described in detail. The "Virtual Control Room", a versatile graphical web interface used for the management of NenuFAR (from observation planning to instrument status monitoring), was presented and new users learned how to prepare and submit their observation requests. Processing pipelines and dedicated software tools on the Nançay Data Center were explained and live demonstrated, including automatic observation scheduling, data reading/analysis, instrumental simulations and sensitivity & data volume estimations.

A photo of the Second NenuFAR Users Workshop

(Credits: NenuFAR team)

Science Key Project representatives were offered to present their latest results, highlighting the various instrument configurations, observing modes, receivers, analysis techniques & tools used in order to reach the scientific goals pursued. This gave new users a view of the broad range of NenuFAR capabilities and performances.

A large fraction of the workshop was devoted to practical 'hands-on' sessions delivered by NenuFAR experts, both at beginner and advanced levels. Attendants were thus able to reduce and analyse data from the three main observing modes of NenuFAR: beamformed spectrograms, pulsar-specific data and imaging visibilities.

Further workshops are expected to be organised as the Users community grows and new instrument capabilities are made available, such as the forthcoming instrument completion and its integration in the LOFAR 2.0 upgrade as a "LOFAR Super Station" (see page 2 of this SKA-France bulletin issue).

Contacts: Julien Girard, Alan Loh, Baptiste Cecconi and Philippe Zarka.

MeerKAT pulsar timing workshop: all material available on-line

A two-day MeerKAT pulsar timing workshop was hosted by the South African Radio Astronomy Observatory (SARAO) for the first time in September 2021. Conceived to introduce students to pulsar timing science it is now very nicely fully available on-line.

As described at the workshop webpage, it starts out with a set of foundational lectures that provide general introductions to programming and statistical data analysis with accompanying exercises. Principles of pulsar timing are then introduced, along with data analysis and reduction techniques to obtain optimal pulsar timing residuals using MeerKAT data provided to the students. An overview into the physics that can be extracted from pulsar timing analysis concludes the on-line material.

Thanks to SARAO and all colleagues who made all the material available!

JOB ANNOUNCEMENTS

SKA related open position at Inria

Inria, the French national research institute for the digital science, partner of SKA-France, is looking for a scientific engineer to work on High-Performance Computing (HPC) challenges of the SKA project in collaboration with national and international SKAO partners. The position will start as a temporary contract. All information, including required skills and benefits package are available online.

The recruited person will be part of SKAO PlaNet team that is dedicated to platforms (benchmarking, co-design, profiling, etc) and network issues. This participation involves direct engineering work, regular intra/inter team meetings, closely follow the development of SKA software, define and test benchmarks on different hardware, etc. Raised questions related to various High Performance Computing (HPC) topics such as programming models, I/O, application performances, resource management, or energy efficiency.

Contact person: Christian Perez
Deadline for applications: February 28, 2022

SKAO Current Vacancies

The following SKAO positions are currently open:

- DevOps Engineer - Contract Type: Permanent (closing date: January 16, 2022)
- Science & Operations Administrator - Contract Type: Permanent (closing date: January 18, 2022)
- Resourcing / HR Administrator - Contract Type: Permanent (closing date: January 20, 2022)
- Head Of Science Operations - SKA-Low Telescope - Contract Type: Permanent (closing date: January 30, 2022)
- Future Opportunity - Specialist Engineer (Various Disciplines) - Contract Type:

Permanent (closing date: March 31, 2022)

- Future Opportunity - Control Systems Engineer - Contract Type: Permanent (closing date: March 31, 2022)
- Future opportunity - Platform Developer - Contract Type: Permanent (closing date: March 31, 2021)
- Future Opportunity - RF Engineer - Contract Type: Permanent (closing date: March 31, 2022)
- Future Opportunity - System Engineer - Contract Type: Permanent (closing date: March 31, 2022)
- Future Opportunity - UX Specialist - Contract Type: Permanent (closing date: March 31, 2022)
- Future Opportunity - Database Developer - Contract Type: Permanent (closing date: March 31, 2022)
- Future Opportunity - High Performance Analysis Algorithm Developer - Contract Type: Permanent (closing date: March 31, 2022)

Interested readers can register to automatically receive an e-mail as soon as a relevant job is published. More information can be found at the SKAO webpage.

COMMUNICATION

SKA in the French press

On November 8, 2021, ActuaIA (French magazine about Artificial Intelligence developments) has highlighted the announcement that the Second SKAO Data Challenge (SDC2) has been won by a French team who has benefited from the MINERVA project funded by the Observatoire de Paris – PSL and has used the resources of the French National Jean Zay supercomputer of GENCI operated by the CNRS institute IDRIS.


ActuIA

ACCUEIL THÉMATIQUES SECTEURS ACTEURS AGENDA TUTORIELS ÉTUDES MAGAZINE

Intelligence artificielle · Une équipe française du projet MINERVA remporte le SKAO Data Challenge 2021...

Une équipe française du projet MINERVA remporte le SKAO Data Challenge 2021 en utilisant le supercalculateur Jean Zay

8 novembre 2021

L'observatoire en radioastronomie du projet SKA est annoncé comme l'une des plus grandes machines sur terre. Il s'étendra sur un kilomètre carré comme son nom le laisse présumer : Square Kilometer Array. SKAO, l'observatoire de SKA, fournira aux scientifiques des données d'une qualité inégalée, en grande quantité et d'une grande diversité. Cette année était organisée la seconde édition du Data Challenge de SKAO (SDC2), auquel ont participé des scientifiques du monde entier et c'est l'équipe MINERVA de l'Observatoire de Paris/PSL avec le CNRS, l'Observatoire de la Côte d'Azur, l'Observatoire astronomique de Strasbourg, le partenariat de l'Institut canadien d'astrophysique théorique qui a remporté le challenge grâce à un algorithme innovant ayant bénéficié des compétences du supercalculateur Jean Zay GENCI-IDRIS/Centre National de la recherche scientifique.