



Prospects for Low Frequency Radio Astronomy in South America

IAR 60th ANNIVERSARY

Book of abstracts

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PROSPECTS FOR LOW FREQUENCY RADIO ASTRONOMY IN SOUTH AMERICA:
BOOK OF ABSTRACTS

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Buenos Aires, Argentina, November 2022.

Foreword

Welcome to Buenos Aires!

The development of radio astronomy has been linked to a strong technological impulse. This process is being accelerated thanks to the ambitious new instruments in operation and development, like the Atacama Large Millimeter/Submillimeter Array and the Square Kilometer Array. Latin American countries need to participate more actively in scientific research and technological developments in the area, and the Multipurpose Interferometer Array project, being developed at the Instituto Argentino de Radioastronomía (IAR), is an important step in this direction. The workshop “Prospects for Low-Frequency Radio Astronomy in South America” is designed to exchange and discuss ideas, experiences, and research perspectives in this exciting field of centimeter to meter Astronomy. The meeting will consist of various review conferences on cutting-edge topics, talks on specific scientific-technological research, and plenty of time for discussion throughout four days. Participants will also have the opportunity to visit the IAR and celebrate during these days IAR’s 60th ANNIVERSARY (detailed info at <https://congresos.unlp.edu.ar/iar60ws/>).

Scientific organizing committee:

- Andruchow, Ileana
- Benaglia, Paula (Chair)
- Gancio, Guillermo Matías
- Romero, Gustavo Esteban

Local organizing committee:

- Andruchow, Ileana
- Aquino, Esteban Facundo
- Benaglia, Paula
- Borgetto, Marcos
- Galante, Camila Ailén
- García, Leandro Manuel (Chair)
- Saponara, Juliana

Final words

Now that we have arrived at the end of the conference, it is my time to say a few words.

First I want to say that I am very happy indeed with the outcome of this meeting. We have had a set of very diverse talks, covering a wide variety of subjects, and this is a felicity because it is a promise of the many things to do in the future.

To organize a meeting such as this, actually any scientific meeting, requires several ingredients. First you need a clear motivation. Then you need a team to run the show, then you need some sponsors –since without funding it is impossible to carry out the enterprise–, and finally you need the participants. And the secret of success is the quality of the ingredients, as any good cook knows. And I think we had very good ingredients here.

We had a clear motivation: we want to have a better institute, and we thought in using the opportunity of the occasion of the 60th anniversary of our institute to make a workshop where we could learn from some remarkable people how to improve and to show them what we are doing right now, and what are the prospects for the future; and I think this is a noble motivation.

Then, the team. We had a wonderful organizing committee, and the driving force behind it was Paula Benaglia. I also want to mention the other people in the local organization. Ileana Andruchow who was always here helping with everything. Marcos Borgetto that contributed with many tasks prior and along the workshop, Facundo Aquino with the preparation of the media material and the computing these days, and Juliana Saponara and Camila Galante. And then, I also want to thank the venue hotel liaison Maria Cecilia Casasco.

A word of gratitude to our sponsors: this meeting would not have been possible without the strong support from the Office of Naval Research Global, and specially Kyle B. Gustafson: he helped us all the way from the application for funding to the aftermath. I want to thank him and also the Embassy of the United States of America here in Argentina for all the support received.

Also, we got support from the Comisión Nacional de Actividades Espaciales, for which I am grateful. I thank the Universidad Nacional de La Plata and the Consejo Nacional de Investigaciones Científicas y Técnicas, too, for help on different levels.

My final thanks are to all of you: for your talks, your questions, your commentaries, your participation.

I hope to see you very soon again here working with us for a better future for radio astronomy in Argentina and also in South America.

Thank you.

Gustavo E. Romero
IAR's Director
Buenos Aires, November 18, 2022.



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1. Invited Talks

1.1 Science research from the Instituto Argentino de Radioastronomía

Benaglia, Paula
Instituto Argentino de Radioastronomía, Argentina

Abstract: In this talk, I will present a personal review of the main scientific achievements carried out by researchers working at IAR, and show the global parameters of the production and the people involved. Besides, in the frame of the current instrumental developments along Argentina, the scientific objectives of MIA will be briefly depicted.

1.2 Astrophysics as a service: Turning radio astronomy as an opportunity to impact society and businesses

Fliger, Elias
Instituto Argentino de Radioastronomía, Argentina

Abstract: For more than 25 years, IAR has been directing efforts from basic research and radio astronomy development to technology transfer projects around the National Space Plan and to SMEs. With the surge of COVID-19, our organization's transformation accelerated, bringing new opportunities and challenges which can be applied to impact health, education, processes and businesses. In this talk, I will review our efforts to bridge the gap between basic science and the needs of our society.

1.3 IAR Multipurpose Interferometer (MIA) and development of the technological demonstrator

Gancio, Guillermo
Instituto Argentino de Radioastronomía, Argentina

Abstract: The Argentine Institute of Radio Astronomy is developing a new radio astronomical observational instrument called Multipurpose Interferometer Array, MIA which initially consists of an arrangement of 16 antennas of 5 meters in diameter arranged in an area that can cover 50Km in

order to obtain an angular resolution of at least 1.5 seconds of arc in Band L, that is, 1420 MHz. In order to advance in the design and planning of MIA, began the development of a prototype or Pathfinder that will be installed in the IAR, where 3 complete antennas will be tested and the Back End Digital and Correlator for the implementation of the functions of correlation between the different baselines thus obtaining the interferometry products. In this talk, the main aspects of the MIA instrument and advances in the development of the pathfinder will be explained.

1.4 Galaxy clusters at low radio frequencies – New insights on non-thermal emission and surprising new phenomena

Giacintucci, Simona
Naval Research Lab, USA

Abstract: Extended radio emission from galaxy clusters takes many shapes. Radio jets and lobes are routinely observed from cluster galaxies, their radio structure often shaped by motions of the surrounding hot X-ray emitting gas. Diffuse emission from the intra-cluster medium itself takes the form of giant cluster-wide synchrotron halos, elongated relics, and mini-halos that fill the cluster cores. Their origin is an intriguing problem of the physics of the intra-cluster medium. Low-frequency radio observations play a crucial role in the study of cluster radio sources, which are often characterized by steep synchrotron spectra. Recent observations have provided new insights on these complex non-thermal sources, revealing surprising phenomena. In this talk, I will present a number of remarkable examples that may challenge our current physical picture of galaxy clusters and understanding of particle acceleration processes in the intra-cluster medium.

1.5 Toward a global network of radio telescopes for ionospheric science

Helmboldt, Joseph
Naval Research Lab, USA

Abstract: Density fluctuations within Earth's ionosphere complicate radio-frequency astronomical observations, especially at low frequencies (<500 MHz). In particular, synthesis-imaging interferometers with baselines longer than a few km can lose coherence and be unable to image sources within this frequency regime. Conversely, these corrupted observations can serve as extremely precise probes of ionospheric structure on spatial scales from kilometers to 100 km and on time scales on the order of seconds to hours. It is not surprising then that in the past few decades, several unique investigations of ionospheric disturbances have been undertaken using telescopes such as the Very Large Array (VLA), the Long Wavelength Array (LWA), the Low-Frequency Array (LOFAR), the Murchison Widefield Array (MWA), and the Giant Metrewave Radio Telescope (GMRT). While these pioneering efforts have quite successfully elucidated several unique aspects of ionospheric structure, they suffer from a common shortcoming: portability. Establishing a network of similar telescopes to enable global studies of ionospheric disturbances/irregularities is not economically feasible. Here, we describe efforts to develop a Deployable Low-band Ionosphere and Transient Experiment (DLITE) to address this. The DLITE system is an interferometer consisting of four LWA inverted vee dipole antennas spread out over baselines of 200–500 m. The backend uses commercial off-the-shelf parts, including software-defined radios with the real-time “correlator” at its heart written in GNURadio. DLITE operates in a nominal band of 30–40 MHz, using time difference of arrival (TDOA) methods and nonlinear fitting techniques to isolate bright cosmic sources in the sky. By monitoring “A-Team” sources (Cygnus A, Cassiopeia A, Virgo A, Taurus A, Hercules A, Hydra A, and Centaurus A) with a relatively wide bandwidth, the array can detect the

intensity and phase fluctuations from irregularities with strength parameters as small as $CKL = 1027$. Additionally, by using DLITE to track the apparent motions of these sources, transverse gradients in the line-of-sight total electron content (TEC) can be measured with a precision $\sim 10^{-4} - 10^{-3}$ TECU km^{-1} . More details can be found within the DLITE system paper (Helmboldt et al. 2021). We will discuss the current state of the network, which consists of three arrays in Maryland, New Mexico, and Florida; recent science results; and plans/opportunities for future deployments.

1.6 MeerKAT - from conception to science

Kapp, Francois
California Institute of Technology, USA

Abstract: The MeerKAT radio telescope is situated in the arid Karoo region of central South Africa. The development and deployment of MeerKAT marked a dramatic increase in radio astronomy activity in the country and region. The history of MeerKAT is also tied to that of the SKA in South Africa. This talk will provide a historical overview of MeerKAT, including key decision points, important factors in the success of the telescope, and lessons learned.

1.7 Pulsar observations at low radio frequencies

Lousto, Carlos
Rochester Institute of Technology New York, USA

Abstract: The Pulsar Monitoring in Argentina (PuMA) collaboration between IAR and RIT has been observing southern pulsars with high cadence using the two restored IAR antennas in the L-Band (1400MHz). A program to observe transient phenomena, such as magnetars and glitching pulsars as well as the precise timing of millisecond pulsars has been carried out since 2017. Access to lower frequency bands, where most of the pulsars are brighter, allows us to reach additional pulsars currently buried in the interference noise. For instance, we display two dozen glitching pulsars that could be easily observable by MIA in the 400MHz band. We also discuss the challenges and importance of pulsar timing at low frequencies.

1.8 An Argentinian window to the fast transient sky and to the very high-resolution observations

Marcote, Benito
Joint Institute for VLBI Eric - The Netherlands

Abstract: The transient sky is composed of diverse phenomena that exhibit drastic changes in short timescales. These events range from sub-second emission to weeks and month timescale variability. Several challenges need to be addressed by any facility that aims to observe such events: a fast re-positioning scheme to trace the first moments of events like Gamma-Ray Bursts (GRBs), a large field of view to be able to detect new Fast Radio Bursts (FRBs), or high sensitivity to detect the outflows and flaring activity in Galactic binaries. Combined with a large bandwidth in order to recover the spectral information from these sources, it would allow us to unveil the physical properties required in these systems. The new Multipurpose Interferometer Array (MIA) in Argentina may represent a suitable facility to conduct deep and leading-edge studies on the transient sky as the ones aforementioned. In this talk, I would summarize these topics and how astronomers may exploit the MIA for these purposes. Additionally, I would discuss the interest from the community in the possibility of connecting the 30-m IAR antennas within a VLBI network such as the European VLBI Network (EVN), and place Argentina in the map to achieve very-high-

resolution (on the milliarcsecond level) observations. This mode, together with the observations with the MIA would open a potential new regime that would allow astronomers to significantly increase our knowledge of the Southern Sky.

1.9 IAR: past, present, future

Romero, Gustavo E.
Instituto Argentino de Radioastronomía, Argentina

Abstract: I present an overview of the Instituto Argentino de Radioastronomía (IAR): its origins, milestones, present, and prospects.

1.10 SAGA of SARAS: An experiment to detect the global cosmic down / epoch of reionisation signal

Udaya Shankar, Narayana Rao
Raman's Research Institute, India

Abstract: The SARAS (Shaped Antenna Measurement of the background Radio Spectrum) is an ongoing experiment aiming to detect the redshifted global 21-cm signal expected from Cosmic Dawn (CD) and the Epoch of Reionization (EoR). Observations of the 21 cm transition are challenged by the orders-of-magnitude brighter foreground from Galactic and extragalactic radio emission, ionospheric effects, radiofrequency interference (RFI), and the chromatic response of the radiometer. This talk traces the evolution of the SARAS design, the challenges faced, and the results of our observations. The talk will describe our approach to modelling the Galactic and extragalactic radio emission using maximally smooth functions. Its feedback on the antenna design and the evolution of antenna design from a fat dipole on an absorbing ground plane to the first of its kind, "A Floating Octave Bandwidth Cone-Disc Antenna", will be discussed. The talk will highlight system design emphasis on achromaticity, double differencing, optical isolation and cross-correlation digital spectrometer for improved accuracy in calibration and rejection of additive and multiplicative systematics. We follow a system design philosophy to nip the systematics before it even buds. I will share our adventures to look for interference-free sites on mountains 5000m high and sufficiently broad and deep lake waters to minimise systematics arising from ground reflections. I will describe the salient features of our data analysis scheme, which showed that the profile of Bowman et al. in data taken with EDGES low-band instrument is not of astrophysical origin. The conclusion will touch upon what is next in the SARAS collaboration.

1.11 Extragalactic science with the Murchison Widefield Array

Vernstrom, Tessa
International Center for Radio Astronomy Research - University of Western Australia, Australia

Abstract: The Murchison Widefield Array (MWA) is a low-frequency radio interferometric telescope based in the world's quietest radio astronomy zone: the Murchison Radio-astronomy Observatory (MRO) in rural Western Australia. It is designated as one of the Precursors to the Square Kilometre Array (SKA) Low telescope and has been revolutionising our understanding of the low-frequency extragalactic radio sky. The phase I all-sky survey, GLEAM, and the follow-up Phase II survey, GLEAMX, are the only wide area surveys to cover the Southern sky at such low frequencies. From these a wealth of science has already been enabled from new kinds of transients, GHz peaked spectrum sources, diffuse cluster sources, and discoveries of synchrotron emission from the cosmic web. In this talk, I will cover the details of the telescope and these transformative surveys and go

over some of the science highlights thus far as well as looking to the future.

1.12 Instrumentation and technology supporting the Event Horizon Telescope

Weintroub, Jonathan

Center for Astrophysics | Harvard & Smithsonian, USA

Abstract: The Event Horizon Telescope (EHT) is an Earth-size very long baseline interferometry (VLBI) array, operating at the shortest radio wavelengths of about 1 millimeter, corresponding to radio frequencies 230 GHz and higher. As a result it has an extremely fine angular resolution of the order of 20 microarcseconds. For supermassive black holes (SMBH) which are relatively nearby and sufficiently massive, this is the angular scale subtended by the event horizon. Relativistically lensed emission from the black hole's accretion disk and jet can be directly observed. Retrofitting new wideband technology and atomic clocks to existing radio telescopes led to the first image of the "shadow" of the event horizon of the black hole in M87 and SgrA* at the center of the Milky Way. I will give an introduction to the science behind the EHT and describe the significance of the image published in 2019, and of polarization images published just the year. The balance of the talk will focus the technology and instrumentation that enabled these observations. I will close by outlining our vision for the next generation EHT or ngEHT.



2. Talks

2.1 Radio emission from ultraluminous X-ray sources

Abaroa, Leandro^{1,2}; Romero, Gustavo E.¹ & Sotomayor, Pablo¹

1 - Instituto Argentino de Radioastronomía, Argentina

2 - Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Argentina

Abstract: Ultraluminous X-ray sources are point-like, extragalactic non-nuclear objects, where the luminosity in the X-ray band appears to be higher than the Eddington luminosity. These objects are thought to be X-ray binaries accreting at super-Eddington rates, in which the $\sim 10^{40}$ erg/s power in the X-ray band is emitted from the innermost part of the accretion disk around the compact object. The super-critical disk ejects a powerful radiatively-driven wind that collides with the stellar wind, where strong shocks are generated. In this work, we show that the collision of winds in these systems leads to nonthermal emissions. The ULXs usually yield a broadband spectrum, with radio luminosities of the order of $\approx 10^{34}$ erg/s produced by the electron synchrotron radiation.

2.2 Development of an antenna array simulator

Cabral, Luca

Instituto Argentino de Radioastronomía, Argentina

Abstract: The first task to solve in designing a radio interferometer is the location of the antennas, a problem that defines the interferometer response, whose solution determines which points of the (u,v) plane will be sampled, together with their density. These two parameters are extremely important because the antenna's location, in turn, defines the synthesized beam or point spread function of the whole instrument, and an inadequate array configuration implies an ill-constructed synthesized beam. Consequences, in this case, are for example the need to delete measures over a range of spatial frequencies due to low signal-to-noise ratio, or, at the data reduction stage, to degrade spatial resolution in order to get a cleaner image. In order to have a better understanding of the parameter involved in the interferometer response, in this presentation we will introduce an in-progress simulator that provides the (u,v) distribution and the corresponding synthesized beam, like other common software developed years before, but that it is also able to run various optimization tasks, like Lagrangian multipliers or custom tasks more related with the particular characteristics of this problem.

2.3 A machine learning approach to inverse problems and its application to microwave tomography imaging

Caiafa, César¹ & Irastorza, Ramiro²

1 - Instituto Argentino de Radioastronomía, Argentina

2 - Instituto de Física de Líquidos y Sistemas Biológicos, Argentina

Abstract: Solving ill-posed inverse problems has applications in imaging systems found in various areas of science and technology, from medical diagnosis to astronomical studies. The reconstruction of images from limited and noisy measurements requires the development of algorithms that can incorporate the physical mechanisms by which these measurements are produced, together with the properties of the images under study. In this talk, the sparse representation of images is introduced, which is a realistic, compact and effective generative model for natural images allowing us to solve, for example, ill-conditioned linear inverse problems by training the model on a large set of images. A potential application of this type of technique is microwave tomography imaging. Microwave tomography can potentially provide a low-cost and non-invasive imaging tool with applications in medicine and other industrial fields. Currently, our institute is involved in a collaboration project for developing a laboratory prototype of the measurement device and new image reconstruction algorithms based on machine learning ideas. The preliminary results of this project will be presented in this talk.

2.4 LLAMA millimeter and submillimeter observatory. Current status

Fernández López, Manuel (on behalf of the LLAMA Science Group)

Instituto Argentino de Radioastronomía, Argentina

Abstract: The Large Latin American Array (LLAMA) will be a millimeter and submillimeter 12-meter antenna installed in Salta, toward the northwestern border of Argentina. This bi-national project between Argentina and Brazil is getting momentum to get operational in the next few years. The IAR has been historically one of the promoters of this project and today is still one of its main actors. In this talk, I will present the current status of the LLAMA project from the technical side, and a brief summary of its recently updated scientific niches, including the perspective of LLAMA as a member of the next generation Event Horizon Telescope (ngEHT).

2.5 Search for extraplanar radio emission in a sample of edge-on starburst galaxies

Galante, Camila^{1,2}; Romero, Gustavo E.^{1,2}; Saponara, Juliana¹ & Benaglia, Paula¹

1 - Instituto Argentino de Radioastronomía, Argentina

2 - Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Argentina

Abstract: The intense star formation in starburst galaxies results in the production of strong winds that sweep matter up to 10 kpc out of the galactic plane. These winds can be detected in several bands of the electromagnetic spectrum. At radio wavelengths, they can be detected when the galaxies are observed edge-on. We present the current status of the analysis of a small sample of edge-on starburst galaxies that we recently observed by means of radio interferometer techniques. We explain the criteria used to select them, the methodology developed to detect the presence of the winds and discuss the next steps in this work, as well as the expected results.

2.6 An approach to detecting the 21cm signal from the reionization epoch using the MIA array

García, Octavio¹; Domínguez, Mariano²; Valotto, Carlos²; Pellizza, Leonardo³; Ramírez, Marcos¹; Araujo Furlan, Susana⁴; Rodríguez Kamenetzky, Adriana¹ & Pedrosa, Susana³

1 - Universidad Nacional de Córdoba, Argentina

2 - Instituto de Astronomía Teórica y Experimental - Observatorio Astronómico de Córdoba, Argentina

3 - Instituto de Astronomía y Física del Espacio, Argentina

4 - Instituto Argentino de Radioastronomía, Argentina

Abstract: First stars and galaxies formation produces the IGM reionization. Several interferometers that have been built could observe this process by detecting the hydrogen's 21cm line in the high redshift universe between 50 y 200 MHz. We simulated the signal and its detection for simplified foreground scenarios using the array's final configuration.

2.7 End-to-end developments for the MIA Pathfinder from the IAR electronics laboratory

González, Juan Manuel¹; Valdez, Gastón¹ & Command, Hugo¹

Instituto Argentino de Radioastronomía, Argentina

Abstract: The MIA is a radio astronomical instrument based on interferometry techniques, designed for the detection of radio emissions from astronomical sources. Phase one consists of 16 antennas of 5 meters in diameter, with the possibility of increasing their number. In addition, it is equipped with a dual polarization receiver with a bandwidth of 250 MHz, centered at 1325 MHz, and a digitizer and processor for the correlation functions. For the development of this instrument, a three antenna pathfinder is currently being built with its positioning control, radio frequency systems, acquisition and processing stages. This presentation will describe the concept design and its current progress for each stage.

2.8 Peruvian capabilities to study the Geospace and beyond

Marco A. Milla Bravo

Pontificia Universidad Católica del Perú, Peru

This year, we have celebrated the 60th anniversary of the Jicamarca radio observatory, a Peruvian research facility dedicated to the study and observation of the ionosphere and upper atmosphere. The observatory operates a variety of instruments, among them, the most powerful incoherent scatter radar in the World. The Jicamarca radar with its gigantic antenna (that covers an area of $300 \times 300 \text{ m}^2$) has contributed significantly to the development of space physics and aeronomy research. Over the years, the system has undergone multiple upgrades, expanding its capabilities to conduct more complex experiments and allowing the possibility of new scientific discoveries. Recently, the development of a major upgrade for the radar system has started. Two VHF radio receiving systems, effectively, two low-frequency radio-telescopes composed of around 256 cross-polarized antennas are being designed and will be deployed one to the south and the other to the east of the observatory. These radio telescopes, in conjunction with the Jicamarca radar, will constitute a multi-static incoherent and coherent scatter radar system, improving the capabilities of Jicamarca to study ionospheric dynamics and plasma irregularities, as well as, other geospace phenomena. However, these radio telescopes will have the capability to do much more. Applying digital beamforming, the receiving systems will be capable of pointing simultaneously in multiple

directions at different radio frequencies in the 10–80 MHz band. New studies of the space environment around the Earth will be possible, including radio imaging of the Sun, interplanetary scintillations, and others. In this presentation, we will summarize some of the contributions of the Jicamarca radar to aeronomy and radio astronomy, as well as, a description of the new radar upgrades that will allow us to observe and study the geospace and beyond.

2.9 Black holes in the early universe

Mirabel, Felix^{1,2} & Rodríguez, Luis Felipe^{3,4}

1 - Instituto de Astronomía y Física del Espacio, Argentina

2 - Commissariat à l'énergie atomique et aux énergies alternatives, France

3 - Universidad Nacional Autónoma de México

4 - Mesoamerican Center for Theoretical Physics, Mexico

Abstract: It has been proposed that those SMBHs result from rapidly growing BH seeds of intermediate masses, formed at very high redshifts. I will review the status of the projects for the indirect detection of radio-loud, rapidly growing BHs in the early universe, by means of absorption signals in the highly redshifted 21cm line of HI. It is concluded that low frequency radio arrays, rather than low-frequency global sky detectors are needed for the indirect detection of mass-growing radio loud BHs at redshifts $z > 7.5$. A review on this and other issues has been recently published in *New Astronomy Reviews*.

2.10 Supernovae radio emission

Orellana, Mariana¹ & Bersten, Melina²

1 - Universidad Nacional de Río Negro, Argentina

2 - Instituto de Astrofísica de La Plata, Argentina

Abstract: Supernovae are powerful stellar explosions that mark the final stage in the evolution of some stars. They are extremely luminous events that can be detected out to cosmological distances. Their study has an intricate connection with various astrophysical topics, and therefore they have deserved large investments in terms of observational campaigns. We study them from a complementary perspective, trying to explain optical observations by deriving the physical properties of the explosions and the stellar progenitors. After applying a 1D radiation-hydrodynamic code with a long history of results already published, we can estimate the thermal emission that is channeled to radio wavelengths. As found by other studies, this component is not enough to explain most of the observed SNe that have been monitored so far by different radio telescopes. In order to understand radio emission, interaction with circumstellar material seems to be very relevant. Our prospects, in the near future, are to develop calculations that provide non-thermal luminosities that our code does not currently estimate. Based on the literature, we discuss what kind of assumptions are needed to achieve that goal. Our focus will be directed to the emission produced by supernovae explosions at the low-frequency energy range (100 MHz - 2 GHz) proposed for future facilities that will operate in our country.

2.11 Non-thermal emission of star-forming galaxies

Pellizza, Leonardo¹; Kornecki, Paula²; del Palacio, Santiago³ & Benaglia, Paula³

1 - Instituto de Astronomía y Física del Espacio, Argentina

2 - Observatoire de Paris, France

3 - Instituto Argentino de Radioastronomía, Argentina

Abstract: Star-forming galaxies emit non-thermal radiation across the whole electromagnetic spectrum. Observations show that their radio and gamma-ray luminosities scale with their star formation rates, supporting the hypothesis that non-thermal radiation arises from the cooling of cosmic rays accelerated in stellar systems such as supernova remnants. However, the nature of the cosmic-ray production, transport, and escape processes that shape the emission in these galaxies is still poorly understood, especially at low star formation rates. In this talk we will present population-orientated models developed by us to describe the correlations observed between non-thermal emission and other global galaxy properties, across the whole star formation rate range. We will discuss how these correlations could provide key information on winds, magnetic fields, or the amount of ionized gas in these galaxies. We will pay special attention to the contributions that could be made to this topic by future low-frequency facilities such as the Square Kilometer Array (SKA) or the Multipurpose Interferometric Array (MIA), the latter under development at the Argentine Institute for Radioastronomy.

2.12 Optical system for a mm/sub-mm 12m aperture radiotelescope

Rasztocky, Emiliano
Instituto Argentino de Radioastronomía, Argentina

Abstract: Modern radio telescopes make extensive use of their available space (cabins) to fill them with as many detectors as possible. For this reason, it is essential to use optical systems (commonly known as tertiary optical systems) that couple the detectors with the antenna. The LLAMA radiotelescope, an enterprise between Argentina and Brazil, to be installed during 2023/2024 at 4860 m in Alto Chorrillos, Province of Salta in northern Argentina is not an exception. In this job, I will present, firstly, the NACOS FL (Nasmyth Cabin Optical System for First Light), the optical system developed for the First Light phase of LLAMA, which will allow populating one of the Nasmyth cabins of the Antenna and it is currently in the AIV (Assembly Integration and Verification) process in Brazil. Secondly, I will present the complementary optical system to reach the NACOS LT (Long Term), the complete optical system which will allow the population of the antenna's second Nasmyth cabin.

2.13 Star formation activity in the group of galaxies NGC 6221 & NGC 3263.

Saponara, Juliana¹; Koribalski, Bärbel²; English, Jayanne³ & Yeung, Jing³

1 - Instituto Argentino de Radioastronomía, Argentina

2 - CSIRO Astronomy and Space Science, Australia Telescope National Facility. Western Sydney University, Australia

3 - University of Manitoba, Canada

Abstract: We obtain 21-cm spectral line and continuum data with the MeerKAT interferometer of three nearby galaxy groups known to contain widespread tidal debris. Our targets, the NGC 3263, NGC 2434, and NGC 6221 groups, are at different evolutionary stages. In order to study the star formation activity in the group members and potentially in their tidal features, we use MeerKAT's radio continuum observations along with H_α data from the SuperCOSMOS survey, FIR data (60 μm and 100 μm) from IRAS, and mid-IR (22 μm) from WISE. In this opportunity, we present some preliminary results of the NGC 6221 & NGC 3263 galaxy group. We will discuss possibilities such as separating the thermal contribution from radio continuum emission in the central galaxies of the studied groups to understand the origins, energetics, and thermal and nonthermal processes

producing the radio continuum emission observed in these galaxies.

2.14 PuGli-S: First glitches detected from IAR

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Abstract: Pulsars are radio-bright magnetized and very dense neutron stars. Their very high moment of inertia renders them with an extraordinarily stable rotation, making pulsars one of the most accurate clocks in the Universe. However, the rotational stability of some pulsars is disturbed by glitches, which consist of a sudden increase in the rotation frequency of the pulsar. The physical mechanism behind these glitches is still not well understood. The PuMA collaboration has been monitoring with high cadence since 2017 a set of pulsars from the southern hemisphere that had shown glitches before by using the antennas from the Argentine Institute of Radio astronomy (IAR). Observations were taken in the radio band (1.4GHz), with a bandwidth of 56MHz. In the present study, we report the detection of two glitches in the pulsar PSR J1048-5832 and a glitch in the Vela pulsar, and their characterization through the pulsar timing technique.



3. Posters

3.1 Prospects for detecting fast transients with the radio telescopes of the Argentine Institute of Radioastronomy

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Abstract: We present a study of the prospects for detecting radio transient flares from magnetars and compact objects with the radio telescopes Carlos Varsavsky and Esteban Bajaja of the Argentine Institute of Radioastronomy (IAR). Magnetars are a particular class of young, slowly rotating neutron stars with extremely high surface magnetic fields ($B \sim 10^{13} - 10^{15}$ G). They exhibit X-ray and γ -ray outbursts, where the energy is provided by the decaying magnetic fields. A handful of magnetars have associated pulsed radio emission and a few exhibited large, isolated, and fast radio flares. Studying magnetars and their pulsed emission in radio is necessary for enlightening the characteristics of their outstanding spectral and temporal phenomenology. Additionally, magnetars have long been suspected to be the source of another transient radio phenomenon, fast radio bursts (FRB). Recently, the detection of an FRB associated with the galactic magnetar SGR 1935+2154 lends strong support to the idea that starquakes in magnetars trigger at least some of these events. Pulsating radio emission from magnetars has been detected throughout a long range of frequencies ($\sim 1 - 45$ GHz) with single-dish telescopes. Here we present an analysis of the capabilities at the Argentine Institute of Radioastronomy for performing observational campaigns of magnetars with the goal of detecting single pulses from these objects, and we discuss the methodology and data analysis techniques to be used in forthcoming campaigns with this instrumentation.

3.2 First polarization measurements with the new digital receiver of the E. Bajaja radio telescope at the Instituto Argentino de Radioastronomía

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Abstract: We describe the procedures followed to achieve the calibration of the polarimetric capabilities of the new digital receiver of the 30-m radio telescope Esteban Bajaja, located at the Instituto Argentino de Radioastronomía (IAR). The goal was to optimize the determination of the Stokes parameters associated with polarized radio sources with an adequate characterization of the instrumental errors. An observational campaign targeting at calibration sources, both polarized and unpolarized, was conducted to fix the instrumental properties and the stability of the system. We developed the software for the data analysis. We present here our conclusions.

3.3 High-performance computing simulation of early Universe astrochemical problems

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Abstract: Astrochemistry plays an important role in most of the astrophysical processes at all stages of the universe's life. Most of the chemical processes can't be simulated in labs because of the physical conditions. The cosmological and astrophysical hydrodynamic simulation helps us to understand physical processes in the early Universe. The results of the simulation can help to generate predictions for what low-frequency radio observatories will see. We will present our latest high-performance computing code for the numerical simulation of astrochemical problems. This code can be used as a standalone application for the simulation and visualization of modeled chemical processes as well as a part of hydrodynamics codes for complex astrophysical simulation. We will show some test results for simple and complex astrochemical problems from hydrogen formation to stars astrochemistry as well as complex astrophysical simulation with hydrodynamics, chemistry, cooling/heating, and other processes. This work is supported by RSF grant No. 18-11-00044.

3.4 The new coarray Fortran code for numerical modeling in special relativistic hydrodynamics

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Abstract: A new parallel code based on models of special relativistic hydrodynamics is presented for describing interacting flows. A new highly accurate numerical method is considered and verified. A parallel implementation of the method by means of Coarray Fortran technology and its efficiency are described in detail. The code scalability is 92% on a cluster with Intel Xeon 6248R NKS-1P with 192 Coarray Fortran images [1]. Different interacting relativistic flows are considered astrophysical applications.

[1] Kulikov I., Chernykh I., Karavaev D., Prigarin V., Sapetina A., Ulyanichev I., Zavyalov O. A New Parallel Code Based on a Simple Piecewise Parabolic Method for Numerical Modeling of Colliding Flows in Relativistic Hydrodynamics // *Mathematics*. - 2022. - Vol. 10 (11). - Article Number 1865. <https://doi.org/10.3390/math10111865> This work was supported by the Russian Science Foundation (project 18-11-00044).

3.5 Ultraviolet counterparts detected by HST of CO(3-2) emissors satellite around the HZRG TXS 0828+193

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Abstract: Using the IRAM Plateau de Bure interferometer, Nesvadba et al. (2009) identified intense emission of the line CO (3-2) on TXS 0828+193 halo. This emission line is located 10" South West from the radio galaxy center and consists of two compact components, which were identified as SW1 and SW2. In that study they could not detect the optical counterpart of the CO (3-2) emission. TXS 0828+193 was also observed in 2010 and 2011 with HST ACS and WFC3 in UV emission. Using SExtractor and GAIA software we detected and measured, on the HST images, two sources located South West from the optical center of the galaxy, around the position of the sources detected by Nesvadba. In order to get done the identification of the sources detected by Nesvadba with the sources detected on HST images, we propose new radio observations.

4. Group photo



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