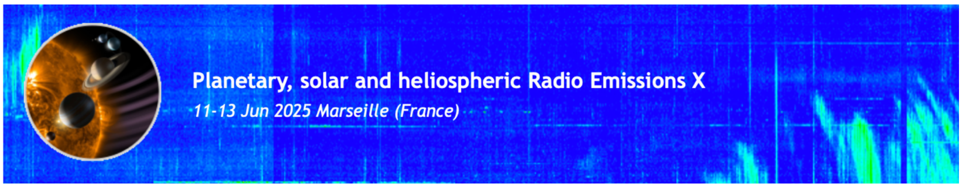

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Deep learning on jovian decametric radioemissions

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Marques et al (1) built a database covering 26 years of daily observation of Jupiter from the Nançay Decameter Array (NDA) (2). We use this database to train semantic segmentation algorithms to automatically identify and localize Jupiter emissions in the observations. We explored different segmentation models (Unet, FPN, SwinUnet) and compare their performance on our task.
We present the results in a website (https://voparis-minerva-jupiter.obspm.fr/). For each observation in the catalog, we represent the classification from Marques et al and our algorithm output. We also provide indicators to assess the performance of the algorithm, and visualizations from Expres simulation (3) and from our Jupiter Probability Tool (4). The algorithm can be also applied to the latest data from the NDA.

(1) Marques, M. S. et al. Statistical analysis of 26 yr of observations of decametric radio emissions from Jupiter. A&A 604, A17 (2017).
(2) L. Lamy, P. Zarka, B. Cecconi, L. Klein, S. Masson, L. Denis, A. Coffre and C. Viou, 1977-2017 : 40 years of decametric observations of Jupiter and the Sun with the Nançay Decameter Array, Planetary Radio Emissions 8, 455-466, 2017. https://doi.org/10.1553/PRE8s455
(3) Louis, C. et al. ExPRES: an Exoplanetary and Planetary Radio Emissions Simulator. Astronomy & Astrophysics 627, (2019).
(4) Aicardi, S., Cecconi, B., & Lamy, L. (2022). Jupiter Probability Tool (Version 1.0). PADC/MASER. https://doi.org/10.25935/TV9M-HX48

*Speaker

Probing the 3D structure of Jovian auroras using Juno-UVS observations

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Jovian auroras, the most powerful in the Solar System, arise from interactions between Jupiter's magnetosphere and its upper atmosphere. While their horizontal structure has been extensively studied, the vertical structure, which depends on the penetration depth of magnetospheric electrons, remains less well understood. Observations from the Hubble Space Telescope (HST) have provided only partial information on this dimension. This work aims to better characterize the vertical profile of Jovian auroral emissions.
We analyzed data from the UltraViolet Spectrograph (UVS) onboard the Juno spacecraft to investigate both the altitude and horizontal distribution of auroral emissions. Using recent maps of the average energy of precipitating electrons in auroral regions, we explored how this energy influences the volume emission rate (VER) of H2. Our analysis includes two types of electron energy distributions: a monoenergetic distribution and a kappa distribution with a value of equal to 2.5.

Based on brightness maps, we reconstructed the three-dimensional structure of the VER for Jovian auroras in both hemispheres, using data from several Juno perijove passes. For perijove 11, we found that in the polar emission region, the average peak altitude of the VER is approximately 250 km for the monoenergetic case and about 190 km for the kappa case. In the main emission region, the peak altitudes are around 260 and 197 km respectively. Similar patterns were observed for other perijoves.

These results are consistent with previous measurements from the Galileo probe and the HST.

*Speaker

They demonstrate the value of Juno data for probing the vertical structure of auroral emissions. Given that the parameter can vary in auroral regions, we assessed its effect on the altitude distribution of emissions.

Our sensitivity analysis indicates that while variations in have only a minor effect on the peak altitude of the VER, they significantly affect its amplitude. This suggests important implications for the thermal and chemical properties of Jupiter's auroral atmosphere.
Determining the vertical structure of auroral emissions and mapping the average energy of precipitating electrons using Juno/UVS observations allows us to understand both the energization processes of magnetospheric particles along Jupiter's magnetic field lines and the influence of magnetospheric precipitation on the thermal structure and chemical composition of auroral regions. These insights will guide future investigations to be carried out with the instruments aboard the JUICE spacecraft.

Comprehensive study of type II radio bursts and the properties of the associated shock waves

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Type II radio bursts are solar radio emissions associated with coronal shock waves and are believed to be produced by electrons accelerated by these shocks. As radio signatures of coronal shocks, they are typically found near the expanding edges of coronal mass ejections (CMEs), making them valuable for studying the dynamics of CME-related shocks in the solar corona. Here, we aim to determine the regions in the solar corona and their properties where the CME-driven shock waves accelerate electrons. To do this, we combine radio observations with magneto-hydrodynamic (MHD) simulations of the solar corona. We conduct an analysis of ten type II radio bursts exhibiting emissions in the 150-300 MHz frequency range from Solar Cycle 25. The novelty of this study lies in the use of radio imaging data for all type II bursts considered to examine the positions of the radio sources. The radio source positions, combined with a geometrical fitting of the CME shock are used to determine essential shock parameters at the acceleration region such as the Alfvénic Mach number and shock normal angle, in the context of the MHD simulations. The shock parameters are then combined in a comprehensive statistical study with the properties of the radio emission observed, electron energies estimated from herringbone radio bursts, CME speeds in both the lateral and radial directions and the presence of open/closed magnetic field regions and other radio emissions.

*Speaker

Geometrical and Local-Time Distribution of Broadband Kilometric Radiation from the Extended Juno/Waves Catalog of Jovian Radio Emissions

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The Juno/Waves cataloged observations between mid-2016 and mid-2019 allowed for the first time to construct the latitudinal distributions of all the jovian radio components (1). Geometrical analysis of these radio observations has proven particularly useful in characterizing the emission beaming and precising the locations of their sources (2). The extension of the Juno/Waves catalog to include data up to early-2023 adds _˜3.5 additional years of low-frequency observations (< 141 kHz) (3). This updated catalog also expands the local-time coverage from 01:00–07:00 to 12:00–07:00, enabling the first study of the geometrical distribution of Jovian radio emissions observed in the dawn and dusk sectors of Jupiter's magnetosphere. In this study, we present the geometrical distribution of broadband kilometric radiation (bKOM) and discuss its implications for the overall emission characteristics.

(1) Louis, C. K., Zarka, P., Dabidin, K., Lampson, P.-A., Magalhães, F. P., Boudouma, A., et al. (2021). Latitudinal beaming of Jupiter's radio emissions from Juno/Waves flux density measurements. Journal of Geophysical Research: Space Physics, 126, e2021JA029435. https://doi.org/10.1029/2021JA029435

(2) Boudouma, A., Zarka, P., Louis, C. K., Briand, C., & Imai, M. (2024). Generation mechanism and beaming of Jovian nKOM from 3D numerical modeling of Juno/Waves observations. Journal of Geophysical Research: Space Physics, 129, e2023JA032280. https://doi.org/10.1029/2023JA032280
(3) Boudouma, A., Prangé, R., Louis, C. K., Zarka, P., and Cecconi, B. (2025). Catalogue of Jupiter radio emissions identified in the Juno/Waves observations (Version 2.1) (Data set), PADC, https://doi.org/10.25935/xgw2-an52

*Speaker

Generation and Location of the source of the Jovian Narrowband Radiations from Numerical Modeling of the Geometrical Statistics of the Juno/Waves Observations

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Measurements of the radio and plasma wave (Waves) instrument, on board the Juno spacecraft, suggest that the generation of the narrowband kilometric radiation (nKOM) at 20-141 kHz and the narrowband low-frequency radiation (nLF) at 5-70 kHz, in the Io plasma torus (IPT) at low latitudes regions. Although the generation of radio waves in the IPT is attributed to the conversion of the natural modes of the plasma into escaping radio waves, at the fundamental or the first harmonic of the plasma frequency, there is no consensus on the specific mechanism involved. Using electron density and the magnetic field measurements by the Jovian Auroral Distribution Experiment (JADE) and the FluxGate Magnetometer (FGM), we identify the range of frequencies accessible to different wave modes during Juno's passage through the plasma. We classify the nKOM and nLF based on their observation modes: trapped (Z-mode or Whistler), escaping (X-mode or O-mode), and undetermined (either trapped or escaping). We apply the modeling method proposed in (1) to the escaping and undetermined modes of nKOM and nLF observations, leading to macroscopic constraints on the generation mechanism, wave mode, characteristic frequency, beaming and radio sources locations. Our analysis supports the idea that high-latitude nKOM is consistent with O-mode, while low-latitude is rather X-mode. We find that nKOM and nLF are consistent with radio waves produced near the plasma frequency fundamental, but only nLF is consistent with radio waves near its first harmonic, suggesting the possible coexistence of both linear and nonlinear generation mechanisms.

(1) Boudouma, A., Zarka, P., Louis, C. K., Briand, C., & Imai, M. (2024). Generation mechanism and beaming of Jovian nKOM from 3D numerical modeling of Juno/Waves observations. Journal of Geophysical Research: Space Physics, 129, e2023JA032280. https://doi.org/10.1029/2023JA032280

*Speaker

Decameter spikes to diagnose the solar corona

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Solar spikes are short-duration, narrowband, strongly polarized radio emissions often detected during solar eruptive events. Despite many studies, the conditions controlling their emission are still unclear.
NenuFAR is a recent ground-based facility dedicated to decameter radio observations. Owing to its high spectral and temporal resolution in spectral observations (down to 0.1 kHz and 0.30 ms, respectively-but not simultaneously) and the polarimetric measurements in four Stokes parameters, it provides clues to study the electron propagation at the base of the corona (observations between 10 and 85 MHz).
A thousand spikes were selected during several kinds of solar conditions in 2022 and 2023: type III storms, Type IV, Type III bursts, and Type II. Statistics on the time duration, frequency extension, intensity above background, polarization, and time-frequency drift are analyzed in these very different plasma environments. Two scenarii are usually discussed: the first relies on the breakup of the electron beam providing the free energy to destabilize the plasma, and the second depends on the damping of the Langmuir waves through electron-ion collisions. Comparison between the spike time duration and beam velocity on one side and temperature on the other enables us to test these two scenarios. The observations of unrelated active regions provide clues to discuss the occurrence conditions vs. several parameters, like temperature, velocity beam, turbulence factor, or the type of eruptive events.

*Speaker

Ground-based radio observations of space weather events with optimized CALLISTO stations

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Continuous ground-based observations of accelerated electrons are a central element of space weather monitoring and research. Harmful impacts on technological systems are costly and should be reduced in times of rising activity in space. The DLR contributes to this international task by providing reliable radio observations by its own CALLISTO (Compound Astronomical Low frequency Low cost Instrument for Spectroscopy and Transportable Observatory). Various types of radio bursts can be studied across a broad frequency range. The original receivers are optimized in hardware and software to increase the signal-to-noise ratio, ease maintenance work, and provide improved comparability. We present measurements of recent events and capabilities of the instrument.

*Speaker

MASER: an Astronomy Open Science Pilot within the OSTrails project

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The MASER (Measuring Analyzing and Simulating Emissions in Radio frequencies, https://maser.lesia.obsp service proposes a set of tools for low frequency radio astronomy, allowing the research teams to access, dispaly, analyse, model and publish radio astronomy data products.
Thanks to the EU-funded OSTrails project (https://ostrails.eu/), the MASER team is developing an open science pilot implementing and testing the three pillars of OSTrails:

- **Plan**: adopting and implementing a Data Management Plan tool, to streamline the data life cycle management and prepare the publication of the MASER datasets.

- **Track**: linking datasets, services, instruments, researchers and institutions in a knowledge graph, to enhance data discoverability as well as better measuring the impact of the MASER service

- **Assess**: design adapted FAIR evalution metrics and tests for astronomy, to assess the FAIRness of the research products published in MASER.

We present the first results of the OSTrails developments and how this applies to MASER and the astronomy community.

This project has received funding from the European Union's Horizon Europe framework programme under grant agreement No. 101130187.

*Speaker

EXTRACT/TASKA: towards a digital computing platform for modern radio astronomy

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The EXTRACT project (https://extract-project.eu/) aims to design a distributed data-mining software platform for extreme data across a continuum of computing resources, including edge devices, cloud systems, and high-performance computing centers. This involves efficiently and smoothly orchestrating tasks using these diverse resources.
One application of the project is in processing massive astronomy datasets through the TASKA (Transient Astrophysics with an Square Kilometre Array pathfinder) use-case, which seeks to test the EXTRACT paradigm with NenuFAR, a SKA Pathfinder instrument developed in Nançay (France). NenuFAR can potentially produce up to 109 PB of raw data annually, necessitating on-site processing using carefully designed pipelines to produce reduced datasets (down to approximately 1 PB per year).

TASKA is divided into four use-cases:

- Real-time detection of high-resolution events in beamformer data streams, integrated with artificial intelligence algorithms.

- Development of a modular and versatile radio imaging pipeline capable of running on local, cloud, or high-performance computing resources.

- Design of a new dynamic radio imager based on video reconstruction techniques and AI, as part of the radio imaging pipeline.

- Creation of a spatial-temporal-spectral feature-matching tool to integrate detected events with images from the imaging pipeline.

The current status and results of TASKA activities are presented, demonstrating their application to NenuFAR data processing and relevance for the SKA Regional Center network.
This project has received funding from the European Union's Horizon Europe programme under grant agreement number 101093110.

*Speaker

A new window into cool dwarf's magnetospheres: radiation belts and beyond

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We present state-of-the-art very long baseline interferometry (VLBI) radio observations of the ultracool dwarf (UCD) LSR J1835+3259, which resolve for the first time ever the extended radio emission of this nearby UCD. The radio morphology is consistent with the presence of a steady radiation belt powered by synchrotron emission, and aurora, powered by the coherent electron cyclotron maser mechanism. This is the first time a radiation belt is found beyond our solar system. Those results show that, similar to the Jupiter case, radio emitting UCDs possess dipole-ordered magnetic fields with radiation belt-like morphologies and aurorae. In this talk, we will present the latest results on very-long baseline interferometry (VLBI) efforts on this magnetic structure akin to the Van Allen belts. We will also take a sneak peek into novel VLBI detections showcasing distinctive radio-emitting behaviors in various UCDs, and will discuss the potential implications of those behaviors on existing models of radio emission from UCDs.

*Speaker

In situ analysis of Jupiter's broadband kilometric auroral radio emissions with Juno

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Among the zoo of Jovian auroral radio emissions, the broadband kilometric (bKOM) component has been the least studied. Taking advantage of Juno in situ measurements within the auroral regions, we surveyed the Juno/Waves radio observations over the 60 first orbits to identify 7 bKOM source candidates. These were mostly detected during dawn storm auroral episodes (4/7) and three were found to be colocated with auroral cavities. By applying a growth rate analysis based on JADE-E electron measurements, we show that the observed waves are driven by the Cyclotron Maser Instability from two free energy sources. The main emission, produced slightly above the electron gyrofrequency (f$_{ce}$), is amplified by conics-type electron distribution functions (EDF) with 2 to 30_˜keV electron characteristic energies. Sporadic bursts, produced slightly below f$_{ce}$, is driven by shell-type EDF of 0.1 to 10_˜keV. These results are analyzed comparatively to those obtained previously for Jovian hectometric and decametric emissions.

*Speaker

A reanalysis of Cassini's SKR source crossings

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The Cassini mission crossed the source regions of Saturn's Kilometric Radiation (SKR). Among these source crossings monitored by the RPWS instrument, only two were sampled with in situ electron measurements from the CAPS-E spectrometer. Their analysis confirmed that SKR is generated by the Cyclotron Maser Instability (CMI) from shell electron distribution functions with 6-12 keV characteristic electron energies. In this work, we re-analyze these events with our growth rate analysis method.

*Speaker

Expanding the search of radio exoplanets with LOFAR

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Gas-giant exoplanets are expected to generate low-frequency radio emission (< 40 MHz) via the cyclotron maser mechanism. Detecting this emission is likely the only viable way to measure exoplanets' magnetic field and space-weather conditions. Despite many attempts, there has not been a confirmed detection of an exoplanet in the radio band. I will present results from our ongoing search for exoplanetary radio signals with the LOFAR telescope. Our primary focus has been on Tau Boötis b, which is currently the most promising candidate for radio emission. However, we are expanding our search into a significant fraction of the Northern sky, thanks to the a new decameter survey (LoDeSS). I will describe our efforts to successfully overcome high levels of radio interference and the rapidly changing ionospheric conditions to obtain reliable radio images down to 15 MHz. I will conclude with key lessons learned and a critical test of radiometric scaling laws that predict the radio flux from magnetized planets.

*Speaker

Tracing Source Regions of Saturn Drifting Bursts

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Saturn Drifting Bursts (SDBs), characterized by spectral drifting elements below 50 kHz, offer insights into magnetospheric processes at Saturn. This study maps possible source regions of SDBs through 3D ray-tracing simulations, based on the Saturn's updated plasma density model (Taubenschuss et al., submitted) and magnetic field model (Dougherty et al., 2018). The density framework integrates the models of Persoon et al. 2019, 2020 with ionospheric and inner magnetospheric profiles, and Langmuir Probe data, enhancing coverage of high-latitude regions and the distant magnetosphere.

We focus on selected SDB events, simulating O- and X-mode wave propagation from Cassini's observational position to trace potential ray paths. The simulations incorporate discrete frequencies and propagation directions, assessing mode conversion or group delay effects driven by plasma density gradients. By comparing these results with direction-finding data from Cassini's Radio and Plasma Wave Science (RPWS) instrument, we evaluate whether the source regions correspond to the outer Enceladus plasma torus or to the auroral zones.

References:

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*Speaker

First imaging evidence of fundamental-harmonic type III radio burst pair in the interplanetary space

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Type III radio bursts are the most frequently observed radio bursts in dynamic spectra and they have been studied extensively for several decades. However, despite significant efforts, many aspects of their origin and propagation remain unclear. Majority of previous studies have been conducted using ground-based observations, and limited therfore to primarily metric-range type III bursts. On the other hand, interplanetary (IP) type III radio bursts observations are more scarce, which resulted in IP type IIIs being explored in much less detail. One of the major challenges in studying these bursts is to distinguishing whether the observed emission corresponds to the fundamental or harmonic component. In this study, we utilize direction finding observations by STEREO and WIND spacecraft and radio triangulation technique to obtain 3D radio source positions of group of type III bursts in the inner heliosphere. The studied IP type III bursts were also observed by the Parker Solar Probe, during its 2nd close approach, providing high resolution dynamic spectra. Our first results provide direct evidence for the simultaneous existence of fundamental-harmonic pairs in the interplanetary range, offering new insights into their emission mechanisms.

*Speaker

Statistical study of the Saturnian Kilometric Radiations (SKR) from Cassini's observations

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From early 2003 to late 2017, the Radio and Plasma Wave Science (RPWS) experiment onboard Cassini quasi-continuously observed Saturn's Kilometric Radiations (SKR) between a few kHz and 1 MHz. The SKR flux density is correlated with auroral activity and known to be controlled by solar wind parameters and time variable illumination of Saturn's northern/southern ionosphere. On top of this, the SKR anisotropic beaming induces strong visibilty effects depending on the observer's position. In this work, we re-analyse the SKR 2003-2017 dataset to quantify the influence of these different drivers by exploring potential cross-correlations using several statistical methods.

*Speaker

Improving exoplanetary radio emissions predictions using stellar magnetic field measurements' compilation and inference

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In our Solar System, radio emission associated with magnetized bodies or interactions in planetary magnetospheres seems strongly correlated to incident magnetic power, following a radio-magnetic scaling law over a wide range of order of magnitude. To test the validity of this law in exoplanetary systems, one needs to know the magnetic field of their host star through measurements or inference. With the progress of ZDI methods in the last two decades, numerous stellar magnetic fields have actually been measured directly or indirectly. The lack of an unified measurement database in the community led us to compile measurements of these magnetic fields, and to develop parametrics methods to infer estimates of stellar magnetic fields for systems for which ZDI measurements are missing. Our methods propose to infer probable values of B derived from parametric modeling and learned networks from the system stellar parameters (mass, effective temperature, etc.). This work, connected with the PALANTIR code, will provide realistic predictions of received radio power that optimize the observation time and observation strategy of exoplanetary systems (emission probability, orbital coverage, limited observing time, etc.)

*Speaker

Partial polarization and propagation of Saturn kilometric radiation at low and very low frequencies

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The Cassini RPWS (Radio and Plasma Wave Science) instrument observed the occurrence and polarization of Saturn kilometric radiation (SKR) for many years. SKR is known to be radiated at frequencies from a few kHz up to about 1.2 MHz along auroral magnetic field lines as a fully polarized wave by the cyclotron maser instability mechanism. When Cassini was at low latitudes beyond the equatorial shadow zone, RPWS usually observed SKR sources from both hemispheres at the same time. In this case right-handed circularly polarized SKR from the northern hemisphere superposed with left-handed SKR from the southern hemisphere leading to SKR of mixed polarization. Since the coherence length of SKR is just a few up to a few tens of kilometers, this kind of incoherent superposition led to a wave depolarization. This means that the superposed SKR was just partially polarized with a total polarization degree smaller than one.

Wu et al. (2024, GRL 51, e2023GL106652) identified an extended equatorial shadow zone beyond the Enceladus plasma torus for low frequency emissions below 100 kHz, and this frequency constitutes the typical maximum plasma frequency of the torus. However, they found that some emissions were able to reach this extended shadow zone. This could work through reflection by the magnetosheath like for 5 kHz narrowband emissions, or by leakage at times when the dynamical torus is compressed. The latter could work for the so-called "caterpillar" emissions, since they have a low overall occurrence probability of less than 2%. "Caterpillars" are thought to be a special form of SKR at very low frequencies, and (in addition to their peculiar caterpillar-like shape in a dynamic spectrum) one of their characteristic properties is their partial polarization.

An inspection of polarization spectra shows that SKR (and its special form of "caterpillars") at low and very low frequencies also shows partial polarization at medium to high Cassini latitudes, when SKR from only one hemisphere should be visible. Therefore, another mechanism is necessary to explain the partial polarization, and here we suggest one: First, there should be SKR propagating to Cassini via a fully polarized direct ray from the auroral source. But second, there should also be another ray from the same hemispheric source, but which is bent by the Enceladus plasma torus. This ray probably gets de-polarized, and Cassini observes an incoherent superposition of a totally polarized ray with a partially polarized ray, and the summation of the Stokes vectors should lead again to a partially polarized ray, which is what RPWS observes. The torus constitutes a region with a refractive index smaller than one, and it can create an inferior mirage image of the SKR source. This is similar to an inferior mirage image

*Speaker

in a desert, which is caused by rays bended in the hot air (with a lower refractive index) at the Earth's surface.

Influence of the Galilean moons on Jupiter's broadband kilometric radiation

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We investigated the occurrence probabilities of Jovian broadband kilometric (bKOM) radiation as a function of the phases of the four Galilean moons using one year of data (mid-2016 to mid-2017) from the Juno Waves instrument. The influence of Io on the occurrence of Jovian decametric (DAM) radiation is known since a long time, and many studies of the influence of Ganymede, Europa, and Callisto on DAM emissions were performed recently. Surprisingly, to the best of our knowledge, no one has ever analyzed bKOM emissions in this respect. Like DAM, also bKOM is thought to originate from sources along auroral magnetic field lines. But, in contrast to DAM, the apex distances of the bKOM source field lines are larger and thought to be beyond 12 R_J (Jovian radii; Zarka et al., 2001, PSS 49, 1137-1149). Consequently, we found no influence of Io (6 R_J) and Europa (9 R_J) on the occurrence probability of bKOM. However, we found a very modest influence of Ganymede (15 R_J) and a clear influence of Callisto (26 R_J) on bKOM. We found an enhancement of the bKOM occurrence probability by 17% at Ganymede phases of 220◦ to 360◦ compared to the other phases, and an enhancement of 35% at Callisto phases from 20◦ to 260◦. We do not yet know if the enhancements are due to the position of the observer with respect to the moon, or if they are due to the local time position of the respective moon.

*Speaker

Diurnal periodicity in Earth's radio emissions

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Planetary radio emissions have potential as a very valuable remote diagnostic of planetary rotation rates as well as magnetospheric dynamics. Auroral Kilometric Radiation (AKR) is Earth's strongest natural radio emission, and is anisotropically beamed from a source locked to auroral latitude magnetic field lines. These field lines are tied to the deep interior of the rotating planet, and hence it is theorised that an observer at a fixed local time will observe a diurnal variation in AKR power, as if the Earth and its emission were a lighthouse. In this study we explore this proposed 24 hour periodicity in AKR power using a decade of observations from Wind/WAVES.

*Speaker

Extensive study of Jovian decametric fine structures with the Nançay Decameter Array

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In this work, we build up on the proof-of-concept study of (Mauduit et al., 2023) who identified automatically millisecond-bursts in Jovian decametric emissions associated to Io, Ganymede and unrelated to moons in 1 month of high resolution observations of the Nançay Decameter Array (NDA). Taking advantage of systematic NDA high resolutions observations acquired by its Juno-Nançay (JunoN) receiver in support to Juno since 2016, we analyze an extended period of time with the same approach.

*Speaker

Statistical analysis of Jovian decametric radio emissions occurence drivers

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The Jovian decametric (DAM) radio emissions are long-known emissions whose origin is attributed to the cyclotron maser instability (CMI), above the magnetic polar regions of Jupiter. These emissions are anisotropically beamed, so that the emissions' observation depends on the position of the observer. We revisit here the work by Jacome et al. (2024) who studied the statistical effect of various drivers including the magnetic declination on the observation occurrence of Jovian DAM emissions, collected since 1978 with different receivers connected to the Nançay Decameter Array (NDA). We analyze here the ranking of several drivers (magnetic declination, declination, distance, elongation) based on the DAM emissions occurrence dataset for Io and non Io emissions, using statistical approaches dedicated to ranking drivers in complex systems: Akaike Information Criterion, Least Absolute Shrinkage Selection Approach and partial correlations.

*Speaker

Automated reduction of Solar, planetary and transient interferometric data with the EXTRACT workflow orchestration tool

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In the past decades, the increasing need for ultra-high-resolution radio observations with enhanced sensitivity has led to a surge in data volumes from next-generation radio telescopes. Efficient tools for data management, processing, and storage optimization are now crucial for helping scientific analysis. The EXTRACT project, funded by the European Commission, is developing a distributed data-mining platform for EXTReme dAta Across the Compute conTinuum. A key use case, Transient Astrophysics with a Square Kilometer Array pathfinder (TASKA), takes advantage of EXTRACT technologies to handle the massive data streams produced by NenuFAR, one of the SKA pathfinders.

This work presents two targeted projects, TASKA-C and TASKA-D, focusing on the development of a new user-oriented, modular and versatile workflow design and orchestration tool (TASKA-C) and a new deep-learning module for imaging transients (TASKA-D) fully integrated in the workflow.

TASKA-C deploys multiple cloud-ready and HPC-ready technologies to furnish radio astronomers with a simple interface to describe data processing workflows which dramatically lowers the difficulty threshold of using complex tools from the radio interferometric community. In the case of NenuFAR, we propose workflows to dynamically process the imaging data of the dynamic Sun, which enables the astrometric localization of the solar bursts (Type II, Type III bursts), and planets (e.g. Jupiter, exoplanets) complementary to beamformed observations. This workflow integrates classical LOFAR tools and methods as well as recent direction-dependent tools (e.g. DDFacet, killMS, DynSpecMS) to perform complex operations on interferometric data such as the processing of the NLFSS sky survey and the search for exoplanetary signatures using rebuilt dynamic spectra derived from imaging data.

TASKA-D is a pilot development which integrates various deep learning networks trained to detect structured emissions in time and restore light curves, in a noisy, confusion-limited dataset. It will be employed to perform serendipitous transient searches in interferometric data but also manage to image moving transients for their study (e.g. Jupiter, etc.) or polluters removal (e.g. Starlink). Being able to lower the difficulty threshold for the community is key to help taking advantage of the full sensitivity of NenuFAR in both imaging and beamforming mode, in preparation for the SKA. Astronomers are able to operate complex imaging workflows in a seamless way without being aware of where and how the actual processing efforts are deployed.

*Speaker

Detecting the Jovian synchrotron emission at very low frequencies using NenuFAR

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Jupiter the strongest source of planetary radio emissions in the solar system, it also features a moderate continuum radio emission associated with the radiation of relativistic electrons trapped between 0 and 4 jovian radii.
Above _˜1 GHz, a typical synchrotron spectrum describes the emission, however, due to the fast rotation of the magnetic field, short-term, long-term and spatial variability are observed. Below _˜1 GHz, a spectral turnover reduces the intensity of the emission while the associated emitting electron populations also change at a larger radial distance from Jupiter.
At decameter wavelengths, the lower part of the synchrotron spectrum can be detected down to 50 MHz with LOFAR (Girard et al. 2016), but it has yet to be validated with a sensitive instrument such as NenuFAR. Below 40 MHz, the decametric emission associated with the cyclotron-MASER instability (CMI) mechanism dominates all other radio emissions at Jupiter during visibility windows.
We will study the feasibility of unambiguously detecting the lowest part of the synchrotron emission down to 20-30 MHz when the CMI emissions are off, using two methods: NenuFAR imaging of the (unresolved) total intensity of the emission and a Lomb-Scargle analysis of the NenuFAR waveform data in the search for periodicity of the belts structure. Data analysis required specific processing for planets and will be on Stokes I, Q and U. Detection will give insight into the electron population that undergoes inward diffusion toward the belts and generates synchrotron emission in lower B regions.

*Speaker

Refining Equatorial Lead Angles of Jupiter's Moons using Juno-UVS

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The auroral footprints of Jupiter's Galilean moons arise from the interaction between the Iogenic plasma co-rotating with the Jovian magnetic field and the moons themselves. These interactions produce Alfvén waves that propagate along magnetic field lines, linking the moons to their corresponding auroral footprint on Jupiter's upper atmosphere. At high altitude above Jupiter atmosphere, plasma instabilities occur within the magnetic fluxtube connected to each moon's auroral footprints, generating decametric radio emission from the cyclotron-maser instability mechanism.

The angular displacement between the magnetic footprint and the observed auroral footprint, known as the equatorial lead angle, depends on the Alfvén wave travel time and varies with the orbital longitude of each moon. The equatorial lead angle therefore controls the position and the beaming of the moon-induced decametric radio emission and is needed to improve the interpretation of the moon-induced decametric emission, using, e.g., the ExPRES modeling tool (Hess et al., 2008; Louis et al., 2019). The ultraviolet and infrared instruments on Juno (Juno-UVS and -JIRAM) provide crucial measurements of these auroral spots lead angle.

Building on prior analysis of used Juno-UVS spectral imaging data from the first 43 orbits (PJ1–PJ43) of Juno (Hue et al., 2023), this work extends the dataset and associated empirical models using additional Juno Perijoves data. This expanded dataset offers improved temporal coverage and increased sampling across different Jovian longitudes, allowing for refined measurements of

*Speaker

the lead angles for Io, Europa, and Ganymede in both hemispheres.

Modelling Gyrosynchrotron Emission from Energetic Electrons in CME Flux Ropes

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The solar atmosphere is a rich source of radio emission, especially during solar flares and coronal mass ejections (CMEs), when several types of bursts are observed as part of the solar radio continuum. One type of burst of particular interest is the broadband type IV continuum. These emissions are routinely detected by ground-based instruments such as LOFAR and NRH, but are rarely observed by space-based instruments. Recently, their occurrence has increased due to novel observations from the Parker Solar Probe. They are believed to involve a combination of emission processes, with coherent plasma emission commonly associated with both stationary and moving components, while incoherent gyrosynchrotron (GS) radiation produced by electrons trapped within CMEs has also been proposed for the moving type. Imaging observations have further shown that both stationary and moving type IV continua can exhibit spatial drift, even when the spectral features appear stationary. These ambiguities present interpretative challenges and motivate the need for physics-based modelling to help resolve them.

In this context, we present a novel coupling of numerical tools to model GS emission in the solar corona. Using the magnetohydrodynamic (MHD) coronal model COCONUT, we generate coronal background configurations containing a CME flux rope. We then use the particle transport code PARADISE to inject mildly relativistic and ultrarelativistic electrons into the flux rope and track their evolution over time. Finally, we input the MHD parameters and electron energy distributions into the Ultimate Fast Gyrosynchrotron Codes (Kuznetsov & Fleishman 2021) to compute emission and absorption coefficients along lines of sight.

The resulting radio spectra show a notable dependence on the electron populations, CME properties, and viewing angle. Our results support the interpretation of GS emission as a major component of type IV continua, while also allowing for contributions from additional coherent emission mechanisms.

*Speaker

Jupiter's Io-related radio fine structures as observed from Juno

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Galilean satellite Io interacts with the Jovian magnetosphere, producing Io's footprint aurora connecting its magnetic field line to the planet's polar regions. This aurora results from the Alfvénic electron acceleration, which also generates the Io-related short radio bursts (S-bursts) on the timescale of milliseconds. A typical S-burst from a few to 35 MHz has a negative drift with a few MHz to a couple of tens of MHz per second. These S-bursts have been characterized by many ground-based radio observatories since the 1950s. Another opportunity to examine these S-bursts comes from the Juno spacecraft, which has been passing through or near the auroral radio sources over Jupiter's polar regions. Juno's Waves instrument captured a couple of S-burst detection examples, while another type of fine structure at frequencies below 3 MHz was detected. In this presentation, we show the results of the Io-related radio fine structures from Juno and compare them with the theoretical model.

*Speaker

Compact Low-Frequency Radio Observatory LWA-Niyodo in Japan

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The low-frequency radio observatories at frequencies below 100 MHz are widely distributed around the world, and some of them operate the daily observations of natural radio emissions from the Sun and Jupiter. Monitoring the low-frequency radio emissions requires three equally separated observatories around the world. While most of the low-frequency radio observatories are located in Europe and the US, there are fewer of the observatories in Japan. We built a new compact low-frequency radio observatory located in Niyodogawa-cho, Kochi, Japan. The observatory called LWA-Niyodo consists of eight bow-tie antennas (originally designed for the Long Wavelength Array station One in New Mexico, US), in which each antenna receives two perpendicular linearly polarized powers. Currently, these signals are combined into two channels using two 8-to-1 analog combiners. With two independent receivers of the Software Defined Radios (SDRs) and Raspberry Pi systems, we have operated the daily observations since March 2024. This receiver is based on Jupiter's radio receiver onboard the KOSEN-1 CubeSat. In this presentation, we report the detailed specifications of the LWA-Niyodo and highlight some early observations.

*Speaker

Low Frequency Extensions of Cyclotron Maser Instability-Generated Radio Emission: A Statistical View of Low Frequency Extensions from Cassini at Saturn

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The Cassini mission spent 13 years in orbit around Saturn from mid-2004 to late-2017, and during that time was quasi-continuously measuring Saturn's radio emissions. One of the key elements of the radio spectrum at Saturn is the Saturn Kilometric Radiation (SKR), and in recent years several studies have been written on events called Low Frequency Extensions (LFEs) which represent strong, continuous extensions of the SKR down to lower frequencies. Thanks to recent work we now have a complete catalogue of LFEs observed throughout the Cassini mission. Here we explore their properties, from recurrence, to duration, to links with the ubiquitous Planetary Period Oscillations (PPOs). The results reveal LFEs as a highly useful remote diagnostic of magnetospheric dynamics at Saturn, with insights for analogous radio emissions at other planets including Earth and Jupiter.

*Speaker

A Weakly Turbulent and Intermittent Plasma: Insights from Parker Solar Probe

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The self-consistent generation of type III radio emissions and their morphological features has remained an open problem since the 1950s. Utilizing data from the Parker Solar Probe, we analyze type III fine structures (striae) and link them to the statistical properties of density fluctuations from 9.9 to 60 solar radii. We find that the average level of density fluctuations decreases with distance from the Sun, while intermittency remains high at scales corresponding to the stria emissions. Our findings demonstrate that quantifying the level of density fluctuations enables a self-consistent description of the type III radio burst generation process, from Langmuir wave excitation to electromagnetic wave emission.

*Speaker

A Golden Age for Solar Radio Science Below the Cutoff: Discoveries from Parker Solar Probe and Solar Orbiter

Immanuel Christopher Jebaraj * [1], V. Krasnoselskikh [2,3], Marc Pulupa [3], A. Voshchepynets [3,4], O. Agapitov [3], Thierry Dudok De Wit [2,5], Stuart Bale [3,6]

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Solar radio emissions, both coherent and incoherent, have been extensively studied through ground-based observations for over seven decades. Historically, these observations were restricted by the ionospheric cutoff, limiting investigations primarily to the solar corona. Despite such constraints, radio observations uniquely enabled measurements of critical parameters, including the coronal magnetic field, plasma temperature variations, and the tracking of shock waves. Early theoretical frameworks developed from these observations, notably the Ginzburg-Zheleznyakov model for plasma emissions, remain relevant today. The advent of space-based observatories overcame the limitations of ground-based observations by capturing radio emissions below the ionospheric cutoff. This allowed uninterrupted measurements spanning from the solar corona through the heliosphere down to local spacecraft plasma frequencies and beyond. Consequently, radio observations uniquely offer a continuous, comprehensive view of the entire Sun-Earth system.

Continuing this legacy, Parker Solar Probe (PSP) and Solar Orbiter (SO) have significantly advanced solar radio studies by enabling observations at unprecedented proximities to the Sun. These close-range measurements are critical for rigorously testing theoretical predictions, particularly distinguishing between fundamental and harmonic emission characteristics. Enhanced instrumentation aboard PSP and SO further amplifies the advantages of proximity. Specifically, PSP's capability to measure the complete set of Stokes parameters at high temporal resolution has enabled detailed examinations of radiation propagation through randomly inhomogeneous plasmas. Additionally, PSP and SO's full waveform measurements of high-frequency electromagnetic fields have facilitated the first direct observations of the magnetic components of Langmuir (Z-mode) waves, phenomena previously only theorized.

In this talk, I will highlight recent discoveries from PSP and SO and discuss the substantial theoretical advancements stimulated by these groundbreaking observations.

*Speaker

Variation in Jovian Decametric radio emissions' characteristics due to Earth's declination changes

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In this study, we investigated the impact of Earth's Jovicentric sub-latitude (declination, DE) variation on characteristics of Jovian decametric (DAM) radio emissions induced by Io (Io-DAM), as observed by the Nançay Decameter Array (NDA). We analyzed specifically these emissions' maximum frequency, duration, average Io phase, and average longitude. The Io-DAM emissions were selected from the NDA digital catalog by intensity and maximum frequency thresholds to remove the influence of Jupiter's distance and elongation angle variation, and isolate the DE effect. Comparing the characteristics of these emissions with simulations from the Exoplanetary and Planetary Radio Emissions Simulator (ExPRES), it was found that the DE variation has a minor but noticeable effect on the emissions, with northern Io-DAM emissions showing a stronger dependence on DE. ExPRES simulations were consistent with observed data, supporting the current understanding of DAM emission generation and propagation.

*Speaker

Radio Emission as a Tool for Studies of Ultracool Dwarfs and Star-Planet Interactions

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As ultracool dwarf stars (M7 and later spectral type), including brown dwarfs, approach planetary masses and temperatures, their stellar-like flare activity gives way to planet-like auroral and radiation belt activity. These overlapping magnetic activity regimes position brown dwarfs as unique, powerful, and accessible laboratories that probe star-planet interaction and exoplanet magnetospheric physics. Maturing low frequency radio arrays and a highly anticipated ngVLA will provide new means for detecting and characterizing substellar magnetospheres. Now is a critical time to prepare for an upcoming era of star-planet interaction and comparative magnetospheric science by harnessing detailed studies of ultracool and brown dwarf magnetic activity. I will synthesize the state of the art for brown dwarf magnetospheric studies; discuss implications for exoplanet magnetism, star-planet interactions, and extrasolar moons and volcanism; and highlight opportunities for the next generation of ground- and space-based radio facilities.

*Speaker

Radio instrument of Radio and Plasma Wave Instruments (RPWI) aboard ESA JUICE: from the Launch (2023), via the Lunar-Earth flyby (2024), toward Venus (2025)

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This paper provides initial status of Radio & Plasma Wave Investigation (RPWI) aboard JUpiter ICy moons Explorer (JUICE), from the view for its high frequency radio observation capability in 80k –45MHz.
The high frequency part of this system, i.e., Preamp of RWI and its High Frequency Receiver (HF), is procured by the RPWI team in Austria, France, Japan, Poland, and Sweden. This part enables the characterization of Jovian radio emissions (including gonio-polarimetry), passive radio sounding of the ionospheric densities of icy moons, and passive sub-surface radar measurements. It has an enough capability to detect Jovian radio emissions from magnetosphere (aurora etc.), atmosphere (lightning), and icy moons. Direction and polarization capabilities are first enabled in the Jovian system, to identify their source locations and characteristics.

After the launch on April 14, 2023, the RPWI did the deployment of our antennas. Although it had to wait due to a problem happened with the RIME antenna, all deployments were successfully completed in May 2023. However, immediately after that, we started the life struggling with the the spacecraft noise. As a result, new onboard software with the noise reduction function was uploaded in January 2024, and the spacecraft was going to the Lunar-Earth Gravity Assist (LEGA) operation in August 2024. It was the unique opportunity to observe "an airless body" before real icy moons flybys in 2030s. Next flybys are Venus (August 2025), Earth I (September 2026), and Earth II (January 2029). Arrival to Jupiter will be in July 2031.
This paper reviews those activities in 2023-2025, focusing on the verification of the basic functions of the radio observation capability of RPWI. We also summarize the plans with the proved performances for Jupiter and icy moons in 2030s.

*Speaker

An ultracool bridge to exoplanet magnetic fields

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Magnetic fields play a key role throughout the lives of planets, shaping their formation and atmospheric escape. At planetary scales, magnetism is driven by the motion of electrically conductive material in their interiors. Therefore, magnetic fields are a unique probe of a planet's interior structure. In our solar system, planetary magnetic fields are signposted by their bright radio emission, driven by electrons trapped within the magnetic field. Despite extensive searches, radio emission from an exoplanet has so far eluded detection. As a result, our understanding of magnetism on extrasolar planets is in its infancy. However, Jupiter-like objects known as ultracool dwarfs (UCDs) have been detected at radio wavelengths for over two decades. These objects, comprised of late M dwarfs and brown dwarfs, share many structural similarities to Jupiter, and are ideal targets for advancing our understanding of magnetic fields on Jupiter-like exoplanets. However, this potential has not been fully realised, primarily due to a lack of numerical models to interpret their radio emission. In this talk, I will present our recent progress on inferring the magnetic characteristics of UCDs via their radio emission from a numerical perspective. Ultimately, this work will enable robust estimates for the magnetic fields of extrasolar planets in anticipation of their direct detection with upcoming radio facilities such as LOFAR 2.0 and the SKA.

*Speaker

Low-frequency VLBI observation with Iitate, Zao, and Toyokawa observatory

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Although there have been many observations of exoplanet auroral radio emissions using large radio telescopes, only one or two have been detected so far. In previous studies, all circularly polarized components from planetary systems are assumed to be auroral radio waves, but circularly polarized components are also emitted from the main star. VLBI is widely used in the GHz band, but VLBI observations in the MHz band have been not yet established a stable method due to ionospheric fluctuations. Therefore, it is necessary to establish a method to compensate for the electron density fluctuations between the source and the antenna. We conducted VLBI observations at 327 MHz using the Iitate Planetary Radio Telescope (Tohoku Univ.), the radio telescope at the Zao observatory (Tohoku Univ.), and cylindrical parabola antenna at the Toyokawa observatory (Nagoya Univ.), in order to evaluate instrumental stability and ionospheric variations for future international VLBI observations. The baseline length of Iitate-Zao is 44.5 km, and Iitate-Toyokawa is 438 km. K5/VSSP sampler was used for data acquisition, and FURY10M a double oven type GPS-OCXO was used as the reference clock. Observations were made from 2021 to 2025 with the compact sources. We successfully detected the fringe between Iitate-Zao and Iitate-Toyokawa. The fringe phase fluctuation will be investigated.

*Speaker

Attempts to detect auroral radio emissions from Beta Pictoris b using the ionospheric correction pipeline

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The detection and measurement of exoplanet magnetic fields greatly advances our understanding of planets. Planets with atmospheres and magnetic fields, such as the Earth and Jupiter, have auroras, which emit radio waves originating from charged particles accelerated in the polar regions. We studied the radio emission from the exoplanet Beta Pictoris b, which is young, has a long orbit (about 10 AU from Beta Pictoris), and is about 10 times more massive than Jupiter. Beta Pictoris b has a high luminosity, which suggest a strong magnetic field, thus strong auroral emission. We have made radio observations in 2020 with the Giant Metrewave Radio Telescope (GMRT) at band 3 (250-500 MHz). About 2 hours of observations including flux and phase calibrator were made over 4 days. The GMRT data were calibrated using the SPAM pipeline, which corrects for terrestrial ionospheric effects. No signal was detected at the background rms level of 41 μJy/beam.

*Speaker

Results from a 2024-2025 Observation campaign of Jupiter's radiation belts using GMRT and single dish telescopes

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Since its discovery in the late 1950s, Jupiter's radiation belt (JRB) has continuously presented surprising features and dynamical behaviors, yet to be understood from observational and theoretical studies. The objective of the present paper is to discuss our efforts regarding our understanding of JRB from improved empirical and physical models. To constrain the energy spectrum and transport process of the relativistic electrons in JRB, ground-based observations of Jovian Synchrotron Radiation (JSR) were carried out during close approaches of Jupiter by the Juno spacecraft (NASA). The coordinated ground-based observations were made during Juno's flyby of Jupiter PJ (Perijove) 65 (2024/9/20), 66 (2024/10/22), and 69 (2025/1/28). We observed Jupiter with the GMRT (Giant Metrewave Radio Telescope) at 1000-1400 MHz (band-5), 125-250 MHz (band-2), and 550-900 MHz (band-4). We also observed Jupiter with Usuda 64m telescope at 3 GHz, Iitate Planetary Radio Telescope at 325 MHz, and Yamaguchi 32 m telescope at 6.86 GHz and 8.45 GHz. The initial result of band-4 data for PJ 66 indicates that the wideband images are of the best quality compared to the narrowband observations previously obtained with GMRT. The reduced band 2 data for PJ 66, which clearly display the dawn and dusk equatorial spots, provide angular resolutions comparable to LOFAR observations at the HBA band. We will show an overview of these observation settings and present the initial results of the GMRT and single dish data analysis, as well as our strategy to combine ground-based, remote sensing, and in-situ data to achieve our science objectives.

*Speaker

The Space Weather Impacts on Planetary Emissions (SWIPE) mission concept: an observatory for Solar System radio aurorae

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Space Weather Impact on Planetary Emissions (SWIPE) is a NASA-funded mission concept to track the impact of coronal mass ejections (CMEs) and other solar wind disturbances such as stream interaction regions (SIRs) and high-speed streams (HSSs) on planetary magnetospheres. SWIPE will observe enhancements in planetary auroral radio emission caused by these space weather events when they interact with solar system planets. SWIPE consists of an interferometric array of four 12U CubeSats in a near geosynchronous orbit (GEO) equipped with vector sensor payloads – a novel antenna that fully resolves the incident electromagnetic field and provides additional directional information when compared to a dipole triad. SWIPE's science band is 100 kHz -15 MHz. We will describe the results of our recently completed mission study to define key requirements and features of SWIPE. We will also present simulation results where we demonstrate what SWIPE would have observed from GEO during past CME impacts on Saturn that were recorded by Cassini. These results indicate that SWIPE will be a capable remote monitoring station for space weather impacts on Earth, Jupiter, and Saturn (and potentially Uranus). SWIPE would provide continuous monitoring and a consistent data set to augment in-situ spacecraft measurements at Jupiter (Juno, Europa Clipper, JUICE) and resume monitoring of Saturn's radio aurora in the post-Cassini era.

*Speaker

Radio observations of spectral cleaving feature in solar type II bursts

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We report the first detailed radio observations of a novel spectral feature – spectral cleaving – in a solar type II burst recorded on 2011 February 14 by means of Ukrainian radio telescope URAN-2 (8.25-33 MHz). Type II bursts are widely recognized as radio signatures of coronal shock waves driven by solar flares or coronal mass ejections. Unlike the well-known band-splitting phenomenon, spectral cleaving manifests as an actual branching of the emission lane in the dynamic spectrum, observed here in the lower-frequency band (LFB) while the upper-frequency band (UFB) remains undivided. The high-resolution spectrogram reveals that the cleaving point divides the LFB into two diverging lanes. We interpret this cleaving as a consequence of source migration along the shock front, triggered by evolving magnetic field orientation in the upstream region. This restructuring modifies the efficiency of shock-drift electron acceleration, causing distinct radio source regions to emerge.

*Speaker

Electromagnetic wave radiation in turbulent magnetized and inhomogeneous plasmas : theory and simulations

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In a weakly magnetized and randomly inhomogeneous solar wind plasma where upper-hybrid wave turbulence is generated, electromagnetic radiation at plasma frequency is modeled theoretically and numerically. Owing to three independent approaches which lead to the same results (Particle-In-Cell simulations, theoretical and numerical modeling, as well as analytical calculations performed in the framework of weak turbulence theory extended to randomly inhomogeneous plasmas), electromagnetic emissions in the ordinary and extraordinary modes, as well as their corresponding radiation rates, are calculated as a function of the ratio of the cyclotron to the plasma frequency $\omega c/\omega p$ and the average level of random density fluctuations. These emissions are due to electrostatic waves transformations and mode conversion on random density fluctuations. In this view, the conditions for appearance or absence of some modes are discussed for the case of type III solar radio bursts.

*Speaker

Exploring Interplanetary Type III Radio Bursts as Proxies for Flare-Site Reconnection

Vratislav Krupar * [1], Oksana Kruparova [2], Adam Szabo [3], Milan Maksimovic [4], Hamish Reid [5], Katerina Pesini [6], Juan Carlos Martinez Oliveros [7], Ondrej Santolik [8]

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Type III radio bursts are signatures of electron beams escaping from solar flare sites, but their connection to flare reconnection properties remains poorly understood. We present a statistical study of _˜500 type III bursts observed by Wind and associated with C- to X-class ribbon flares between 2010 and 2016 from the Kazachenko et al. (2017) catalog. Our goal is to explore correlations between radio burst parameters and flare properties, with the broader aim of using radio observations to complement traditional flare diagnostics. We also analyze the distribution of radio fluxes at each frequency, fitting power-law profiles to characterize their energy content. Preliminary results show that the radio flux distribution systematically flattens with increasing frequency, suggesting evolving beam or emission properties along the propagation path. Our study demonstrates that radio burst diagnostics can serve as practical proxies for magnetic-reconnection parameters, paving the way for flare energy estimation with future wide-band heliospheric radio monitors such as SunRISE.

*Speaker

Jupiter Radio Emissions from Juno and Support Observations

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Juno has provided the first opportunities to directly sample sources of Jovian auroral radio emissions. In addition to measuring the radio emissions, themselves, supporting plasma observations from the Juno plasma instrument, JADE, have enabled the identification of free energy sources including loss cones. electron conics, and shell distributions. While studies at Earth have shown these to be unstable to the cyclotron maser instability, they had only been conjectured for Jovian emissions. The Juno observations have also shown the distribution of radio source locations, such as on the equatorward edge of the auroral oval. Earth-based observations have also been used to restrict the latitudinal beaming of the emissions. Jovian auroral radio emissions have also been used in studies examining the effects of the solar wind on Jupiter's magnetosphere and variations in auroral UV brightness.

*Speaker

Search for exoplanets at radio wavelengths : validity of predictions

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The search for exoplanets at radio wavelengths, initiated in the 1990s, has been both a major objective and a long-term challenge for the most sensitive ground-based radiotelescopes. To identify targets of interest in the solar neighboorhood, physical scaling laws predicting the expected radio flux have been constructed from our knowledge of Cyclotron Maser-driven auroral radio emissions of solar system magnetospheres. Still, despite many nearby planetary systems are expected to host bright enough radio sources to be detected at low frequencies by giant facilities in operation (such as UTR-2, LOFAR or NenUFAR, while waiting for SKA), a confirmed detection is pending. Hereafter, we reconsider the various physical hypotheses and limitations of used scaling laws to account for the discrepancy between predictions and detections.

*Speaker

A wideband search for nearby Star-Planet systems and Ultracool dwarves with FAST, NenuFAR and the NRT

Laurent Lamy * [1,2], Yang Gao [3], Philippe Zarka [4], Deng Peng [3], Lei Qian [5], Ismael Cognard [6], Corentin Louis [7], Xiang Zhang [7]

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In this work, we present a recent multi-telescope observing program aimed at tracking auroral and/or solar-type radio emissions from a limited set of nearby Star-Planet systems (Eps Eri, GJ 1151) and Ultracool Dwarves (WISEJP J1122, BDR J1750) from 3 to 60pc. To do so, we used the Five-Hundred Aperture Spherical Telescope (FAST) in China and the Nançay decimetric Telescope (NRT) In France to perform meridian observations at 1-2 GHz, together with NenuFAR over 10-88 MHz in Nançay only with beam-formed tracking. Overall, this enabled us to search for radio emissions over a wideband spectrum and over close-in complementary time windows.

*Speaker

Saturnian Kilometric Radiation properties from Cassini's "Grande Finale"

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In April 2017, Cassini was placed on a series of 22 orbits each passing between the planet and its rings, and also exploring the high latitudes. Called ''Grand Finale", this latest phase of the mission has yielded unparalleled observations of Saturn's Kilometer Radio Emission (SKR) and its relationship to the auroral and magnetospheric physics occurring on the planet.
In this presentation, we study measurements obtained from the RPWS instrument and, more specifically, its broadband radio correlator HFR and the three 10-meter wire antennas associated with it.

In addition to previous observations made mainly from the equator (Voyager and the first phase of the Cassini mission), high-latitude trajectories of the Grand Finale and induced occultations of the SKR by the planetary limb, may provide new information on the location and structure of SKR source regions and their association with UV/IR aurorae.
The corresponding Cassini data have been processed using a method used elsewhere to map the extended Galactic radio background, which does not rely on the assumption of an emitting point source, as is usually the case in standard direction-finding studies.

*Speaker

Study of unusual spectral features on multi-scale spectra of the Jovian decameter emission

Galina Litvinenko [1,2], Vladimir Ryabov [3], Vyacheslav Zakharenko [1], Alexander Konovalenko [1], Hanna Rothkaehl [2], Oleg Ulyanov * [1]

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We report the study of unusual fine time-frequency patterns and their complex temporal evolution found on the Jovian sporadic decameter emission (DAM) spectrograms in several examples of wide- (WB), and narrow-band (NB) emission components and their combinations. The waveform data have been recorded with the Ukrainian telescope UTR-2 (Ukrainian T-shape Radio telescope) and a baseband digital receiver at its frontend during a powerful Jupiter decameter storm on 26 November 2009. Spectral images have been calculated with a specially designed software adopted for multi-scale analysis that includes a high pass filter aimed at removing narrow-band RFI patterns. This method of preprocessing reveals both already known and new spectral patterns in the Jovian decameter signal and allows tracing their non-stationary behavior on the time-frequency plane. For instance, a wideband spectrum comprising several emission bands of different morphology, from which frequency-separated narrowband events are subsequently formed, is presented for the first time. The presence of fine and super-fine internal structures is clearly demonstrated for the considered Jovian WB and NB emission patterns and their main characteristic parameters are discussed. Hypotheses based on both the theory of plasma waves interaction with flows of charged particles and the probability charts of Jovian signal occurrence including the sources of different polarization were put forward for physical interpretation of the processes underlying the observed spectral features. In order to approach a more accurate description of the physical processes within the radiation source, the frequency modulation processes, which can be caused by signal wave propagation path through different plasma media, were taken into account.

*Speaker

Methods and results of low-frequency beamformed exoplanet detection studies with NenuFAR

Corentin Louis * [1,2], Alan Loh [3], Philippe Zarka , Laurent Lamy , Emilie Mauduit , Julien Girard , Jean-Mathias Griessmeier , Baptiste Cecconi , Quentin Nenon , Stéphane Corbel

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The Electron Cyclotron Maser (ECM) is the well-accepted paradigm for the auroral radio emissions from magnetized Solar System planets. The emitted frequencies are local electron cyclotron frequencies, directly related to planetary magnetic field strength. Detecting ECM radio emissions from exoplanets is thus the key for measuring exoplanetary magnetic fields (inaccessible via Zeeman Doppler measurements), with implications on internal structure, habitability, compared magnetosphere population and exo-space weather studies. Planetary radio emissions are expected at low frequencies, typically below 100 MHz. In the frame of the corresponding large program running at the NenuFAR radio array in France, we have developed several methods for enhancing detection capabilities, based on radio periodicities, drifting fine structures and linearly polarized emission. We have tested them on Jupiter, our closest exoplanetary radio analog. We will present the methods, test results, and first application to long series of beamformed observations.

*Speaker

Study of the Evolution of the Periodicity of Jovian Decametric Emissions Over 30 Years Using Data from the Nançay Decameter Array

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In this presentation, we investigate the long-term evolution of the periodicity of Jupiter's decametric radio emissions over the 1990-2020 period, using data from the Nançay Decameter Array and an extended version of the Marques et al. (2017)'s catalogue. We apply a Lomb-Scargle analysis to characterize temporal variations in the radio signal's periodicity. The results include both the auroral emissions of Jupiter and the emissions induced by its moons Io, Europa, and Ganymede.

*Speaker

Do Galilean moons influence Jovian radio emissions in the kilometer range?

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The radio emissions generated at Jupiter by the Cyclotron Maser Instability (CMI) are categorized based on their frequency-kilometric, hectometric, or decametric-and their origin, whether auroral or induced by the Galilean moons. Regarding this latter category, the moons Io, Europa, and Ganymede are known to influence Jupiter's radio spectrum. Emissions induced by Io have long been observed from Earth in the decametric range (> 10 MHz, Bigg, 1964) and were later confirmed down to the hectometric range by space missions (Zarka et al., 2001). In contrast, radio signatures from Europa and Ganymede in the hectometric and decametric ranges have only been confirmed more recently (Louis et al., 2017; Zarka et al., 2017, 2018; Jacome et al., 2022), through both ground-based and spacecraft observations. However, no clear evidence has yet been found of their influence on kilometric emissions (see, e.g., Fischer et al., 2025 for a first attempt). In this study, we present an extended search for radio emissions induced by Europa, Ganymede, and, to a lesser extent, Callisto, using six years of observations from the Juno spacecraft.

*Speaker

Recents advances on solar radio monitoring and space weather

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The Earth is under the continuous impact of the solar wind plasma flow and its transients, such as coronal mass ejections (CMEs) which can produce disturbed geomagnetic conditions. Solar eruptions are associated with a rich variety of physical processes, e.g. plasma heating, mass motions, waves and shocks, and acceleration of energetic particles. The majority of these processes are accompanied by radio emission. The most frequently observed radio emission are type II, type III and type IV radio bursts which provide precious information on different solar phenomena across a broad range of temporal, spatial and energy scales. Combining ground- and spaced-based radio observations permits us to track the radio emissions mapping the plasma processes all the way from the low corona up to the interplanetary space. This characteristic makes solar radio emission important component of the both, operational space wearther and space weather science. In this presentation I will discuss how the solar radio observations can be employed in the space weather diagnostics, and what is the recent progress brought by the novel ground-based (e.g. LOFAR and MWA) and space-based instruments (e.g. Parker Solar Probe and Solar Orbiter). The focus will be on the radio burst which can provide information about the space weather important solar eruptive phenomena such as flares, CMEs and the associated shock waves.

*Speaker

Jupiter's magnetic field and its relation with generation and control of decameter radiation observed by Juno

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Decametric radio emissions (DAM) originating in Jupiter's polar magnetosphere ought to originate on magnetic field lines at the local electron gyrofrequency. The Io-related DAM have received the most attention since the 1980's. The maximum frequency of these emissions ought to be bound by the maximum magnetic field strength above the footprint of the instantaneous Io Flux Tube (IFT). However, there remains a lack of agreement between the frequency extent of Io-related decameter radiation and the frequency extent predicted by Jovian magnetic field models. Here, we analyze peak frequencies and source locations of Io and non-Io-related DAM observed by Juno during the prime mission (_˜10,600 events) and show how the latest magnetic field models (JRM09, JRM33) can accommodate and control Io-DAM. We note that the observed peak frequencies appear to be truncated at 37 MHz although the magnetic field in the northern hemisphere would allow events up to 55 MHz at some longitudes. Lower frequencies than those allowed by the cyclotron maser instability are consistently observed for most of Io's longitudes. To reconcile this discrepancy, we analyze the upper electron density limit along the magnetic field lines, the possible existence of plasma cavities and the locations in the magnetosphere where the extraordinary mode (fpe/fce $<$ 0.3) is no longer allowed. For this, we make use of beaming angles of Io-DAM and the geometry of the Jovian magnetic field.

*Speaker

Real-time detection of Solar and Jovian radio bursts with NenuFAR: advancing astrophysical data mining with the EXTRACT project.

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In the past decades, the increasing need for ultra-high-resolution radio observations with enhanced sensitivity has led to a surge in data volumes from next-generation radio telescopes. Efficient tools for data management, processing, and storage optimization are now crucial for helping scientific analysis. The EXTRACT project, funded by the European Commission, is developing a distributed data-mining platform for EXTReme dAta Across the Compute conTinuum. A key use case, Transient Astrophysics with a Square Kilometer Array pathfinder (TASKA), takes advantage of EXTRACT technologies to handle the massive data streams produced by NenuFAR, one of the SKA pathfinders.
This work presents two targeted projects, TASKA-A1 and A2, focusing on real-time detection of (A1) Solar radio spikes and (A2) Jupiter's fast-drifting radio bursts (S-bursts), in high resolution time-frequency dynamic spectra. TASKA-A1 employs the deep learning-based SpikeNet convolutional neural network (Murphy et al., 2024) to detect Solar spikes in real-time observations. TASKA-A2 adapts an existing detection pipeline based on Fast Fourier Transform (FFT) and Radon Transform (Mauduit et al., 2023) to enable real-time identification of Jovian S-bursts. Additionally, we are developing a novel convolutional neural network based on anomaly detection to enhance detection efficiency and robustness. Both algorithms are embedded within the MurMuRe pipeline (Modular Multicast Receiver), specifically developed for the NenuFAR real time data receiver, which allows to use either the real-time data flow from the instrument or stored data with various formats.

These advancements provide an important step toward smart data filtering for next-generation radio telescopes. Indeed, by enabling real-time decision-making, astronomers can dynamically store high-resolution data for only the most scientifically valuable events while preserving lower-resolution data for broader analysis. It also paves the way of "analog to information" processing, which would drastically reduce the storage needs. As a matter of fact, the emissions studied in this work require a high time-frequency resolution, but are often embedded within larger slowly-varying emissions that can be studied at a lower resolution. This approach helps optimizing data

*Speaker

storage while maintaining its value for scientific analysis, thus preparing for scalable solutions in the era of the Square Kilometer Array.

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Resolving spatial and temporal shock structures using LOFAR observations of type II radio bursts

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Collisionless shocks are one of the most powerful particle accelerators in the Universe. In the heliosphere, type II solar radio bursts are signatures of electrons accelerated by collisionless shocks launched at the Sun. Spectral observations of these bursts show a variety of fine structures often composing multiple type II lanes. The origin of these lanes and structures is still not well understood and has been attributed to the inhomogeneous environment around the propagating shock. Here, we investigate the large-scale local structures near a coronal shock wave using high-resolution radio imaging observations of a complex type II radio burst observed on 3 October 2023 with the Low Frequency Array (LOFAR). In this observation, we identify at least three radio sources at metric wavelengths corresponding to a multi-lane type II burst. The type II burst sources propagate outwards with a shock driven by a coronal mass ejection. We find a double radio source that exhibits increasing separation over time, consistent with the expansion rate of the global coronal shock. Our results also show the importance of increased spatial resolution in determining either the small-scale spatial properties in coronal shocks or the structuring of the ambient medium. Our observations suggest that possible shock corrugations or structuring of the upstream plasma at the scale of 10ˆ5 km can act as hotspots for the acceleration of energetic electrons.

*Speaker

Investigating the origins of three acceleration episodes during a weak solar eruption accompanied by type II radio bursts

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Observing the Sun in the radio domain is a powerful tool to detect and study the presence of shock waves in the solar corona, especially in the absence of other clear observations of coronal mass ejections (CMEs) capable of driving these shocks. Electrons accelerated by coronal shocks can be remotely detected through the radio waves that they emit in the form of type II solar radio bursts. In this study, we investigate the source locations of three type II bursts using imaging and spectroscopic observations with the Low Frequency Array (LOFAR). The type II bursts occur in the absence of a notable CME, with only a faint and narrow eruption observed at other wavelengths. The type II bursts, however, indicate the presence of a shock wave and multiple periods of electron acceleration despite the presence of a weak CME. By tracking the spatial and temporal evolution of the type II radio sources over multiple frequencies, we find that the three type II bursts are generated in separate and distinct regions. We also extend the analysis into three dimensions by combining LOFAR imaging with a magnetohydrodynamic (MHD) model of the solar corona to investigate the properties of the emission regions of these type II bursts.

*Speaker

SIRIO: A public open Python code to predict radio emission from star-planet interaction

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We present SIRIO (Star-planet Interaction and Radio Induced Observations), a public Python code that
predicts the radio emission arising from star-planet interaction, for three different stellar wind magnetic geometries (closed dipole, open Parker spiral, and Potential Field Source Surface) and takes into account the free-free absorption of the radio emission caused by electrons present in the stellar wind. SIRIO predicts the radio emission from any number of confirmed star-planet systems, as a function of the stellar wind mass loss and/or the exoplanetary magnetic field. In its current version, the radio predicted radio emission assumes a sub-Alfvénic scenario.

SIRIO can be used to compute the expected radio emission from a putative planet, as a function of the separation from its host star. SIRIO can also be used to do quick evaluations of the feasibility of radio proposals aimed at detecting star-planet interaction, and to constrain the stellar wind mass-loss rate and/or planetary magnetic field.

*Speaker

Solar Radio Burst Tracker – A Citizen Science Campaign for Identifying Type III Solar Radio Bursts

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Context. Type III solar radio bursts are among the most common radio emissions from the Sun, produced by energetic electron beams propagating through the solar corona and interplanetary space. These bursts are characterized by their rapid frequency drift, and through them, we can further study solar activity. Since the launch of ESA's Solar Orbiter mission in 2020, the Radio and Plasma Waves (RPW) instrument has collected more than four years of data, but identifying Type III bursts remains a challenge due to their varying intensities and morphologies. While efforts for automated algorithms exist, they often struggle with faint or more complex bursts. Human participation can help optimize automated Type III detection.
Aims. We aim to create the first extensive catalog of Type III solar radio bursts detected from space, including precise time and frequency ranges for each identified event. This catalog will serve as a valuable resource for studying the relationship between Type III bursts and solar flares, as well as their variability throughout the solar cycle.

Methods. To achieve this, we developed Solar Radio Burst Tracker, a citizen science project hosted on Zooniverse.org, where volunteers analyze spectrograms from the RPW instrument and identify Type III bursts. Each spectrum is classified by eight participants to ensure accuracy. In addition, we developed a post-processing analysis algorithm where we can filter the noise from the volunteers' classifications and provide a measure of uncertainty to their identifications.
Expected Outcomes. We present the design of the project and the initial results from the first phase of classifications. The dataset will be compared with X-ray observations of solar flares, helping to establish a connection between radio bursts and flare-associated electron acceleration. Additionally, the project is planned to be extended to incorporate STEREO spacecraft data, further expanding the catalog and allowing for long-term studies of solar radio emissions over the solar cycle. We also plan to provide this catalog to optimize automatic Type III detection for future observations.

*Speaker

Exploring Magnetic Star-Planet Interactions in GJ 486 Using Radio Observations

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Detecting auroral radio emissions from planets is an exceptionally challenging task, largely limited to Jupiter-like objects. This is because Earth-like exoplanets are expected to have electron-cyclotron frequencies that fall below the ionospheric cut-off. However, when a sub-Alfvénic interaction takes place between an exoplanet and its host star, it can produce auroral emissions at frequencies ranging from a few hundred MHz to the GHz regime. This phenomenon arises because the dominant magnetic field is that of the host star. The successful detection of such radio signals could establish radio observations as a novel and independent method for discovering exoplanets. In this work, we present the findings from our radio campaigns targeting GJ 486b, utilizing the upgraded Giant Metrewave Radio Telescope (uGMRT) at Band 4 (550–950 MHz). I will share the results achieved so far and discuss their implications for shaping future observational strategies.

*Speaker

Exploring Habitability and Radio Emission in Proxima b's Space Weather Environment

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The habitability of exoplanets around M dwarfs like Proxima Centauri is profoundly influenced by space weather, where stellar wind properties and planetary magnetic fields dictate atmospheric retention and radio emission. We investigate the magnetospheric dynamics and radio signatures of Proxima b-an Earth-like planet in the habitable zone-under both calm and extreme space weather conditions (e.g., coronal mass ejections). Using 3D magnetohydrodynamic simulations (PLUTO code), we explore three key scenarios: (1) sub-Alfvénic stellar wind dominance (magnetic pressure-driven), (2) super-Alfvénic regimes (ram pressure-driven, forming a bow shock), and (3) transient extreme events.

Our results suggest that an Earth-like or stronger magnetic field can shield Proxima b's surface from stellar wind erosion for most planetary tilts during calm conditions. However, during extreme events, higher field strengths or smaller tilts are required for protection. Notably, radio emission is significantly enhanced in super-Alfvénic regimes due to bow shock contributions, and extreme space weather boosts emission by orders of magnitude-a promising avenue for detecting exoplanetary magnetospheres via radio observations. This work bridges planetary magnetospheric physics and observational radio astronomy, offering critical insights for future searches of habitable worlds around active stars.

*Speaker

Probing the energy of Jovian auroral electrons with HST/STIS through the brightness ratio method

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The Far-UV auroral observations of the giant planets, such as those obtained the Hubble Space Telescope, can be used to probe the energy of primary auroral electrons precipitating to the atmosphere through two methods known as (i), the color ratio, calculated between H2 bands absorbed and not absorbed by hydrocarbons, and (ii) the brightness ratio, calculated from the rartio between the HLya line and the H2 bands. While the former, sensitive to highly energetic electrons yielding deep enough emissions to undergo absorption (typically $>$ 10 keV) has been intensively used at Jupiter, the latter, more sensitive to weakly energetic electrons precipitating at higher altitudes, has only been tested in the proof-of-concept work of (Tao et al., 2017). Here, we analyze HST/STIS long-slit slewing observations of the Jovian auroral regions, such as those previously analyzed by (Gérard et al., 2014) to reconstruct spectro-images and derived maps of both the color ratio and the brightness ratio, from which we aim at producing complementaty maps of electron energies.

*Speaker

Observation of low-frequency planetary radio emissions with an orbiting interferometer

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The magnetized planets of the outer Solar System emit intense kilometric radio waves at frequencies below 1 MHz, which provide valuable insights into their magnetospheric dynamics and interactions with the solar wind. These emissions also serve as potential indicators for monitoring interplanetary space weather. Space-based radio interferometry offers a unique opportunity to observe these low-frequency signals, as it circumvents the Earth's ionospheric cutoff (_˜10 MHz) and enables spatially resolved measurements.

This study is conducted within the framework of the NOIRE (Nanosatellites for a Radio Interferometer in Space) mission concept, which aims to deploy an array of 50 nanosatellites in lunar orbit to perform high-sensitivity, low-frequency radio observations. We investigate the system's expected sensitivity, accounting for both instrumental noise and systematic errors, and evaluate the achievable time-frequency resolution under current design constraints. Based on this analysis, we identify the key components of planetary radio emissions that could be effectively studied with such a configuration.

Our results indicate that NOIRE would be capable of producing dynamic spectra of Jupiter and Saturn with sufficient temporal and spectral resolution for both phenomenological and long-term analyses. While the detection of emissions from Uranus and Neptune is also feasible, it would be limited by a low revisit rate (_˜1 measurement every 4 hours). We conclude by discussing the limitations of the current performance model and outlining potential avenues for improving detection capabilities in future iterations of the mission design.

*Speaker

OASyS: A Simulation Framework for Orbiting Low-Frequency Radio Interferometers

Erwan Rouillé * [1], Baptiste Cecconi [1], Boris Segret [2], Julien N. Girard [1], Alan Loh [1]

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The development of orbiting radio interferometer concepts offers new opportunities for astronomical observations but also introduces significant challenges, particularly assessing and optimizing instrument performance. This work introduces a simulation toolbox for orbiting low-frequency radio interferometers tailored to evaluate the impact of design parameters on the instrument performances.
Space-borne interferometers are envisioned to perform observations of radio emissions with frequencies below the Earth's ionospheric cutoff (_˜10 MHz) that cannot be observed from the ground. They provide spatially resolved observations that enable mapping the sky or measuring dynamic spectra from distant sources.
While concepts involving surface-based arrays on the Moon can leverage existing simulation tools developed for terrestrial interferometers, orbiting interferometers require specialized simulation capabilities that are currently lacking.

To address this need, we present OASyS (*Orbital Aperture Synthesis Simulator*), a Python-based simulation toolbox specifically developed for modeling orbiting low-frequency interferometers.
We address the unique operational characteristics of such instruments and how this framework implements them. We also present the tools provided by OASyS and the type of pipeline that was intended to be implemented with it to evaluate the instrument's performance.
We test OASyS results against already existing simulators for a ground-based interferometer.
We then present examples of results of simulations applied to NOIRE (*Nanosatellite pour un Observatoire Interferométrique Radio dans l'Espace*) study.
We discuss the benefits of this toolbox and its limitations, and we suggest improvements.

*Speaker

Autonomous Attitude Determination on a Radio Interferometric Swarm

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The emergence of satellite swarm technology enables new capabilities in space science but also introduces significant challenges, particularly in determining the swarm's topology and absolute attitude. This work presents an autonomous swarm attitude determination algorithm tailored for orbiting radio interferometric missions.
This algorithm uses the imaging capability of a low-frequency radio interferometer to act as a star-tracker using bright radio sources as references.
Operating in a *Lost-In-Space* (LIS) mode, the algorithm reconstructs radio sky maps and extracts source positions through iterative Gaussian fitting, with each source successively deconvolved from the image to enable subsequent detections.
The measured source positions are then matched to a catalog using a voting system based on geometric parameters among source triplets.

Simulations are conducted across the kilometric wavelength range (30 kHz – 1 MHz), though the technique is extensible to higher frequencies. The implemented sky model is extrapolated from higher-frequency observations.
This study is conducted within the framework of the NOIRE (*Nanosatellites for a Radio Interferometer in Space*) mission concept, which aims to deploy an array of 50 nanosatellites in lunar orbit to perform high-sensitivity, low-frequency radio observations.
The algorithm's accuracy on the swarm attitude is evaluated for different levels of noise and errors in the measurements.
The simulation shows that the proposed algorithm can achieve an attitude knowledge error lower than 1 arcmin for a swarm scale of 100 km. The requirements in terms of memory and computation capability are discussed, as well as the limitations of the technique and the simulation. These results support the feasibility of autonomous absolute swarm attitude estimation with radio interferometric observations.

*Speaker

Forecasting the Outer Heliosphere Solar Wind using Gas Giant Radio Aurorae

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The auroral radio emissions of the gas giants– Jupiter and Saturn– are driven by a complex combination of internal magnetospheric dynamics and external solar wind processes. These emissions thus serve, in part, as remotely-observable beacons of the state of the solar wind in the outer heliosphere. The radio aurorae of these planets are incredible useful in this role, as the solar wind in the outer heliosphere is otherwise poorly sampled by in-situ spacecraft. The Space Weather Impact on Planetary Emissions (SWIPE) mission concept is being developed to deepen our understanding of these interactions and exploit the radio aurorae of the gas giants as solar wind monitors in the outer heliosphere. To effectively monitor the reactions of Jupiter and Saturn to space weather events, state-of-the-art solar wind and ICME propagation models are required to forecast the arrival of significant events, and thus signal when observations should be taken. Here we present the results from a new, data-assimilative solar wind ensemble model based on the HUXt solar wind propagation model. This model uses sequential importance resampling (SIR) to refine its forecasts by incorporating information from solar wind monitors between the Sun and the gas giants, including Parker Solar Probe, Solar Orbiter, L1 solar wind monitors, STEREO-A, and MAVEN. Uniquely, this model both forecasts auroral radio emissions at Jupiter and Saturn based on the state of the solar wind, and uses observations of these radio emissions to further refine the solar wind estimates. Future applications of this model to the JUICE and {Europa Clipper} missions, particularly during interplanetary cruise, will also be discussed.

*Speaker

Addressing the complexity of Jupiter's radio spectrum from multi-interferometric observations at 0.05-10 GHz

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We present results from an ongoing multi-interferometer investigation of Jupiter's Magneto-Bremsstrahlung Radiation (JMBR). VLA, NenuFAR, LOFAR, GMRT, MeerKAT and ATCA observations from 1986-2025 are being examined to understand the frequency dependence of JMBR on different timescales. Although JMBR provided the first evidence of Jupiter's harsh radiation environment in 1959 (from the assumption that JMBR is primarily Synchrotron Radiation (SR) from Jupiter's electron radiation belt), its spatio-temporal and frequency-dependent variations are yet to be fully understood more than 60 years later. Our objective is to discuss the possibility that Cyclo-Synchrotron Radiation (CSR), produced by trans-relativistic electrons with 100's of keV, can contribute to JMBR radio spectrum. VLA observations from 1992, late 90s-early 2000s, 2014 and 2025 at 0.05-10 GHz are analyzed towards that objective. When available, additional analysis results from other interferometric observations are presented to assist in our investigation of variations on timescales of Jupiter's planetary rotation and solar cycle. GMRT observations from Sep 2024 - Jan 2025 are discussed in a companion paper.

*Speaker

Plasma conditions at the orbits of Io, Europa, and Ganymede derived from the lead angle of the satellite auroral footprints observed by Juno-UVS

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Io, Europa, and Ganymede act as an obstacle to the corotating plasma in the Jovian magnetosphere. Through the electrodynamic interaction at the moons (e.g., Kivelson et al., 2004), Alfvén waves are launched and propagate along the magnetic field. Auroral electrons are accelerated toward/away from Jupiter's atmosphere by the Alfvén waves and ultimately induce multiple satellite auroral footprints and a diffuse auroral tail in Jupiter's atmosphere (e.g., Clarke et al., 2002; Bonfond et al., 2008).
The Alfvén velocity depends on the local magnetic field magnitude and the local plasma mass density. The position of satellite auroral footprints is detemined by the Alfvén wave propagation time. The angular separation between the satellite body and the auroral footprint is called the lead angle, and controls the beaming of the satellite-induced decametric emission. The recent report by Hue et al. (2023) provided an empirical fit of the equatorial lead angle of Io's, Europa's, and Ganymede's Main Alfvén Wing (MAW) spot measured with Juno-UVS, showing that the decametric radio emissions induced by the Galilean moons can be simulated more precisely using the ExPRESS tools when the footprint lead angle is taken into account (Louis et al., 2019). Understanding of variation of the footprint lead angle will help the future observations with the Jovian decametric radio emissions such as the estimation of Ganymede's ionospheric electron density using the radio occultation between JUICE spacecraft and the radio sources near Jupiter (Yasuda et al., 2024),

The footprint lead angle has also been proven to be useful to investigate temporal variations of plasma parameters in the Io plasma torus (Moirano et al., 2023) and the plasma disc at Europa's orbit (Satoh et al., 2024). These studies traced the Alfvén waves from the moon to the MAW spot in the plasma sheet with various plasma parameters and estimated the lead angle to find the best fit parameters. Estimation of the plasma parameters at the orbits of the icy moons is important because the magnetospheric plasma controls source and loss of neutral atmospheres in the icy moons.
Using the same fitting procedure as Satoh et al. (2024), we derive the three ion parameters (atomic mass, number density, and temperature) at the orbits of Io, Europa, and Ganymede, from the footprint lead angle measured by Juno-UVS. We also investigate temporal variations of these ion parameters at each orbit. In addition to the MAWs, we also use the lead angle of

*Speaker

the Transhemispheric Electron Beam (TEB) spot (Bonfond et al., 2008) as another constraint for the fitting. The TEB spot is generated by the electrons accelerated away from Jupiter in the other hemisphere. Hence, the TEB spot in one hemisphere is strongly associated with the other hemisphere's MAW spot. Using the TEB spot, we can trace the Alfvén waves that have different propagation paths than the ones corresponding to the MAW spot observed in the same hemisphere at the same time. We'll report the progress of our study.

Development of Analytical Model Generalized for Exoplanetary Auroral Radio Emission

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Planetary aurora is believed to play a key role in the direct detection of planetary magnetic fields and atmosphere. The circular polarization of the auroral radio emissions (Wu & Lee, 1979) enables them to be easily distinguished from other radio sources, and their emission frequency is theoretically proportional to the magnetic flux density in the radio source region. Therefore, auroral radio observations can directly constrain the magnetic field flux density without relying on complex model assumptions. However, auroral radio emissions have not yet been observationally detected from any exoplanet, except for a marginal detection (Turner et al., 2021). Modeling of auroral radio emission is needed to predict which exoplanets are suitable for auroral detection. Modeling of exoplanetary aurora has been conducted by several studies, focusing on the Magnetosphere-Ionosphere (M-I) coupling (Nichols, 2011) and the Star-Planet Interaction (SPI) mechanism (Saur et al., 2013), but they have not been able to generally explain emissions from a variety of exoplanets simultaneously. Here, we developed a new generalized analytical model of the M-I coupling that predicts the exoplanetary auroral radio power, based on the pioneering exoplanetary M-I coupling model by Nichols (2011). We use only the magnetospheric velocity distribution as a measure of radio power to allow for generalization, ignoring unobservable variables in exoplanets, such as the flux function and the mass loading rate. Validation of our model with Jupiter and Saturn suggests that our model successfully describes the total auroral energy dissipated through Joule heating in the planet's ionosphere (Jupiter: _˜450 TW; Saturn: _˜5TW). The results align with observations within an uncertainty of one order of magnitude and are consistent with past modeling. We believe that our results on the total auroral power will help us understand the thermal atmospheric escape associated with the auroral Joule heating (Cowley et al., 2004; Gronoff et al., 2020) when we apply our model to exoplanets in the future. Analysis of past models suggests a 0.01% conversion efficiency of energy dissipated through auroral Joule heating into radio emission (Cowley et al., 2004; Zarka, 2007). Applying this conversion efficiency to our results suggests that the radio emission from Jupiter and Saturn is consistent with observational results within an uncertainty of one order of magnitude (Jupiter: _˜50 GW; Saturn: _˜0.5 GW; Zarka, 2007). Furthermore, the application of our model to ultracool dwarfs (UCDs) shows that the observed UCD auroral radio emission, up to _˜1000 GW (Hallinan et al., 2008; Kao et al., 2023), suggests that UCD atmospheres are weakly ionized. We are currently modifying our model to understand the dependence of auroral power on the corotation breakdown location in the magnetosphere. We also attempt to apply our model to recent unverified observations from Tau Boö b (Turner et al., 2021) to investigate the plasma and magnetic conditions around hot Jupiters. Here, we present the current status of our modeling and validation.

*Speaker

MeerKAT observations of Jupiter

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The MEeeKAT radiotelescope facility in the Northern Cape, South Africa, has observed Jupiter system on several occasions. We present an inventory of observations as well as examples of interferometric imaging of Jupiter synchrotron radiation, demonstrating the sensitivity to resolve fast variations of the radiation belt morphology.

*Speaker

NenuFAR Observations of Scintillation During High Solar Activity

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We present an analysis of scintillation observations conducted with the NenuFAR multi-baseline interferometer between May and September 2024. The study focuses on the frequency range of 23.4–67 MHz. At present, we utilize 64 mini-arrays, forming a non-equidistant antenna array that operates in transit mode. The primary objective of the study is to observe radio emissions from supernova remnants. To determine the contributions of ionospheric and interplanetary irregularities causing scintillation (IS and IPS, respectively) in radiation from radio sources, we analyze the power spectrum distribution of scintillation.
For Cassiopeia A, the 2024 observations reveal two components, differentiated by scale: slow and fast scintillations. These could be associated with IS and IPS, which are influenced by radiation from the shell and a very small object within it. Moreover, it is highly likely that high solar activity induces a special state of the ionosphere, generating this effect. These observations once again highlight the possible activity of a low-frequency compact source in Cassiopeia A. Further low-frequency observations of Cassiopeia A would be valuable.
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*Speaker

Direction finding for Saturn Drifting Burst emissions

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The Radio and Plasma Wave Science (RPWS) instrument onboard the Cassini spacecraft analyzed Saturn radio emissions at frequencies up to 16 MHz. Among various types of emissions well known from previous flybys of the Voyager spacecraft, a new type of radiation has been detected by Cassini in the frequency range below 50 kilohertz. It has been named Saturn Drifting Bursts (SDBs) due to its characteristic spectral drift when displayed as a function of frequency over time. Observations of harmonic emissions as well as distinct polarization features suggest that SDBs are generated by a mode conversion mechanism, for which the local plasma density gradient plays a major role. In this study, we are exploiting the direction finding capabilities of the RPWS instrument, which enables to discriminate potential auroral sources from those connected to the Enceladus plasma torus. Using a newly developed plasma density model for Saturn's magnetosphere, we pinpoint the SDB generation region by tracing a straight ray path, starting from the vantage point of Cassini.

*Speaker

Ionospheric D-region temporal response to solar forcing

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The D-region is the lowest region of the Earth's ionosphere (60 - 90 km). Impulsive X-ray radiation during solar flares increases the ionisation and thus, the electron density. The chemical reactions between the species at those altitudes govern the D-region's temporal response.
The D-region is monitored through Very Low-Frequency (VLF, 15 - 45 kHz) waves propagating between the Earth and the ionosphere. In this waveguide, several modes propagate, and the total measured amplitude and phase result from their interaction. The electric field is the sum of all these modes, weighted by the attenuation and gain factors, which depend on frequency and reflection height and electric properties of the waveguide limits. A change in the electron density modifies these coefficients, thus resulting in the amplitude and phase of the VLF signal.

The VLF amplitude and phase show a substantial dispersion for a given flare strength. The D-region's response to several flares of the same strength but different durations or occurring at various solar zenith angles is taken as case studies to highlight the factors underlying this dispersion. For each solar flare, the amplitude and phase measurements from a VLF receiver in Nançay (Sologne, France), monitoring several transmitters (e.g. GQD and GBZ in the UK, NAA in the USA) are investigated in two steps:

> The Longwave Mode Propagator (Gasdia & Marshal, 2021) code is used, assuming an exponential electron density in the D-region (Wait profile, Wait & Spies, 1964), to model the propagation of the modes in the Earth-Ionosphere waveguide.
>
> A more complex D-region chemistry is considered through a five-species description of this region (Lehtinen & Inan, 2007), which leads to a more realistic electron-height profile.

Comparing the results from those two approaches will reveal the role of ion chemistry in solar flares' response and their impact on the modes composing the VLF signal.

*Speaker

Characterization of Fluctuations in Solar Type III Radio Spectra Observed by PSP and SolO

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Solar type III radio bursts are common radio emissions generated by energetic electron beams traveling through the solar corona and wind. They can serve as important remote sensing tools for studying plasma and electron beams in the solar wind. In this work, we combine observations from Parker Solar Probe (PSP) and Solar Orbiter (SolO) in order to study solar type III radio bursts from different points of view and distances. In particular, we investigate there fine structures, such as striae and radio spectrum fluctuations, and their differences when observed from different viewpoints to gain a deeper understanding of the physical mechanisms related to the propagation of electron beams and radio emission. Our preliminary results indicate that the fluctuations of the maximum type III radio flux appear similar when observed by both spacecrafts, in despite of their different radial distances and heliolongitudes, suggesting that local effects are responsible for these fluctuations.

*Speaker

Extensive follow-up observations of the Tau Bootis exoplanetary system with NenuFAR

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Observations of an exoplanet's magnetic field would yield constraints on its planetary properties that are difficult to study, such as its interior structure, atmospheric escape, and any star-planet interactions. Observing planetary auroral radio emission is the most promising method to detect exoplanetary magnetic fields.
Recently, we published a study of the Tau Bootis (Tau Boo) exoplanetary system where we have the first possible detection of an exoplanet, Tau Boo b, in the radio using LOFAR beamformed observations (Turner et al. 2021). The derived planetary magnetic field of Tau boo b is consistent with theoretical predictions and if this detection is confirmed it will place important constraints on exoplanetary science in general. Initial follow-up observations in 2020 by our group from NenuFAR taken during its commissioning phase (Turner et al. 2023) and LOFAR (Turner al 2024) show no signs of emission. Therefore, the original signal may have been caused by an unknown systemic or we are observing variability in the planetary radio flux due to observing at different parts of the 120 day stellar magnetic cycle. Hence, we developed a new follow-up observing campaign designed to test the latter conclusion.
In this talk, we will present the first results of this extensive multi-year campaign to confirm the Tau Boo radio detection using NenuFAR. We observed for over 1000 hours in beamformed mode (ON- and 3 OFF-beams) from 15-52 MHz. The campaign is designed to determine whether the stellar magnetic cycle is the cause of the possible radio variability. Therefore, we ensure our observations cover the orbit of tau Boo b at different phases of the stellar magnetic cycle at least several times. We also have coordinated observations of the magnetic maps of the host star from NeoNarval and CFHT alongside our intensive radio monitoring. Preliminary results and the implications of this multi-year campaign will be presented.

*Speaker

Diagnostics of the solar wind using pulsars radio emission

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The study demonstrates how solar wind parameters at distances from 2R to Earth's orbit (1 AU) can be estimated using pulsed radio emission from pulsars aligned with the solar corona. Utilizing pulsar radio pulses to probe the solar corona enables the observation of both first- and second-order effects.
First-order effects include the dependence of the dispersion measure on elongation, where the dispersion measure increases as the line of sight moves toward the Sun. This effect results from the increased free electron density in the solar corona at shorter distances within the solar wind.

Second-order effects mean the dispersion measure's frequency dependence, which arises only near the Sun in regions with strong magnetic fields (_˜10 G). Both longitudinal and transverse magnetic field components contribute to an apparent increase in dispersion measure at lower frequencies compared to higher frequencies. The existence of a frequency-dependent dispersion measure also implies a similar dependence for the rotation measure. This relationship provides a basis for distinguishing the effects of the longitudinal and transverse magnetic field components of pulsar radio pulses.

Although second-order effects are an order of magnitude weaker than first-order effects, their detection-along with the observed frequency dependence of the rotation measure on elongation and the use of solar corona and interplanetary magnetic field models-allows for direct estimation of the average intensities of longitudinal and transverse magnetic field components in the solar corona.
Thus, using pulsar radio pulses to probe the solar corona or other magneto-active plasma regions is a promising scientific approach. The broadband and pulsed nature of pulsar radiation, along with the absence of confusion effects, enables precise determination of the magnetic field's contribution to integral propagation parameters such as dispersion and rotation measures.

*Speaker

Usage of the Solar Energy for the Solar Radio Observations with Mobile Antenna Array

Oleg Ulyanov * [1], Igor Bubnov [2], Mykola Shevchuk [3], Lev Stanislavsky [3], Vyacheslav Zakharenko [1], Oleksandr Konovalenko [3], Oleksandr Stanislavsky [3], Oleksandr Reznichenko [3], Vladimir Dorovskyy [3], Vladyslav Selin [3], Oleksandr Belov [3], Serge Yerin [3], Peter Tokarsky [2], Valerii Shevchenko [3], Victor Bortsov [3], Mykhailo Sidorchuk [3], Anatolii Miasoied [3]

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The first results of registration of the various solar radio bursts with broadband (meter-decameter range) compact mobile quickly-deployable antenna array which can operate autonomously in field conditions, i.e. away of stationary alternating-current power network, being powered only by solar energy are presented in the report. The main characteristics of the antenna and the solar power station are also given.

*Speaker

The Radio & Plasma Wave Investigation (RPWI) for the JUpiter ICy moons Explorer (JUICE)

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The Radio & Plasma Wave Investigation (RPWI) onboard the ESA JUpiter ICy moons Explorer (JUICE) is described. The RPWI provides an elaborate set of state-of-the-art electromagnetic fields and cold plasma instrumentation, including active sounding with the mutual impedance and Langmuir probe sweep techniques, where several different types of sensors will sample the thermal plasma properties, including electron and ion densities, electron temperature, plasma drift speed, the near DC electric fields, and electric and magnetic signals from various types of phenomena, e.g., radio and plasma waves, electrostatic acceleration structures, induction fields etc. A full wave vector, waveform, polarization, and Poynting flux determination will be achieved. RPWI will enable characterization of the Jovian radio emissions (including goniopolarimetry) up to 45 MHz, has the capability to carry out passive radio sounding of the ionospheric densities of icy moons and employ passive sub-surface radar measurements of the icy crust of these moons. RPWI can also detect micrometeorite impacts, estimate dust charging, monitor the spacecraft potential as well as the integrated EUV flux. Together, the integrated RPWI system can carry out an ambitious planetary science investigation in and around the Galilean icy moons and the Jovian space environment. Some of the most important science objectives and instrument capabilities will be described. RPWI focuses, apart from cold plasma studies, on the understanding of how, through electrodynamic and electromagnetic coupling, the momentum and energy transfer occur with the icy Galilean moons, their surfaces and salty conductive sub-surface oceans. The RPWI instrument is planned to be operational during most of the JUICE mission, during the cruise phase, in the Jovian magnetosphere, during the icy moon flybys, and in particular Ganymede orbit, and may deliver data from the near surface during the final crash orbit. We will also show some data from the last Lunar-Earth flyby.

*Speaker

Substorm Properties of Auroral Kilometric Radiation

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Auroral Kilometric Radiation (AKR) is a strong Earth-based radio emission generated by the acceleration of electrons along auroral latitude magnetic field lines. AKR is closely linked to auroral ionospheric activity, with greater irradiance correlating with stronger auroral electrojets and enhanced particle precipitation. AKR provides a means to remotely sense ionosphere-magnetosphere coupling, which becomes most dynamic during magnetospheric substorms. These substorms exhibit clear onset signatures in auroral imagery and ground-based magnetometer data. Using these signatures and an AKR burst list identified from Wind/WAVES observations, we investigate the properties of AKR that indicate substorm occurrence, contributing to a greater understanding of ionosphere-magnetosphere dynamics throughout the substorm timeline.

*Speaker

AKR Observations From All Local Times Indicate Substorm Activity

James Waters * [1], Laurent Lamy [1], John Coxon [2], Caitriona Jackman [3], Christian Lao [4], Colin Forsyth [4], Alexandra Fogg [3]

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Auroral Kilometric Radiation (AKR) is known to present emission at lower frequencies near substorm onset, corresponding to activation of higher altitude sources along auroral magnetic field lines and acting as a proxy of the vertical distribution of acceleration processes during these events. While remote observations are more difficult to relate to ionospheric activity than those made in-situ due to the illumination of the instrument by multiple AKR sources, there is a question of how the association of a particular observation with substorm activity can change with observer local time (LT) and more generally whether AKR observations can track geomagnetic activity in the same way as other proxies. This study addresses these questions by computing binary contingency tables and classification statistics including the Matthews Correlation Coefficient (MCC), using automatically selected AKR observations from Wind/WAVES and substorm event lists. AKR observations made on the dusk and dawn flanks present the greatest balance between true positive and negative associations with substorm activity, where active acceleration regions due to the enhanced substorm current wedge are distinct from typical nightside activity. Observations from the dayside and L1 can also be a reliable indicator, with AKR rarely observed from this region outside of substorm activity. Our results show that observations of AKR below 70 kHz (corresponding to active source regions above \$∼ \$12000$kmatanL-shellof7)canactasagooddiscriminatorofsubstormactivity,particularlyforobservationsfromLTsnearmidnig$

*Speaker

Spatial distribution and plasmaspheric ducting of auroral kilometric radiation revealed by Wind, Polar and Arase

Siyuan Wu * [1], Daniel Whiter [1], Sai Zhang [2], Ulrich Taubenschuss [3], Philippe Zarka [4], Georg Fischer [5], Laurent Lamy [6], Shengyi Ye [7], James Waters [6,8], Baptiste Cecconi [4], Ping Li [2], Caitriona M Jackman [9], Alexandra Fogg [9], Claire Baskevitch [4], Yoshiya Kasahara [10], Yasumasa Kasaba

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Auroral Kilometric Radiation (AKR), the dominant radio emission from Earth, has been extensively studied, though previous analyses were constrained by limited spacecraft coverage. This study utilizes long-term observations from Polar, Wind, and Arase spacecraft to generate comprehensive global AKR occurrence rate maps, revealing a high-latitude and nightside preference. A detailed investigation of the equatorial shadow region confirms that the dense plasmasphere blocks AKR emissions across all wave frequencies. Low-frequency emissions (are presents outside the shadow region at larger radial distance, which is attributed to magnetosheath reflection, while higher-frequency emissions ($>$ 100 kHz) propagate via plasmaspheric ducting and leakage, filling the equatorial region immediately outside the plasmasphere. Ray-tracing simulations identify low-density ducts within the plasmasphere as crucial channels that enable AKR to penetrate the dense plasmasphere, particularly at higher frequencies. These results align with meridional AKR observations, offering new insights into AKR propagation patterns.

*Speaker

Radio emissions reveal Alfvénic activity and electron acceleration prior to substorm onset

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Magnetospheric substorms are among the most dynamic phenomena in Earth's magnetosphere, yet their triggering mechanisms remain unclear. Ground-based observations have identified auroral beads as precursors to substorms. Here, we report a new precursor feature in space-based auroral kilometric radiation (AKR), marked by the appearance of emissions with slowly frequency-drifting tones (< 2 kHz/s) above 100 kHz. Simultaneous observations and statistical analysis show that both AKR precursors and auroral beads occur simultaneously, ˜10 minutes before substorm onset, indicating a shared physical process. Analysis of the emissions with frequency-drifting tones suggests they are linked to moving double-layers driven by dispersive Alfvén waves, consistent with the Alfvénic acceleration mechanism for auroral beads. These findings highlight the importance of Alfvénic activity in substorms and suggest that Alfvénic acceleration is not only responsible for optical auroral features but also for radio emissions, potentially explaining the ubiquitous frequency-drifting emission features observed at other magnetized planets like Saturn and Jupiter.

*Speaker

Aurora Kilometric Radiation and Aurora: Observations from Polar

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Auroral Kilometric Radiation (AKR) is the most intense non-thermal radio emission from Earth, generated via the cyclotron maser instability (CMI) in regions where the plasma frequency is much smaller than the electron cyclotron frequency (fpe fce). AKR is produced along auroral magnetic field lines by keV electrons exhibiting mono-energetic inverted-V-shaped precipitation, often associated with quasi-static acceleration above discrete auroral arcs. In addition to discrete aurora, AKR has also been linked to transpolar aurora arcs and high-latitude dayside aurora recently. Direct imaging of AKR source regions remains impossible due to the long wavelengths and limited antenna sizes in space. Most previous studies relied on direction-finding or multi-satellite methods, providing limited case-specific source locations. In this study, we perform a statistical analysis of AKR source regions using the full dataset from the Polar spacecraft, which, with its highly elliptical orbit, frequently crossed AKR source altitudes during perigee passes. We identify AKR source regions and examine associated plasma parameters including fpe, fce, and wave intensities. All AKR sources are found in low-density plasma region where fpe/fce < 0.1, consistent with CMI conditions. By tracing spacecraft footprints to auroral altitudes, we construct long-term AKR source maps ("AKR radio oval"), which show strong correspondence with optical auroral oval. The electron spectra associated with AKR generation reveal diverse precipitation characteristics, and event-by-event comparisons with auroral images suggest that AKR can be co-generated above a variety of auroral forms.

*Speaker

Unveiling Magnetospheric Dynamics of Giant Planets: Recent Insights from Radio Emission and Magnetic Field Perturbation Studies

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Recent investigations into Jovian radio emissions and magnetic field perturbations have significantly advanced our understanding of giant planet magnetospheric dynamics, with implications for Jupiter, Saturn, and beyond. Intense radio emissions, such as Jupiter's decametric (DAM) and broadband kilometric (bKOM) radiation, are driven by magnetic field perturbations and resulting electron precipitation. Ultraviolet auroral observations complement this by mapping the spatial and temporal evolution of energy transfer, with Jupiter's auroras near the magnetic poles exhibiting dynamic morphology and brightness variations tied to particle precipitation and magnetosphere-ionosphere coupling. Radio emissions provide quasi-continuous monitoring of high-frequency energy dynamics, while auroral data offer a global view of energy dissipation and mass transport processes. Together, these tools elucidate magnetic configurations, plasma activities, and planet-solar wind interactions, deepening our knowledge of giant planet magnetospheres and providing a foundation for studying magnetospheric phenomena in other celestial systems, such as exoplanets.

*Speaker

Ground-based perspective of PRE radioastronomy, from historical observations to modern giant facilities

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I will present an overview of ground based observations of planetary, solar and exoplanetary radio observations (briefly mentioning stellar radio observations when related to planetary ones), from early days of radioastronomy to present-day instruments. Emphasis will be put on the evolution of observation techniques, from single dishes and analog phased arrays, through classical interferometric imaging, to modern digital interferometers (made, at low frequencies, of phased arrays). In parallel, I will mention the evolution of receiver capabilities (their t-f resolution in particular). Digital interferometers allowed the development of software integral field spectroscopy on residual visibilities, providing the most powerful means to detect weak long bursts from exoplanets, stars and their interaction. VLBI observations of Jupiter's decameter emission are also progressing. I will conclude with the perspectives offered by the SKA.

*Speaker

Location and energy of electrons producing the radio bursts from AD Leo observed by FAST in December 2021

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In a 2023 paper, circularly polarized radio bursts detected by the radio telescope FAST from the flare star AD Leo on December 2-3, 2021 were presented. They were attributed to the electron cyclotron maser instability. In that context we use here two independent and complementary approaches to constrain for the first time the source location (magnetic shell, height) and the energy of the emitting electrons. This new methodlogical paradigm consists of (i) modelling the overall occurrence of the emission with the ExPRES code, and (ii) fitting the drift-rate of the fine structures observed by FAST. We obtain consistent results pointing at 20-30 keV electrons on magnetic shells with apex at 2-10 stellar radii. Emission polarization observed by FAST and magnetic topology of AD Leo favour X-mode emission from the southern magnetic hemisphere, from which we draw constraints on the plasma density scale height in the star's atmosphere. We provide elements of comparison with solar system radio bursts (Jovian and Solar), emit hypotheses about the driver of AD Leo's radio bursts and discuss the perspectives of future observations at very low frequencies (e.g. with NenuFAR below 85 MHz).

*Speaker

Probing Exoplanetary Magnetospheres at Low Radio Frequencies with NenuFAR

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Low-frequency radio observations provide a powerful tool for studying exoplanetary magnetospheres, offering insights into planetary magnetic fields and star-planet interactions. Using NenuFAR (10–88 MHz) in imaging mode, we conducted a targeted search for radio emissions from the HD 189733 system, detecting a 1.5 Jy circularly polarised burst at 50 MHz in dynamic spectra. The burst properties are consistent with cyclotron maser instability (CMI) emission, potentially linked to sub-Alfvénic star-planet interactions. Additionally, we identified candidate bursts from brown dwarfs, highlighting the role of low-frequency radio studies in probing substellar magnetic activity.

While these detections open new possibilities for planetary and substellar magnetospheric studies, the increasing presence of artificial radio sources presents a growing challenge. A complementary study with NenuFAR detected broadband polarised emissions from 134 Starlink satellite passes (54–66 MHz, max flux > 500 Jy), significantly complicating the detection of faint astrophysical signals.

We discuss the implications of these findings for exoplanetary and substellar radio studies, the observational challenges posed by satellite interference, and the prospects for future radio facilities in advancing planetary magnetospheric science.

*Speaker

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