List of abstracts

Jean Yves Heloret

“3U Transat: a cubesat constellation to boost the multi-messenger astronomy”

Advent of sensitive gravitational waves (GW) and neutrino detectors marks the start of multi-messenger study of the Universe and of its content. Most GW events signal the merger of binary black holes(BH),binary neutron stars (NS) and binary BH-NS. The last two events could also give rise to Gamma-ray bursts .However, finding electromagnetic counterparts of GW events is difficult given their current huge error boxes ($\sim 10^{2-3}$ deg^2). It is therefore needed to develop an all-sky instrumentation in hard X-rays with a good sensitivity to catch on the fly such rare events like GW170817/GRB170817A and to improve their localization. The nano-satellites constellation project 3UT TRANSAT ambitions to do this, starting with a demonstrator made of 3 clone satellites operated in a low-Earth polar orbit from 2027 in synergy with GW detectors. The aims of my Ph-D are:

- to build an end-to-end simulator able to produce data for ground algorithms development and for data analysis strategy
- to help characterizing the spectral performance of some prototypes of the science payload

Paul Charpentier

“Chasing activity indicators with SPIRou”

Recent instruments have extended radial velocity observations from the optical to the near-infrared. This has in particular allowed the study of M dwarf stars, known to host a higher frequency of rocky planets. However, to search for planets around such stars, investigating the stellar magnetic activity is crucial. Indeed, the precision of spectrometers depends on both photon noise and intrinsic stellar variations. In this study, a selection of targets from the SPIRou Legacy Survey (SLS) was employed to identify new magnetic activity proxies. By comparing these with small-scale magnetic field measurements, we confirm a correlation between both signals. With the small-scale magnetic field being a well-established indicator that matches the RV activity jitter in solar studies and proven by recent studies to also be a reliable one for M dwarfs, further studies of these new activity indicators have promising potential in filtering out RV stellar jitter to uncover low mass exoplanets.

Thea Hood

“A Beginner’s Guide to Characterising Exoplanetary Atmospheres”

No abstract

Jon Oers

“Filaments and magnetic fields in the ISM”

Filamentary structures are ubiquitous in the interstellar medium (ISM). This is particularly true in molecular clouds, with most clumps and cores forming inside the densest regions of filaments. Both simulations and ob- servations suggest that magnetic fields play a key role in the formation and evolution of filaments and in the process of star formation, and yet their exact role is still poorly understood. In this context, the study of the rela- tive orientation between filaments and magnetic fields has become a go-to method to obtain new insight.

Here, we use a dedicated method, FilDReaMS, to detect and extract fil- aments at multiple scales in the 116 fields of the Herschel ‘Galactic Cold Cores’ (GCC, Juvela et al., 2010) key-project (18”-36” resolution), which measures dust emission in star-forming regions located in various Galactic environments. We then compare the filament orientations to the orientation of the magnetic field in the plane of the sky ($B_\perp$), inferred from Planck observations of the dust polarized emission (7’ resolution).

We present the results from our statistical analysis of these relative orien- tations as functions of filament spatial scale, gas column density (N_H) and Galactic environment. In most Herschel fields, we find that small, low-N_H filaments tend to be roughly parallel to the magnetic field, while large, high- N_H filaments tend to be roughly perpendicular. Although this trend is not systematically observed, it is still prevalent, which confirms the existence of a coupling between magnetic fields at cloud scales and filaments at smaller scales.

Alexeï Molin

“Investigating the turbulent intra-cluster medium with X-IFU”

The intra-cluster medium is the highly ionised, high temperature gas present in clusters of galaxies. Its emission spectrum allows probing its thermodynamical and dynamical states. The future X-IFU instrument on board the Athena mission will allow, with its high spectral and spatial resolutions, a precise mapping of the dynamics of the intracluster medium. We use simulations to predict the level of constraint X-IFU will be able to provide on the dynamics of this gas.

Landry Marquis

“Fusion of astronomical data: application to JWST images”

Amongst the JWST instruments, the Near InfraRed Spectrograph (NIRSpec) enables us to get precise spectra with a low spatial resolution. On the contrary, the Near InfraRed Camera (NIRCam) covers a high resolution field of view at a given wavelength. We can merge the information of both instruments according to a physical model. This particular method is called image fusion and can be described as a regularized inverse problem. Although commonplace in earth observation, the job is tougher in astronomy. We will discuss its implementation, results and limits through the example of the Orion Bar.

Quentin Pilate

“Trying to explain the variability of Betelgeuse with surface convection”

No abstract

Jules Marti

“Can the regolith structure explain the seismic behavior changes due to seasonal temperature variations observed on Mars and the Moon ?”

No abstract

Lucien Mauviard-Haag

“Millisecond Pulsar parameter estimation with NICER”

Millisecond pulsars (MSPs) are fast spinning neutron stars, which host yet unknown extreme states of matter. NICER is an X-ray telescope dedicated to observing phase resolved surface emission of MSPs. Using NICER and XMM-Newton observations, along with radio priors, yields constraints on mass and radius of MSPs, which can in turn give information on extreme states of matter. I will first present MSPs surface emission mechanisms and their link to MSPs mass and radius, followed by the specificity of NICER data and how it is analyzed to yield mass-radius constraints using Nested Sampling. I will finally briefly present how to use these constraints to infer information on the equation of state of dense matter.

Jonas Rabia

“Moon-magnetosphere interactions at Jupiter: new insights from the Juno mission”

In Jupiter’s magnetosphere, the Galilean moons disrupt the flow of magnetodisc plasma driven in quasi-corotation by the planet’s magnetic field. This interaction gives rise to a variety of physical processes, including the generation of Alfvén waves that can propagate along magnetic field lines and accelerate charged particles. One manifestation of these phenomena is the acceleration of electrons that precipitate into Jupiter’s atmosphere, triggering UV auroral emissions. These auroral footprints are composed of a main spot, the Main Alfvén Wing (MAW) spot followed by an auroral tail that extends in the direction of the magnetospheric plasma flow. Depending on the location of the moons in the Jovian magnetodisc, a spot created by a Trans-hemispheric Electron Beam (TEB) The Juno spacecraft, in orbit since 2016, allows to characterize in-situ the particles accelerated during the moon-magnetosphere interactions thanks to its highly inclined orbit. In-situ measurements obtained within the magnetic field lines connecting the moons’ orbital locations to Jupiter’s atmosphere reveal the diversity of physical processes occurring during the moon-magnetosphere interactions. We present here a comparison of the properties of electrons measured in the Io-, Europa-, and Ganymede-Jupiter circuits by Juno. In particular, we explore the energy distributions and show that different distributions are observed. At all three moons, electrons creating the MAW spot and the auroral tail always have broadband distribution while in the TEB flux tubes of the two moons that Juno has crossed, Europa and Ganymede, the electrons are distributed non-monotonically, with a higher characteristic energy. This observation provides an important insight for the study of particles acceleration processes involved in the moon- magnetosphere interactions.

Pierre Stammler

“The analysis of a millisecond pulsar from its far-UV and soft-X rays surface emissions”

No abstract

Miguel Llamas lanza

“Searching for high-energy transient sources with SVOM/ECLAIRs: offline trigger development”

ECLAIRs is the leading instrument on-board the Sino-French mission SVOM to be launched in June 24th 2024. It consists in a wide-field (2 sr) coded-mask camera, covering the 4-150 keV energy range. Tasked to autonomously search for Gamma-ray Bursts (GRBs) and other high-energy transient sources, it features an on-board trigger which will operate in near real time, albeit with certain limitations. To enhance and complement the detection capabilities, an offline trigger will perform a thorough search for high-energy transients in all the data, using ground computing facilities. It uses all photons detected on-board and benefits from a better knowledge of the context, including the counts before and after the time period under study. External inputs from multi-wavelength and multi-messenger facilities will also be integrated into the offline trigger to perform targeted searches within ECLAIRs data. This presentation will offer an overview of the overall structure of the offline trigger, outlining some of the search algorithms that are executed simultaneously to search for transient sources amid the intricate background noise, including a blind search and a targeted search.

Anastasia Kilina

"Ionized nebulae around ultra-luminous X-ray sources"

Ultraluminous X-ray sources (ULXs) are non-nuclear sources located within the extent of their host galaxy that have X-ray luminosities $L_x > 3 \times 10^{39} erg.s^{-1}$. These luminosities are reached when matter from a donor star in a binary system with a compact object (a neutron star or a black hole) falls into an orbit around the compact object due to its gravitational pull (a process called accretion), emitting X-ray radiation. This emission is able to ionize the gas around some of these sources, creating ionized nebulae. Studying these nebulae allows us to better understand the accretion processes of ULXs and their feedback on their environment. This in turn helps us to understand the formation of massive black holes.

Trung-Tin Dinh

"Statistical tests for unsupervised classification of coded hyperspectral acquisitions"

Conventional hyperspectral imaging techniques require a large number of acquisitions and involve spatial or spectral scanning to fill the (x, y, λ) cube with hyperspectral image data. In our project, a reconfigurable coded aperture snapshot spectral imager (DD-CASSI) is used to analyze the hyperspectral scene with typically ten times fewer acquisitions. In this contribution, we present a promising approach for unsupervised classification of coded hyperspectral data without reconstructing the full cube, leveraging separability assumptions and statistical tests. Despite having only one-tenth of the information available, an unknown number of materials, and the absence of reference spectra, we successfully detect most of the homogeneous regions in the observed scene while effectively rejecting mixed regions.

Antoine Espagnet

"Modeling the chemical impacts of luminosity outbursts in protostellar envelopes"

More and more large spectral surveys are carried out in the radio/submm/mm range to characterize the molecular composition of star-forming regions. The observational studies carried out so far seem to indicate that the chemical content differs between protostars. With chemical models, it is possible to test different scenarios and better understand the possible origins of these differences. In this study, we want to investigate the impact of luminosity outbursts on the chemical composition of solar-type protostars. Accretion bursts and consequently luminosity outbursts can be experienced by some young stellar objects. The sudden rise in temperature caused by luminosity outbursts can sublimate the molecules frozen on the dust grains. The release of new molecules into the gas phase with the temporary increase in temperature could affect the long-term evolution of the chemical composition of the protostar. We used the APE code (Marchand et al. in prep.) to model the 1D evolution of a protostellar envelope. We produced a grid of models with luminosity outbursts occurring at different times of the protostellar collapse. The physical evolution of the density and temperature of the different models was then used as inputs of the Nautilus gas-grain chemistry code (Ruaud et al. 2016) (updated to allow a better COMs description) to predict the evolution of the molecular abundances from the cold outer regions to the warm inner regions. In this presentation, I will summarize our preliminary results on the expected impact of luminosity outbursts on the chemical composition of protostellar envelopes.