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XI FRIENDS OF FRIENDS MEETING

April 18th - 22nd, 2022

CÓRDOBA, ARGENTINA

CONICET

UNC Universidad Nacional de Córdoba

IATE

OAC Observatorio Astronómico de Córdoba

UNC Universidad Nacional de Córdoba

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Contents

About

FoF meeting

The Friends of Friends is a yearly international meeting that gathers astronomy & astrophysics researchers from several countries with the purpose of fostering interactions with local researchers and promotes the creation of new collaborative networks.

The meeting is organized jointly by the *Instituto de Astronomía Teórica y Experimental* (IATE) and the *Observatorio Astronómico de Córdoba* (OAC). The event encourages the strong participation of researchers and doctoral and postdoctoral students from the local community. The main topics are astrophysical plasmas, cosmology, large scale structure, extragalactic astronomy, stellar astrophysics and planetary systems. The official language of the meeting is English.

The main purpose of this meeting is to strengthen existing collaborations and to encourage the interaction between recognized researchers and students, postdocs and local researchers. Also, it aims at promoting the creation of new collaboration networks, exposing the works of local researchers in an international environment, updating the knowledge on the topics presented at the meeting and bringing new research topics and projects to students. The organization of all the activities are oriented to encourage the development of new initiatives with local and visiting participants. Previous editions of this meeting have produced successful collaboration networks to generate observational and theoretical projects.

The organized activities of the FoF meeting generate a friendly environment that promotes interactions between researchers, and include plenary talks, contributed talks and posters, discussing groups and hand-on sessions. Also, the introduction of new “friends” to the collaboration networks allows the inclusion of new approaches, data sources or theoretical tools to ongoing projects.

The talks are oriented to a professional audience and promote the discussions of the state of the art of hot topics within the areas of expertise of the organizing institutions research departments and of the participants from other countries. Also, special sessions are organized in order to help students and young researchers to initiate new subjects or to develop skills and use modern tools.

XI edition

From 18 to 22 April 2022, the XI edition of the FoF meeting took place at the "Mirta Mosconi" Auditorium of the Córdoba's Observatory. It was the first hybrid edition of this annual event.

Seven areas of astronomy have been covered: Instrumentation and Tools, Planetary Systems, the Sun and Heliophysics, Stellar Astrophysics, Galactic Astronomy, Extragalactic Astronomy, and Cosmology & Gravity.

The meeting registered 177 individual participants, among which 88 were in-person attendees while the remaining participated remotely. Regarding the gender distribution of participants, 57 per cent were male.

This edition included 12 keynote addresses (50-50% male-female), 38 contributed short talks (55-45% male-female), 17 e-posters (65-35% male-female), 7 workshop/hands-on sessions, and 2 round table discussion sessions.

All the activities have been recorded, and the videos published on YouTube. In this booklet, we include the abstracts of talks and e-posters presented at the XI FoF meeting.

Organizing committee

Viviana Bertazzi	Carlos M. Correa	Valeria Cristiani
Vanessa Daza	Eugenia Díaz-Giménez	Leticia Ferrero
Sebastián Gurovich	Damián Mast	Rafael Pignata
Agustín Rodriguez	Federico Stasyszyn	

List of Abstracts – Talks

– **key** – IS: Invited Speaker, CT: Contributed Talk, eP: e-Poster.

Monday 18th

Chemical Abundances in Planetary Nebulae: Collisionally Excited Lines vs. Recombination Lines

M. Peña Cárdenas IS

Instituto de Astronomía, UNAM, Ciudad de México, Mexico.

Chemical abundances of planetary nebulae (PNe) help us to understand several processes of the nucleosynthesis of the progenitor star. Elements such as He, C, and N can be processed in the stellar nucleus and partially brought up to the stellar surface through dredge-up processes. Other elements such as O, Ne, Ar, S (the alpha-elements) are supposedly not perturbed by stellar nucleosynthesis, therefore they provide information of the chemistry at the stellar formation time. Although there are some well documented cases where O and Ne abundances seem altered by nucleosynthesis and some of these elements have been transported to the surface, and have been ejected in the nebular material. Chemical abundances are generally determined by analyzing the collisionally excited lines (CELs) and also can be determined from some recombination lines (RLs). CELs and RLs line intensities allow to obtain nebular physical parameters (temperature and density), and ionic abundances of several elements. Total abundances are obtained by using Ionization Correction Factors (ICFs) from the literature. It is known that there exists a discrepancy in the abundances (ADF) derived from both types of lines. Usually the abundances derived from RLs are larger than the one derived from CELs This occurs in HII regions as well as in PNe. ADFs determined for PNe are usually larger than in HII regions. In same cases the value is as large as 100 or more. In this work we analyze the chemistry of some PNe, determined from CELs and RLs. Some possible causes for such a discrepancy will be presented.

Automated classification of eclipsing binary systems in the VVV Survey

V. Daza Perilla CT

Instituto de Astronomía Teórica y Experimental, CONICET-UNC, Córdoba, Argentina.

In this study, we use a recently published catalogue of one hundred EBSs, classified by fine-tuning theoretical models according to contact, detached or semi-detached classes. We describe the method implemented to obtain supervised machine learning models, capable of classifying EBSs using information extracted from the light curves of variable object candidates in the phase space.

Strong non-dipolar magnetic fields in millisecond pulsars?

J. Pelle CT

Facultad de Matemática, Astronomía, Física y Computación, UNC, Córdoba, Argentina.

It has been recently suggested that the millisecond pulsar PSR J0030+0451 has a significant off-centered non-dipolar magnetic field component. This has been deduced via statistical inference methods on the shape and location of the hot spots over the surface of the neutron star by modelling the latest NICER observational data. In this talk we revise these conclusions under the light of a similar emission model based on relativistic force-free pulsar magnetosphere simulations which yield complex hot spot configurations using only dipolar magnetic fields.

Formation and Evolution of central stars of Planetary Nebulae

M. Miller Bertolami IS

Instituto de Astrofísica de La Plata, CONICET-UNLP, La Plata, Argentina.

Since their discovery in 1764 our ideas for the formation of Planetary Nebulae (PNe) have improved continuously. The basic picture traced in the mid-twentieth century of PNe being transition objects between the giant branch century of PNe being transition objects between the giant branch and the final white dwarf stage has been enriched by the discovery of strong axisymmetric PNe and the realization in the last decades that completely isolated star might not be able to form these structure. Additionally, the discovery that many solar-like stars have planetary companions or are in binary systems suggests that stellar and sub-stellar companions likely play a role in either the formation or the shaping of axisymmetric PNe. In this presentation, I will review our current understanding of the formation of PNe and the evolutionary channels that give rise to the wide diversity of central stars and PNe.

Exploration of magnetic activity indices in M dwarfs

C. Oviedo CT

Instituto de Astronomía y Física del Espacio, CONICET-UBA, Buenos Aires, Argentina.

During the last decades, M stars have gained substantial interest in the search for exoplanets due not only to the high occurrence of terrestrial-type planets but also to the greater ease of detection of low-mass planets. However, one of the major limitations in the study of extrasolar planetary systems using the radial velocity method is the presence of the activity cycles of the stars. In this talk, we present the first steps to perform a unique study of activity in those M stars that are targets in planet search programs.

Plasma Correction in the “Cosine Relation” for Pulsar Pulse Profile

G. Briozzo

CT

Facultad de Matemática, Astronomía, Física y Computación, UNC, Córdoba, Argentina.

We will study the trajectories of photons emitted by a pulsar with emphasis on the chromatic effects derived from the presence of a plasmatic environment. We will show how to obtain numerically the trajectories and the luminosity curve of the pulsar. Starting from the approximate Beloborodov formalism, we will introduce plasma corrections to extend the range of validity of the model, obtaining simple analytical expressions for the trajectories and the observed flux, significantly simplifying the calculation of the pulse profiles and drastically reducing their computational cost. We will compare the numerical results with the analytical approximations. Once the validity ranges of our model have been established, we will show how to use the obtained approximations to easily model more realistic, non-antipodal, homogeneous or circular emission shells. Finally, we will expand the classification introduced by Beloborodov for the case of two non-antipodal and distinguishable emission shells.

Regolith ejection on the asteroid Didymos due to its fast rotation

N. Trógolo

CT

Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

(65803) Didymos is the binary Near Earth Asteroid target of the DART (NASA)/LICIA (ASI) andHera (ESA) missions. It orbits the Sun with a semi-major axis of 1.64 AU, and it is made of a 780m diameter primary body (Didymos) and a 160 m satellite (Dimorphos), orbiting the primary witha semi-major axis of 1180 m and an orbital period of 11.9 h. The primary has a rotation period of2.26 h, very close to the limit of structural stability. The low density estimated for Didymos, 2170kg/m3, shows that it is not a monolithic body, will have high macro-porosity, typical of gravitationalaggregates (or rubble-piles) and it also shows an equatorial bulge, like top-shape asteroids Ryuguand Bennu. Local acceleration near Didymos’ equatorial region may be directed outwards, allowingregolith to leave the surface. In this work, we study the dynamics of particles that are ejected fromthe surface of Didymos when the centrifugal acceleration is large enough to overcome local gravity.The analysis is carried out with a numerical code that integrates the particles’ equation of motion in anon-inertial rotating frame of reference, centered on the primary asteroid. A polyhedral shape modelfor Didymos is considered, formed by 1000 vertices and 1996 triangular faces, at which center, sampleparticles are placed. The environment of the asteroid is studied by computing the radial density ofparticles, assuming -as an arbitrary reference- an ejection mass rate of 1 kg/s. We found that thedensity of mass in orbit is strongly dependent on the physical parameters of the system, like Didymos’density. Since the mass (m) and volume (V) are not well determined, we perform different simulationsadopting different pairs of values for m and V in order to determine under what conditions it is possible to obtain a cloud of particles around the asteroid.

Orbital evolution of circumbinary planets due to creep tides

F. Zoppetti CT

Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

In this work, we present the results of applying the creep tide model (Ferraz Mello 2013) to the orbital evolution of circumbinary planets. This model allow us to consider stiff bodies, in addition to the gaseous bodies considered in previous works (Zoppetti 2019,2020). We perform a series of direct numerical integrations of the full equations and also we compare the results with the ones obtained with a high-order secular analytical model. Between the most interesting results, we find that the direction of migration of planetary semimajor axis depends, not only of the planetary eccentricity, secondary mass and semimajor axes ratio; but also on the viscosity of the circumbinary planet.

The physical and chemical signatures of young protostars and planet-forming disks

E. Artur de la Villarmois IS

Instituto de Astrofísica, PUC, Santiago, Chile.

In the process of low-mass star formation, a protoplanetary disk is assembled around the young star and planets will form within this disk. Therefore, the chemical composition of the early disk is crucial for the gaseous content of future planetesimals. Some molecular species are believed to survive from the parental cloud to the inner regions of the disk, while others are being destroyed or formed by some physical processes that alter the chemistry of the disk. In this talk, I will summarize our current knowledge of the main physical and chemical processes that are involved in the formation of low-mass stars and planets, and present new ALMA observations of a particular protostar, IRS 44. A peculiar strong and warm emission of sulphur-related species is seen towards this source, suggesting the presence of shocks when material from the envelope reaches the disk. These shocks will have important consequences on the material available at the time of planet formation.

Tuesday 19th

Link to YouTube full Tuesday session

The host galaxies of binary compact objects across cosmic time

M.C. Artale IS

Physics and Astronomy Department Galileo Galilei, University of Padova, Italy.

In 2015, the first direct detection of a gravitational wave (GW) by the two ground-based LIGO interferometers opened a new era for gravitational-wave astrophysics. Since then, more than 90 events have been announced by the LIGO-Virgo-KAGRA collaboration including merging binary black holes (most of them), binary neutron stars (BNS), and black hole – neutron star binary systems. GW observations will allow us to address an impressive set of questions in cosmology and astrophysics, such as the nature of dark matter, the nature of gravity, the early Universe, and the different stellar evolution stages currently under debate. In this talk, I will focus on the properties of the host galaxies where merging compact objects form and merge. Characterizing the host galaxies' properties of merging compact objects provides essential clues to interpreting current and future GW detections. I will discuss the probability that a galaxy hosts a compact binary coalescence according to its stellar mass and star formation rate. I will show that, at low redshift, galaxies with low specific star formation rate (sSFR $< 1e-10\,\mathrm{yr}^{-1}$) contribute significantly to the merger rate density, while those with high specific star formation rate (sSFR $> 1e-10\,\mathrm{yr}^{-1}$) dominate at $z \gtrsim 1$. These results are crucial for low-latency searches of GW sources, reducing the number of viable host candidates. Finally, I will discuss the connection between BNS mergers and short gamma-ray burst events and the probability of afterglow detection from GW-triggered BNS mergers.

Video available on YouTube

Gravastars in f(R,L) gravity

C. Vieira Gomes CT

University of the Azores & CF-UM-UP, Ponta Delgada, Portugal.

Gravastars are exotic compact objects alternative to black holes. In the context of alternative theories of gravity, they present relevant signatures. Thus, we shall present the gravastar solutions of a general non-minimal coupling gravity model, namely f(R,L) gravity, where its properties have some bearings. Some cosmological and astrophysical applications shall be analysed.

Video available on YouTube

The integrated Sachs-Wolfe effect in 4D Einstein-Gauss-Bonnet gravity

M. Ghodsi Yengejeh

CT

Shahid Beheshti University, Tehran, Iran.

A novel 4-dimensional Einstein-Gauss-Bonnet (4D EGB) gravity has been proposed that asserts to bypass Lovelock's theorem and to result in a non-trivial contribution to the gravitational dynamics in four-dimensional space time. Although inconsistencies have been raised for this theory in nonlinear perturbation limits, the results of the consistent 4D EGB model indicate that the background equations and the linear scalar modes are in good agreement with the initial 4D EGB model. We study the integrated Sachs-Wolfe (ISW) effect, as a linear phenomenon, in the 4D EGB model. For this purpose, we calculate the evolution of the gravitational potential and the linear growth factor as a function of redshift for the 4D EGB. We also calculate the ISW-auto power spectrum and the ISW-cross power spectrum as functions of cosmic microwave background multipoles for the 4D EGB model.To do this, we use the strongest constraint on the coupling parameter proposed for the 4D EGB model. Additionally, to calculate the ISW effect for the 4D EGB model, we employ three large-scale structure surveys at different wavelengths. The results exhibit that the ISW effect in the 4D EGB model is higher than the one obtained from the ΛCDM model. Hence, we show that the 4D EGB model can amplify the amplitude of the ISW power spectrum, which can be considered as a relative advantage of the 4D EGB model comparing the ΛCDM one. Also, we indicate that the deviation from the ΛCDM model is directly proportional to the value of the dimensionless coupling parameter β.

Video available on YouTube

Wiener filter for CMB maps using Neural Networks

M. B. Costanza

CT

Facultad de Ciencias Astronómicas y Geofísicas, UNLP, La Plata, Argentina.

In this work, we have studied a Convolutional Neural Network (CNN) called WienerNet to apply the Wiener Filter to noisy CMB (Cosmic Microwave Background) maps. We present how these neural networks work and how good the results are compared to the traditional method of Wiener Filter with the conjugate gradient. Also, we show that the predictions of the neural network are faster and more efficient than the conjugate gradient method, which is a bottleneck in CMB analyses. For these purposes, we have applied this neural network to CMB maps with different numbers of pixels, from 28×28 to 512×512, to study how the computation time scales with the size of the maps.

Video available on YouTube

NumCosmo halo tools: application to cluster cosmology and cluster mass estimation

M. Penna-Lima IS

Instituto de Física, Universidade de Brasília (UnB), Brazil

Galaxy clusters are important cosmological probes since their abundance and spatial distribution are directly linked to structure formation on large scales. The principal uncertainty source on the cosmological parameter constraints concerns the cluster mass estimation from mass proxies. In addition, future surveys will provide a large amount of data, requiring an improvement in the accuracy of other elements used in the construction of cluster likelihoods. Therefore, accurate modeling of the mass-observable relations and reducing the effect of different systematic errors are fundamental steps for the success of cluster cosmology. In this work, we present a brief review on that topic, and also describe some tools implemented in the Numerical Cosmology Library, and the cross-check with other public libraries.

Video available on YouTube

Giant $\mathrm{H\,II}$ Regions and $\mathrm{H\,II}$ Galaxies as tracers of the Hubble expansion and its use in cosmology

D. Fernandez-Arenas CT

Instituto Nacional de Astrofísica Óptica y Electrónica, CONACYT, Tonantzintla, Mexico.

The relationship between the integrated Hβ line luminosity and the velocity dispersion of the ionized gas of $\mathrm{H\,II}$ galaxies (HIIGs) and giant $\mathrm{H\,II}$ regions (GHIIRs) has been known for a long time as the L-σ relation (Terlevich et. al. 1981 and more recently Bordallo & Telles 2011 and Chavez et. al. 2014). The scatter in the relation is small enough that it can be used to determine cosmic distances independently of redshift and represents an interesting distance estimator that, in principle, can be used up to redshifts $z \sim 4$. Locally it can be used to obtain high precision measurements of the local Hubble parameter. This can be done using a sample of nearby ($z \leq 0.1$) HIIGs galaxies and, crucially, an anchor sample of GHIIRs in nearby galaxies for which distances via primary indicators are available. I will be presenting our recent results of the use of the L-σ relation to measure the local value of the Hubble constant (Fernández et. al. 2018) and to constrain the Dark Energy equation of State Parameter (w) (González-Morán et. al. 2020,2021).

Video available on YouTube

Cosmology with baryons: modelling the cosmic matter distribution for Large-Scale Structure analyses

G. Aricò

CT

Institute for Computational Science, University of Zurich, Switzerland.

In this talk, we show a framework to consistently model the spatial distribution and time evolution of dark matter, gas, and galaxies, in the Large Scale Structure of the universe. The core of our framework is given by large, high-resolution N -body simulations, which ensure robust modelling of non-linearities on small scales, and accurate predictions on large scales. In a post-processing phase, we displace the particles in our simulations to explore different cosmological and baryonic scenarios, by combining two state-of-the-art algorithms: cosmology-rescaling and baryon correction model. We implement extended and optimised versions of these algorithms, to reach the accuracy required by next-generation surveys, and we systematically test them, both separately and jointly. Finally, we use artificial neural networks, trained to learn the connections between cosmological and astrophysical parameters and relevant summary statistics of the cosmic matter field, as measured in our simulations. In this way, our predictions can be delivered at a negligible computational cost, and the linear, nonlinear and baryonic contributions can be computed separately. By using our framework, the modelling of the cosmic matter field can be extended to unprecedentedly small scales, in a highly accurate and flexible fashion, and additionally with a consistent speeding-up in the computational time. We expect that the techniques developed and the results presented here will be useful for a broad range of applications in Large Scale Structure analyses, and in particular in the exploitation of weak lensing and galaxy surveys.

Video available on YouTube

On dynamo theories for cosmological magnetic fields

M. Rubio

CT

Institute for Fundamental Physics of the Universe (IFPU-SISSA), Trieste Italy.

We present well-posedness results for two particular theories aiming to model large-scale magnetic field amplification. We report on the existence of spurious modes when the electromotive force is linear in the magnetic field, making the theory unsuitable in the kinematic regime. We then prove that this pathology is actually removed when allowing magnetic field derivatives in such a force. Finally, we give bounds for the magnetic energy in the force-free regime and generalise some of these results for full non-relativistic MHD.

Video available on YouTube

Universal renormalization procedure for higher curvature AdS gravity in up to 5 dimensions

I. Araya Quezada

CT

Universidad Arturo Prat, Iquique, Chile.

We implement a universal method for renormalizing AdS gravity actions applicable to arbitrary higher curvature theories in up to five dimensions. The renormalization procedure considers the extrinsic counterterm for Einstein-AdS gravity given by the Kounterterms scheme, but with a theory-dependent coupling constant that is fixed by the requirement of renormalization for the vacuum solution. This method is shown to work for a generic higher curvature gravity with arbitrary couplings except for a zero measure subset, which includes well-known examples where the asymptotic behaviour is modified and the AdS vacua are degenerate, such as Chern-Simons gravity in 5D, Conformal Gravity in 4D and New Massive Gravity in 3D.

Video available on YouTube

Wednesday 20th

Link to YouTube full Wednesday session

Clues on the formation of giant low surface brightness galaxies

G. Galaz IS

Pontificia Universidad Católica, Santiago, Chile.

Using the EAGLE hydrodynamical simulation, we explore what drives the formation of giant (and massive), low surface brightness galaxies of the Kind of Malin 1. We investigate on the role of angular momentum, stellar formation and environment. The talk will conclude on the next efforts that should be done with the models in order to better understand the formation of this kind of objects.

Video available on YouTube

Low Surface Brightness Galaxies in the IllustrisTNG Simulation

L. Peréz-Montaño CT

Instituto de Radioastronomía y Astrofísica, UNAM, Michoacán, Mexico.

We explored the nature of Low Surface Brightness galaxies (LSBGs) in the local universe, by using a set of simulated galaxies from TNG100. We compared galaxy properties at $z = 0$ such as stellar mass, magnitude, star formation rate and size. We found that LSBGs are mainly spirals over a large mass range, fainter, less massive, quiescent and larger than High Surface Brightness Galaxies (HSBGs). We found that LSBGs are gas-rich and with marginally younger stellar populations formed within dark matter halos with high spin parameter, retaining larger amounts of angular momentum, resulting in the trends observed nowadays. We track the evolution of these quantities back in time, finding that the spin parameters of the haloes hosting LSBGs and HSBGs exhibit a clear bifurcation at $z \sim 2$, which causes a similar separation in the evolutionary tracks of other properties. The higher values of specific stellar angular momentum and halo spin in LSBGs seem to be responsible for their extended nature.

Video available on YouTube

2D Surface Brightness Modelling of Large Galaxies: Photometry, Structural Parameters and Black Hole Scaling Relations

E. Ríos-López

CT

Instituto de Astrofísica de Canarias, Tenerife, Spain.

In this work is performed a photometric analysis for a sample of 101 galaxies in the near infrared (NIR) bands of 2MASS (J, H, Ks) with the goal of estimating the structural parameters of galaxies. Then, galaxy Scaling Relations among global properties such as luminosity, size, kinematics, among others, are explored. Furthermore, Black Hole Scaling Relations involving host galaxy properties are also studied. The results of this work are presented in the evolutionary context of classical bulges and pseudobulges, which were identified using a detailed bulge classification.

Video available on YouTube

Formation of Ultra-Diffuse galaxies in different environments

J. Benavides-Blanco

IS

Instituto de Astronomía Teórica y Experimental, CONICET-UNC.
Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

Being the lowest-surface-brightness galaxies known, Ultra-diffuse galaxies (UDGs) are among the most intriguing objects in the Universe. Since their rediscovery a few years ago, different mechanisms have been proposed to explain the formation of these puzzling objects with the stellar mass of a dwarf galaxy but the size of a large galaxy like the Milky Way. Using cosmological numerical simulations we identify and follow simulated UDGs galaxies to analyze their formation mechanism and temporal evolution focusing on environmental dependencies. As envisioned by simple analytical arguments, we find that these extended objects form preferentially in dark matter halos having systematically higher angular momentum. For satellite galaxies, in high-density environments, we found that although tidal interactions are correlated to size increase it is not necessarily an effective mechanism.

Video available on YouTube

Influence of environment on the AGN-starburst connection in small galaxy systems

F. Duplancic

CT

Facultad de Ciencias Exactas, Físicas y Naturales, UNSJ, San Juan, Argentina.

In this work, we study the relationship between star formation activity and the active galactic nucleus phenomenon, known as AGN-starburst connection. For this purpose, we use a catalogue of galaxy systems with a low number of members (2 to 6) and different diagnostic diagrams to identify active galaxies both in the optical and in the infrared. These methods also allow the identification of star-forming galaxies and “Retired/Passive” objects that have already completed their star formation cycle. We compare the fractions of AGN and galaxies with active star formation, seeking to study the conditions that favour this type of activity. Also, we characterize the density environment inhabited by the systems, in order to study its influence on the AGN-starburst connection at different scales.

Video available on YouTube

AGN & Voids. The role of active objects in cosmic voids

M. L. Ceccarelli

CT

Instituto de Astronomía Teórica y Experimental, CONICET-UNC.
Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

Properties of galaxies and their evolution are strongly affected by their local environment. It has also been explored how local environment affects the active galactic nuclei (AGN) phenomena. These studies have positioned cosmic voids and their surrounding regions as promising candidate sites to host AGN galaxies. In this talk, I will show the results we obtain from the statistical analysis of AGN in cosmic voids and in their surroundings using SDSS data. To this end, we use diverse methods to classify active galaxies, and apply a void finding algorithm to galaxy distributions. The talk is centered on analysis of galaxy properties related to nuclear activity, and takes into account the relative position with respect to the void center. To start, I will describe the different diagnostic diagrams used to classify galaxies and the void identification algorithm and show some properties of the resulting galaxy samples. Then, I will show the main results on the nuclear activity of galaxies prevailing at voids, and, finally, I will give a brief discussion of our results.

Video available on YouTube

Spin alignment around Illustris voids

F. Dávila Kurbán CT

Instituto de Astronomía Teórica y Experimental, CONICET-UNC, Córdoba, Argentina.

Using a set of well–behaved novel statistical parameters we study the alignment signal of galactic spins with respect to the center of voids identified in the TNG-300 simulation.We explore this signal in different samples of galaxies, varying their distance from the void center, mass, spin norm, local density, and velocity. We find a signal of over 9 sigma of massive, high-spin, and low radial velocity galaxies to be aligned perpendicularly to the void-centric direction for distances varying from 0.9 to 1.4 void radii. Furthermore, we find that, in these subdense environments, local density is irrelevant to the alignment signal, while the largest impact on the alignment is due to radial velocity: galaxies that lose linear momentum with the void expansion seem to be strongly aligned perpendicularly to the center of the void.

Video available on YouTube

Fermionic dark matter halos from a maximum entropy principle

C. Argüelles CT

Instituto de Astrofísica de La Plata, CONICET-UNLP, La Plata, Argentina.

The formation and stability of collisionless self-gravitating systems are long-standing problems, which date back to the work of D. Lynden-Bell on violent relaxation and extend to the issue of virialization of dark matter (DM) haloes. An important prediction of such a relaxation process is that spherical equilibrium states can be described by a Fermi–Dirac phase-space distribution, when the extremization of a coarse-grained entropy is reached. In the case of DM fermions, the most general solution develops a degenerate compact core surrounded by a diluted halo. As shown recently, the latter is able to explain the galaxy rotation curves, while the DM core can mimic the central black hole. A yet open problem is whether these kinds of astrophysical core–halo configurations can form at all, and whether they remain stable within cosmological time-scales. We assess these issues by performing a thermodynamic stability analysis in the microcanonical ensemble for solutions with a given particle number at halo virialization in a cosmological framework. For the first time, we demonstrate that the above core–halo DM profiles are stable (i.e. maxima of entropy) and extremely long-lived. We find the existence of a critical point at the onset of instability of the core–halo solutions, where the fermion-core collapses towards a supermassive black hole. For particle masses in the keV range, the core-collapse can only occur for $\mathcal{M}_{\rm vir} < 10^9 \mathcal{M}_\odot$ starting at $z_{\rm vir} \sim 10$ in the given cosmological framework.

Video available on YouTube

Pairwise velocities in the strongly nonlinear regime of large-scale structures

J. Garcia-Farieta

CT

Center for Theoretical Physics, Polish Academy of Sciences, Warsaw, Poland.

We perform a systematic validation of the models of the pairwise velocities of galaxies based on the pair conservation of cosmic tracers. The equation that governs the dynamics of pairwise motions is derived from the BBGKY hierarchy and solved numerically in the strongly nonlinear regime of large scale structures. We analyze the complete solution of this equation with the prediction of the convolved Lagrangian perturbation theory approach and with approximated expressions where the pairwise velocity is proportional to the two-point correlation function scaled by the structure factor. Finally, we compared our results with the velocity statistics obtained from N-body simulations and analyzed the time-dependence and the effect of tracer bias on the pairwise velocities.

Video available on YouTube

Modelling the formation of the GD-1 stellar stream inside a host with a fermionic dark matter core-halo distribution

M. F. Mestre

CT

Instituto de Astrofísica de La Plata, CONICET-UNLP, La Plata, Argentina.

Stellar streams are a consequence of the tidal forces produced by a host galaxy on its satellites (i.e. globular clusters and dwarf spheroidals). As the self-gravity of stellar streams is almost negligible, they constitute excellent probes of the gravitational potential of the host galaxy. For this reason, some Milky Way stellar streams have been used to put constraints on the dark matter (DM) total mass and shape, under empirical DM distributions (i.e. NFW, logarithmic, etc). In particular, Malhan & Ibata (2019) have fitted the GD-1 orbit embedded in an axisymmetric NFW potential plus barions, obtaining that the density flattening of the dark halo is slightly oblate. In this work we consider an alternative DM model for the halo hosting GD-1, as previously deduced from first principles by means of the maximization of a coarse-grained entropy for self-gravitating fermions. Thanks to a self-consistent inclusion of the Pauli principle, the most general DM density profile out of this mechanism develops a degenerate compact core surrounded by a diluted halo which resembles the King profile. As recently shown, the latter is able to explain the galaxy rotation curves, while the dense DM core can mimic the central Black Hole (BH). Remarkably, we show that it is possible to model the GD-1 stellar stream with such a fermionic core-halo distribution, while at the same time the degenerate DM core lying at the center is in agreement with the orbits of the S-stars at Sagittarius A* without the need to assume a central BH. For this task we have used a genetic algorithm in order to fit both the stream orbit's initial conditions and the fermionic halo. We modelled the barionic potential with a bulge and two disks (thin and thick) with fixed parameters according to the recent literature. The stream observable is 6D phase-space data from Ibata et al. (2020), including the Gaia DR2 survey.

Video available on YouTube

Thursday 21st

Link to YouTube full Thursday session

On the influence of halo mass accretion history on galaxy properties and assembly bias

A. Montero Dorta IS

Universidad Técnica Federico Santa María, Valparaíso, Chile.

Halo assembly bias is the secondary dependence of the clustering of dark matter haloes on their assembly histories at fixed halo mass. This established dependence is expected to manifest itself on galaxy clustering, a potential effect commonly known as galaxy assembly bias. In this talk, I will focus on a recent work where we analyse the dependence of the properties and clustering of galaxies on the specific mass accretion history of their hosting haloes (sMAH). We first show that several halo and galaxy properties strongly correlate with the slope of the sMAH (β) at fixed halo mass. We also demonstrate that β provides a more stable link to these key galaxy formation properties than other broadly employed halo proxies, such as formation time. Finally, we measure the secondary dependence of galaxy clustering on β at fixed halo mass. By tracing back the evolution of individual haloes, we show that the amplitude of the galaxy assembly bias signal for the progenitors of $z = 0$ galaxies increases with redshift, reaching a factor of 2 at $z = 1$ for haloes of $\mathcal{M}_{\rm halo} = 10^{11.5} - 10^{12}{\rm h}^{-1}\mathcal{M}_{\odot}$. In the last part of my talk, I will briefly present new results on the modelling of the halo-galaxy connection using machine learning techniques.

Video available on YouTube

EMPIRE: A new semi-empirical model for the Galaxy-Halo connection

A. Rodriguez-Puebla CT

Instituto de Astronomía, UNAM, Ciudad de Mexico, Mexico.

In this talk, I will introduce EMPIRE, a new consistent semi-empirical model for the Galaxy-Halo connection. EMPIRE uses the mass assembly of dark matter halos and a battery of observations to constrain star formation histories, contributions from mergers, the intra-halo mass, supermassive black holes, and the half-light and mass-radius growth of star-forming and quiescent galaxies from z 0 to z 10. Results from EMPIRE will be presented, in particular, the newest result on the evolution of the stellar-to-halo mass relation divided into star-forming and quiescent galaxies.

Video available on YouTube

Dark-matter-deficient galaxies in the Illustris-TNG simulations

E. Tau CT

Universidad de La Serena, Chile.
Facultad de Ciencias Astronómicas y Geofísicas, UNLP, La Plata, Argentina.

In the standard model of galaxy formation, galaxies form within a halo of dark matter, which is the component that dominates the matter budget of the Universe. Surprisingly, some recent observations have discovered a few galaxies that lack dark matter and that would therefore be dominated by baryonic matter. Dark matter deficient galaxies (DMDGs) could have lost their dark matter halos due to interactions during their evolution; in particular, during their fusion history. In this work, we study the population of dark matter deficient galaxies at different redshifts using the hydrodynamical simulation IllustrisTNG, which follows the evolution of dark matter and baryonic matter. We analyse the dark matter fraction of these galaxies considering their total mass and also within their central regions. We also analyse the evolution of their baryonic and dark matter components tracing them through time, as the satellite orbits its host halo in order to determine if the loss of the dark matter is due to the tidal stripping that could be taking place.

Video available on YouTube

Spiral galaxies with ring structures

S. Alonso CT

Facultad de Ciencias Exactas, Físicas y Naturales, UNSJ, San Juan, Argentina.

In this talk we will present a statistical analysis of different characteristics of ringed spiral galaxies with the aim of assessing the effects of rings on disk galaxy properties. We built a catalog of ringed galaxies from the Sloan Digital Sky Survey Data Release 14 (SDSS-DR14). We classified the face-on spirals into galaxies with: an inner ring, an outer ring, a nuclear ring, both an inner and an outer rings, and a pseudo-ring. We found 1868 ringed galaxies, accounting for 22% of the full sample of spiral galaxies. Moreover, 64% of the ringed galaxies present bars. We also found that ringed galaxies have both a lower efficiency of star formation activity and older stellar populations with respect to non-ringed disk objects. Moreover, there is a significant excess of ringed galaxies with red colors. These effects are more important for ringed galaxies that have inner rings and bars with respect to their counterparts that have some other types of rings and are non-barred. These findings seem to indicate that rings are peculiar structures that produce an accelerating galactic evolution, strongly altering the physical properties of their host galaxies.

Video available on YouTube

Bar properties in dwarf barred galaxies from Virgo

V. Cuomo CT

University of Atacama, Chile.

We study 5 barred dwarf galaxies located in the Virgo cluster to understand the effect of the environment on the formation and evolution of their bars. We measure the properties of bars with different methods using MUSE data. In particular, we measure the bar pattern speed with the Tremaine-Weinberg method: a slowly-rotating bar is expected by the presence of a huge amount of DM or when the bar formation is driven by galaxy interaction. Dwarf galaxies are the best candidates to host slowly-rotating bars.

Video available on YouTube

MaNGA/SDSS-IV: Archaeological reconstruction of the radial and global growth of galaxies

V. Ávila-Reese IS

Instituto de Astronomía, UNAM, Ciudad de México, Mexico.

The MaNGA survey has observed >10,000 local galaxies from SDSS using the integral field spectroscopy technique. By applying inverse stellar population synthesis (fossil record method) to their spatially resolved spectra, the local and global star formation (SF), chemical enrichment, and stellar mass growth histories of these galaxies were inferred. In this keynote talk, after briefly reviewing the survey and the publicly available products, I will present some selected results related to the archaeological inferences. The main questions we seek to answer are: How has the radial and global evolution of galaxies of different types been as a function of their mass and morphology? What has been their contribution, after correcting for volume completeness, to the cosmic SF history? When and how did the SF quenching process occur in elliptical galaxies?

Video available on YouTube

Gas shocks around galaxy clusters

A. Rost CT

Instituto de Astronomía Teórica y Experimental, CONICET-UNC, Córdoba, Argentina.

Gas shocks occur naturally around galaxy clusters, among several processes, the high-speed infalling gas deaccelerates and heats up near the centre of the cluster. The material infalling towards these objects is not completely isotropic, in general, we observe a filamentary structure that connects the surroundings. In this work we study how the shock and accretion occur around the cosmological filaments attached to these galaxy clusters, taking into account the dynamic state and the mass of the clusters. We observe that hot, impacted gas engulfs both the filaments and the cluster, while cold gas is injected into the cluster through the filaments.

Video available on YouTube

A deep near-infrared view of the Ophiuchus galaxy cluster

G. Coldwell CT

Facultad de Ciencias Exactas, Físicas y Naturales, UNSJ, San Juan, Argentina.

The Ophiuchus cluster of galaxies, the 2nd brightest X-ray cluster in the sky, has been relatively poorly studied. It is located at low latitudes in the direction of the Galactic bulge, in the Zone of Avoidance. To study the hidden galaxy population, deep near-infrared images and photometry from the VISTA Variables in the Vía Láctea eXtended survey (VVVX) were used. Adopting the Galdeano et al. (2021) criteria to select the galaxies among the foreground sources we identified 537 visually confirmed galaxy member candidates of the Ophiuchus cluster up to 2 Mpc from the cD galaxy. This represents 7 times more galaxies than obtained in previous works. Furthermore, we classified the galaxy candidates following the morphological features. We found that the proportion of Ellipticals reaches more than 60% in the central region of the cluster and the fraction of Spirals is lower than the 20% remaining almost constant throughout the cluster. Moreover, from the red sequence, we verified the sample of galaxy member candidates. We compared the integrated number of galaxies expected up to the Ophiuchus redshift, finding that the value derived from the mock catalog towards an overdense region is in agreement with the galaxy excess of the central zone of the cluster. Our investigation of the hidden population of Ophiuchus galaxies underscores the importance of this cluster as a prime target for future photometric and spectroscopic studies. Moreover, the results of this work highlight the potential of VVVX survey to study extragalactic objects in the Zone of Avoidance.

Video available on YouTube

Kinematics of the Local Group gas and galaxies in the Hestia simulations

L. Biaus CT

Facultad de Ciencias Exactas y Naturales, UBA, Buenos Aires, Argentina.

We investigate the kinematic properties of gas and galaxies in the Local Group (LG) using a suite of high-resolution simulations performed by the Hestia (High-resolution Environmental Simulations of The Immediate Area) collaboration. Our simulations include the correct cosmography surrounding the LG-like regions such as the Virgo cluster, the local void and the local filament. The simulated LGs consist of two main spiral galaxies of $\sim 10^{12}\mathcal{M}_{\odot}$, their satellites and minor isolated galaxies, all sharing the same large-scale motion within a volume of a few Mpc. With this study, we are aiming at characterizing the gas and galaxy kinematics within the simulated LGs from the perspective of the Sun to compare the observed trends with recent HST/COS absorption-line observations and LG galaxy data. To analyze the velocity dipole pattern for LG gas and galaxies seen in the observational data, we build sky maps from the local standard of rest, and other reference systems such as the galactic and local group barycentre frames, as seen by an observer sitting in the model Milky Way.

Video available on YouTube

The physical origin and impact of stellar-gas misalignments in galaxies from the CIELO simulation

C. Casanueva CT

Pontificia Universidad Católica, Santiago, Chile.

We use zoom-in galaxies from the Chemo-dynamIcal propertiEs of gaLaxies and the cOsmic web (CIELO) cosmological hydrodynamical simulation to study the physical origin and structural impact of the kinematic misalignment between star-forming (SF) gas and stars across cosmic time. We have identified unbound gas accretions and mergers as the leading causes of alignment/misalignment depending on the orientation of the gas falling into the galaxy. We follow the stars and gas particles involved in these processes to determine their final location. Our results aim to unravel the possible role of the processes that lead to the change of the alignment state between SF gas and stars in the current structure of the galaxy, acting as a finger-print to unveil their history.

Video available on YouTube

Nearby galaxies – insights into galaxy evolution

K. Menéndez-Delmestre

IS

Observatório do Valongo, Universidade Federal do Rio de Janeiro, Brazil.

Galaxies in the local universe are a fossil record of events in the distant universe and present critical constraints on the physical processes underlying the formation and evolution of galaxies. Understanding the variety in properties of galaxies today is thus key to unveiling how galaxies form and transform across cosmic time. We have been plunging into deep imaging of nearby galaxies to get a careful mapping of where stellar mass is concentrated in galaxies. Galaxies present a myriad of distinct stellar structures. We focus on structures that typically characterise local galaxies — such as bulges, disks, bars, and spiral arms — with the intention of building a present-day benchmark to understand the different agents that dictate when and where stars form and through which processes (giant galaxy collisions, interactions with smaller galaxies, etc.). We have also recently launched a long-term observing program to produce the deepest mapping of galaxies accessible from the Southern Hemisphere, complementing the exquisite work that has been performed in the north. I will show a number of discoveries we have made and give you a preview of the exciting work we are doing with our nascent southern survey.

Video available on YouTube

New and upcoming astronomical instrumentation: opportunities for collaboration between Latin American astronomers

T. Goncalves

IS

Observatório do Valongo, Universidade Federal do Rio de Janeiro, Brazil.

The next decade will see a true revolution in astronomical instrumentation, starting with the launch and first light of the James Webb Space Telescope and extending to the new thirty-meter-class telescopes to be inaugurated by 2030. In this talk, I will discuss my current involvement in some of these projects, more specifically regarding my interest in galaxy formation and evolution, as well as the opportunity for new projects and collaborations between astronomers in Latin America.

Video available on YouTube

Friday 22nd

Link to YouTube full Friday session

Chemical evolution of galaxies

P. Tissera IS

Institute of Astrophysics & Center for Astro-Engineering, PUC, Santiago, Chile.

The evolution of chemical abundances in galaxies provides crucial information to study how they formed and evolved. Results in the Local Universe show that on average, star-forming gas-phase in galaxies have negative metallicity gradients and that flat and inverted positive gradients could be associated with galaxy interactions. As a function of redshift, the trend is not clear enough yet, although there is a significant fraction of inverted metallicity gradients. In series of papers using the EAGLE simulations, we studied the metallicity gradients at $z = 0$ and the processes that might affect them and the azimuthal metallicity distribution such as mergers, SN and AGN feedback and gas inflows. We extended the analysis as a function of redshift, focusing on the impact of mergers in triggering strong positive or negative gradientes. We found galaxies with negative metallicity gradients more frequent in disc-dominated galaxies, which also determine a relation with size. Galaxies with positive gradients departure from this relation and show systematic differences to be associated with recent mergers or starbursts. In this talk, I am going to summarize the latest results from the EAGLE project, on the evolution of the metallicity gradients as a function of stellar mass, galaxy size and star formation efficiency up to $z \sim 2.5$ and on the impact of the environment by analyzing the metallicity gradients of galaxies in voids and filaments.

Video available on YouTube

On the Magellanic Clouds stellar clusters characterization from their integrated spectra

F. Simondi Romero CT

Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

As part of a work carried out on Magellanic Clouds (MCs) stellar clusters (SCs), we present results in age, metallicity and reddening for Bruck 50, NGC 176, SL 164 and SL 396, applying different methods (equivalent widths, template matching and spectral synthesis) from the SC integrated spectrum. These interesting SCs are useful on determining parameter of others SCs. We present results derived by other authors and discuss them with our results.

Video available on YouTube

The dynamics of the Milky Way and the Large Magellanic Cloud

N. Garavito Camargo

CT

Flatiron Institute, New York, United States.

The ongoing interaction with the Large Magellanic Cloud (LMC) is revolutionizing our view of the dynamical state of the Milky Way. The perturbations caused by the LMC open new avenues to test the nature of dark matter. Using results from high-resolution N-body simulations, I will describe the two main perturbations caused by the LMC: the DM wake and the reflex motion. The recent discovery of the stellar wake counterpart of the DM wake opens the opportunity to test the different DM models. I will also discuss how some current challenges to cold dark matter theory, such as the plane of satellites of the MW, are likely natural consequences of the out of equilibrium state due to the MW-LMC interaction.

Video available on YouTube

Star clusters study in the inner region of the Small Magellanic Cloud

B. De Bortoli

CT

Instituto de Astrofísica de La Plata, CONICET-UNLP, La Plata, Argentina.

We present the results of the chemical analysis of 6 star clusters in the inner region of the Small Magellanic Cloud (SMC). We used near infrared spectra obtained with GMOS (GEMINI-S) in the region of Calcium Triplet (CaT) lines of red giant stars belonging to the star clusters and their surrounding fields. We measured radial velocities and equivalent width of CaT lines and we determined the mean cluster and field metallicity of each cluster.We enlarged this sample with information available in the literature for star clusters studied with the same technique, obtaining a final sample of 58 star clusters with CaT metalicities. Finally, we analyzed the chemical evolution of the SMC.

Video available on YouTube

The internal structure of clusters in the Magellanic Clouds

J. Rodríguez

CT

Instituto de Astrofísica de La Plata, CONICET-UNLP, La Plata, Argentina.

The analysis of the internal structure of star clusters can provide us important information about their formation and dynamic evolution. Using data from the VISCACHA survey, we studied the spatial distribution of the stars in clusters located at the peripheries of the Large Magellanic Cloud and the Small Magellanic Cloud. We characterized their internal structure through the construction of the corresponding minimum spanning trees. In each case, we used m, s and Q parameters to distinguish between radial symmetry, homogeneous or substructured distributions. The dependence of the obtained parameters with field stellar contamination and with the different characteristics of the clusters, such as their dynamical ages and spatial distribution, was also investigated.

Video available on YouTube

Machine learning for membership determination in open clusters

P. Hasan

CT

Maulana Azad National Urdu University, Hyderabad, India

Membership of stars in clusters is very crucial in parameter determination and studies of clusters. We compare results obtained using supervised and unsupervised methods with Gaia DR2 and EDR3 data. We shall provide insights in to what are the suitable methods to be used and compare results using Gaussian Mixture Models and DBScan as well as Random Forest. We shall highlight the importance of machine learning especially in the study of faint cluster members which can enrich color-magnitude diagrams as well as IMF studies.

Video available on YouTube

CAPOS: Distance, reddening and global metallicity determination of Bulge Globular Clusters

S. Villanova CT

Universidad de Concepción, Chile

Bulge Globular Clusters have always been a challenge for the determination of their distance and reddening. This is because they are affected by high differential reddening and strong field contamination. In addition, in most of the cases only the RGB is observed since SGB and MS are too faint. However, thank to the advent of new databases like GAIA and 2MASS, and to the development of more reliable stellar models, it is now possible to isolate the cluster from the field, to correct for the differential reddening and apply a proper isochrone fit to the RGBs in order to get cluster parameters. This is particularly important for the purpose of calculating their orbits.

Video available on YouTube

A statistical study of the compressible energy cascade rate in the solar wind: MAVEN and PSP observations

M. Brodiano CT

Instituto de Física, CONICET-UBA, Buenos Aires, Argentina

Turbulence is a unique nonlinear phenomenon in fluid and plasma flows that allows the transfer of energy between different temporal and spatial scales. For instance, the solar wind is observed to contain a turbulent cascade at different heliocentric distances from the Sun. Thanks to the availability of in situ measurements from various spacecraft missions, the solar wind provides a unique opportunity to investigate plasma turbulence. In the present work, we investigated the magnetohydrodynamics (MHD) energy cascade rate at the largest scales in the pristine solar wind at different heliocentric distances. Making use of magnetic field and plasma observations provided by Mars Atmosphere and Volatile EvolutioN (MAVEN) and Parker Solar Probe (PSP) missions, we estimated the incompressible and compressible cascade rates. Finally, we compared two different general exact law models for compressible isothermal and polytropic MHD turbulence.

Video available on YouTube

Large amplitude oscillations in solar filaments

M. Cécere CT

Instituto de Astronomía Teórica y Experimental, CONICET-UNC.
Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

It has been known that solar filaments show oscillations. These types of motions are normally triggered by nearby flares or jets, EIT waves and Moreton waves. In this work we analyse how coronal waves are able to excite filament oscillations through 2.5 MHD simulations. We find correlations between height, size and mass with period, amplitudes and damping times. We also find that magnetic tension is the main restoring force exerted on the filament.

Video available on YouTube

Pseudostreamer influence on flux rope evolution

A. Sahade CT

Instituto de Astronomía Teórica y Experimental, CONICET-UNC.
Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

Pseudostreamers (PSs) are coronal magnetic structures formed by arcs of twin loops capped by magnetic field lines from coronal holes of the same polarity that meet at a central spine. They contain a single magnetic null point in the spine, just above the closed field lines, which are thought to have the potential of influencing the evolution of nearby flux ropes (FRs). To study the early evolution of the FR, focusing on ejection and non-radial motions, we performed numerical simulations in which an FR structure is in the vicinity of a PS magnetic configuration. We determine different classes of dynamic behaviour from the FR trajectories and analyse the magnetic cages that enclose de FRs and the FR variables to explain them. The combined magnetic field of the PS and the FR results in the formation of two magnetic null points. These affect the trajectory of the FR and the topology of the initial magnetic field. While the magnetic cage over the FR plays a crucial role in whether or not the FR erupts, the magnetic null points are decisive in the direction and amount of deflection that the FR undergoes.

Video available on YouTube

List of Posters

Full list of YouTube poster videos.

Analysis of the eclipsing times variations of an evolved binary

M. Ramos

eP

Observatorio Astronómico de Córdoba.
Facultad de Matemática, Astronomía, Física y Computación, UNC, Córdoba, Argentina.

The Eclipsing Timing Variations (ETV) technique permits an indirect determination of orbital parameters of a circumbinary planet orbiting an eclipsing binary star. In this work, we show preliminary results on the analysis of the eclipsing binary star QS Virginis in search of an explanation for the variations in its orbital period. This system has been analyzed before but, there are no reliable explanations for the signal. Using an analytical model and minimizing strategy, we find the orbital parameters of this body, that correspond to the best-fit. We test two strategies for estimating the uncertainties and, lastly, we analyze how the best fits changes as a function of the observational set.

Video available on YouTube

The effect of galaxy orbits on the outer regions of clusters:connections with the splashback radius

A. De Almeida

eP

Institute of Astronomy, Geophysics and Atmospheric Sciences, USP, Sao Paulo, Brazil

The outer regions of dark matter halos does not behave as expected: the density profile slope reaches a minimum and increases again (Diemer and Kravtsov 2014). The radius where this occurs is the splashback radius (More, Diemer, and Kravtsov 2015), and is related to the halo formation and evolution (Adhikari, Dalal, and Chamberlain 2014). To study this relation we simulated spherical collapse and orbit of galaxies in a cluster. We get that the splashback radius as a function of R_{200m} depends on the force of collapse (in terms of the virial ratio), while the minimum slope of the density profile can give us information about the halo mass. Recent splashback radius detection show us that studies like this will be increasingly important as a way to better understand the information we can get from the splashback features about halo formation and evolution.

Video available on YouTube

Low Surface Brightness Galaxies in IllustrisTNG

L. Peréz-Montaño

Instituto de Radioastronomía y Astrofísica, UNAM, Michoacán, Mexico.

We explore the nature of low surface brightness galaxies (LSBGs) in the hydrodynamic cosmological simulation TNG100 of the Illustris TNG project, selecting a sample of LSBGs at z = 0 over a wide range of stellar masses ($\mathcal{M}^* = \infty\prime^{\exists} - \infty\prime^{\infty\in}\mathcal{M}_{\odot}$). We show that the specific star formation rates of LSBGs are not significantly different from those of high surface brightness galaxies (HSBGs), but that LSBGs are systematically less massive and more extended than HSBGs, and tend to display spiral-like morphologies according to a kinematic criterion. At fixed stellar mass, we observe no systematic differences in their dark matter halo masses, but we find that the haloes hosting LSBGs have a higher baryonic fraction. We finally find that LSBGs have higher stellar specific angular momentum and halo spin parameter values compared to HSBGs, as suggested by previous works. We track the evolution of these quantities back in time, finding that the spin parameters of the haloes hosting LSBGs and HSBGs exhibit a clear bifurcation at $z \sim 2$, which causes a similar separation in the evolutionary tracks of other properties such as galactic angular momentum and effective radius, ultimately resulting in the values observed at $z = 0$. The higher values of specific stellar angular momentum and halo spin in LSBGs seem to be responsible for their extended nature, preventing material from collapsing into the central regions of the galaxies, also causing LSBGs to host less massive black holes at their centres.

Video available on YouTube

Age determination of 3 star clusters belonging to the Magellanic Clouds

M. Tapia Reina

Observatorio Astronómico de Córdoba.
Facultad de Matemática, Astronomía, Física y Computación, UNC, Córdoba, Argentina.

Ages of 3 star clusters (SCs) of Magellanic Clouds whose spectra were obtained at the Complejo Astronómico El Leoncito (CASLEO, Argentina) are presented. Those spectra have been obtained by an integrated spectroscopy technique, a powerful tool for SCs study. Ages were derived using the correlations between the equivalent width (EW) of Balmer absorption lines and the age as well as diagnostic diagrams (DD) which involve the sum of the EWs of selected spectral lines. The results presented herein and those found by other authors are also presented for SCs from the sample.

Video available on YouTube

Is a 4U 0114+65 a wind-accreting magnetar? a glimpse of NuSTAR and NICER

E. Saavedra

Facultad de Ciencias Astronómicas y Geofísicas, UNLP, La Plata, Argentina.

4U 0114+65 is an X-ray pulsar with one of the slowest pulsations known to date. The most accepted hypothesis is that this is an accreting magnetar. We present an analysis of a simultaneous observation of NuSTAR and NICER telescopes. We searched for the presence of cyclotron-resonant scattering features in the spectra. No cyclotron resonant dispersion features are found in any interval. In order to obtain physical parameters of the system, the Becker-Wolff self-consistent cyclotron line model was fitted, obtaining in both intervals a magnetic field of the order of 10^{12} G.

Video available on YouTube

Galaxy pairs in S-PLUS DR2

C. Cerdosino

Facultad de Matemática, Astronomía, Física y Computación, UNC, Córdoba, Argentina.

In this poster, we present details of the implementation and testing of the purity and completeness in the Southern Photometric Local Universe Survey Data Release 2 (S-PLUS DR2) of an isolated galaxy pairs identification algorithm. To this end, we use a simulated galaxy catalogue that imitates the characteristics of S-PLUS. The final goal is to study isolated galaxy pairs using the information provided by the photometric bands and photometric redshifts. With the systems identified in the S-PLUS DR2, we will carry out a study from different approaches to better understand the evolution of galaxies in low-density regions and the environmental effects in these regions.

Video available on YouTube

Kinematics of the Local Group gas and galaxies in the Hestia simulations

L. Biaus

Facultad de Ciencias Exactas y Naturales, UBA, Buenos Aires, Argentina.

We investigate the kinematic properties of gas and galaxies in the Local Group (LG) using a suite of high-resolution simulations performed by the Hestia (High-resolution Environmental Simulations of The Immediate Area) collaboration. Our simulations include the correct cosmography surrounding the LG-like regions such as the Virgo cluster, the local void and the local filament. The simulated LGs consist of two main spiral galaxies of $\sim 10^{12}\mathcal{M}_{\odot}$, their satellites and minor isolated galaxies, all sharing the same large-scale motion within a volume of a few Mpc. With this study, we are aiming at characterizing the gas and galaxy kinematics within the simulated LGs from the perspective of the Sun to compare the observed trends with recent HST/COS absorption-line observations and LG galaxy data. To analyze the velocity dipole pattern for LG gas and galaxies seen in the observational data, we build sky maps from the local standard of rest, and other reference systems such as the galactic and local group barycentre frames, as seen by an observer sitting in the model Milky Way.

Video available on YouTube

Ultralight Dark Matter: A very short review

M. Díaz Araque

Universidad de Los Andes, Mérida, Venezuela.

In this a very short review we show some Ultra-light Dark Matter (ULDM) models as an alternative on small scales, where there is discrepancies between simulations and observations of Cold Dark Matter (CDM) models. ULDM represent an interesting alternative of addressing some of the small scale challenges of λCDM, with an large masses ranging bosons from $10^{-22}eV < m < eV$.

Video available on YouTube

Galaxy rotation curve fitting using state-of-the-art machine learning tools

S. Collazo

Facultad de Ciencias Astronómicas y Geofísicas, UNLP, La Plata, Argentina.

Nowadays machine learning is a tremendously powerful tool to solve a lot of different problems. In this work, we will use a specific machine learning tool known as gradient descent to fit the observed Galaxy's rotation curve. We will perform this fitting by assuming a theoretical velocity profile, arising from a composite model which includes baryons and a fermionic dark matter component. The last one explains the Galactic halo through a semi-analytical model of self-gravitating quantum fermions under the frame of general relativity. It has four free parameters including the particle mass which, in addition to the free parameters of the baryons, will be constrained by minimizing a loss function through the aforementioned gradient descent method.

Video available on YouTube

Chemical signatures of planetary formation and evolution in the WASP-160 binary system

E. Jofré

Observatorio Astronómico de Córdoba, UNC, Córdoba, Argentina.

Wide binary stars with similar components hosting planets provide an interesting opportunity for exploring the star-planet chemical connection. Here, we present a detailed characterization of the solar-type stars in the WASP-160 binary system. No planet has been reported yet around WASP-160A while WASP-160B is known to host a transiting Saturn-mass planet, WASP-160B b. For this planet, we also derive updated properties from both literature and new observations. Furthermore, using TESS photometry, we constrain the presence of transiting planets around WASP-160A and additional ones around WASP-160B. The stellar characterization includes, for the first time, the computation of high-precision differential atmospheric and chemical abundances based on high-quality spectra. Our analysis reveals evidence of a correlation between the differential abundances and the condensation temperatures of the elements. In particular, we find both a small but significant deficit of volatiles and an enhancement of refractory elements in WASP-160B relative to WASP-160A. After WASP-94, this is the second stellar pair among the shortlist of planet-hosting binaries showing this kind of anomalous chemical pattern. We discuss that the formation of WASP-160B b and late accretion of rocky material by its host star, likely triggered by the inward migration of this giant planet, could explain the observed chemical pattern. Alternative scenarios involve the formation of additional giant planets around WASP-160B and rocky objects around WASP-160A. Full details about this work can be found in Jofré et al. (2021)

Video available on YouTube

A determination of the local Hubble constant using Giant HII Regions and HII Galaxies

D. Fernández-Arenas

eP

Instituto Nacional de Astrofísica Óptica y Electrónica, CONACYT, Tonantzintla, Mexico.

The relationship between the integrated Hβ line luminosity and the velocity dispersion of the ionized gas of HII galaxies (HIIGs) and giant HII regions (GHIIRs) has been known for a long time as the L-σ relation (Terlevich et. al. 1981 and more recently Bordallo & Telles 2011 and Chavez et. al. 2014). The scatter in the relation is small enough that it can be used to determine cosmic distances independently of redshift and represents an interesting distance estimator that, in principle, can be used up to redshifts $z \sim 4$. Locally it can be used to obtain high precision measurements of the local Hubble parameter. This can be done using a sample of nearby ($z \leq 0.1$) HIIGs galaxies and, crucially, an anchor sample of GHIIRs in nearby galaxies for which distances via primary indicators are available. I will be presenting our recent results of the use of the L-σ relation to measure the local value of the Hubble constant (Fernández et. al. 2018) and to constrain the Dark Energy equation of State Parameter (w) (González-Morán et. al. 2020,2021).

Video available on YouTube

Early-type dwarf galaxies in low-density environments: the case of CGCG014-074

N. Guevara

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Early-type dwarf galaxies (dE, dS0) are the most common galaxy type in nearby galaxy clusters and groups. According to the hierarchical theory of formation and evolution of the large scale structures in the Universe, dwarf galaxies would be the building blocks of those bright galaxies we observe today. In particular, the formation scenarios for dE and dS0 focus mainly on the transformation of late-type to early-type galaxies through different processes (e.g., interactions, mergers), including environmental effects in high-density environments (e.g., ram-pressure stripping, harassment, suffocation). However, it is not yet clear whether these processes would be relevant in low-density environments such as poor groups and the field. In this sense, analyzing the morphology of dwarf galaxies turns out to be one of the fundamental elements to understand their underlying dynamics as well as their assembly histories. In this work, we present a photometric study of the dS0 galaxy CGCG014-074 that forms a small group with NGC 4546, an S0 galaxy located in a low-density environment. The analysis presented here shows the first results obtained on the dS0 galaxy, using deep Gemini-GMOS images in the filters g' r' i' z' , we characterize the photometric properties of the dwarf galaxy by determining its isophotal parameters, surface brightness profiles, colour gradients, and different structural components. This initial analysis allows us to inquire about its evolutionary past, giving us an idea if its current morphology could be due to internal galaxy properties and/or environmental mechanisms (nature or nurture).

Video available on YouTube

Black Holes Shadows in Konoplya-Stuchlik-Zhidenko metrics

G. Briozzo

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Employing the family of stationary, axisymmetric and asymptotically flat metrics proposed in [Konoplya, Stuchlik & Zhidenko (2018)], which allows the separation of variables in the Klein-Gordon and Hamilton-Jacobi equations, we imitated the work [Perlick & Tsupko (2017)] to analytically obtain the shadow contour curve of rotating black holes immersed in plasmatic environments. This procedure was performed considering different Kerr-like spacetime models and different plasma concentrations. Finally, we imitated the work [Grenzebach (2015)] to study the effect of relativistic aberration on the shadow of black holes.

Video available on YouTube

Skylight: a new code for general relativistic ray tracing and radiative transport in arbitrary spacetimes

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Modelling the observed spectra and light curves originated in the vicinity of compact objects requires accurate numerical codes for relativistic ray tracing and radiative transfer. Here, we present Skylight, a new code we developed for achieving such purposes in arbitrary space-time geometries. From the code we can extract images, spectra and light curves as seen by distant observers starting from astrophysical models of the compact sources. The code can operate under two different schemes, namely a Monte Carlo method integrating geodesics from the emitting source to the distant observers, and, on the other hand, camera techniques with backwards integration from the observer to the emission region. We present several test cases which our code successfully passed, including thin accretion disks around black holes and neutron stars hot spot emission.

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Low-Frequency Detection of Diffuse Radio Emission from Low-mass PSZ Clusters

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Observations of diffuse radio emission from the intra-cluster medium (ICM) in galaxy clusters due to synchrotron processes reveal the dynamical state and the non-thermal energy evolution in these structures. However, Low-mass ($\mathcal{M}^{500} < 5 \times 10^{14} \mathcal{M}_{\odot}$) galaxy clusters have been largely unexplored in radio observations, because of the limited sensitivity of existing telescopes. But the study of these low mass objects has become possible with exceptionally sensitive low-frequency telescopes like the upgraded Giant Metrewave Radio Telescope (uGMRT) and the Low-Frequency Array (LoFAR). In this study, we present the first large-scale program to systematically search for diffuse radio emissions from low-mass galaxy clusters, chosen from the Planck Sunyaev–Zel'dovich cluster catalogue. We report here the detection of diffuse radio emission from four of the 12 objects in our sample, shortlisted from the inspection of the LoFAR Two-Meter Sky Survey data release 1 (LoTSS-I), followed up by uGMRT Band-3 deep observations. The clusters PSZ2 G089 (Abell 1904) and PSZ2 G111 (Abell 1697) are detected with relic-like emission, while PSZ2 G106 is found to have an intermediate radio halo and PSZ2 G080 (Abell 2018) seems to be a halo-relic system. PSZ2 G089 and PSZ2 G080 are among the lowest-mass clusters discovered with a radio-relic and a halo- relic system, respectively. A high ($\sim$30 per cent) detection rate, with powerful radio emission found in most of these objects, opens up prospects of studying radio emission in galaxy clusters over a wider mass range, to much lower-mass systems.

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Study of Stellar Populations Properties in Simulated Galaxies

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In this project, we aim at developing a numerical tool that allows us to mimic IFU observations. For this purpose, we studied the properties of stellar populations in two simulated galaxies of the CIELO project. Synthetic spectra of the simulated populations were generated for the galaxies and per spaxel by combining the age and metallicity of simulated stellar populations with SEDs (GALAXEV). Preliminary results are shown.

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The Integrated Sachs-Wolfe Effect in 4D Einstein-Gauss-Bonnet Gravity

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A novel 4-dimensional Einstein-Gauss-Bonnet (4D EGB) gravity has been proposed that asserts to by-pass Lovelock's theorem and results in a non-trivial contribution to the gravitational dynamics in four-dimensional spacetime. Although inconsistencies have been raised for this theory in nonlinear perturbation limits, the results of the consistent 4D EGB model indicate that the background equations and the linear scalar modes are in good agreement with the initial 4D EGB model. In this work, we study the integrated Sachs–Wolfe (ISW) effect, as a linear phenomenon, in the 4D EGB model. For this purpose, we calculate the evolution of the gravitational potential, the linear growth factor as a function of redshift, the ISW-auto and cross power spectrum as a function of cosmic microwave background (CMB) multipoles for the 4D EGB model and compare those with the one obtained from the ΛCDM model. The results exhibit that the ISW effect in the 4D EGB model is higher than the one obtained from the ΛCDM model. Correspondingly, we indicate that the deviation from the ΛCDM model is directly proportional to the value of the dimensionless coupling parameter

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