FoF 2019

FRIENDS OF FRIENDS MEETING

IATE
CONICET
UNC

April 1-5 2019
Córdoba - Argentina

OAC
Observatorio
Astronómico
de Córdoba

The codes used to generate this booklet, including the LaTeX template, are available at
`https://github.com/maximelucas/AMCOS_booklet`

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FOF 2019

The Meeting

This is the 9th edition of the Friends of Friends Meeting; a a yearly international gathering jointly organized by the Institute of Theoretical and Experimental Astronomy (IATE, http://iate.oac.uncor.edu) and the Astronomical Observatory of Córdoba (OAC, http://oac.unc.edu.ar). It aims to enhance interactions between members of the local and international scientific communities and to promote the creation of new collaboration networks in a friendly and respectful atmosphere. The main topics of the present edition are astrophysical plasmas, cosmology and large scale structure, multimessenger astronomy, extragalactic astronomy, stellar astrophysics and planetary systems. The official language of the meeting is English.

The organization of all the activities are oriented to encourage the development of new initiatives with local and visiting participants.

The organized activities of the FoF Meeing generates a friendly environment which 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.

Local Organizing Committee

Yamila Yaryura	Mario Sgró	Gaia Gaspar	Martín Chalela
Viviana Bertazzi	Heliana Luparello	Ezequiel Boero	Belen Mari

Scientific Organizing Committee

Lucas Macri   Mario Abadi   Mario Díaz   Nelson Padilla

Timetable

CT : Contributed Talk, **PT** : Invited Talk.

Monday, April 1st

8:30–9:30	**Registration and Welcome speech**		
9:30–10:20	PT	**L. Silva** Osservatorio Astron. di Trieste	*Modelling exoplanetary climates and habitability*
10:20–10:40	CT	**F. Zoppetti** OAC - UNC	*A self-consistent weak friction model for tidal evolution of circumbinary planets*
10:40–11:10	**Coffee break**		
11:10–12:00	PT	**H. Cremades** UTN - Fac. Reg. Mendoza	*Morphology and Expansion of Coronal Mass Ejection from multi-viewpoint observations*
12:00–12:20	CT	**A. Esquivel** UNAM	*Hydrodynamical interaction of stellar winds and hot-jupiter planetary winds*
12:20–13:10	PT	**A. Araudo** Czech Academy of Science	*Acceleration of Ultra High Energy Cosmic Rays in Active Galactic Nuclei*
13:10–14:30	**Lunch**		
14:30–15:20	PT	**R. Riffel** Univ. Fed. Rio Grande do Sul	*Does star formation play a decisive role in active galactic nuclei fueling?*
15:20–15:40	CT	**L. Ferrero** OAC - UNC	*Multifrequency study of HH 137 and HH 138: discovering new knots and a molecular outflow with Gemini and APEX*
15:40–16:00	CT	**A. Ahumada** OAC - UNC	*Ages and metallicities of Large Magellanic Cloud star clusters from integrated spectroscopy*
16:00–16:30	**Coffee break**		
16:30-17:20	PT	**V. Firpo** Gemini Observatory	*Violent Star Formation: kinematics and chemical abundances*
17:20-17:40	CT	**C. Oviedo** OAC - UNC	*Search for stellar variability in the fields of NGC4349 and NGC6250 open clusters*
17:40-18:00	CT	**M. Orellana** UNRN - CONICET	*Magnetar powered Superliminous Supernovae*

Wednesday, April 3rd

9:00–9:50	PT	**C. Boehm** University of Sydney	*To be published*
9:50–10:40	PT	**P. Benítez-Llambay** University of Copenhagen	*Unraveling the role of dust on planetary migration*
10:40–11:10		**Coffee break**	
11:10–11:30	CT	**L. Krapp** University of Copenhagen	*Simulations of Multi-Species Protoplanetary Disks*
11:30–11:50	PT	**C. Giuppone** SECYT - OAC - UNC	*Planet formation and stability in polar circumbinary discs*
11:50–12:10	PT	**D. Dravins** Lund Observatory	*Radial Velocities and Wavelengths Shifts - Stellar Spectra and Exoplanet Detection*
12:10–12:30	PT	**M. Rubio** FAMAF - UNC	*Novel approach for simulating ultrarelativistic fluid systems*
12:30–12:50	PT	**J. Horak** Academy of Science Czech Rep.	*Corotation instabilities in accretion flows*
12:50–13:10	PT	**J. Minniti** PUC	*Studying the hidden side of the Milky Way's disk using Classical Cepheids*
13:10–14:30		**Lunch**	
14:30–15:20	PT	**L. Pasquini** ESO	*Planets in Open Clusters*
15:20–15:40	CT	**C. Correa** IATE - CONICET	*The abundance of voids as a cosmological test*
15:40–16:00	CT	**J.M. Salerno** IATE - CONICET	*Filaments in VIPERS: galaxy quenching in the infalling regions of groups*
16:00–16:30		**Coffee break**	
16:30-16:50	CT	**T. Tagliaferro** IATE - CONICET	*Dynamical analysis of simulated clusters*
16:50-17:20	CT	**M. Mestre** IALP - UNLP	*Effects of chaoticity on the detectability of stellar streams*
17:20-17:40	CT	**L. Zenocratti** FCAGLP - UNLP	*Revisiting the colour-magnitude diagram of elliptical galaxies in cosmological context*
17:40-18:00	CT	**F. Milla Castro** Univ. de La Serena	*The VISTA Variables in the Vía Láctea Survey and the Large-Scale Structure of the Universe*
18:00-18:20	CT	**C. Ragone-Figueroa** IATE - CONICET	*Evolution of the BCG-Cluster Alignment in Cosmological Hydro-Simulations*

Thursday, April 4th

9:00–9:50	PT	**A. Biviano** Osservatorio Astron. di Trieste	*Structure and dynamics of clusters of galaxies*
9:50–10:40	PT	**E. Carlesi** Leibniz Inst. Astroph. Potsdam	*Reverse Engineering the local Universe*
10:40–11:10	**Coffee break**		
11:10–12:00	PT	**M. Makler** C. Brasilero de Pesq. Fisicas	*Strong Lensing Constraints on Cosmology, Dark Matter and Modified Gravity*
12:00–12:20	CT	**E. González** IATE - CONICET	*Weak-lensing analysis of galaxy pairs using CS82 data*
12:20–13:10	PT	**O. López-Cruz** INAOE	*Desperately Seeking Gargantua*
13:10–14:30	**Lunch**		
14:30–15:00	PT	**G. González** Louisiana State University	*Latest results from LIGO/Virgo, and prospects for observations in the near future*
15:00–15:30	PT	**M. Branchesi** Grand Sasso Science Institute	*Astrophysical implications of the one year multi-messenger observations of GW170817*
15:30–16:00	PT	**L. Macri** Univ. Texas A&M	*The TOROS project: Status report*
16:00–16:30	**Coffee break**		
16:30-17:00	PT	**D. Siegel** Columbia University	*Multimessenger astronomy and cosmic nucleosynthesis*
17:00-17:30	PT	**L. Lehner** Perimeter Institute	*Possible channels for EM counterparts in binary mergers*
17:30-18:00	PT	**C. Chirenti** Universidade Federal do ABC	*Oscillations of (hyper-massive) neutron stars*
18:00-18:30	PT	**E. Ferrer** City University of New York	*EOS of Magnetized Quark Matter and the Mass-Radio Relationship for Strange Stars*

Friday, April 5th

9:00–9:50	PT	**S. Cora** Inst. de Astrof. de La Plata	*Origin of passive satellites: environmental and/or mass quenching?*
9:50–10:40	PT	**L. Sales** University of California	*Diffuse stellar halos as cosmological time machines*
10:40–11:10	**Coffee break**		
11:10–12:00	PT	**A. Benítez-Llambay** Durham University	*Starless low-mass dark matter halos: an unprecedented probe to LCDM*
12:00–12:20	CT	**E. Sillero** IATE - CONICET	*Chemical abundance patterns of interacting galaxies*
12:20–13:10	PT	**C. Scoccola** Univ. Nacional de La Plata	*QUBIC: the Q&U bolometric interferometer for Cosmology*
13:10–14:30	**Lunch**		
14:30–15:20	PT	**A. Hawken** Osservatorio Astron. di Biera	*Constraining the growth rate of structure using cosmic voids*
15:20–15:40	CT	**F. Dávila Kurbán** IATE - CONICET	*Enter the Void: Statistical models of small scale clustering*
15:40–16:00	CT	**A. Taverna** IATE - CONICET	*Raiders of the Lost Algorithm: an optimal Compact Group finder*
16:00–16:30	**Coffee break**		
16:30-16:50	CT	**G.L. Granato** Osservatorio Astron. di Trieste	*Dust evolution in galaxy cluster simulations*
16:50-17:20	CT	**M. Schaller** Durham University	*The impact of baryon physics on future cosmological probes*
17:20-17:40	CT	**I. Ferrero** IEEC - CSIC	*The Euclid Flagship galaxy mock*
17:40-18:00	CT	**V. Santucho** IATE - CONICET	*A measure of Future Virialized Structures (FVS) spatial correlations*

List of Abstracts – Talks

Monday, April 1st

Morning Talks

Modelling exoplanetary climates and habitability

L. Silva, INAF - Osservatorio Astronomico di Trieste, Trieste, Italy **PT**

One of the main drivers for the comprehensive boost in exoplanetary search and characterization is the possibility that life could have arisen on other planets and could possibly be detected with time-consuming spectroscopic observations. In absence of a theory for the origin of life, the suitability of exoplanets to potentially host life - their habitability - can be estimated based on environmental (astronomical and planetary) conditions. In contrast with solar system planets, exoplanetary habitability in general refers to surface conditions, on the notion that only a well developed surface life could produce spectroscopically detectable biosignatures. Surface habitability can be quantified by adopting temperature-dependent criteria, e.g, the liquid-water criterion, and by computing surface temperatures with climate models. In the past few years, we have developed the model ESTM - Earth-like planet Surface Temperature Model - a simple climate model based on a latitudinal Energy-Balance Model formalism for the meridional heat transport, coupled with a radiative-convective atmospheric column model for the vertical transport. This model allows to explore the vast parameter range of undetected planetary factors affecting surface temperature, in addition to the observed (orbital and stellar) quantities. This modelling, coupled a with a quantitative habitability index that maximizes the probability of detecting atmospheric biomarkers, can help to select the best targets for spectroscopic follow-up.

A self-consistent weak friction model for tidal evolution of circumbinary planets

F. Zoppetti, OAC-UNC, Córdoba, Argentina **CT**

As of 2018, the Kepler mission has only discovered ten circumbinary (CB) planetary systems. All binary components define compact systems and a wide range of eccentricities and mass ratios. The planets surrounding them also have a diversity of masses (between super-Earths to Jupiter masses) but they are all almost coplanar with the binary, very close to it and in low eccentricity orbits (except Kepler 34b and Kepler 413b). While the low inclinations suggest that these planets formed in a CB disc aligned with the orbital plane of the central binary, it is well accepted that in-situ formation so close to the binary is unlikely due to the strong eccentricity excitation induced by the secondary star (e.g. Lines et al. 2014; Meschiari 2012). However, as we move away from the binary, the gravitational potential became much more similar to that of a single star and planetary formation appears to be easier, following usual core-accretion models. This suggest that CB planets could have formed farther out, later migrated inward due to dissipation with a primordial disc and finally stalled near their current orbits by some mechanism (Dunhill & Alexander (2013)). In our previous work (Zoppetti et al. (2018)), we tested the possibility that the planet stops its inward migration due to a capture in a high mean-motion-resonance (MMR) with the binary and once the disc is dissipated, slowly escapes from the resonance due to tidal forces. We validated this hypothesis using as a working example Kepler-38, a particular very old system in which captures in the 5/1 MMR have been reported with hydrosimulation (Kley & Haghighipour (2014)). In that case, the tidal forces were included in a N-body integrator following Mignard (1979) as applied in (e.g. Rodriguez et al. 2011) and we curiously observed that while the binary orbit shrinked due to tides, the planet moves away from it. In this talk we show and discuss a self-consistent tidal model for a multibody system, in which all tidal forces between pairs are computed following the Mignard model. We show some preliminary results that arise from applying our model to study the orbital evolution of circumbinary planets.

Morphology and Expansion of Coronal Mass Ejections from multi-viewpoint observations

H. Cremades Fernandez, Facultad Regional Mendoza, Mendoza, Argentina **PT**

Coronal mass ejections (CMEs) are likely the most spectacular dynamic events originating at the Sun. Mainly because of their ability to interact with Earth's magnetosphere, they are key players in determining space weather conditions. To date, the event of a CME has been impossible to predict, so that the best attempt at forecasting is to assess their impact with the best possible accuracy. In this respect, understanding how magnetic fields are organized within CMEs, and how they evolve from the low corona into the heliosphere, is crucial. Exceptional ongoing solar missions, such as STEREO, SOHO, and SDO, provide a unique opportunity to shed light into this aspect. The stereoscopic-view images provided by the STEREO/SECCHI suite in combination with images from Earth's perspective recorded by SDO/AIA and SOHO/LASCO enable the study of CME evolution from their birth in the low corona. An appropriate combination of spacecraft vantage points and CME propagation direction is helpful to reduce uncertainties in the forward modeling. The events under study are carefully analyzed as they originate low in the corona by means of simultaneous observations of STEREO/EUVI and SDO/AIA, and followed up to the outer fields of view of the STEREO and SOHO coronagraphs. In particular, we examine the evolution of the global magnetic field configuration of these CMEs, and how they expand in the directions of their main symmetry axis and orthogonal to it.

Hydrodynamical interaction of stellar winds and hot-jupiter planetary winds

A. Esquivel, UNAM, City of México, México **CT**

Lyman alpha observations of transiting hot jupiters have shown an extended atmosphere in some of them. The most studied case being that of the HD209458 system, which consist in a solar type star and a jupiter type planet in an orbit 1/8th of that of Mercury. Such observations prompted the study of such systems from various approaches. I will present a brief review of our attempts to model the absorption seen in Ly-alpha as the result of the hydrodynamical interaction of the stellar wind and a wind that arises from the photo-evaporation of the atmosphere of the planet.

Acceleration of Ultra High Energy Cosmic Rays in Active Galactic Nuclei

A. Araudo, Astronomical Institute – Czech Academy of Sciences, Prague, Czech Republic **PT**

One of the most exciting and unsolved problems in Astrophysics is figuring out the origin of the Ultra High Energy Cosmic Rays (UHECRs). These are protons and heavy ions having an energy larger than 1 EeV arriving on Earth from outside our Galaxy, but their origin remains unknown. Relativistic jets in Active

Galactic Nuclei (AGN) are candidates to be the sources where these particles are accelerated. Diffusive shock acceleration is the most established mechanism to accelerate particles in sources where strong shocks are present, such as AGN jets. However, recent theoretical advances combined with multi-frequency observational data indicate that relativistic shocks in AGN jets are unable to accelerate particles to energies much larger than a PeV. The implication of this result is that if UHECRs are accelerated by shocks, then those shocks are probably not relativistic, and therefore mildly relativistic shocks in the backflow of giant-lobed radio galaxies such as Centaurus A and Fornax A are very promising candidates to accelerate UHECRs. In this talk I will present the state of the art of UHECR acceleration by shocks in AGN. I will focus on particle acceleration and magnetic field amplification in termination shocks and in the backflows in AGN jets. I will also (briefly) describe how high-power laser experiments can shed light on astrophysical phenomena such as particle acceleration, plasma instabilities, and UHECR propagation.

Afternoon Talks

Does star formation play a decisive role in active galactic nuclei fueling?

Rogério Riffel, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil **PT**

Active Galactic Nuclei (AGN) characterize a critical phase in galaxy evolution in which its nuclear supermassive black hole (SMBH) is being fed due to gas accretion onto the nuclear region. The AGN feeding and feedback processes are believed to couple the growth of the SMBHs and their host galaxies, and are claimed to be responsible for the correlation between the mass of the SMBH and that of the galaxy bulge. The co-evolution scenario, and the gas feeding in the inner kiloparsec of galaxies when they are in the active phase implies that the galaxy bulge grows in consonance with the SMBH. Over the last few years, our team has undertaken a major observational effort to understand this co-evolution by recovering the spatially resolved star formation history and studying the stellar kinematics of the inner few tens parsecs of galaxies. To this purpose we are applying an updated version of the STARLIGHT code to Gemini Near-infrared Integral Field Spectrograph (NIFS) data-cubes of nearby Seyfert galaxies. We found rings of intermediate-age stars, being correlated with low stellar velocity dispersion values, interpreted as being originated by stars that still preserve the kinematics of the gas from which they formed. Hot dust emission was detected nearly 80% of the galaxies accounting for 20-90% of the observed K-band nuclear flux. A featureless (FC) component was detected, contributing with 25% of the K-band nuclear flux in more than 50% of the sources.

Multifrequency study of HH 137 and HH 138: discovering new knots and a molecular outflow with Gemini and APEX

L. Ferrero, OAC-UNC, Córdoba, Argentina **CT**

Jets and outflows are the first signposts of stellar birth and can be observed over a wide range of wavelengths, from the ultraviolet to the radio. The study of these events can provide a better understanding of how the stars form, how they interact wiht their environments. We present results of a study of the jets HH 137 and HH 138 using Gemini images and APEX molecular line data, as well as archive images from diverse surveys from the optical to sub-milimeter. Several 2.12 μm knots linked to HH 137 are identified on the Gemini image. Many extended 4.5 μm emissions are found in a larger area than that covered by the Gemini image, including not only HH 137 but also HH138. 12CO(3-2), 13CO(3-2), and C18O(3-2) molecular lines data reveal the molecular counterpart of HH$\sim$137. Spitzer combined images suggest the location of the exciting source of HH 137/138, almost coincident with a high-density molecular clump detected in the $C^{18}O$(3-2) line, in the cold dust emission at 870 μm and in high-density tracers, such as HCO+(3-2) and HCN(3-4). We derive physical parameters of the molecular clump and the molecular outflow and propose a simple scenario for the whole complex.

Ages and metallicities of Large Magellanic Cloud star clusters from integrated spectroscopy

A. Ahumada, OAC-UNC, Córdoba, Argentina **CT**

Flux-calibrated integrated spectra in the optical range have been obtained for a sample of 16 blue compact and high surface brightness Large Magellanic Cloud (LMC) star clusters (SCs). We simultaneously derive foreground reddening values and ages for the SCs by comparing the line strengths and continuum distribution of their integrated spectra with those of LMC cluster spectra templates. Through evolutionary synthesis models for simple stellar populations and using a full-spectrum fitting code, we also derive reddenings, ages, and metallicities for the SC sample. No metallicity determinations have been previously performed for nine out of the 16 clusters here studied. We find good agreement between the SC ages derived from the template-matching method and those ages estimated from theoretical evolutionary synthesis models. We compare our results with those reported in the literature, and discuss the distribution of metallicity values.

Violent Star Formation: kinematics and chemical abundances

V. Firpo, Gemini Observatory, La Serena, Chile **PT**

The effect of violent star formation has on the surrounding interstellar medium involves a large number of physical interaction processes: gas photoionisation by hot stars, stellar winds, formation of super-bubbles, outflows, and even trigger formation of a new generation of stars. The analysis of these processes related between a star-forming region and its environment requires the complete study of the gaseous component, from the internal kinematic structure to the physical properties of the components. In this talk, will be shown a resume of results obtained using high and low spectral resolution spectroscopy combined with integrated field spectroscopy of star-forming complexes in isolated and interacting galaxies. The complex internal kinematic suggest large star-forming regions and chemical enrichment of the intergalactic medium.

Search for stellar variability in the fields of NGC4349 and NGC6250 open clusters

C. Oviedo, OAC-UNC-FaMAF, Córdoba, Argentina **CT**

Variable stars represent essential sources for stellar evolution studies, being at the same time tracers of different galactic structures. On the other hand, the recognition of new variable stars in the fields of well-studied open clusters can facilitate the characterization of the new variables discovered. In this work we present the detection and characterization of new variable stars in the fields of NGC4349 and NGC6250 open clusters, both projected on the Galactic disk. The photometric data were obtained using the VISTA 4.1m telescope of the VVV survey (Vista Variables in the Via Lactea). The variability was carried out in the near-IR Ks band. The detection of variability was made with an automated software where a total of 193 new variables were obtained in the fields of the studied clusters. In this talk I will present the four classification criteria for the new variables discovered, and I will show some excellent new candidates for further follow-ups studies and to join the dataset of "templates" stars.

Magnetar powered Superliminous Supernovae

M. Orellana, UNRN – CONICET, Rio Negro, Argentina **CT**

Currently, with the most exhaustive surveys of transient phenomena in the sky, new super-luminous supernovae (SLSNe) have been reported. The increase in the population of the known events makes the problem of establishing (probably depending on the sub-type) what is the mechanism capable of making them shine with peak luminosities far exceeding (10 to 100 times) those of normal supernovae. It has been proposed that some of these SLSNs can be explained by the formation via gravitational collapse of a highly magnetized neutron star, or magnetar, which initially rotates with a period of the order of milliseconds. We have incorporated in our 1D hydrodynamic simulations the effect of the sustained energy injection of a magnetar. The variation of the properties of the ejecta and the magnetar introduces changes in the light curve (rising time, maximum luminosity, width of the light curve). We show the most important features of our work in progress, and that our models can explain some observed light curves.

Tuesday, April 2nd

Excursion to the Astrophysical Station of Bosque Alegre on the Hills of Córdoba.

Since April 2nd is a national holiday, during the day it is planned a journey to the country side of Córdoba for an informal activity visiting the facilities of the astrophysical station: Estación Astrofísica de Bosque Alegre, EABA. The aim of this tour is to share an outstanding part of the Argentinian astronomical history and to encourage interaction among participants in a relaxed atmosphere immerse in the beautiful landscapes of the hills of Córdoba.

We will meet at the headquarter of the Observatorio Astronómico de Córdoba (OAC), the hosted place of the meeting at 10:00am in order to leave towards EABA. We will be arriving there at midday where we will have time for launch with typical Argentinian dishes and spent a few hours to know the place and the surroundings.

We recommend to take water and wear comfortable for a small walk during the journey.

The return to the Córdoba city is estimate between 5:00pm and 6:00pm.

Wednesday, April 3rd

Morning Talks

To be published soon

C. Boehm, School of Physics – University of Sydney, Sydney, Australia **PT**

To be published soon.

Unraveling the role of dust on planetary migration

P. Benítez-Llambay, NBI - University of Copenhagen, Denmark **PT**

Gas and dust are essential components of protoplanetary disks, actively participating in the formation of planetesimals and planetary bodies. The gravity of planetary embryos perturbs the disk which, in turn, reacts producing gravitational feedback onto the nascent planets. This feedback has the potential of changing the planets' orbits, leading to a process known as planetary migration. The characterization of this migration requires detailed calculations of the global disk structure and detailed physical models. For example, the headwind exerted by a sub-keplerian gas flow onto dust particles produces a mutual radial drift which, combined with planet torques, may have a significant effect on the resulting local mass distribution of the disk. This dust torque could – depending on the dust-to-gas mass ratio, the particle-size distribution, and the mass of the embryos – modify the orbit of the nascent planets. In this talk, I will introduce the concept of planetary migration, and I will present recent results related to torques induced by scattered pebble-flows in protoplanetary disks, obtained with the new multifluid version of the publicly available code FARGO3D.

Simulations of Multi-Species Protoplanetary Disks

L. Krapp, NBI – University of Copenhagen, Denmark **CT**

Our understanding of protoplanetary disks is undergoing a revolution driven by high-resolution observations. In order to unravel the processes driving the evolution of these disks, including the formation and evolution of planets, it is critical to accurately model the self-consistent dynamics of gas and dust. I will present a new asymptotically stable numerical scheme to solve the momentum transfer between multiple species that conserves momentum to machine precision. Furthermore, I will discuss its implementation in the publicly available code FARGO3D and show how this implementation correctly describes the self-consistent aerodynamic coupling between gas and multiple dust species. This opens up new opportunities for investigating several fundamental processes involving dust dynamics which have been so far investigated in the realm of a single dust-species approach. The capabilities of the new multi-fluid FARGO3D code are crucial for investigating a wide range of phenomena in dusty protoplanetary disks, including dust growth processes, dust and planetesimals dynamics, and, ultimately how planets form.

Planet formation and stability in polar circumbinary discs

C. Guippone, SECYT-OAC-UNC, Córdoba, Argentina **CT**

Dynamical studies suggest that most of the circumbinary discs (CBDs) should be coplanar, i.e. the rotation vectors of the binary and the disc are aligned. Additionally, some theoretical works show that under certain conditions a CBD can become polar, which means that its rotation vector is orthogonal with respect to the binary orbital plane. Interestingly, very recent observations showed that polar CBDs exist in the nature. We check under which conditions the polar alignment of a CBD is expected around an eccentric binary. This is done by constructing dynamical maps of inclined configurations using several chaos indicators. Then, through Smoothed Particle Hydrodynamics (SPH) simulations, we show how the initial conditions for polar alignment can be reached, and also test the recent theoretical predictions based on linear theory. Finally, by means of long-term N-body integrations, we assess the stability of inclined and polar configurations for massless and massive planets. We establish a robust connection between the binary parameters and the resulting CBD polar alignment. Hence, provided that planets form in these discs, we study their stability and long-term evolution for different orbital configurations. In particular, we thoroughly characterize the orbits of single polar circumbinary P-type planets around eccentric binaries.

Radial Velocities and Wavelengths Shifts - Stellar Spectra and Exoplanet Detection

D. Dravins, Lund Observatory (Sweden) & Visiting scientist, ESO-Chile **CT**

A major challenge lies in finding exoplanets that are "true" Earth-analogs, such with Earth-like mass orbiting solar-like stars in Earth-like orbits. Challenges include measuring stellar radial velocities with exquisite precision. Limitations appear not primarily set by instrumentation but more by the dynamic nature of stellar atmospheres. Spectral lines formed in dynamic stellar atmospheres become asymmetric and their wavelength "flickers" in response to the evolution of inhomogeneities across stellar surfaces. 3-dimensional hydrodynamic models can now be computed for different classes of stellar atmospheres. From such simulations, profiles of spectral lines can be computed, revealing patterns of wavelength displacements and gradual changes of spectral line shapes across stellar disks. Testing such models was previously possible only for the spatially resolved Sun but is now feasible also for other stars, exploiting exoplanet transits. During a transit, successive stellar surface portions become obscured and differential spectroscopy between various transit phases provides spectra of small surface segments temporarily hidden behind the planet. Any planet covers only a tiny fraction of the star, enabling high spatial resolution but demanding very precise observations. Using data from the UVES and HARPS high-resolution spectrometers, adequate S/N can be reached after averaging over numerous similar absorption lines, enabling retrieval of photospheric line profiles at several positions across spatially resolved stellar disks. Additional bright host stars with large transiting planets will likely be discovered by ongoing surveys, then offering new targets that enable tests of hydrodynamic models with calibrations of stellar wavelength flickering.

Novel approach for simulating ultrarelativistic fluid systems

M. Rubio, FAMAF - UNC, Córdoba, Argentina **CT**

Much effort has been devoted in order to develop a theory that describes dissipative fluid dynamics in the context of General Relativity. It is well known that much of the equations that describe those effects are of parabolic type, and thus the information propagates at infinite speed. This fact goes against the causality principles of Einstein's theory, that postulates that nothing can travel faster than speed of light. This problem makes the issue of describing dissipative fluids in the context of General Relativity a highly non-trivial task. In this talk I will present a novel theory for utrarelativistic fluids, that are invariant under conformal transformations of the background metric tensor. We show that such a theory is symmetric-hyperbolic, which implies that it has a well-posed initial value problem, and study causality and stability of equillibrium states. Finally, we comment on a original way for numerically evolve this class of theories, focusing on the difficulties that appear during evolution, and show some simulations at short and long times, within different dissipative regimes. This system can be directly adapted for simulating astrophysical fluid systems around compact objects like rotating black holes.

Corotation instabilities in accretion flows

J. Horak, Astronomical Institute, Academy of Sciences of the Czech Republic **CT**

We discuss different scenarios of transfer of rotational energy from an accretion flow to its global coherent oscillations. The oscillation modes can gain energy either in a linear processes by means of the corotation resonance, or in a nonlinear interaction with other oscillation modes. Both ways will be discussed in thin and thick accretion flow geometries.

Studying the hidden side of the Milky Way's disk using Classical Cepheids

J. Minniti, PUC, Chile - ESO, Chile **CT**

Classical Cepheids are young stars (20-300 Myr) for which we can determine accurate distances by means of their well-defined Period-Luminosity relations. Using data from the VVV survey we are now able to study these young standard candles in highly reddened regions of our Galaxy that were previously hidden to us. We are conducting a time-series analysis of VVV PSF photometry to search for new Classical Cepheids towards the inner 1^o around the plane at $|l| < 5^o$. Our goal is to get a sizable sample of Classical Cepheids to map the 3D distribution and kinematics of the young stellar populations of the disk on the other side of the Milky Way. We have access to VVV proper motions in the surveyed area, where, given the extreme extinction, these objects cannot be detected even by Gaia. Moreover, we have obtained NIR spectroscopy for a sample of 50 Classical Cepheid candidates in the direction of the Galactic bulge and the southern disk. In this talk, I will briefly discuss the challenges in differentiating Classical Cepheids from population II Cepheids using NIR photometry alone. I will show what we have learned about the far side of the Galaxy from the NIR spectroscopic follow-up observation of Classical Cepheids in terms of their 3D distribution, kinematics and metallicities. I will also present preliminary results on our search for new Cepheids towards the inner region of the Galaxy, with which we expect to shed new light on the spiral structure in the far side of the southern disk and behind the bulge.

Afternoon Talks

Planets in Open Clusters

L. Pasquini, ESO, Garching bei Muenchen, Germany **PT**

In spite of more than 4000 exo-planet candidates known, exo-planets around stars in open clusters are very important, because these stars share the same age and metallicity, and the observational biases can be controlled very well. In addition, exo-planets in open clusters tell us about the influence of the environment on planet formation and evolution. I will discuss the present status of exo-planets search in open clusters, with emphasis on the results from radial velocity surveys.

The abundance of voids as a cosmological test

C. Correa, IATE - CONICET, Córdoba, Argentina **CT**

In the same way as the abundance of structures, such as galaxy clusters, encodes cosmological information, the number density of voids as a function of their volume is also sensitive to the values of certain cosmological parameters, such as the matter density and the amplitude of density fluctuations. Besides the intrinsic change in the number density of voids for different cosmological parameters, the distortions introduced by the peculiar velocities (redshift space distortions) and the choice of the fiducial cosmology in order to transform the observed redshift and angular positions into three-dimensional distances (Alcock Paczynski effect) must be taken into account before comparing these measurements with theoretical predictions. Both effects affect the volume element of the survey, leading to a change in the apparent volume of each void, and hence produce an impact on the obtained void catalogue.

Filaments in VIPERS: galaxy quenching in the infalling regions of groups

J. M. Salerno, IATE - CONICET, Córdoba, Argentina **CT**

We study the quenching of galaxies in different environments and its evolution in the redshift range $0.43 \leq z \leq 0.89$. For this purpose, we identify galaxies inhabiting filaments, the isotropic infall region of groups, the field, and groups in the VIMOS Public Extragalactic Redshift Survey (VIPERS). We classify galaxies as quenched (passive), through their NUV - r versus r - K colours. We study the fraction of quenched galaxies (Fr) as a function of stellar mass and environment at two redshift intervals. Our results confirm that stellar mass is the dominant factor determining galaxy quenching over the full redshift range explored. We find compelling evidence of evolution in the quenching of intermediate mass galaxies ($9.3 \leq \log(M^*/M_\odot) \leq 10.5$) for all environments. For this mass range, Fr is largest for galaxies in groups and smallest for galaxies in the field, while galaxies in filaments and in the isotropic infall regions appear to have intermediate values with the exception of the high redshift bin, where the latter show similar fraction of quenched galaxies as in the field. Galaxies in filaments are systematically more quenched than their counterparts infalling from other directions, in agreement to similar results found at low redshift. The least massive galaxies in our samples do not show evidence of internal or environmental quenching.

Dynamical analysis of simulated clusters

T. Tagliaferro, IATE - CONICET, Córdoba, Argentina **CT**

We use several sets of cosmological numerical simulations to investigate the mass and velocity anisotropy profiles of cluster-size halos extracted from these simulations. We analyze 100 clusters from simulated catalogs based on the DLB07 model, within cubic boxes of 25*Rvir side, and the same 100 clusters based on the GAEA model. within cubic boxes of 5*Rvir side. For each cluster we compare the mass profile M(r) obtained via application of the Jeans equation to the intrinsic mass profile, to check on the validity of application of this equation. Moreover, we determine the velocity anisotropy profiles of different populations of simulated galaxies, distinguished by color, star formation rate, type and stellar mass, as well as in clusters of different masses. Finally, using the DLB07 clusters, we consider only the limited information available to observers to evaluate the capability of recovering the mass and anisotropy profiles from projected phase-space information, via the MAMPOSSt and Jeans-inversion methods.

Effects of chaoticity on the detectability of stellar streams

M. Mestre, IALP-UNLP, La Plata, Argentina **CT**

Stellar streams with a dwarf galaxy progenitor happen frequently in the Universe according to observations and in agreement with the current cosmological paradigm that predicts a hierarchical growth of structures in the Universe. Another theoretical prediction is that dark matter halos have triaxial density distributions. Triaxial potentials have the phase–space divided in regular and chaotic orbits and it could happen that the formation and evolution of a stellar stream be related to the level of chaoticity of the orbit of its progenitor. We perform N-body numerical simulations in order to measure the effect of chaos on the detectability of stellar streams, applying a simple criterium on the velocity distribution of the stellar stream particles. We find a correlation between chaos and the length of a temporal window of detectability, as long as the error of the velocity distribution of the background stellar halo is not greater than one percent.

Revisiting the colour-magnitude diagram of elliptical galaxies in cosmological context

L. Zenocratti, FCAGLP - UNLP, La Plata, Argentina **CT**

We analyze the colour-magnitude diagram (CMD) of elliptical galaxies in cosmological context, exploring secondary dependences of the color-magnitude relation (CMR) on different galaxy properties such as stellar masses, ages, chemical abundances and metallicities. The location of observed early-type galaxies in this diagram is compared with that of z=0 simulated elliptical galaxies. A detailed comparison between simulated and observed trends of the diagram as function of different galaxy properties is carried out. Our results indicate that stellar and halo masses are key parameters for determining the CMR, while stellar age constitutes an important source of scatter around the CMR. We discuss about how to use the observed CMD to obtain information about the evolutionary history of galaxies by means of cosmological simulations.

The VISTA Variables in the Vía Láctea Survey and the Large-Scale Structure of the Universe

F.P. Milla Castro, Universidad de La Serena, La Serena, Chile **CT**

We present some results about the search for extragalactic sources located behind the Milky Way, based on near-IR data provided by VISTA Variables in the Vía Láctea Survey. We applied an algorithm that combines morphological and photometric parameters for the detection of extended sources of extragalactic nature in four regions at lower galactic extinction. We have detected hundreds of galaxies never seen before, clusters of galaxies and the trace of a major structure in the direction of Norma Cluster. The good results so far obtained, will allow us to extend our search for extragalactic objects to the VVV survey, and its extension, VVVx.

Evolution of the BCG-Cluster Alignment in Cosmological Hydro-Simulations

C. Ragone-Figueroa, IATE - CONICET, Córdoba, Argentina **CT**

It is now well established that in the local Universe the brightest cluster galaxies (BCGs) are often elongated in the same direction as their host clusters. Nevertheless, little is known at higher redshifts where the determination of the position angles of galaxies and clusters presents more inconveniences. We examine clusters in cosmological hydro-simulations in order to provide a glimpse into how the BCG-Cluster alignment has evolved over time. The cluster position angles were measured using both dark matter and galaxies finding in both cases strong indications of an alignment between the cluster and the BCG up to redshift 1, results that are in line with recent observational claims.

Thursday, April 4th

Morning Talks

Structure and dynamics of clusters of galaxies

A. Biviano, INAF - Osservatorio Astronomico di Trieste, Trieste, Italy **PT**

I will report recent results on the internal structure and dynamics of clusters of galaxies in the redshift range $z \sim 0 - 1$, (mostly) based on the spectroscopic surveys OmegaWINGS, CLASH-VLT, GCLASS, and SPT-SZ follow-up. These results have been obtained from the analysis of the distribution of cluster galaxies in projected phase-space, and from the internal dynamics of brightest cluster galaxies. I will discuss the possible implication of these results for the dynamical history of clusters, the evolutionary history of galaxies therein, the nature of dark matter, and the use of clusters as cosmological probes, also in view of the forthcoming Euclid survey.

Reverse Engineering the local Universe

E. Carlessi, Leibniz Institute for Astrophysics Potsdam, Potsdam, Germany **PT**

Constrained simulations (CS) provide a powerful alternative approach to the random-phase Initial Conditions (ICs) cosmological simulations. In this method, galaxy peculiar velocity measurements are used to reconstruct the matter density field and generate a set of ICs whose final outcome closely matches the observed Universe. Hence, while the results obtained with the standard techniques can be compared to the data in a statistical sense only, in a CS we can exploit the constraining potential of the high-precision near-field observations by means of a direct comparison. After introducing the main ideas and algorithms behind the CS technique, its applications on both large and small scales will be discussed. I will describe the results of a recent Nature Astronomy publication where these simulations have been used to reconstruct the quasi-linear matter distribution and determine for the first time the non-linear bias factor on scales below 20 Mpc. I will then show how these results can be used to link the anisotropies of the Ultra High Energy Cosmic Rays (UHECR) spectrum (measured by the Pierre Auger Collaboration) to the large scale structure. The last part of this seminar will show some of the small-scale applications of the method introducing the Local Group Factory, a numerical pipeline designed to study Local Group (LG) lookalikes within a realistic environment, akin to the observed one. I will show how this can be used to shed light on poorly-constrained LG properties such as its mass and the tangential velocity of M31 as well as constrain alternative cosmological models. I will conclude introducing future applications of the pipeline such as the HESTIA project, a suite of hydrodynamical zoom simulations of the Local Group run with the AREPO code.

Strong Lensing Constraints on Cosmology, Dark Matter and Modified Gravity

M. Makler, Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil **PT**

The strong gravitational lensing (SL) effect produces highly distorted, magnified and/or multiple images of distant sources, whose light bundles are affected by the gravitational field of a foreground galaxy or galaxy cluster acting as a lens. This effect can be used to constrain the mass distribution of the lens, which in turn may set constraints on Dark Matter models. If combined with complementary data, such as from x-rays and/or velocity dispersion, SL can yield limits on Modified Gravity models. If the SL system has many sources at different redshifts, it can be used to set limits on the large-scale geometry of the Universe and therefore on cosmological parameters. We briefly review the state-of-the-art of these applications and present our recent results on constraints on a wCDM model using the strong lensing cluster Abell S1063. In this study we more than double the families of multiple images as compared to previous results in the litterature, setting the strongest constraints on cosmology from a single SL system. We compare the results to those from more standard cosmological observables, such as type Ia supernovae, baryon acoustic oscillations and the cosmic microwave background and find a striking agreement between all of them. We also investigate the use of photometric redshifts of the sources when spectroscopy is not available. We discuss future prospects of the field in light of current and upcoming data.

Weak-lensing analysis of galaxy pairs using CS82 data

E. González, IATE - CONICET, Córdoba, Argentina **CT**

Here we analyze a sample of close galaxy pairs (relative projected separation <25 h -1 kpc and relative radial velocities $<$ 350 km s-1) using a weak-lensing analysis based on the Canada-France-Hawaii Telescope Stripe 82 Survey (CS82). We determine halo masses for the total sample of pairs as well as for interacting, red, and higher-luminosity pair subsamples with $\sim 3\sigma$ confidence. The derived lensing signal for the total sample can be fitted either by a Singular Isothermal Sphere (SIS) with σ $V = 223 \pm 24$ km s-1 or a Navarro–Frenk–White (NFW) profile with R $200 = 0.30 \pm 0.03$ h -1 Mpc. The pair total masses and total r band luminosities imply an average mass-to-light ratio of $\sim$200 h M /L . On the other hand, red pairs which include a larger fraction of elliptical galaxies, show a larger mass-to-light ratio of $\sim$345 h M /L . Derived lensing masses were compared to a proxy of the dynamical mass, obtaining a good correlation.

Desperately Seeking Gargantua

O. López-Cruz, Instituto Nacional de Astrofísica, Óptica y Electrónica, Puebla, México **PT**

We have embarked on the search for ultramassive black holes (UMBH), those whose mass is close to a hundred billion solar masses. I discuss the reliability of different BH mass indicators, followed by discussion of Holm 15A and IC 1101 a plausible candidates to hosting UMBH, I will spice the talk with my own take on the recent controversies that have arisen regarding the core size of those galaxies. I, then discuss the feasibility of IFU observations, which can help us to uncover dynamical constraints on the fusion of supermassive black hole binaries (SBHB) as a stage of UMBH formation.

Afternoon Talks

Latest results from LIGO/Virgo, and prospects for observations in the near future

G. González, Louisiana State University and the LSC collaboration, USA **PT**

I will present some details of the latest results obtained from data taken with Advanced LIGO and Virgo in their recent Observing runs (O1, O2), and describe the prospects for observations with ground-based detectors in the next few years, including improvements in sensitivity of LIGO and Virgo detectors, and progress in other detectors in the international network.

Astrophysical implications of the one year multi-messenger observations of GW170817

M. Branchesi, Grand Sasso Science Institute and the VIRGO collaboration, Italy **PT**

The talk will give an overview of the gravitational-wave and broadband electromagnetic follow-up of GW170817, the first gravitational-wave observation of the coalescence of a binary system of neutron stars. This groundbreaking discovery has impacted different astrophysical fields, from relativistic astrophysics, to nucleosynthesis, nuclear physics and cosmology. I will focus on the astrophysical implications of the observations and the prospects for the next years.

The TOROS project: Status report

L. Macri, Texas A&M and the TOROS collaboration, USA **PT**

I will present an update on activities related to the Transient Optical Robotic Observatory of the South (TOROS) collaboration, including recent publications and progress on construction at the Macón site. I will discuss our survey strategy and expected capabilities, informed by the knowledge gained with the GW170817 event.

Multimessenger astronomy and cosmic nucleosynthesis

D. Siegel, Columbia University, New York, USA **PT**

The recent detection of the binary neutron star merger GW170817 by advanced LIGO and Virgo and its fireworks of electromagnetic counterparts across the entire electromagnetic spectrum marked the beginning of multi-messenger astronomy and astrophysics with gravitational waves. In this talk, I will discuss what the electromagnetic counterparts of compact object mergers (kilonovae in particular) reveal about the merger process and what to expect for future mergers. Combining multimessenger observations of compact object mergers with observations of other prime targets of transient astronomy such as GRB supernovae I will show how this allows us to address and solve long-standing questions about the origin of the heavy elements in the Universe.

Possible channels for EM counterparts in binary mergers

L. Lehner, Perimeter Institute, Canada **PT**

This talk will discuss some ways through which binary mergers could induce EM counterparts to gravitational waves together with (some of their) implications to understand both astrophysical and fundamental questions.

Oscillations of (hyper-massive) neutron stars

C. Chirenti, Universidade Federal do ABC, Santo André, Brasil **PT**

Neutron star asteroseismology has the promise to help us solve the inverse problem and find out the masses and radii of these stars, consequently bringing information on their equation of state. Although stellar oscillations have been detected and studied in the sun for decades, they are much more difficult to observe in distant neutron stars. So far, r-modes may have been detected in some low mass X-ray binaries, and quasiperiodic oscillations observed in the tail of the rare giant flares of soft gamma-ray repeaters could be connected to crustal oscillations. Looking towards the future, hyper-massive neutron stars that could be briefly formed after a binary neutron star merger are likely to be highly deformed and strongly oscillating, and the early blue-bump of the kilonova spectrum observed in GW170817 seems to support this phase. Numerical relativity simulations indicate a relevant emission of gravitational waves in this stage that, although in ∼kHz frequencies too high for current gravitational wave detectors, could be seen as modulation of the associated short gamma-ray burst. I will discuss the modelling of these neutron star oscillations, prospects for their detection and the important physical information that can be gained by their observation.

EOS of Magnetized Quark Matter and the Mass-Radio Relationship for Strange Stars

E. Ferrer, College of Staten Island, City University of New York, USA PT

Compact stars with significant high densities in their interiors can give rise to quark deconfined phases that can open a window for the study of strongly interacting dense nuclear matter. Recent observations on the mass of two pulsars, PSR J1614-2230 and PSR J0348+0432, have posed a great restriction on their composition, since their equations of state must be hard enough to support masses of about at least two solar masses. The onset of quarks tends to soften the equation of state, but due to their strong interactions, different phases can be realized with new parameters that affect the corresponding equations of state and ultimately the mass-radius relationships. In this talk I will review how the equation of state of dense quark matter is affected by the physical characteristics of the phases that can take place at different baryonic densities, as color superconducting BCS and BEC phases, as well as in the presence of strong magnetic fields.

Friday, April 5th

Morning Talks

Origin of passive satellites: environmental and/or mass quenching?

S. Cora, Instituto de Astrofísica de La Plata, La Plata, Argentina **PT**

A great deal of work has been devoted in the last years to determine the role of mass and environmental quenching on the properties of central and satellite galaxies, and on the corresponding dependence of the fraction of passive galaxies on stellar mass, halo mass and halo-centric distance. We use the semi-analytic model of galaxy formation SAG to study these aspects, focusing on satellite galaxies. We find that environmental processes dominate the star formation (SF) quenching of low-mass satellites, whereas high-mass galaxies typically quench as centrals. High-mass galaxies that remain actively forming stars while being accreted are found to be mainly affected by mass quenching after their first infall. Our model supports a two-stage scenario to explain the SF quenching. Initially, the SF of satellites resembles that of centrals until the gas cooling rate is reduced to approximately half its value at infall. Then, the SF fades through secular processes that exhaust the cold gas reservoir. This reservoir is not replenished efficiently due to the action of either ram-pressure stripping (RPS) of the hot gas in low-mass satellites, or feedback from the active galactic nucleus (AGN) in high-mass satellites. The delay times for the onset of SF quenching are found to range from 3 Gyr to 1 Gyr for low-mass and high-mass satellites, respectively. SF fades in 1 Gyr, largely independent of stellar mass. We find that the SF quenching of low-mass satellites supports the so-called delay-then-rapid quenching scenario. However, the SF history of z=0 passive satellites of any stellar mass is better described by a delay-then-fade quenching scenario.

Diffuse stellar halos as cosmological time machines

L. Sales, University of California, Riverside, USA **PT**

Stellar halos provide useful insights on the past formation history of galaxies. They are also a natural prediction of the LCDM model. Observationally, stellar halos are found to be ubiquitous and to show a large diversity on the shapes and fraction of light that is distributed in this extended and diffuse stellar component. In this talk I will describe our efforts using large cosmological boxes to better understand the formation of stellar halos and their correlation with accretion history, morphology and dark matter halo mass of their host galaxies. In the second part of this talk I will present some of the upcoming major improvements that can be expected for the next generation of galaxy formation simulations and I will discuss how this can impact our ability to make theoretical predictions on the structure and evolution of galaxies and dwarf galaxies.

Starless low-mass dark matter halos: an unprecedented probe to LCDM

A. Benítez-Llambay, ICC - Durham University, Durham, United Kingdom **PT**

A fundamental prediction of the Lambda Cold Dark Matter (ΛCDM) model is the existence of numerous low-mass dark matter systems that are too small to host a luminous galaxy. The detection of these "dark" structures would offer an unprecedented probe to the current cosmological paradigm on scales that have not yet been explored. Some of these objects might hold sufficient gas left from the epoch of reionization and could be detectable through emission in HI, or through fluorescence in $H\alpha$. The gas content of all low-mass systems is affected by the early Cosmic Reionisation (CR) of hydrogen, which heats the entire gas of the Universe to a temperature of a few 10^4 K and drives 90%-100% of the available baryons out from haloes less massive than $\sim\ 10^9 M_\odot - 10^8 M_\odot$. The remaining $\sim 10\%$ of the gas stays in thermal equilibrium with the UV background radiation field sourced by external sources, and reach hydrostatic equilibrium with the dark matter potential well, becoming dense enough to recombine and emit in 21cm, but without becoming self-shielding and forming stars. These objects are called "REionisation-LImited HI Clouds" (RELHICs). RELHICs are not, however, in isolation, but can be overtaken by the cosmic web, which may reduce their baryonic content further through ram pressure. The systems that undergo this interaction are called "COSmic WEB Stripped haloes" (COSWEBs). This dichotomy between RELHICs and COSWEBs makes it hard to predict the clustering of RELHICs from analytical considerations alone. Because of this and given their low baryonic content, we must rely on high-resolution cosmological hydrodynamical simulations to tackle this problem. In this talk, I will analyse the origin and the properties of both RELHICs and COSWEBs and discuss the prospects for their detection.

Chemical abundance patterns of interacting galaxies

E. Sillero, IATE - CONICET, Córdoba, Argentina **CT**

The chemical abundances in galaxies are key properties for the understanding of their formation and evolution. The metallicity of the interstellar medium in galaxies is regulated by different processes during their assembly history. Heavy elements are synthesized in the stellar interior and ejected into the ISM by stellar winds and Supernova explosions. A fraction of them will be locked up into stars by ongoing star formation while other part might be expelled from the galaxies into the circumgalactic and intergalactic medium. The chemical properties of the ISM can be also affected by gas inflows and mergers/interactions with other galaxies. The evolution of the metallicity gradients in disc galaxies and the possible correlations with the galaxy properties store information on the processes that act along their evolutionary histories. I will talk about results on the gas-phase metallicity and stellar gradients of disc galaxies simulated during mergers. The predicted evolution of the metallicity gradients will be discussed.

QUBIC: the Q&U bolometric interferometer for Cosmology

C. Scoccola, Universidad Nacional de La Plata, La Plata, Argentina **PT**

Remnant radiation from the early universe, known as the Cosmic Microwave Background (CMB), has been redshifted and cooled, and today has a blackbody spectrum peaking in the THz region. One of the major challenges of modern cosmology is the detection of B-mode polarization anisotropies in the CMB. These originates from tensor fluctuations of the metric produced during the inflationary phase. The expected level of these anisotropies is however so small that it requires a new generation of instruments with high sensitivity and extremely good control of systematic effects. The QUBIC (Q&U Bolometric Interferometer for Cosmology) instrument is designed to map the very faint polarization structure in the CMB. QUBIC is based on the novel concept of bolometric interferometry in conjunction with synthetic imaging. It will have a large array of input feedhorns, which creates a large number of interferometric baselines. The later enable a precise control of the systematics of the instrument. The bolometers are TES (Transition Edge Sensors) sensors, which are a type of cryogenic energy sensor that exploits the strongly temperature-dependent resistance of a superconducting phase transition. They reach an excellent level of sensitivity. All these characteristics make QUBIC a promising instrument to put strong constraints on the primordial B modes. Moreover, the synthesized beam has a non trivial structure, with a primary peak and secondary peaks. The separation between peaks has a frequency dependence, which complicates the map-making process, but at the same time, it allows for doing spectro-imaging with the QUBIC maps, obtaining maps at different frequencies. In this way, the separation of foregrounds can be done with better accuracy. In this talk I review the concept of the QUBIC instrument, and I focus on the component separation of the maps using the spectro-imaging characteristics of the instrument. Using simulations, and different dust models, I show how the use of spectro-imaging help to separate the signal into different maps, and study how well we can reconstruct the CMB polarization signal, in particular, the B modes polarization.

Afternoon Talks

Constraining the growth rate of structure using cosmic voids

A. Hawken, INAF – Osservatorio Astronomico di Brera, Merate, Italy **PT**

Cosmic voids are a key component of the cosmic web and constitute most of the volume in the Universe. In this talk I will present a summary of some of the ways in which cosmic voids can be used to constrain cosmology. In particular I will focus on tests of gravity. The cross correlation between voids and galaxies exhibits an anisotropy indicative of redshift space distortions (RSD) caused by galaxies falling away from the centres of voids onto the surrounding mass. By modelling this phenomenon and comparing our models with observations we can place constraints on the growth rate of structure and thus test general relativity.

Enter the Void: Statistical models of small scale clustering

F. Davila Kurbán, IATE - CONICET, Córdoba, Argentina **CT**

In the ongoing endeavour of characterizing the LSS of the universe, it is important to address the effect of the largest structures on the formation of structures on smaller scales. The VPF is a popular tool for indirectly studying the clustering of matter by describing the clustering of voids. Theoretically, the VPF connects the distribution of voids to the moments of galaxy clustering of all orders, and can be used to discriminate clustering models in the weakly non-linear regime. We set out to calculate the VPF inside and outside voids and analyze whether or not they correspond to the same statistical clustering model. We find that the reduced VPF identified in the Illustris simulation closely follows a negative binomial distribution inside voids, but shows deviations outside voids. We discuss this result in light of previous results that show a negative binomial behaviour for the reduced VPF in observational catalogues.

Raiders of the Lost Algorithm: an optimal Compact Group finder

A. Taverna, IATE - CONICET, OAC - UNC, Córdoba, Argentina **CT**

In general, Compact Groups of galaxies (CGs) are supposed to be systems of a few bright galaxies in close proximity that are relatively isolated in space, and that constitute the ideal laboratories to study galaxy-galaxy interactions. Given that the classic criteria for identifying CGs depend strongly on the observational properties, and produce samples of CGs highly contaminated by chance alignments, the aim of this work is to develop an independent algorithm able to identify physically dense and isolated CGs, free from observational biases. In this work, we defined a set of criteria to find CGs in 3D, and analysed the 3D physical nature of CGs using numerical simulations run with different cosmological parameters combined with different semi-analytical models of galaxy formation. In this talk, we show the preliminary results.

Dust evolution in galaxy cluster simulations

G.L. Granato, INAF - OATS, Italy **CT**

We implement a state-of-the-art treatment of the processes affecting the production and Inter stellar Medium (ISM) evolution of carbonaceous and silicate dust grains within SPH simulations. We trace at a minimal level the dust grain size distribution. We test our method on zoom-in simulations of four massive (M 200 $\geq$ 3 x 10 14 M) galaxy clusters. We predict that during the early stages of assembly of the cluster at $z \sim 3$, where the star formation activity is at its maximum in our simulations, the proto-cluster regions are rich in dusty gas. However, the dust properties in this stage turn out to be significantly different from those observationally derived for the average Milky Way dust, and commonly adopted in calculations of dust reprocessing. We show that these differences may have a strong impact on the predicted spectral energy distributions. At low redshift in star-forming regions our model reproduces reasonably well the trend of dust abundances over metallicity as observed in local galaxies. However we underproduce by a factor of 2-3 the total dust content of clusters estimated observationally at low redshift, using IRAS, Planck, and Herschel satellites data. This discrepancy does not subsist by assuming a lower sputtering efficiency, which erodes dust grains in the hot intracluster medium.

The impact of baryon physics on future cosmological probes

M. Schaller, Institute for Computational Cosmology, Department of Physics, Durham University, United Kingdom **CT**

In recent years cosmological hydro-dynamical simulations of representative volumes have reached a level of maturity where they can be compared effectively against observational data. They can also be used to shed some lights onto galaxy formation processes and how they affect the distribution of baryonic and dark matter. Understanding these effects are a key element required to fully unlock the science of the next generation cosmological probes such as the Euclid mission. In this talk, I will review some results from the EAGLE set of cosmological simulations focusing on the aspects highlighted above, focusing in particular on the dark matter distribution in clusters and consequences on the nature of dark matter. If time permit, I will then discuss the challenges that lay ahead in terms of simulation complexity and how we are tackling some of them using our new modern and open-source simulation code SWIFT.

The Euclid Flagship galaxy mock

I. Ferrero, IEEC, CSIC, Barcelona, Spain **CT**

I will present the official galaxy mock of the Euclid mission. I will give a summary of the current status and future improvements that are being made within the Cosmological Simulations Science Working Group of the Collaboration.

The Euclid Flagship galaxy mock

V. Santucho, IATE - CONICET, Córdoba, Argentina **CT**

The cosmological evolution of the large-scale structure (LSS) has implications in the spatial distribution, frequency and properties of superstructures and the galaxies they contain. LSS structure is usually described by correlation statistics of halos and galaxies in both simulations and the observations. In this context, the 2-point correlation function is an essential and widely known tool to link spatial distribution of galaxies with cosmological parameters. However, this useful formalism is constrained to the assumption that the objects used to build it can be treated as punctual or symmetrical entities, such as voids. When the size of the involved systems are comparable to their mean separation, we can not directly calculate the 2–point correlation function. In this framework, we propose an alternative method, based on the formalism of the 2–point correlation function, that can be applied to measure clustering in extended and non–symmetrical systems. In particular, we examine Future Virialized Structures (FVS) in the MultiDark simulation and compare usual measures of LSS with this new measure of FVS spatial correlations.

List of Abstract - Posters

Weekly Session

Supernova Remnants in Bistable Turbulent Mediums

M.A. Villagran Azuara

The evolution of a supernova remnant (SNR) is highly dependent on the conditions of its surroundings. The interstellar medium (ISM) where the supernova explosions occur is not uniform and hence the evolution of the corresponding SNRs is not perfectly symmetrical, in fact, the opposite is observed most of the time. In the present work we use simulations of magnetized, turbulent and thermally bistable ISM as backgrounds to test the effects of SNRs evolving in a medium generated via several physical ingredients, testing the effects of the geometry, the energy, and the size of the object through time, as well as the changes suffered by both the SNR and the ISM.

Optical and Infrared colors of massive evolved stars

M. Ljungberg

Using available data archives (such as 2MASS, WISE) as well as published catalogs, we investigate the location of different types of evolved massive stars (Wolf Rayet, blue luminous variables, long period variables, etc.) on optical and infrared color-color diagrams (such as B-V vs U-B, J-K vs V-J, W2-W3 vs W1-W2). For each type of evolved stars we find and defined characteristic regions or locus where these objects are more frequently found. In some cases regions occupied by more than one type of objects are also found. We conclude that, in general, optical and infrared color-color diagrams allow an initial and fast classification of new candidate objects selected from large-area surveys. Follow-ups (usually spectroscopic observations) are required to finally confirm their preliminary classifications and/or disentangle two or more type of objects having similar colors.

Exoplanets in binary stars: Observational properties distributions

M.Cerioni

During the last decade, the number of discovered planets in binary stars has increased significantly, raising a number of issues related to their dynamical stability, origin and final fate. Our aim is to derive observational constraints to help address some of the questions concerning planets in binaries stars. In this contribution we use data from public archives and from the literature to construct a database collecting dynamical as well as physical properties of planets and host stars. We analyze the distribution of these properties, searching for correlations and confronting our findings with the corresponding properties or correlations for single-star planets. As it would have been expected, circumstellar (or p-type) planets distributions resemble properties of single-star planets. On the contrary, in circumbinary (or s-type) planets, the binary nature of the host stars account for their peculiarities. In all the analyzed situations, likely observational bias due to the detection techniques (radial velocities, transits and/or direct images) are taken into account to validate our findings and/or to caution against possible misleading correlations.

Weak lensing in a plasma medium using the Gauss-Bonnet theorem

G. Crisnejo

We apply the Gauss-Bonnet theorem to the study of light rays in a plasma medium in a static and spherically symmetric gravitational field. The possibility of using the theorem follows from a correspondence between timelike curves followed by light rays in a plasma medium and spatial geodesics in an associated Riemannian optical metric.

Galaxy cluster beyond the Milky Way

L. Baravalle

We present the results of the systematic search for galaxies cluster using photometric data provided by Vista Variables in the Vía Láctea survey. We use a combination of different techniques for the detection: the observe cluster Red Sequence in the (J - Ks) Color - Ks Magnitude Diagram, the independent and automatic clustering analysis and the visual inspection. Finally, for each detected galaxy cluster, we estimated the photometric redshift of the brightest galaxy using the spectral energy distribution.

The impact of nuclear reaction rates on the age and RGB bump of globular clusters

F. Moyano

Among the various methods to date stellar clusters, one of the most widely adopted is that based on the measurement of the luminosity of the turn-off point, (i.e. the bluest point on the main sequence) , while the location of the red giant branch bump predicted by the models compared with the observed one in globular clusters with different metallicity is a suitable way to evaluate the accuracy of the models. In this work, we analyze the impact of the revised nuclear reaction rates of the hydrogen burning reactions, such as the 14N(p,g)15O, on the estimate of the Globular Cluster ages, as derived from the turnoff luminosity, and their effects upon the red giant branch bump luminosity. In order to do this, we computed a set of evolutionary tracks, ranging from 0.7 Mo to 5Mo for low and high metallicities, adopting a solar-scaled heavy element distribution. For our simulations, we used our stellar evolution code (Panei et al, 2005), we updated the reaction rates concerning the hydrogen burning in our code and computed a set of isochrones , following the method of Pietrinferni et al(2004), and we compare our results with those obtained by using the rates of Angulo et al(1999) and Caughlan & Fowler(1988).

LOCAL HIGHz GALAXIES ANALOGS

S. Motino Flores

Understanding the physical processes driving galaxy formation and evolution is one of the most important goals of observational cosmology. It is also one of the most difficult problems to address due to the large distances involved. We have therefore selected a sample of nearby star-forming galaxies from the Brown et al 2014 (UV to MIR spectroscopic sample) that successfully fit broadband photometric data of high redshift galaxies ($z > 4$) and, hence, are potential local analogs of high redshift galaxies. These galaxies are young, star-forming and are likely to have star formation histories similar to high redshift ($z > 4$) galaxies. We are using SOFIA HAWC+ (53, 89, 154 and 214 μm) to obtain photometry of the local analogs and Herschel photometric FIR data (70, 100, 160, 250, 350 and 500 μm) of a sample of high redshift galaxies. Combined with optical/NIR data we can derive the Spectral Energy Distribution (SED) from UV to FIR wavelengths for both the local analogs and the high redshift galaxies. We also use SOFIA FIFI-LS to observe the [CII] 158 μm and [OIII] 88 μm fine structure lines in our sample of local analogs. These lines are accessible with ALMA for high redshift objects and can be used to characterize the ISM. Our overall aim is to characterize the properties of the local galaxies and determine their star formation history (SFH). These will be compared with photometric and spectroscopic results for $z > 4$ galaxies obtained using Herschel and ALMA. We are exploring ways of deriving Herschel FIR photometry for blended sources using ALMA submm data as priors, either as detections or upper limits.

Estabilización de órbitas periódicas en Hamiltonianos T-periódicos - Stabilization of periodic orbits in T-periodic Hamiltonians

R.E. Floreani

En este trabajo se pretende generalizar el método de control desarrollado por Leiva y Briozzo (2008) a fin de hacerlo aplicable a la estabilización de órbitas periódicas inestables en Hamiltonianos periódicos en el tiempo, para el caso tridimensional general. Se presenta un formalismo teórico para controlar órbitas en la variedad central. El método a desarrollar será luego puesto a prueba aplicándolo a una selección de ejemplos provenientes de la Astronomía Dinámica. In this work we intend to generalize the control method developed by Leiva and Briozzo (2008) in order to make it applicable to the stabilization of unstable periodic orbits in periodic Hamiltonians in time, for the general three-dimensional case. A theoretical formalism is presented to control the orbits in the center manifold. The method to be developed will then be put to the test by applying it to a selection of examples from Dynamic Astronomy.

Dynamical study of transneptunian objects

M. Colazo

One of the open problems of the trans-neptunian region is to find an explanation for the wide variety of orbits that the discovered transneptunian objects (TNOs) exhibit. Some of the members exhibit extreme values of eccentricity and inclination and can serve as particularly laboratories for theories of our solar system's formation and evolution. In particular, TNOs with very large semi-major axes probe the most distant observable regions of the solar system, helping to reveal the migration histories of the giant planets. Very high inclination TNOs and centaurs mostly remain puzzling and is thought that both classes of objects may also be dynamically influenced by distant, yet-unseen perturbers. As of February 2019, the catalog of minor planets contains 528 numbered TNOs. In addition, there are more than 2,000 unnumbered TNOs, first observed between 1993 and 2018. The unnumbered TNOs have more errors in the orbit determination. Is our intention to classificate this database according to their orbits and also make a dynamical study integrating many of them. Then we will be able to predict new orbital behaviors of the unnumbered TNOS and relate these results with some theories about the origin of the solar system.

Molecular characterization of S 169: an IR dust bubble with massive star formation

C. Cappa

Massive stars strongly modify their molecular environment through their stellar winds and UV photons, creating interstellar bubbles, HII regions and even triggering the formation of new generations of stars.

We investigate the molecular environs of the IR dust bubble S 169. The nebula is associated with photodissociation regions and is one of the best examples of triggered massive star formation at the edge of a giant molecular cloud, where IRAS 12326-6245 is located, as revealed by the presence of a methanol maser, CS(2-1) emission, and 1.2mm continuum emission.

We map the southern infrared dust bubble and its environs in the CO(2-1), ^{13}CO(2-1), C^{18}O(2-1), HCN(3-2), and HCO+(3-2) lines using APEX with the aim of analyzing the gas distribution, measure the mass, temperatures and column densities of the molecular material, search for the kinematic signatures of expansion, and finally, test different scenarios of triggered star formation.

Ringed Galaxies: catalog and analysis of the properties

S. Alonso

With the aim of assessing the effects of galactic rings on galaxy properties, we perform an analysis of the characteristics of ringed galaxies. We built a catalog of face-on galaxies, visually classificated in details in the redshift range 0.01 <z <0.1 with an apparent magnitud limit of g <16 mag. We found $\approx$ 3000 ringed galaxies in the Sloan Digital Sky Survey (SDSS) Data Release 14 (DR14). Our sample includes mainly nuclear, inner and outer disc ring galaxies. In this poster we present the details of the classification methodology used and analyzed the statistical characteristics of the sample, taken into account colors, stellar populations (as derived from the $D_n(4000)$ spectral index) and star formation activity. The results suggest that galactic rings produce an important effect on galaxy properties.

Emerging trends in properties of stars with debris disks

C. Chavero

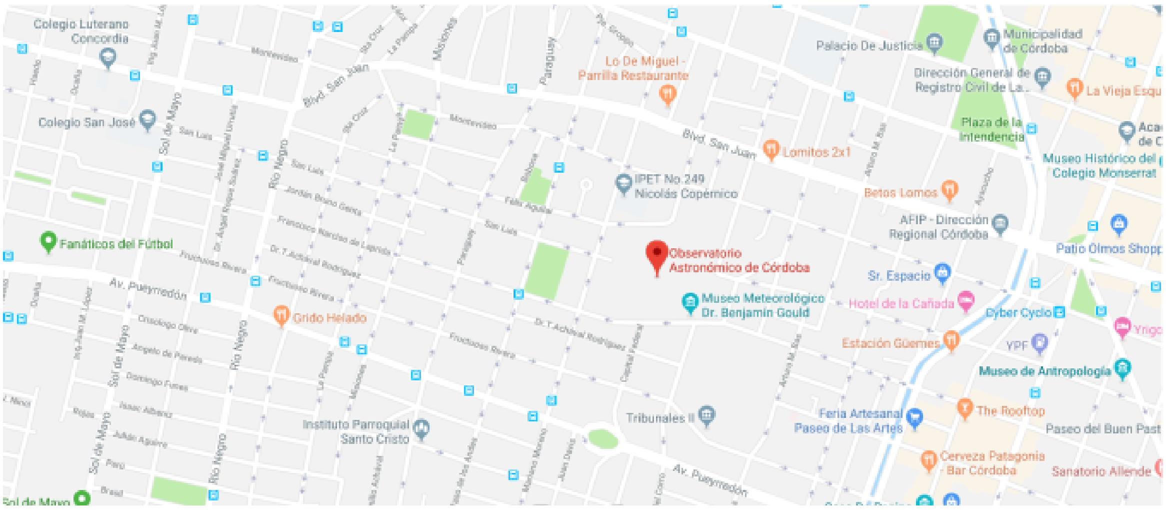
Dwarf stars with debris discs and planets appear to be excellent laboratories to study the core accretion theory of planets formation. In this poster we present the main metallicity and lithium abundance properties of these stars together with stars with only debris discs and stars with only planets. Stars without detected planets nor discs are also considered. Apart from the basic stellar parameters, we include the use of dusty discs masses. The main results show for the first time that the dust mass of debris disc stars with planets correlate with metallicity. We confirm that these disc dust masses are related to their central stellar masses. We conclude that two conditions are necessary to form giant planets: to have a sufficient metallicity and also a sufficient protoplanetary mass of gas and dust. Concerning lithium, we found a agreement with the model predictions, observations indicate that the main lithium depletion occurs during this initial protoplanetary evolution stage. We show that the ultimately lithium depletion is independent of the presence or absence of planets and appears to be only age dependent.

Useful Information

Venue

Observatorio Astronómico de Córdoba (OAC)

Laprida N° 854 Barrio Observatorio, Córdoba City, Córdoba Province, Argentina. (See map here)



Wifi access point

The Auditorium 'Mirtha Mosconi', where dissertations will take place during the meeting will provide the following wifi access point:

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