LXV Congresso nazionale della Società Astronomica Italiana

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INAF - Osservatorio Astronomico di Capodimonte

Book of Abstracts

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Expected breakthroughs in the field of the "Relativistic Astrophysics and Particles" at INAF

Corresponding Author: melania.delsanto@inaf.it

INAF researchers in the field of the Relativistic Astrophysics and Particles are members of the scientific national group 4 (Raggruppamento Scientifico Nazionale 4, RSN4).
The research activities of RNS4 fall in the observational, theoretical and experimental areas.
Observations are performed both with ground-based and space-based telescopes, maily in the high energy domain.
However, in the last years multi-wavelength data, from radio up to very high energy, have been used in close synergy with multi-messenger data in order to reach a complete understanding of the violent phenomena in the Universe.
Models and theory are reaching increasingly high levels of sophistication and realism, also exploiting an increasing knowledge of machine learning and artificial intelligence techniques.
Experimental activity is devoted to the design and the development of new scientific instruments that can broaden the observable horizon and the level of details reachable.
The main research fields of RSN4 are: 1) compact objects, 2) cosmic explosions, 3) multi-messenger astrophysics, 4) fundamental physics experiments.
In this talk I will review the main activities in which the RSN4 community is involved, emphasizing in particular the open questions and the expected breakthroughs reachable in the near future in our research fields.

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Astrofisica relativistica e particellare

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Astrophysics in the Imaging X-ray Polarimetry Explorer (IXPE) Era

Author: Paolo Soffitta[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: paolo.soffitta@inaf.it

The Imaging X-ray Polarimetry Explorer (IXPE), a NASA-ASI discovery Small Explorer mission (SMEX), was launched on December 9, 2021, thanks to the efforts of determined X-ray astronomers and engineers aiming to revolutionize our understanding of celestial sources. This achievement was made possible by an instrument conceived, built, and calibrated in Italy by INAF and INFN, with the industrial contribution of OHB-Italia. In this presentation, I will review the main, and in many cases

surprising, astrophysical results from the first two and a half years of IXPE in orbit, including significant X-ray polarimetry observations from supernova remnants and pulsar wind nebulae, magnetars, black holes and neutron star binaries, and active galactic nuclei.

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High-energy Neutrinos and Gamma-rays from the Galactic Plane

Author: Giulia Pagliaroli[1]

[1] *INFN- LNGS*

Corresponding Author: giulia.pagliaroli@lngs.infn.it

The high-energy (TeV-PeV) diffuse emission from our Galactic Plane has been recently measured both in gamma-ray and in neutrinos from several detectors. In this talk I will review the information that can be derived exploiting these observations and the different open questions raised by the comparison of theoretical expectations and the experimental data. In particular, the interaction of cosmic rays with the gas contained in our Galaxy is a guaranteed source of correlated diffuse high energy neutrinos and gammas. Additional contribution could be due to Galactic sources that are not resolved by actual experiments and their contribution to the diffuse emission could be o big interest

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X-ray view of dual AGN candidates

Author: Lorenzo Battistini[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: lorenzo.battistini@inaf.it

Dual Active Galactic Nuclei (DAGN, projected spatial separation rp < 100 kpc) are sources of great interest in astrophysics, since they are crucial to understand how AGN are triggered. However, DAGN are rare, and identify and characterize such sources is challenging and multi-waveband observations and analysis are needed. At early stage of separation (rp ~ 30 – 100 kpc), we can exploit X-ray data available so far to identify DAGN, while at the closest separations (rp < 30 kpc) most of the sources are not resolved in the X-ray band and indirect methods must be used (such as a Double- Peaked [OIII]λ5007Å line profile). Here, I present a first characterization of an X-ray selected sample of ~ 360 DAGN candidates obtained with XMM-Newton and Chandra observations, up to rp ~ 100 kpc, and the analysis of a sample of 22 optically selected Double-Peaked AGN. I will present the X-ray and optical study of the sample, and derive intrinsic emission properties (such as Luminosity and nuclear absorption) to be compared with those observed in isolated AGN.

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Multi-Messenger Astrophysics and cosmology with next-generation GRB observatories

Author: Lorenzo Amati[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: lorenzo.amati@inaf.it

The huge luminosity, the redshift distribution extending at least up to z~10 and the association with the explosive death of very massive stars make long GRBs extremely powerful probes for investigating the early Universe (pop-III stars, cosmic re-ionization, SFR and metallicity evolution up to the "cosmic dawn") and measuring cosmological parameters. At the same time, as demonstrated by the GW170817 event, short GRBs are the most prominent electromagnetic counterpart of gravitational-wave sources like NS-NS and NS-BH merging events, and both long and short GRBs are expected to be associated with neutrino emission. Moreover, the combination of extremed istances, huge number of photons emitted over wide photon energy range and the variability down to few ms makes these phenomena a promising tool for performing tests of fundamental physics like Lorentz Invariance Violation (LIV). I will review the status, concepts and expected performances of space mission projects in which INAF and the Italian astronomical community are heavily involved, the most advanced being THESEUS, aiming at fully exploiting these unique potentialities of the GRB phenomenon, thus providing an ideal synergy with the large e.m. facilities of the future like LSST, ELT, TMT, SKA, CTA, ATHENA in the e.m. domain, advanced second generation (2G++) and third generation (3G) GW detectors and future large neutrino detectors (e.g., Km3NET).

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Prospects for the detection of high-energy gamma rays from extended sources

Author: Giada Peron[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: giada.peron@inaf.it

Very high energy astrophysics has got a boost in the recent years driven by the development of new observational facilities such as LHAASO, which started observing in the last few years, and CTAO and ASTRI-MiniArray, which are under construction. A key question that these instruments plan to address is the identification of hadronic PeVatrons, namely the most powerful particle accelerators in the Galaxy. In my talk I will overview the main Galactic gamma-ray sources, and give the prospects for detections of these, with a special focus on the performance of the next generation detectors towards morphological and spectroscopical studies.

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Envisioning Tomorrow: INAF prospects and challenges for multi-messenger astronomy in the era of Einstein Telescope

Corresponding Author: silvia.piranomonte@inaf.it

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Gamma-ray burst X-ray afterglows and time-evolving photoionisation: clues for the missing gas problem

Author: Aishwarya Linesh Thakur[1]

Co-authors: Luigi Piro [1]; Alfredo Luminari [1]; Fabrizio Nicastro [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: aishth@outlook.com

Gamma-ray burst spectra are absorbed by a significant amount of gas within their host galaxy. We can estimate the amount of this gas through broadband spectroscopy. X-ray spectra provide the most complete estimate of the amount of gas as they probe the total amount of material along the line of sight compared to optical spectra, which can only probe the relatively neutral gas and miss dust contribution. When optical and X-ray inferred column densities have been compared for the same GRB, they are typically found to differ by up to an order of magnitude. This is referred to as the "*missing gas problem*" since it is expected to arise from a column of very highly ionised material in the immediate vicinity of the GRB. We fit a flux-selected sample of seven GRB X-ray spectra using a newly developed time-dependent ionised absorber to model the medium using the GRB-specific ionising flux. We find that the time-dependent absorber fits improve upon a standard neutral absorber model fit for six out of seven bursts in our sample, providing evidence of this missing highly ionised gas. For all six of these, the corresponding best-fit parameters predict a region of size ~ 10 pc with typical number densities of 10^{3-4} cm^{-3}, consistent with the progenitor having exploded in a dense star-forming environment.

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Hubble constant estimation via electromagnetic and gravitational-wave joint analyses

Authors: Giulia Gianfagna[1]; Luigi Piro[2]

Co-authors: Francesco Pannarale [3]; Hendrik Van Eerten [4]; Fulvio Ricci [3]; Geoffrey Ryan [5]

[1] *Istituto Nazionale di Astrofisica (INAF), Istituto di Astrofisica e Planetologia Spaziali (IAPS)*

[2] *Istituto Nazionale di Astrofisica (INAF)*

[3] *INFN (Roma), Università di Roma, La Sapienza*

[4] *Department of Physics, University of Bath*

[5] *Perimeter Institute for Theoretical Physics*

Corresponding Author: giulia.gianfagna@inaf.it

In August 2017, the groundbreaking observation of GW170817 marked the first-ever identification of a binary neutron star merger, accompanied by the detection of a Gravitational Wave (GW) and a gamma-ray burst (GRB). The GRB exhibited prompt gamma-ray emission and an afterglow across radio, optical, and X-ray bands, originating from a relativistic jet formed post-merger at an angle of 20-30 degrees from its axis. In this work, we estimate the Hubble constant H_0 using broad-band afterglow emission and relativistic jet motion from the Very Long Baseline Interferometry and Hubble Space Telescope images of GW170817. Using a simultaneous fit of GW and afterglow, we probe the H_0 measurement robustness depending on the data set used, the assumed jet model, the possible presence of a late time flux excess. Using the sole GW leads to a 20% error (77^{+21}_{-10} km/s/Mpc, medians, 16th-84th percentiles), because of the degeneracy between viewing angle and luminosity distance. Adding the afterglow light curve and centroid motion in the analysis efficiently breaks parameters degeneracies and overcome the late-time deviations, giving $H_0 = 69.0^{+4.4}_{-4.3}$ km/s/Mpc (in agreement with Planck and SH0ES measurements) and a viewing angle of $18.2^{+1.2}_{-1.5}$ deg. This is valid regardless of the jet structure assumption.

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Indication of Neutron Star activity in Supernova light curve

Author: Fabio Ragosta[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: fabio.ragosta@inaf.it

Neutron stars are the compact remnants of massive stars that produce an energetic explosion we observe as a core-collapse supernova. The majority of massive stars are known to have been born in binary or multiple systems. When one of the stars in the system explodes, the orbital parameters can be significantly altered due to sudden mass loss and a natal kick; the binary can survive with a tighter or wider orbit, or it can be disrupted to become two separate stars. In this general picture, the evolution of the remnant system can end up forming a new pulsar or an X-ray, these observation had helped in constraining the evolved Neutron Stars. However, newly born Neutron Stars are very challenging to observe because of the shielding of the ejecta right after the explosion of the Core Collapse. Thu constraints on the early phase of Neutron Star evolution from observations are yet to be set. In this talk, I will discuss how supernova photometry and spectra can shed light on the evolution of the remnant and how they can constrain models for the neutron star early phase magnetosphere.

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Characterising dual-AGN candidates in galaxy mergers

Author: Manali Parvatikar[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: manali.parvatikar@inaf.it

Galaxy mergers are thought to play a significant role in triggering accretion onto the central super massive black holes (SMBHs), resulting in Dual/Offset AGN. These systems are crucial probes of the accretion history of the universe, but are challenging to detect and characterize, therefore a detailed understanding remains unclear. The X-ray study of optically selected dual-AGN candidates with XMM-Newton and Chandra revealed that (i) dual AGN exhibit higher nuclear obscuration with respect to isolated systems and (ii) around 50% of optical dual-AGN appear as single X-ray nuclei, raising questions about their true nature, the role of X-ray absorption and possible classification. To further investigate the emission properties of these systems, we performed a multi-wavelength study (X-ray vs mid-IR, NIR) with archival and new data. In this talk, I will present the key results of our study and the future perspectives on revealing BH activation mechanisms in galaxy mergers through Integral Field Spectroscopic studies.

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An X-ray spectral and variability study of highly accreting supermassive black holes

Author: Marco Laurenti[1]

[1] *Università di Roma "Tor Vergata"*

Corresponding Author: marco.laurenti@roma2.infn.it

The Eddington ratio λ_Edd is the key parameter that describes the accretion mode of active galactic nuclei (AGN). Among the different modes, high-λ_Edd accretion is particularly fascinating because of its implications in the context of accretion physics, as well as AGN feedback. However, due to their relative paucity in the local Universe (z<0.1), only few dedicated observations of AGN accreting in the high-λ_Edd regime are currently available. To tackle this issue, we exploit the vast database of XMM-Newton serendipitous observations to create a new, large sample of highly accreting AGN named as XMM-Newton High-Eddington Serendipitous AGN Sample (X-HESS). Approximately 40% of the X-HESS AGN has multi-epoch data coverage, disclosing the unprecedented possibility to study not only the spectral but also variability features of high-λ_Edd AGN in much broader intervals of redshift, black hole mass and bolometric luminosity with respect to the bulk of pre-existing highly-accreting AGN samples. Moreover, >60% of the X-HESS AGN dispose of simultaneous optical/UV observation from the OM, providing hints about the interplay between the X-ray corona and the accretion disc. Thanks to the combination of simultaneous optical/UV and X-ray data, we explore the possibility to investigate the renowned Γ-λ_Edd relation in a fully epoch-dependent frame. Evidence of powerful nuclear winds were also found among the X-HESS AGN, enforcing the role of the high accretion mode as an ideal laboratory to study AGN feedback through advanced modelling techniques.

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Study of the dynamical state of galaxy clusters from observations in X-band via Zernike polynomials

Author: Alessio Benincasa[None]

Co-authors: Iacopo Bartalucci [1]; Marco De Petris [2]; Antonio Ferragamo [2]

[1] *INAF*

[2] *Dipartimento di Fisica dell'Università di Roma La Sapienza*

Corresponding Author: alessio.benincasa@icloud.com

Galaxy clusters abundance as a function of mass and redshift is a powerful tool to constrain cosmological parameters, such as Ωm and σ8. However, their mass can be estimated for instance under the assumption that the gas filling the volume of the cluster, i.e. the Intra-Cluster Medium, is in hydrostatic equilibrium with the total matter content of the cluster, which consists mainly of dark matter. For this reason, the determination of the cluster dynamical state becomes fundamental for any study envisaging to use clusters as cosmological probes. It has been shown that the morphology of the gas is directly related to the dynamical status of the gas. In this context, the decomposition in Zernike polynomials has been shown to be a good proxy for the dynamical state of clusters in the Sunyaev–Zel'dovich millimetric observations. In this work we calibrate this approach on mock X-ray maps from THE THREE HUNDRED simulations. These maps are decomposed via Zernike polynomials in order to include all their morphological information in the expansion coefficients that are, for convenience, rearranged in a single
parameter C. By comparing C with the dynamical state parameter χ we find a non negligible linear correlation. We then apply this relation to real XMM-Newton X-ray observed maps to determine their dynamical state and compare to other morphological indicators that probes only small or large scales from literature.

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Ongoing and Upcoming Breakthroughs in the Field of Galaxies and Cosmology

Corresponding Author: roberto.gilli@inaf.it

Within INAF, research in the field of 'Galaxies and Cosmology' falls under the Scientific National Grouping 1 (Raggruppamento Scientifico Nazionale 1, RSN1). The scientific endeavors of RSN1 encompass both theoretical investigation and observational studies employing ground-based and space-

borne telescopes. In this presentation, I will provide an overview of the primary activities undertaken by the RSN1 community, emphasizing ongoing advancements and anticipated breakthroughs in the forthcoming years.

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Sardinia Radio Telescope - Attese nel campo della radioastronomia extragalattica

Author: Federica Govoni[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: fgovoni@oa-cagliari.inaf.it

In questo contributo presenterò il Sardia Radio Telescope e il suo recente upgrade per lo studio dell'Universo alle alte frequenze radio. Particolare risalto verrà posto sulle attese scientifiche nel campo della radioastronomia extragalattica.

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Not all the action is in clusters: environmental effects on field galaxies

Author: Benedetta Vulcani[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: benedetta.vulcani@inaf.it

Galaxies inhabit a wide range of environments and therefore are affected by different physical mechanisms. While environmental effects are typically deemed significant mainly within galaxy clusters, even outside clusters, galaxies can be significantly affected by external processes connected to their position within the cosmic web. Exploiting the data from the GAs Stripping Phenomena in galaxies (GASP) survey I will discuss the multitude of mechanisms that can affect galaxies in isolation, groups and filaments. Spatially resolved maps combined with the knowledge of the hosting environment are indeed very powerful for classifying galaxies by physical process. I will show how a single group can host galaxies undergoing many different processes, such as starvation, ram pressure stripping and gas accretion. I will also show how filaments can assist gas cooling and increase the star formation in the densest regions in the circumgalactic gas of the galaxies flowing through them. I will then show examples of galaxy-galaxy interactions, mergers, and cosmic web stripping. I will emphasise the successes and limitations of a visual optical selection in identifying the processes that deplete galaxies of their gas content and probes the power of IFU data in pinning down the acting mechanism. Future facilities will allow to perform similar analyses at higher redshifts.

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The Low Surface Brightness Universe: studying the Intra-Cluster Light in groups and clusters of galaxies

Author: Rossella Ragusa[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: rossella.ragusa@inaf.it

The LCDM paradigm suggests that the intracluster light (ICL) in galaxy clusters is formed due to the gravitational interactions that occur during the formation of the Brightest Cluster Galaxies (BCG). As a result, the ICL serves as a fossil record of the mass assembly process in galaxies, and its physical properties (luminosity, color, stellar population, fraction(f_icl)), provide insights into the formation mechanisms that contributed to the ICL and the dynamical and evolutionary state of the system. Understanding how the f_icl is related to the virial mass(M_vir) or the other properties of the host environment can help to better understand the physical processes involved in the formation of the ICL, and therefore can give us the possibility to add knowledge about all the processes involved in the evolution of the systems.
Detecting and studying the ICL is a challenging task due to its very low surface brightness and extension, requiring deep imaging and wide field and despite limited measurements of f_ICL, both in the Local Universe and in the higher redshift objects, no clear conclusion on the correlation with M_vir has been established. In this talk, I explore the relationship between f_ICL and M_vir, as well as f_ICL and f_ETG N_ETG/N_ETG+N_LTG). These results were achieved through a statistically significant and homogeneous sample of 22 groups and clusters (z < 0.05), taking advantage of the VEGAS data and published in the recent works by Ragusa et al 2021, 2022 and 2023.

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Constraining cosmology and astrophysical feedback processes with CAMELS simulations

Author: Valerio Busillo[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: valerio.busillo@inaf.it

Cosmology and astrophysical processes (like Supernovae and AGN feedback) both influence the formation and evolution of galaxies in different ways.
By comparing scaling relations among size, dark matter and stellar mass from thousands of CAMELS simulations with observations, we demonstrate that it is possible to constrain the cosmological parameters ($\Omega_{\rm m}$ and, with less accuracy, $_8$) and supernovae feedback-related parameters.
CAMELS simulations calibrated to the original IllustrisTNG simulation cannot reproduce the observed scaling relations for SPARC late-type galaxies. Results show that a lower value of wind energy per unit SFR than the one proposed in the fiducial IllustrisTNG simulation is required to

correctly reproduce the observations.
I will also show, extending the procedure to early-type galaxies, what are the key differences between late- and early-type galaxies in simulations and what is the sensitivity of the method to the observational sample, by considering observations from different galaxy samples (SPIDER, $\mathrm{ATLAS}^{\mathrm{3D}}$ and MaNGA DynPop). I will point out the difficulties in finding a simulation which can coherently reproduce the scaling relations for late- and early-type galaxies.
The comparison of observed and simulated scaling relations with such a level of detail provides a promising method to validate the capacity of sub-grid physical processes in cosmological simulations to reproduce correctly real data encompassing different galaxy types and masses.

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Euclid: a terapixel window on cosmic history

Author: Benjamin Rudolph Granett[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: benjamin.granett@inaf.it

The ESA Euclid space telescope is carrying out routine survey operations and rapidly building an unparalleled imaging and spectroscopic dataset. The near-infrared spectrometer and photometer (NISP) is imaging the sky with direct imaging and slitless spectroscopy, complemented in the optical with the high resolution VIS camera, as well as ground-based photometry. Over the six-year mission, Euclid will complete the Wide Survey of approximately 15 000 sqr deg of extragalactic sky, and the Deep Survey (50 sqr deg). These observations will unveil the history of cosmic structure over half the age of the Universe through galaxy shape measurements from weak gravitational lensing, and the spectroscopic clustering pattern of galaxies spanning the cosmic web. Jointly these probes will tightly constrain the nature of dark energy and gravity. Moreover, the rich spectrophotometric dataset will enable investigations into the evolutionary histories of galaxies and their active galactic nuclei since high redshift.

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An investigation of galaxies at extreme redshifts with deep NIRCam and NIRSpec observations

Author: Marco Castellano[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: marco.castellano@inaf.it

JWST is transforming our understanding of the high-redshift universe and of the epoch of cosmic dawn. In this talk, I will focus on the results from the GLASS-JWST survey and from its follow-up spectroscopic Cycle2 campaign. The first set of GLASS-JWST NIRCam observations led to the discovery of two bright photometric candidates at z~10.5 and z~12.2 providing the first evidence of

a puzzling high number density of bright galaxies 300-500 Myr after the Big Bang. A subsequent analysis of GLASS and other programs targeting the foreground cluster A2744 led to the discovery of 7 bright objects at z>9 hinting at the presence of an overdensity in the field. I will discuss the implications of these findings for our understanding of early galaxy evolution, and, in particular, I will present the results from the ongoing deep NIRSpec spectroscopic follow-up which confirms a high number density of z>10 sources in the GLASS/A2744 fields. Finally, I will discuss constraints obtained combining NIRCam and NIRSpec on the ionizing, AGN and clustering properties of galaxies at the earliest epochs probed so far.

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The centre of the Milky Way

Author: Mattia Sormani[None]

Corresponding Author: mattiacarlo.sormani@gmail.com

I will give an introduction to the structure and dynamics of the central 3 kpc of the Milky Way. This region hosts a complex star-forming ecosystem that is continually exchanging matter with the rest of the Galaxy through inflows and outflows. The Galactic bar efficiently transports gas from the Galactic disc towards the centre at a rate of ~1 Msun/yr, creating a ring-like accumulation of molecular gas known as the Central Molecular Zone (CMZ) at a radius R=120pc. The CMZ is the local analog of the star-forming nuclear rings commonly found at the centre of external barred galaxies, and forms by a process similar to the one that creates gaps in Saturn's rings. Once in the ring, approximately 10% of the gas is consumed by its intense star formation activity. Star formation does not occur uniformly throughout the CMZ ring, but is more likely to occur near the sites where the bar-driven inflow is deposited. The star formation rate of the CMZ varies as a function of time, but it is currently debated whether this is due to an internal feedback cycle or to external variations in the bar-driven inflow rate. The radius of the CMZ gas ring slowly grows over Gyr timescales, and its star formation activity builds up a flattened stellar system known as the nuclear stellar disc, which currently dominates the gravitational potential of the Milky Way at 30pc<R<300pc.

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Unveiling galaxy mass assembly via strong gravitational lenses with Euclid

Author: Crescenzo Tortora[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: crescenzo.tortora@inaf.it

Strong gravitational lensing provides the most precise mass probe in the Universe. It not only enables the constraint of total mass within lensed structures (arcs, rings, or multiple images), but also facilitates the exploration of mass density profiles, dark matter content, and the Initial Mass Function within lens galaxies. Therefore, *strong lenses have the potential to obtain unique constraints on*

how dark matter and stars have been assembled in the most massive galaxies across the cosmic history.

Only a few hundred strong lenses have historically been well-characterized, which has limited the ability to conduct comprehensive analyses. However, the landscape is rapidly changing. Ongoing wide-field ground-based surveys like KiDS@VST, and the forthcoming Euclid space mission, promise an unprecedented influx of new gravitational lenses up to z = 2, 100 times larger than the existing samples, by surveying vast portions of the sky.

The development of these large datasets has motivated the community to conceive novel and fast methodologies for their analysis. In this presentation, I will delve into our research employing Convolutional Neural Networks, to identify gravitational lenses with KiDS@VST data. Additionally, I will also present our ongoing efforts in the lens modelling in light of the upcoming Euclid data.

I will discuss the exciting prospects of applying these cutting-edge techniques to Euclid data, as well as the collaborative efforts within the Euclid mission. Finally, I will outline future avenues of exploration, and the impact that this research can have on our understanding of massive galaxy evolution.

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AGN feedback in a nutshell: the multi-phase, sub-pc to galaxy-scale outflows in PDS 456, the most luminous quasar in the local Universe

Author: Enrico Piconcelli[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: enrico.piconcelli@inaf.it

PDS 456 is a nearby, radio-quiet, type 1 QSO with a $L_{\rm BOL} \sim 10^{47}$ erg/s and can be regarded as the local counterpart of QSOs shining at $z \sim$2-3. It exhibits the prototype of massive and persistent X-ray ultra-fast ($\sim 0.25c$) outflow with a kinetic power of $0.2 L_{\rm BOL}$(i.e., enough to significantly influence the evolution of the host galaxy). Our high-resolution ALMA mapping of the molecular gas discovered an extended ($\sim$6 kpc) AGN-driven outflow being able to remove large amounts of gas from the galaxy center and provide efficient feedback. We will also focus on the NFM+WFM MUSE view of the properties of the ionized gas in PDS 456 reaching an unprecedented spatial resolution of $\sim$300 pc. MUSE uncovers an ionized outflow spanning 20 kpc with NFM data revealing a striking similarity in morphology and kinematics between the ionized and molecular outflow within the inner 1-3 kpc. The momentum load of the multiphase, galaxy-wide outflow challenges the conventional energy-conserving expansion paradigm. MUSE also unveils a complex environment of PDS456 with a CGM up to $\sim$50 kpc and 8 companions within $\sim$10-40 kpc. Our results strongly suggest that mergers, powerful AGN activity, and feedback via AGN-driven winds will collectively contribute to shaping the host galaxy evolution of PDS 456, and likely, that of similar objects at the brightest end of the AGN luminosity function across all redshifts.

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Tecnologie Avanzate e Strumentazione / **174**

Expected breakthroughs in the field of "Advanced Technologies and Instrumentation"

Author: Deborah Busonero[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: busonero@oato.inaf.it

Within INAF, research in the field of "Advanced Technology and Instrumentation"falls under the Scientific National Grouping 5 (RSN5). Technological research in INAF is highly multidisciplinary and diversified and innovation is always at the basis of INAF's technological development. Design and realization of more and more complex hardware and software tools, developing innovative methodologies, technologies and materials are needed to meet the demanding requirements of the new experiments, as complex numerical simulations necessary in the design, analysis and interpretation phases of the observed results, pose further challenges towards complex and innovative systems. Within that framework we will provide an overview of the primary activities undertaken by the RSN5 community, currently deeply involved in the PNRR activities, emphasizing ongoing advancements and anticipated breakthroughs in the forthcoming years.

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The next generation of Cherenkov telescopes: innovations, challenges, and perspectives of ASTRI and CTAO

Author: Salvatore Scuderi[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: salvatore.scuderi@inaf.it

Within the next five years, the next generation of Cherenkov Imaging Atmospheric Cherenkov telescopes (IACT) arrays will be completed or very close to completion. The first of these facilities is the ASTRI Mini-Array, a project, led by INAF, to build and operate nine IACT telescopes at the Teide Astronomical Observatory in Tenerife (Spain). The second one is the Cherenkov Telescope Array Observatory (CTAO) which will be the world's largest and most sensitive instrument to study high-energy phenomena. INAF contributes to the project in the construction of all three kinds of telescopes and the software development. INAF leads the international consortium to build 37 Small-Sized Telescopes (SSTs) and the program to build 2 Large-Sized Telescopes to be installed at the CTAO

southern site. Finally, the Large Array of imaging atmospheric Cherenkov Telescopes, an array of 32 of telescopes of 6 meters diameter, will be installed by the Chinese Academy of Sciences at the site of the Large High-Altitude Air Shower Observatory on Mt. Haizi (China).
The implementation of such arrays comes with various technical, logistic, and management challenges. In this regard, innovative technologies have been utilized to develop the ASTRI-Horn prototype, and similar solutions have been adopted to tackle these challenges in the case of the ASTRI Mini-Array. The ASTRI Mini-Array project serves as a precursor to produce the SST Telescopes, as optics and electro-mechanical structures are similar. Therefore, the ASTRI Mini-Array project provides a critical training ground for optimizing methods and approaches for SST telescopes production and quality assurance processes.

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SKAlow –The INAF contribution

Author: Jader Monari[1]

Co-authors: Monica Alderighi [1]; Carolina Belli [1]; Gianni Bernardi [1]; Pietro Bolli [1]; Letizia Caito [1]; Federica Caputo [1]; Simone Chiarucci [1]; Giovanni Comoretto [1]; Sergio D'Angelo [1]; Paola Di Ninni [1]; Davide Fierro [1]; Giulia Macario [1]; Andrea Mattana [1]; Giovanni Naldi [2]; Federico Perini [1]; Giuseppe Pupillo [1]; Marco Schiaffino [1]; Francesco Schilliro' [1]; Alice Tabellini [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

[2] *IRA-INAF*

Corresponding Author: j.monari@ira.inaf.it

INAF, along with several Italian industries, universities, and other research institutes, has been engaged in this significant project since its inception in 2002. The initial advancements occurred in 2004 with the Institute of Radio Astronomy's involvement in the EC FP6 SKADS project, using the Northern Cross radiotelescope for testing new technologies, such as analog RF optical fiber links and digital domain beamforming systems, vital for the SKAlow receiving system. In 2009, a national INAF group was established, joined by colleagues from OAA, OAC, IASF-Mi, and external partners from UNIBO, UNIFI, CNR-IEIIT, and industries, driving Italian technological progress. This cross-national collaboration has positioned INAF as a leader in various technological areas, including antenna design and an innovative UAV-based test system, digital acquisition systems, and beamforming firmware. Many of these technologies have been applied to the Aperture Array Verification Program (AAVP-2010) and the Aperture Array Design Consortium (AADC-2016). Following the System SKA Critical Design Review, the baseline design of the entire SKAlow receiving system is predominantly "Made in Italy". The initial Aperture Array Verification System (AAVS1/2/3) prototypes were installed with substantial contributions from INAF staff. Additionally, INAF participated in the initial observations, verification, and commissioning of these instruments, furthering the industrialization phase. Presently, INAF holds a pivotal role in the SKA Low antennas, receivers, and signal processing system, deeply involved in the construction of the telescope's first release (AA0.5).

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SOXS: the new transient tracker for the ESO NTT

Authors: Mirko Colapietro[1]; Team SOXS[None]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: mirko.colapietro@inaf.it

SOXS (Son Of X-Shooter) is the new spectroscopic facility for the ESO 3.58m New Technology Telescope (NTT) at the La Silla Observatory, which will become one of the premier transient follow-up instruments in the Southern hemisphere.
It will be used for the classification and characterization of all kind of astrophysical transients and variable sources with a flexible schedule managed by the consortium.
SOXS combines an average spectral resolution of ~4500 for a 1"slit with a wide spectral range (350-2000 nm) obtained observing simultaneously the same target with two separate spectrographs, one operating in the UV-VIS (350-850 nm) and the other in the NIR (800-2000 nm) wavelength regimes.
The Assembly Integration and Verification (AIV) of SOXS followed a modular approach, as the consortium is geographically spread. All the main subsystems have been internally aligned and tested in the respective institutes and are now at INAF-Astronomical Observatory of Padova, where the integration with the instrument control electronics/software and the system-level tests and verifications are ongoing.
Here, I'll present the updated status of the project in preparation of the Preliminary Acceptance in Europe (PAE) and the shipment of the instrument to Chile.

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Integrating Optical Polarimetry into the VLT Survey Telescope: The VSTPOL Project

Author: Salvatore Savarese[1]

Co-author: Team VSTPol

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: salvatore.savarese@inaf.it

The VSTPOL project, funded by the EU's Recovery Plan (PNRR) in the context of the CTA+ program, will upgrade the VLT Survey Telescope (VST) to enhance the Cherenkov Telescope Array Observatory (CTAO) with new capabilities in optical polarimetry. The proposed upgrade positions the VST as the first large wide-field telescope equipped for advanced polarimetric observations, and will be primarily aimed at the optical follow-up and monitoring of CTA transient sources.
The project design introduces a dual-mode operational capability that allows switching between standard imaging and polarimetric observation modes. This involves replacing the existing ADC exchange system with a new, interface-compatible mechanism and integrating a linear polarized filter into the VST's optical path. A filter wheel will be implemented to ensure polarization selection and continuous tracking of astronomical targets. Adhering to the current ESO control electronics standards for VLT, the updated system will employ a PLC-based control architecture, which also requires developing new control software to seamlessly integrate these functionalities with the VST's existing systems for pointing, image acquisition, and active optics.
This talk will outline the VSTPOL project's roadmap, discuss its current development status, and present the technical challenges as the project approaches its final implementation.

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Next generation Wide Field Adaptive Optics correction systems for ESO telescopes

Author: Valentina Viotto[1]

Co-authors: Maria Bergomi [1]; Lorenzo Busoni [1]; Paolo Ciliegi [1]; Jacopo Farinato [1]; Demetrio Magrin [1]; Enrico Pinna [1]; Marco Riva [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: valentina.viotto@inaf.it

INAF is playing a major role in the next generation wide field Adaptive Optics systems for ESO telescopes. This includes, in particular, two instruments, dedicated to wavefront compensation: MAVIS, for the VLT UT4, and MORFEO, for the ELT. The two systems face different challenges: short wavelength on one side and huge size on the other.
MAVIS will be part of the next generation of VLT instrumentation and it will include a visible imager and a spectrograph, both fed by a common MCAO module (AOM), whose challenge is to provide a 30" AO-corrected FoV in the visible domain, with a 50% sky coverage at the Galactic Pole. The current AOM scheme includes the use of 8 LGSs + 3 NGSs, to drive more than 5000 actuators, divided into 3 deformable mirrors (one of them being UT4 secondary mirror).
MORFEO will be the first generation MCAO system for the ELT, feeding the MICADO infrared camera. The instrument will provide spatially uniform AO compensation over a 1 arcmin2 FoV with with a Strehl Ratio greater than 35% at 2.2 microns with 50% of sky coverage. Wavefront sensing is performed using 6 LGSs + 3 NGSs and the wavefront compensation is performed by two adaptive post focal DMs, which work together with the telescope's adaptive and tip-tilp mirrors M4 and M5.
I'll introduce the main expected performance of the systems and present the current status of the projects on behalf of the two big teams working on them, especially focusing on OAPD involvement.

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Accurate PSF Analysis; exploiting data from ELT/VLT to Rubin Telescope, passing through James Webb

Authors: Giuliana Fiorentino[1]; Laura Schreiber[1]

Co-authors: Vittorio Francesco Braga [1]; Marcella Di Criscienzo [1]; Emiliano Diolaiti [1]; Carmela Lardo [2]; Claudia Mignone [1]; Estelle Moreax [3]; Davide Ricci [1]; Salvatore Savarese [1]; Pietro Schipani [1]; Vincenzo Testa [1]; Ricardo Zanmar Sanchez [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

[2] *Alma Mater Studiorum Università di Bologna*

[3] *IPAG - Grenoble*

Corresponding Author: laura.schreiber@oabo.inaf.it

The Point Spread Function (PSF) is the response of a system to a point source. It depends on many factors, such as instrument optical quality, atmospheric turbulence, gravitational effects due to telescope optics mass, and the diffraction of the telescope entrance pupil. It is generally variable across the Field of View (FoV), and the reasons for its variability have different origins. Its knowledge is crucial to maximising the exploitation of high-precision quantitative science, restricting the astrometric and photometric errors to noise limitations. We will make a journey through different use

cases in which the PSF modelling has different roles in data exploitation improvement. A topical example is the case of Adaptive Optics (AO), which is considered an enabling technology for future giant telescopes like the ELT. AO data are characterised by a structured PSF, variable across the FoV, and its modelling is still one of the main limitations in AO data exploitation. Space data are also characterised by structured PSF, which, in James Webb's case, could be the origin of false detections when an accurate model of the PSF is missing. Classical seeing limited data are characterised by a smoother and larger PSF, dominated by the seeing, easy to describe with a simple analytical model. Optical field aberrations slowly varies in time with telescope pointing and these aberrations determine a variation of the PSF across the FoV. These PSF variations can be modelled and used to monitor and control the telescope aberrations: this will be the case òf Rubin Observatory.

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Astrophysics and Cosmos Observation. The Italian National Centre on HPC, Big Data and Quantum Computing

Author: Claudio Gheller[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: gheller@ira.inaf.it

High Performance Computing (HPC) and Big Data technologies are powerful tools to model the complex dynamic systems studied in Astrophysics and Cosmology today. They are essential for the majority of activities in modern astrophysics. These activities range from processing and analysing astronomical data to interpreting and comparing them to theoretical predictions, as well as running simulations and artificial intelligence applications. INAF is a key player in the Italian National Centre on HPC, Big Data, and Quantum Computing. The Centre is managed by the ICSC foundation and it is funded by the EU PNRR plan. INAF has the leadership in one of the ten founding Spokes, namely "Astrophysics and Cosmos Observations". The Spoke is conducted adopting a collaborative approach that involves the active participation of the community. By utilising a codesign methodology, the aim is to develop applications supporting large-scale experiments such as SKA, CTA, EUCLID, GAIA, LOFAR. This approach combines the expertise of scientists and community code developers to create innovative software and hardware solutions fostering the coordinated development of applications and technology. In addition the challenges of Big Data processing and analysis using cutting-edge techniques like Artificial Intelligence and Bayesian statistics are tackled. Finally, advanced scientific visualisation methods for an intutive insight to complex multidimensional data are investigated. The Spoke promotes also a close collaboration with industrial partners and private subjects by means of the dedicated "Innovation Grants"and "Cascade Fundings"programmes, promoting an effective knowledge and technology transfer from research to industry at the national scale.

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Virtual Astronomy: eXtended Reality tools to support the design of astronomical instrumentation

Authors: Christian Eredia[1]; Enrico Cascone[1]; Vincenzo Cianniello[1]; Domenico D'Auria[1]; Vincenzo De Caprio[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: christian.eredia@inaf.it

The technologies in the eXtended Reality (XR) field have been rapidly developing in the last few years, allowing for their effective implementation in several different applications, beside the entertainment world they are more commonly associated with.
Virtual, augmented and mixed reality environments can effectively support the various phases in the development of instrumentation for astronomy, with its ever-growing size and complexity, making them complementary tools to other methods of design verification and validation, like prototyping. An actual immersion in an instrument that is still being developed can help considerably in identifying potential criticalities in the design, studying its interfaces, or evaluating integration and maintenance procedures.
In the scope of the PNRR project STILES, an eXtended Reality laboratory is being implemented at the INAF Astronomical Observatory in Naples. It will be integrated inside an innovative Concurrent Design Facility, with the aim of providing a significant contribution in the optimization of the design process for the next generation of astronomical instrumentation.

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Code parallelization alternatives: measuring performance portability within the Gaia AVU-GSR case study

Author: Valentina Cesare[1]

Co-authors: Marco Aldinucci [2]; Ugo Becciani [1]; Giulio Malenza [2]; Marco Santimaria [2]; Alberto Vecchiato [3]

[1] *Istituto Nazionale di Astrofisica (INAF) - Osservatorio Astrofisico di Catania*

[2] *Università degli Studi di Torino*

[3] *Istituto Nazionale di Astrofisica (INAF) - Osservatorio Astrofisico di Torino*

Corresponding Author: valentina.cesare@inaf.it

Modern computing needs for astronomical applications are soon reaching the ExaFLOPs scale. This calls for the usage of heterogeneous supercomputers accelerated with GPUs which, however, span several architectures that might imply portability problems of applications. For this purpose, several programming frameworks that allow portability of codes across these architectures without significant performance losses have been developed. We experiment the effective performance portability of some of these frameworks (HIP, C++ PSTL, SYCL, and OpenMP offloaded to GPU) using the AVU-GSR code of the Gaia mission as a study case. The code aims to find with a 10-100 micro-arcsecond accuracy the astrometric parameters of up to 10^8 primary stars in the Milky Way with LSQR iterative algorithm, widely employed in other scientific applications. This approach also allows to provide an optimized version of the solver used in the Gaia GSR pipeline with a > 2x speedup over the less optimized CUDA porting currently in production. These results are fundamental for the future Gaia Data Releases and other LSQR-based codes.

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A new scientific era for the Northern Cross

Author: Germano Bianchi[1]

Co-authors: Gianni Bernardi [1]; Pietro Bolli [1]; Alice Bosi [1]; Gianluca Esposito [1]; Matteo Fiorentini [1]; Andrea Orlati [1]; Davide Pelliciari [2]; Maura Pilia [1]; Rosy Poerio [1]; Alessandro Poli [1]; Andrea Possenti [1]; Emanuele Santandrea [1]; Rachele Toniolo [1]; Martin Topinka [1]; Matteo Trudu [1]; Michela Zardi [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

[2] *INAF*

Corresponding Author: germano.bianchi@inaf.it

The Northern Cross(NC) is a transit radiotelescope composed of two branches located in Medicina(BO). The North-South branch was upgraded in recent years and is now involved in many projects, included the study of transient phenomena, particularly Fast Radio Burst(FRBs). Important results have been already obtained, discovering new FRBs and monitoring several repeaters.
The NG-Croce project, financed by the Next-Generation-EU funds within the PNRR, foresees the refurbishment/upgrade of the East-West branch that will greatly improve the capabilities of the radiotelescope in terms of field-of-view, sensitivity and resolution.
To support and fully exploit the activities of the NC, the project includes activities for the parabolic dish of Noto (32m) as well as CHORD (Canadian Hydrogen Observatory and Radio-transient Detector) instrument in Canada. At the end of planned activities, Italy will have a national network of sensors (SRT will be included), to carry out a monitoring of transient phenomena with state-of-art technology and performance. The scientific data will be available to the international scientific community and used by doctoral students and young researchers, to increase their knowledge and astrophysics training. An archive will also be set up to make accessible, reusable and interoperable the data under the FAIR rules.
The presentation will show the upgrades of the Northern Cross, particularly focusing on the installation of new focal lines, receivers, a new CED and the implementation of innovative algorithms both for signal processing and for data analysis. The presentation will also describe the upgrades planned for Noto parabolic dish and the synergies with CHORD.

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Mechanical Engineering effort to support the design of Astronomical Instrumentation & Telescopes: current status and post-PNRR scenarios

Authors: Vincenzo Cianniello[1]; Vincenzo De Caprio[1]; Christian Eredia[1]; Domenico D'Auria[1]; Enrico Cascone[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: vincenzo.cianniello@inaf.it

The design and development of astronomical Instrumentations and Telescopes of the ELT (Extremely Large Telescope) class represents one of the most complex technological challenges of recent times. This task, from an engineering point of view, certainly deserves an innovative, curious and proactive approach that can always support and stimulate the activity of the researchers involved in it. Technologies in the field of advanced 3D CAD (Computer Aided Design) mechanical design and CAE (Compute Aided Engineering) finite element structural validation have been consolidated strongly in

recent years, providing increasingly precise and reliable results. The use of specific professional design software and the know-how gained in several ESO (European Southern Observatory) VLT (Very Large Telescope) and ELT projects, by the technological INAF (National Institute for Astrophysics) group of Naples, will allow us to move, in a very short time and using a Concurrent approach, from the conceptualization phase of an idea to the finalization/definition of a technological case study.
All these activities have found further life as well as a strong infrastructural strengthening in the framework of the PNRR (Piano Nazionale di Ripresa e Resilienza) STILES (Strengthening the Italian leadership in ELT and SKA) project. Thanks to this program, laboratory activities with a high technological impact, now present in INAF-Capodimonte facilities, such as Reverse Engineering, Additive Manufacturing FDM (Fused Deposition Modelling) and SLA (Stereo-lithography) as well as Laser Metrology, will assist and strengthen INAF's technological leadership in the design, prototyping and validation of the next generation of astronomical instrumentation.

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Discussion

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Expected breakthroughs in the field of "Stars, stellar populations and interstellar medium"

Author: Ilaria Musella[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: ilaria.musella@inaf.it

At INAF the research in the field of "Stars, stellar populations and interstellar medium"is included in the scientific national group 2 (Raggruppamento Scientifico Nazionale 2, RSN2).
The INAF community holds an internationally relevant position in the field of stellar astrophysics, playing a leading role from theoretical, observational, and experimental perspectives.
The variety of topics covered includes the study of star and planetary formation, interstellar medium, extrasolar planetary systems, stellar evolution, stellar populations in the Milky Way and in resolved external galaxies, the Galaxy as a whole, the nearby Universe, and the determination of cosmic distances.
The wide range of spatial scales involved requires diverse methodologies, a multi-disciplinary approach including increasingly advanced algorithms and data analysis techniques, and synergies between ground and space multiwavelength observations.
Today, INAF has access to the most sophisticated instruments and holds many leadership roles, conducting research of excellence with innovative methodologies and obtaining results of great impact.
In this talk, I will review some of the main activities the RSN2 community is involved in and outline the expected breakthroughs.

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Stelle, Popolazioni Stellari e Mezzo Interstellare / **72**

StarDance: the non-canonical evolution of stars in clusters

Author: Elena Pancino[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: elena.pancino@inaf.it

Thanks to their ubiquity, brightness, and the fact that they are made of stars with similar properties, star clusters have been used as astrophysical laboratories or test particles in an impressive range of research domains. However, we still do not understand fundamental details of their formation and evolution: a list of unsolved problems and apparently isolated mysteries has been accumulating over time, some standing since decades. Among them, the existence of multiple stellar populations in globular clusters, with different chemistry, has challenged generations of researchers. Given the mounting problems faced by the most favored scenarios to explain multiple populations, it is now time to revisit the foundations of our current thinking. New results show that: (i) the peculiarities in the chemistry of multiple populations are not limited to the oldest globular clusters; (ii) they can be transient in the evolution of individual cluster stars; and most importantly (iii) binary interactions and fast stellar rotation cannot be neglected in the study of star clusters and do have the capability to produce the observed chemistry. With StarDance, a new hypothesis will be tested: that multiple stellar populations and five other non-canonical stellar populations (extreme horizontal branch stars and hot sub-dwarfs; extended main sequence turn-offs; red stragglers and sub-subgiants; lithium-rich stars; and blue stragglers) are caused by the interplay between stellar rotation and binary interactions, that are greatly enhanced in the special environment of star cluster, with spectacular results.

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Stelle, Popolazioni Stellari e Mezzo Interstellare / **113**

Resolved stellar populations in Local Group dwarf galaxies

Author: Matteo Monelli[1]

[1] *Istituto de Astrofísica de Canarias (IAC)*

Corresponding Author: monelli@iac.es

Local Group dwarf galaxies provide valuable information about the early Universe through the detailed study of their resolved stellar populations. I will present some of the latest results concerning the the star formation history and variable stars content of nearby galaxies. In particular, I will show how RR Lyrae stars can be used to constrain the early chemical evolution and the early star formation history, and that this can be applied to nearby groups of galaxies.

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Stellar Pulsation Models to Pave the Road to the Rubin-LSST Revolution'

Author: Giulia De Somma[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: giulia.desomma@inaf.it

Pulsating stars are pivotal both as primary distance indicators for calibrating the cosmic distance ladder and as reliable stellar population tracers. Their intrinsic variability and the relations between pulsation properties and evolutionary parameters make them excellent probes for studying galactic evolution and star formation. The modeling, both from an evolutionary and pulsation point of view, is crucial to understanding these objects. We have recently computed detailed and homogeneous nonlinear pulsation models for Classical Cepheids (CCs) using the Stellingwerf hydrodynamical code. These models account for variations in chemical composition, the mass-luminosity (ML) relation, and the efficiency of super-adiabatic convection, resulting in accurate predictions of observable quantities such as instability strips, multi-filter light curves, mean magnitudes, and colors. The whole theoretical scenario has been transferred in the Gaia and Rubin-LSST photometric systems. By combining pulsation predictions with self-consistent evolutionary models, we have also derived accurate metal-dependent Period-Age and Period-Age-Color relationships.
This framework has been applied to investigate a sample of Galactic Cepheids from Gaia Early Data Release 3 (EDR3) to constrain, e.g., the Cepheid age distribution.
These analyses are integral in our SPECTRUM project whose main aim is to develop a synergy between stellar pulsation and evolution models to allow an important step forward in stellar astrophysics.

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Identification and characterization of AGB stars in NGC 6822

Author: Maria Tantalo[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: maria.tantalo@iac.es

The thermally-pulsing Asymptotic Giant Branch (TP-AGB) stars are considered tracers of the intermediate-to-old populations in a galaxy, as they cover a broad range of stellar masses (M ~ 1-8 $M_{\odot}$). Moreover, and even more importantly, their classification in oxygen- (O-) and carbon-rich (C-rich) stars can serve as useful galaxy diagnostics. Indeed, the efficiency of the physical mechanisms that occur during this evolutionary stage and affect their surface chemical composition (i.e. third dredge-up, convective overshooting, mass loss, hot bottom burning) depends, among others, on the stellar mass and the metal abundance. This means that the population ratio between C- and O-rich stars can be used to estimate the metallicity of the environment from which they formed. Besides, they play a key role in the dust production process and in the chemical enrichment of galaxies, since they produce neutron capture elements.
I plan to discuss the pros and cons of the different diagnostics adopted in the literature to identify AGB stars and the new solid optical/NIR/MIR colour-colour diagrams we developed for the identification and characterization of the O- and C-rich stars in the Local Group dwarf irregular galaxy NGC 6822. I will also deal with the comparison of the new photometric diagnostics with evolutionary prescriptions either including or neglecting the presence of the dust.

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The extragalactic distance scale from near infrared observations of Type II Cepheids in the Magellanic Clouds

Authors: Teresa Sicignano[1]; Vincenzo Ripepi[2]; Marcella Marconi[2]; Roberto Molinaro[2]; Anupam Bhardwaj[2]; Giulia De Somma[2]

[1] *Scuola Superiore Meridionale-INAF OACN*

[2] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: teresa.sicignano@inaf.it

Type II Cepheids(T2Cs) are the less used counterparts of classical Cepheids(CCs), which provide the primary calibration of the distance ladder for measuring H0 in the local Universe. In the era of the 'Hubble tension', T2Cs together with the RRLyrae stars and the tip of the red giant branch(TRGB) can potentially provide non-CC-dependent calibration of the cosmic distance ladder.
Our goal is to provide an absolute calibration of the period-luminosity and period-Wesenheit relations(PL and PW) of T2Cs in the Large Magellanic Cloud(LMC), which serves as anchor of the extragalactic distance ladder.
We exploited time-series photometry in the near-infrared(NIR) YJK bands for 320 T2Cs in the Magellanic Clouds. These observations were acquired in the context of the VISTA survey of the Magellanic Clouds system, an ESO public survey. We used the best-quality NIR light curves to generate templates for modelling sparsely sampled light curves.
The template light curves were used to derive accurate and precise intensity-averaged mean magnitudes and pulsation amplitudes. We used optical and NIR mean magnitudes for different T2C subclasses to derive PL/PW relations in multiple bands, then calibrated with the geometric distance to the LMC and with the Gaia parallaxes.
We used our new empirical calibrations of PL-PW relations to obtain distances to 22 T2C-host Galactic globular clusters, which were found to be systematically smaller by 0.1 mag and 0.03-0.06 mag than in the literature. Better agreement is found between our distances and those based on RR Lyrae stars, providing support for using T2Cs for future distance scale studies.

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Our chemical origins: from prestellar cores to planets

Author: Linda Podio[None]

Since the discovery of the first exoplanet more than 5000 exoplanets have been detected. This indicates that planet formation is a robust mechanism and nearly every star in our Galaxy hosts a system of planets. However, little is known about the chemical processes which were at work during the star and planet formation process, and which concurred to determine the chemical composition of the Solar System and of an habitable planet.

The Solar System is born from a dense core in a molecular cloud which underwent gravitational collapse giving rise to the Sun, and a disk of gas and dust, the protosolar nebula, where planets

formed due to dust grains growth and assemble. The chemical composition of planets depends on the processes occurring along the star and planet formation process, from the prestellar core stage, when complex organic molecules form on the icy mantles of dust grains, to the formation of planets in the disk and the delivery of organic material from comets and meteorites. Investigating the physical and chemical processes occurring along the star and planet formation process is a fascinating journey to reconstruct our chemical origins.

I will review the observational efforts carried out to chemically characterise young Solar-System analogs, from the prestellar stage to planet-forming disks. I will show the efforts to understand the formation routes of molecules through the synergy with experts of theoretical and laboratory chemistry. I will stress the importance of future radio observations to investigate the chemistry in the planet formation region.

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Stelle, popolazioni stellari e mezzo interstellare

Stelle, Popolazioni Stellari e Mezzo Interstellare / 125

Revealing the Milky Way's Hidden Satellites with the current and ongoing facilities

Author: Massimiliano Gatto[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: massimiliano.gatto@inaf.it

In the past two decades, the exploration of Milky Way (MW) satellites has intensified due to the availability of wide-field deep panchromatic photometric surveys carried out with the new generation of telescopes. The application of high-performance overdensity detection techniques on extensive datasets has significantly increased our knowledge of stellar systems residing in the MW halo. These surveys have unlocked the exploration of the low-luminosity faint end of the galaxy luminosity function, which was previously inaccessible, encompassing dwarf galaxies and ultra-faint dwarf (UFD) galaxies. UFDs are not only renowned as the most dark-matter-dominated objects in the Universe but also as the oldest and least chemically evolved galaxies, making them invaluable probes for unraveling the MW's mass assembly history. Anticipating the impact of the forthcoming Vera C. Rubin Observatory on the census of UFD galaxies in the Local Group, we exploited the untapped potential of the Kilo-Degree Survey (KiDS), which has not yet been utilized in the quest for low-surface brightness satellites of the MW. This endeavor culminated in the discovery of a novel member within the MW satellite family.

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Stelle, popolazioni stellari e mezzo interstellare

Stelle, Popolazioni Stellari e Mezzo Interstellare / 70

Can the Oosterhoff dichotomy unveil the formation of the Galactic Halo?

Author: Emanuela Luongo[1]

Co-authors: Marcella Marconi [1]; Vincenzo Ripepi [1]; Giuseppe Longo [2]; Zdenek Prudil [3]; Marina Rejkuba [3]

[1] *Istituto Nazionale di Astrofisica (INAF)*

[2] *UNINA*

[3] *ESO*

Corresponding Author: luongoemanuela@libero.it

The Gaia mission astrometric and photometric data releases have revolutionized our knowledge about the Milky Way. The discoveries of ancient merging episodes with a range of satellites and progenitor galaxies, such as Gaia-Enceladus, Sequoia, Kraken and others, led to new insights on the formation of the Galactic halo. We investigated pulsational, photometric, kinematic and chemical properties of RR Lyrae variable stars located in Galactic Globular Clusters (GGCs) and among the Galactic halo populations to probe the possible correlation between the Oosterhoff behaviour and past merging episodes. To this purpose, we adopted the Gaia Data Release 3 (DR3) combined with the literature compilation of radial velocities from the large surveys. The association between the different populations of RR Lyrae with Galactic halo substructures is explored using the integral of motion space diagrams that are computed on the basis of observables. We also discuss the comparison with the Galactic Halo studies by Belokurov and Kravtsov (2023) and Callingham et al. (2022) and the implications of our results for a better understanding of the origin of the Oosterhoff dichotomy and of the assembly history of the Galactic halo.

sessioni congresso:

Stelle, popolazioni stellari e mezzo interstellare

Stelle, Popolazioni Stellari e Mezzo Interstellare / **110**

What we expect from PLATO

Author: Isabella Pagano[1]

[1] *INAF*

Corresponding Author: isabella.pagano@inaf.it

Labeled as M3 in the ESA Cosmic Vision 2015-2025 program, the PLATO (PLAnetary Transits and Oscillations of stars) satellite is scheduled for a launch with Ariane 6 from French Guyana at the end of 2026. Although conceived and preliminary designed 16 years ago, when the research on exoplanets was at his infancy, the PLATO mission main scientific objectives continue to be unachieved by other experiments appeared in meantime. With 26 telescopes on board, providing a huge field of view (eleven thousand times the size of the full Moon in the sky) PLATO is expected to monitor at high cadence and for uninterrupted series - lasting months to years - MS bright stars, in this way providing unique information on their age and mass and on the architecture of their planetary system, with unprecedented characterisation of the interior of terrestrial planets in the habitable zones of solar type stars.
I will illustrate the project and the opportunities it will offer to the researchers' community.

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Stelle, popolazioni stellari e mezzo interstellare

Stelle, Popolazioni Stellari e Mezzo Interstellare / **117**

Neptune-sized exoplanets come in a far more diverse range than we ever imagined

Author: Luigi Mancini[1]

[1] *Department of Physics, University of Rome "Tor Vergata"*

Corresponding Author: lmancini@roma2.infn.it

Sub-Neptune and Neptune-sized Exoplanets exhibit a more and more surprising wide diversity of masses and bulk density. Determining their internal composition is, actually, a key parameter that can provide insights into whether these planets are predominantly composed of volatile materials or if they have significant amounts of denser substances such as water or rocky materials. Such information is, therefore, fundamental for understanding their formation and evolution, especially for those that lie in the hot-Neptune "desert" where the vicinity with their parent stars can induce atmospheric escape processes. Also in the context of possible planetary atmosphere characterization with the JWST, it is very important to measure the mass of these planets with a precision of ~5sigma. Such precision requires a long RV monitoring of the parent stars and the use of very high-resolution spectrographs. The TESS space telescope is providing many transiting-planet candidates, orbiting bright stars, that are excellent targets for high-precision spectroscopic follow-up observations, which allow us to physically characterize these planets and explore their parameter space. In this context, we will present an update on our project concerning the high-cadence RV monitoring of a list of Neptune-sized Tess planet candidates. This project is currently split into two observational programs: the first is performed by using HARPS-N at the TNG and is focussed on hot-Neptune TESS candidates, while the second involves the use of HARPS at the ESO 3.6m telescope and a list of warmer Neptunes has been selected.

sessioni congresso:

Stelle, popolazioni stellari e mezzo interstellare

Stelle, Popolazioni Stellari e Mezzo Interstellare / 135

VBMicrolensing: a code for the computation of microlensing of multiple systems

Authors: Valerio Bozza[1]; Vito Saggese[2]

[1] *Istituto Nazionale di Astrofisica (INAF)*

[2] *Dipartimento di Fisica "Ettore Pancini", Università di Napoli Federico II*

Corresponding Author: vito.saggese@unina.it

Microlensing is a specific case of gravitational lensing in which we observe an apparent amplification of the brightness of the source in a typical bell-shaped light curve. Microlensing enables us to study a variety of objects; in particular, it is the most promising technique for finding Earth-mass extrasolar planets located beyond the snowline.
The computation of microlensing light curves poses a significant computational challenge because it is extremely time-consuming. The release of the VBBinaryLensing code, utilizing the contour integration method, represents a notable advancement in the field, being the fastest public code for calculating microlensing effects. However, it is limited to binary events.
In this work, we present a new code, VBMicrolensing, with the aim of expanding upon the previous one to analyze systems with more than two lenses. This includes triple star systems, host stars with two planets in the lensing zone, or even planetary systems with exomoons.
The ability to model multiple-lens events will play an important role, especially with upcoming space missions such as the Nancy Grace Roman Space Telescope mission. Scheduled for launch in 2026, Roman incorporates a microlensing planet-finding program and will be more sensitive than current instruments. It is expected to reveal numerous microlensing events caused by multiple systems.
The availability of a public code capable of solving systems with several lenses becomes fundamentally important and would make it possible to contribute to future analyses of microlensing events.

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Da Arte Liberale del Quadrivio a disciplina opzionale: l'esperienza dell'insegnamento / 157

Saluti Istituzionali

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Da Arte Liberale del Quadrivio a disciplina opzionale: l'esperienza dell'insegnamento / 77

Uso di contesti astronomici per la ricostruzione didattica dei contenuti del curriculum di fisica

Author: Italo Testa[1]

Co-author: Silvia Galano [1]

[1] *Dipartimento di Fisica "E. Pancini", Università degli Studi di Napoli Federico II*

Corresponding Author: italo.testa@unina.it

Le ricerche internazionali mostrano che gli studenti sono generalmente poco interessati agli argomenti di fisica che incontrano nel corso del loro percorso scolastico. Una strada proposta per porre rimedio a questa situazione è quella di sfruttare il capitale motivazionale offerto dagli argomenti di Astronomia, considerata spesso come una sorta di "Gateway Science" per gli studenti che vogliano poi intraprendere percorsi STEM (Science Technology Engineering and Mathematics). In tale ottica, l'obiettivo più ampio dell'insegnamento dell'astronomia ai vari livelli scolastici non è più quello di creare futuri astronomi e astrofisici, ma ispirare gli studenti ad apprezzare la scienza in generale e favorire un apprendimento più consapevole e profondo di concetti come la luce, l'energia o la gravitazione universale. In questa presentazione, riassumerò le ricerche del mio gruppo in cui contesti astronomici come l'evoluzione e la stabilità delle stelle, l'alternarsi delle stagioni o il Sole, sono stati "ricostruiti didatticamente" ed utilizzati per affrontare argomenti del curriculum di fisica, dal suono alla termodinamica, dal momento angolare all'elettromagnetismo. Dimostrerò quindi come sia sempre più necessario un dialogo tra la comunità dei ricercatori in didattica della fisica e la comunità degli astronomi e degli astrofisici al fine di giungere ad una visione condivisa della didattica dell'astronomia che sia alla base di iniziative consolidate di orientamento e divulgazione come il Piano Lauree Scientifiche o i Percorsi per le Competenze Trasversali e l'Orientamento rivolte a studenti ma anche delle future attività rivolte a docenti in prima formazione o in servizio.

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I campionati di astronomia un ponte per la didattica

Corresponding Author: gcutispoto@oact.inaf.it

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Il Concorso "Giovani Astronomi/e al TNG"

Authors: Angela Misiano[1]; Vincenzo Testa[2]

[1] *SAIt*

[2] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: vincenzo.testa@inaf.it

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Tavola rotonda "L'interdisciplinarità dell'astronomia e le competenze trasversali"

Corresponding Authors: stefano.sandrelli@inaf.it, italo.testa@unina.it, vincenzo.testa@inaf.it

Coordina Massimo Esposito - Già Ispettore tecnico MIM

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Conclusioni

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Expected breakthroughs in the field of "Sun and Solar System"

Author: Maria Elisabetta Palumbo[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: mepalumbo@oact.inaf.it

At INAF the research in the field of "Sun and Solar System"is included in the scientific national grouping 3 (Raggruppamento Scientifico Nazionale 3, RSN3). As in other fields of science, the research activities are divided into three main areas: observations, models/theory, and laboratory.
Like the other groupings, observations in the area of RSN3 are carried out with ground-based and space-borne telescopes (remote sensing). However, our grouping is in addition characterised by the extensive use of space probes that provide close-up imaging or even sampling of the objects of interest. Models and theory are reaching increasingly high levels of sophistication and realism by taking advantage of modern and state of the art knowledge on machine learning and artificial intelligence (e.g. for space weather applications). Laboratory activity is devoted (i) to design and test scientific instruments, (ii) to analyse extraterrestrial samples and relevant analogues, and (iii) to study the effects of energetic processing on solid samples to simulate the effects of space weathering (solar wind, solar energetic particles, galactic cosmic rays, electromagnetic radiation, meteorite and micrometeorite impacts) on the surface of solar system objects without a thick atmosphere and/or without a magnetic field.
In this talk, I will review some of the main activities the RSN3 community is involved in and will outline the expected breakthroughs.

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Sole e Sistema solare

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Molto grande, molto piccolo: le nuove frontiere nello studio dei piccoli corpi del sistema solare

Author: Davide Perna[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: davide.perna@inaf.it

I piccoli corpi del sistema solare, quali asteroidi, comete e oggetti transnettuniani, rappresentano una finestra unica sulla storia del sistema solare. Lo studio delle loro proprietà fisiche e orbitali consente

infatti di ottenere indizi fondamentali sui processi di formazione ed evoluzione del nostro sistema planetario.
La prossima decade si preannuncia come un periodo rivoluzionario per la scoperta e la caratterizzazione di questi oggetti, grazie all'entrata in funzione di strumentazione di nuova generazione e all'innovazione tecnologica nel settore spaziale.
Il Vera C. Rubin Observatory, con il suo progetto Legacy Survey of Space and Time (LSST), aumenterà di almeno un ordine di grandezza il numero di piccoli corpi conosciuti, mentre l'Extremely Large Telescope (ELT) dell'ESO permetterà di sondare le loro proprietà fisiche con un livello di dettaglio senza precedenti per osservazioni da terra.
Inoltre, l'utilizzo di nanosatelliti nello spazio profondo rappresenta una nuova frontiera per l'esplorazione del sistema solare. In particolare, la possibilità di dispiegare flotte di queste piattaforme per studiare asteroidi e comete, permetterà di esaminare la loro enorme diversità fisica in modo più sistematico e dettagliato.

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Aeolian bedforms and cimate on Mars

Author: Simone Silvestro[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: simone.silvestro@inaf.it

Wind is the dominant agent of landscape modification on Mars, playing this role throughout much of the planet's history. Therefore, accurately characterizing the interaction between the atmosphere and the surface could provide insights into present and past Martian climates. Aeolian (wind-related) dunes and ripples (bedforms) are commonly used to infer current and paleo winds on Mars. This is key for validating atmospheric models and accurately interpreting local geology. Two main classes of aeolian bedforms have been identified from satellite imagery on Mars: large, active dark dunes, reaching up to 700 meters in spacing and 80 meters in height, and smaller, mostly inactive bright-toned dune-forms, with spacings ranging from 5 to 100 meters and heights from 1 to 14 meters. We will present results from different study areas, including the ESA ExoMars 2028/30 landing sites, where aeolian bedforms have been used to encode Martian climatic conditions at different spatial and temporal scales.

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A measurement system for the characterization of the electrostatically levitated lunar dust.

Author: Carmen Porto[1]

Co-authors: Francesca Esposito [1]; Gabriele Franzese [1]; Giuseppe Mongelluzzo [1]; Simone Silvestro [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: carmen.porto@inaf.it

The Moon is covered by a layer of regolith which consists of fractured rock and unconsolidated debris, mainly resulting from micrometeorite bombardment. With no magnetosphere and almost no atmosphere, the regolith is directly exposed to solar wind and the full solar spectrum. As a result, it acquires a charge, and its finest part, the so-called lunar dust, may exhibit unusual behavior, including levitation and transport across the surface due to electrostatic forces. Several observations indicate the occurrence of this electrostatic process, which has attracted increased attention for its important role in the evolution of the physical and spectral properties of the lunar surface. Moreover, the lunar dust is regarded as one of the major technical challenges for future exploration on the Moon, especially for long-term human presence. Dust mobilization due to natural mechanisms and/or human activity, indeed, poses a hazard to operations and hardware and crew safety. The behavior of charged dust needs to be well characterized to define appropriate operations, design, and mitigation strategies.

I will present the research activity that the INAF-OACN planetology group is carrying out as part of the "Earth-Moon-Mars (EMM)"project, founded in the framework of the PNRR. This activity aims to develop a prototype of a system conceived to characterize the dust grains that electrostatically levitate above the lunar surface, measuring their charge and velocity. In addition, the project involves the development of a facility to simulate the lunar dust environment and the conditions that electrically charge the dust grains on the lunar surface.

sessioni congresso:

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Indication of organics in small areas of Ceres'surface: investigation in the Yalode crater

Author: Samuel D'Urzo[1]

Co-authors: Maria Cristina De Sanctis [1]; Andrea Raponi [1]

[1] *INAF/IAPS*

Corresponding Author: durzo.1805501@studenti.uniroma1.it

Ceres is a dwarf planet in the main asteroid belt. In 2007, NASA launched the Dawn mission, which entered Ceres' orbit in 2015. The mission collected a vast amount of data by using Visible and Infrared Spectrometer (VIR). This data has made Ceres an intriguing target for astrobiological investigation, revealing carbon, minerals, salts and aliphatic organics. We can identify aliphatic organic matter by an absorption band around 3.4 μm in IR spectra and a redder spectral slope in VNIR wavelengths. These elements can be found in a large region near Ernutet crater. The "Yalode region" was examined in this study because it was identified by previous research based on the camera data as a candidate area for hosting organic material. The objective of this study was to confirm the presence of aliphatic organics using a modeling approach to the VIR spectra, applying the Hapke theory. The spectra show deep bands at wavelengths of 3.4 μm that could be due to carbonate and/or organics, making the identification of the organics particularly challenging. We inserted mixtures containing materials from the medium soil of Ceres plus organics from and into the model. The study found that the most accurate model involves a combination of semianthracite and medium anthraxolite as organic components. These organic materials are different from those previously used to interpret the intense absorption in the Ernutet crater. The study identified Fe-carbonate (siderite) as new mineral on Ceres' surface that can be used to model both global and localized regions.

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The JUICE mission to the Jupiter System

Author: Giuseppe Piccioni[1]

Co-authors: François Poulet [2]; Yves Langevin [2]

[1] *Istituto Nazionale di Astrofisica (INAF)*

[2] *Institut d'Astrophysique Spatiale, CNRS/Université Paris-Saclay, France*

Corresponding Author: giuseppe.piccioni@inaf.it

The JUICE mission is the first large-class mission under the ESA Cosmic Vision Programme. The spacecraft was successfully launched on April 14 2023 and the insertion into Jupiter's orbit is foreseen in July 2031 after several fly-bys, including Earth, Moon, and Venus. JUICE will provide a comprehensive survey of the Jupiter system, with particular emphasis on the three ocean worlds Ganymede, Europa, and Callisto. Europa and Ganymede are considered special cases in terms of Solar System habitability, a key question of the Cosmic Vision Program. The Galilean satellites exhibit extreme diversity today in a relatively short distance, reflecting the complexity of the processes along their evolution. Ganymede will be investigated with 12 flybys followed by a 9-month orbital phase starting in December 2034 and at this point, JUICE will be the first mission with a spacecraft orbiting another satellite besides our Moon. Europa will be investigated with two flybys, Callisto will be studied in detail during 21 flybys, and additional remotely sensed information on Io, the smaller moons, will complete the satellite tour. Finally, during the nominal duration of the Jovian tour (about 3.5 year), the mission will characterize the Jupiter's atmosphere, its aurorae and magnetosphere, along their interaction with the Galilean satellites. Among the key instruments on board, MAJIS (Moons And Jupiter Imaging Spectrometer), an hyperspectral imager operating from 0.50 μm to 5.54 μm, will perform observations to characterize the geology, the surface composition and the exospheres of satellites as well as the Jovian atmosphere and aurorae.

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Heliophysics and Space Weather: Integrating Data, Expanding Horizons

Author: Dario Del Moro[1]

[1] *University of Rome Tor Vergata*

Corresponding Author: dario.delmoro@roma2.infn.it

Space Weather represents a "science with applications" that inherently requires the integration of various areas of study and expertise for a detailed description of the physical parameters characterizing interplanetary space and its interaction with the planetary environment. The scientific component of this discipline, heliophysics, is currently seeking new data to improve short and long-term forecasts and further test our understanding of scientific fundamentals. Indeed, in many cases, the availability and quality of data are not sufficient to validate the models developed by the scientific community to address the remaining open questions (e.g., magnetic reconnection, coronal heating, particle acceleration, and magnetic field transport).

In the coming years, significant progress can be anticipated, driven by the launch of new space missions, the construction of new ground-based infrastructures, and a paradigm shift in data access. Large national research centres will collaborate to standardize and make available interdisciplinary datasets. New, broader, and more detailed datasets will open up new opportunities for the application of advanced methodologies, such as Machine Learning, already used with significant success for Space Weather event prediction, and will support the expansion of the discipline towards Planetary Space Weather and the study of planetary habitability in relation to stellar activity.

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Sol Invictus: Risultati recenti e prospettive future nello studio della fisica solare italiana

Author: Silvano Fineschi[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: fineschi@oato.inaf.it

RSN3

sessioni congresso:

Sole e Sistema solare

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Multi-scale, multi-view and multi-messenger observations of solar eruptions

Author: Giuliana Russano[1]

Co-authors: Vincenzo Andretta [1]; Serena Maria Lezzi [1]; Preity Sukla Sahani [1]; Clementina Sasso [1]; Thomas Straus [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: giuliana.russano@inaf.it

The launch of the Solar Orbiter mission in February 2020 heralded a new era in the field of solar physics. The spacecraft is equipped with both remote sensing and in-situ instruments, enabling true multi-messenger observations of the Sun and the solar wind. Integrated on the same spacecraft are all the necessary instruments for a comprehensive sampling of the inner heliosphere, from in situ measurements of solar wind plasma, magnetic fields, waves and energetic particles, as well as remote sensing measurements at unprecedented temporal coverage and spatial resolution of solar radiation spanning from X-ray to extreme ultraviolet.
In particular, one of the payloads, the Metis coronagraph built and operated in Italy, is equipped with two distinct channels, a narrow-band one in the UV H I Ly-alpha line (121.567 nm) and a broad-band in visible-light (580-640 nm range), whose field of view extends from 1.7 to about 9 solar radii varying with the heliocentric distance. The Metis coronagraph can track the evolution of eruptive events and measure plasma properties such as temperature, density distributions, and energy budget.

It also enables the analysis of the kinematic state of these events, including their speed, acceleration, and geometry.
In this presentation, we provide an overview of the eruptive events observed not only by the Metis coronagraph and the other instruments aboard the Solar Orbiter –both in-situ and remote-sensing. Additionally, we combine data from ground-based and other space observatories to achieve a 3D perspective and conduct a multi-messenger analysis of these events.

sessioni congresso:

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An innovative facility for the simulation of Martian sand/dust phenomena

Author: Giuseppe Mongelluzzo[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: giuseppe.mongelluzzo@inaf.it

In the framework of the "Earth Moon Mars"(EMM) project of the PNRR, the INAF –OACN Space Planetology Laboratories are upgrading their Martian facility to develop a unique, ground-breaking facility that will permit a comprehensive simulation of the Martian environment. The facility is made of a vacuum chamber, that allows the reproduction of Martian atmosphere in terms of pressure and composition, and of several instruments, systems and sensors. The facility will be able to reproduce the presence of dust in Martian atmosphere and the consequently induced electrical field, allowing the study of the effect of the electrical field on dust lifting on Mars, which is novel in literature. A Martian wind tunnel will be installed in the vacuum chamber, and will be suited to accommodate a sandbed, allowing the study of wind-formed features on Martian soil. The sandbed will be positioned over a cold plate that will bring it to Martian temperatures. To study grain electrification, UV sources will simulate the effect of sun irradiation on the sand/dust and its effect in terms of electrical behaviour. By combining all these features, we will be able to comprehensively simulate Martian environment and sand/dust lifting phenomena, providing a significant input to Martian climatic models and possibly the answers the numerous open questions regarding these research topics. The presentation will show the capabilities of the facility and the expected outcomes of the research activities forecasted.

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The Great Debate: dalla galassia-universo agli universi-isola

Author: Ileana CHINNICI[1]

[1] *INAF OAPa*

Corresponding Author: ileana.chinnici@inaf.it

La storia dell'astronomia registra tra le tappe più importanti dello sviluppo dell'attuale conoscenza dell'universo il cosiddetto Great Debate, avvenuto agli inizi degli Anni Venti tra Harlow Shapley ed Heber D. Curtis. I due astronomi americani argomentarono ciascuno a favore di due modelli cosmologici, sulla base dello studio delle nebulose: il primo modello considerava le nebulose come oggetti appartenenti alla Via Lattea, il secondo ipotizzava invece che esse fossero altrettante galassie, separate e distanti dalla Via Lattea. Il talk intende ripercorrere le fasi del dibattito, fino all'evento che più tardi diede ragione a Curtis, ovvero l'osservazione di alcune Cefeidi nella galassia di Andromeda da parte di Edwin Hubble. La transizione dalla galassia-universo agli Universi-isola ha segnato l'inizio della comprensione attuale dell'universo. Il talk vuole dunque illustrare il punto di partenza e il contesto su cui si sono gettate le basi della cosmologia moderna.

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Innovazione e Coinvolgimento: Il Public Engagement nell'INAF - Trasformare la Ricerca in Esperienza

Author: Caterina Boccato[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: caterina.boccato@oapd.inaf.it

Il Public Engagement nell'Istituto Nazionale di Astrofisica (INAF) rappresenta una rivoluzione nel panorama della divulgazione scientifica, trasformando la ricerca in un'esperienza condivisa e coinvolgente. Come Responsabile Nazionale del Public Engagement, ho il privilegio di guidare questa iniziativa che va oltre la mera comunicazione scientifica, concentrandosi sull'interazione e sulla partecipazione attiva del pubblico e dei ricercatori stessi. In questa presentazione, esplorerò la struttura e le basi fondamentali del nostro approccio al Public Engagement, evidenziando come sia centrato sulle persone: non solo il pubblico, ma anche i ricercatori che trovano uno stimolo maggiore nel loro lavoro attraverso il processo di valorizzazione della ricerca. Condividerò le nostre strategie, le migliori pratiche e le esperienze significative che dimostrano il potenziale trasformativo di questa attività nel promuovere la comprensione pubblica della ricerca scientifica e nel consolidare il legame tra la comunità scientifica e la società.

sessioni congresso:

Didattica e Terza missione

Terza missione (didattica, divulgazione, MAB) / 84

Cosmic vision: Learning from the past to look at the future using the INAF historical astronomical atlases

Author: Mauro Gargano[1]

[1] *INAF - Osservatorio Astronomico di Capodimonte*

Corresponding Author: mauro.gargano@inaf.it

Astronomical observatories are the oldest scientific institutions in Italy. They preserve a remarkable heritage of star atlases, planetary cartography, selenography and cometography. These volumes are works of rare beauty that blend art, mythology and science. Within the INAF cultural heritage, the collection of celestial atlases plays a noteworthy role in the history of astronomy and modern culture as a whole.
With this project, we have identified a relevant group of rare and valuable atlases and books showing a clear vision of the evolution of scientific knowledge of the universe. The atlases have been studied and digitized; then the scientific catalogue Cosmic Pages and the virtual exhibition: *Look Up!* were made. Furthermore, in collaboration with Save the Children-Italia, we have developed educational workshops for children living in the most socially vulnerable Italian urban areas. Finally, we produced the documentary *Touch Sky*, the first one realized by INAF, programmed by Rai Cultura on national channels and offered on its digital platform.

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L'Office of Astronomy for Education Center Italy, l'ufficio internazionale della IAU per l'education: che cosa è, che cosa fa

Author: Stefano Sandrelli[None]

Corresponding Author: stefano.sandrelli@inaf.it

Fondato nel marzo 2021, l'OAE Center Italy è un ufficio internazionale, parte integrante dell'Office of Astronomy for Education della IAU.
Fra gli altri progetti, lo OAE ha sviluppato una serie di processi collaborativi nel settore dell'education, con un focus iniziale sul Mediterraneo. Hanno partecipato, in varie fasi, rappresentanti di Albania, Cipro, Croazia, Egitto, Francia, Grecia, Israele, Italia, Marocco, Montenegro, Palestina, Portogallo, Slovenia, Siria, Spagna e Turchia.
Il metodo adottato è la coprogettazione tra pari, con due obiettivi specifici:
• Creare un network di persone che assumono la coprogettazione come prassi
• Realizzare un percorso di apprendimento per le scuole primarie arricchito da punti di vista diversi, tenendo sempre presente il protagonista dell'apprendimento: lo studente
Dopo gli incontri del 2021 (Lampedusa) e del 2022 (Ifrane, Marocco), nel 2023 la Mediterranean Regional SHAW-IAU Workshop on Astronomy for Education si terrà in ottobre presso la Istanbul Kultur University, Istanbul (Turchia). Sempre a Istanbul, OAE Center Italy organizza il workshop residenziale FRESCO, un co-design centrato sull'Game-Based Learning. A Milano, si terrà invece dal 2 al 7 settembre il workshop residenziale Sabir, un co-design centrato sull'Inquiry-Based Learning.
L'OAE Center Italy è un ufficio IAU coordinato e finanziato da INAF e supportato da SAIt e Università di Tor Vergata.

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Valorizzazione e preservazione del Patrimonio Astronomico "extra moenia"nel territorio di Palermo

Author: Maria Luisa Tuscano[1]

[1] *Sisfa*

Corresponding Author: mltuscano@gmail.com

Con questo intervento ho intenzione di promuovere e mantenere conoscenza e sorveglianza di un patrimonio astronomico diffuso nel territorio di Palermo, ma non protetto all'interno di peculiari strutture scientifiche.
Costituito da strumenti, iconografie e manufatti, riconducibili alla composita tradizione sociale di diverse etnie che si sono compenetrate e avvicendate con i loro antichi saperi, esso non sempre può essere tutelato dalle norme legislative che garantiscono la preservazione dei beni scientifici.
Alla base di questo problema, esiste la necessità di riconoscere anche a questo patrimonio la dignità di quello custodito nelle collezioni museali. Questo presuppone che se ne comprendano le peculiarità, se ne apprezzino i significati più intimi, si approfondisca la loro contestualizzazione storica, se ne verifichi, ove necessario, la finezza della misurazione.
Si tratta di uno studio che ho condotto negli anni, dando vita ad una recente pubblicazione, con l' intento di consegnare una testimonianza per eventuali future ricerche.

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I quaderni di EduINAF: una collana per appassionare alle STEM fuori e dentro la classe

Author: Maria Teresa Fulco[1]

Co-author: Livia Giacomini [1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: maria.fulco@inaf.it

Le indicazioni nazionali per il curricolo scolastico di ogni ordine e grado, aggiornate agli obiettivi dell'agenda ONU 2030, mettono al centro l'alunno visto come co-costruttore del proprio sapere. Il metodo tradizionale di insegnamento,quindi, si è trasformato da didattica trasmissiva in uno stile che favorisce e valorizza la singola persona spingendola all'autonomia, alla responsabilità, alla ricerca, alla curiosità alla collaborazione e al raggiungimento di competenze che la rendono capace di affrontare e risolvere problemi.
In questo quadro di grandi cambiamenti che sta impattando il mondo della scuola, l'INAF si è dotata di nuovi strumenti e di persone dedicate alla Didattica e Divulgazione per usare l'astronomia e il fascino che ispira come strumento per favorire l'apprendimento delle materie STEM e la crescita personale
In questo intervento verranno presentati I Quaderni EduINAF, una collana di pubblicazioni monografiche pensate dalla redazione come supporto all'insegnante e allo studente per meglio comprendere o realizzare le attività didattiche in classe e fuori. Ogni Quaderno è strutturato in tre percorsi tematici ben distinti, adatti alla scuola primaria e alle scuole secondarie di I e di II grado, con contenuti astrofisici scelti da varie fonti (INAF e non)
I quaderni, fruibili sia in versione stampabile che on line nella forma di libro digitale (FlipBook), sono una delle tante risorse educative di EduINAF, il magazine on line dell'Istituto Nazionale di Astrofisica

un vero portale dove trovare "risorse educative aperte"(OER), ricco di materiali per l'insegnamento, l'apprendimento e la ricerca su qualsiasi supporto - digitale o di altro tipo.

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Commenti memorabili alle news e ai video di Media Inaf

Author: Marco Malaspina[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: marco.malaspina@inaf.it

Questo congresso ha come tema "un secolo di rivoluzioni"in astrofisica. Anche nel giornalismo le rivoluzioni non sono mancate. La mia presentazione si concentra su una rivoluzione in quest'ambito fra le più significative: il rapporto con i lettori. In particolare su un aspetto: i commenti. Limitati fino a due decenni fa alla mezza pagina che ospitava le lettere al direttore e alle domande in sala al termine dei convegni, da quando il giornalismo si è spostato in rete i feedback sono aumentati in modo esponenziale, incentivati dalle stesse piattaforme: ogni singola news ha il suo spazio per i commenti –che sia sul sito della testata o sui social network a essa associati.

Il caso su cui mi soffermerò è quello di Media Inaf, la testata giornalistica online dell'Istituto nazionale di astrofisica, e in particolare i commenti sulla sua pagina Facebook (oltre 100mila followers) e sul suo canale YouTube (50mila iscritti, 20 milioni di visualizzazioni): che commenti sono? Di cosa parlano? Ci sono tratti che si ripetono? Cosa ci dicono del nostro pubblico? E soprattutto cosa ci dicono di noi –di quel che facciamo e di come lo comunichiamo? Avendo ben chiaro che il pubblico dei commentatori non coincide con il pubblico tout court, certo. Ma anche che un flusso di commenti quotidiano e generoso, da un pubblico non selezionato, spesso anonimo e comunque molto libero è una fonte d'informazioni preziosissima. Nonché un'occasione imperdibile per sciacquarsi di dosso la patina d'autoreferenzialità che inesorabilmente tende a depositarsi sulla comunicazione istituzionale.

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MAB@INAF Musei archivi biblioteche INAF fra passato e futuro

Author: Antonella Gasperini[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: antonella.gasperini@inaf.it

Il Servizio Biblioteche Musei Terza Missione dell'INAF coordina una molteplicità di attività e progetti che toccano tematiche che possono sembrare fra loro distanti. Numerose sono le attività rivolte alla conservazione e restauro del patrimonio storico come pure i progetti di valorizzazione su specifici aspetti realizzati anche nell'ambito di ampie collaborazioni interistituzionali. Il patrimonio storico è

in grado di raccontare lo sviluppo delle conquiste scientifiche, generando anche occasioni di incontro tra la scienza e gli altri campi del sapere. In questo senso l'utilizzo di nuove tecnologie ha consentito la costruzione di un canale più diretto verso il pubblico favorendo la conoscenza di un patrimonio scientifico unico. Inoltre il Servizio è coinvolto nelle attività legate all'open access e alle questioni inerenti la pubblicazione dei risultati scientifici e, in una visione più ampia, della scienza aperta. Tra passato e futuro.

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Astri e schermi: coinvolgere il pubblico dalle dirette osservative al cinema

Author: Claudia Mignone[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: claudia.mignone@inaf.it

Questa presentazione illustra i risultati di due progetti di public engagement condotti dall'Istituto Nazionale di Astrofisica: il programma di dirette osservative "Il cielo in salotto" e la collaborazione con Circuito Cinema Scuole per portare l'astronomia al cinema.
"Il cielo in salotto" è il programma di dirette della rivista online EduINAF, per portare il fascino del cielo nelle case e nelle scuole d'Italia. Lanciato nel 2020, il programma ha creato un format per il livestreaming di osservazioni al telescopio della Luna, del Sole, di pianeti, stelle e galassie, molto apprezzato sia dalle scuole che dal grande pubblico. Per sfruttare la risonanza dei media e raggiungere un pubblico vasto, le dirette vengono organizzate in occasione di eventi astronomici speciali come eclissi, allineamenti e la visita di comete, ma anche della cosiddetta "superluna" (approfittando dell'attenzione mediatica per spiegare la reale portata dell'evento). L'ultima diretta, dedicata all'eclissi di Sole dell'8 aprile 2024, ha raggiunto oltre centomila visualizzazioni.
Dal piccolo schermo di smartphone, tablet e computer al grande schermo, "INAF al cinema" è una collaborazione con Circuito Cinema Scuole (associazione che organizza proiezioni di film per le scuole) per organizzare laboratori e incontri con ricercatrici e ricercatori in occasione della proiezione al cinema di film sui temi dell'astronomia e dell'astrofisica. Iniziata nel 2022 con il film "Peter va sulla Luna", la collaborazione ha raggiunto circa 2000 bambine e bambini nell'anno scolastico 2022/23 tra Roma, Genova, Firenze e Como e ha riscosso discreto interesse anche nell'anno scolastico corrente.

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Premiazioni SAIt

Galassie e Cosmologia / **150**

An investigation of galaxies at extreme redshifts with deep JWST observations

Author: Marco Castellano[None]

Corresponding Author: marco.castellano@inaf.it

JWST is transforming our understanding of the high-redshift universe and of the epoch of cosmic dawn. In this talk, I will focus on the results from the GLASS-JWST survey and from its follow-up spectroscopic Cycle2 campaign. The GLASS-JWST NIRCam observations led to the discovery of a puzzling high number density of bright galaxies 300-500 Myr after the Big Bang and to the presence of an overdensity at z~10 in the field. I will discuss the implications of these findings for our understanding of early galaxy evolution, and, in particular, I will present the results from the ongoing deep NIRSpec spectroscopic follow-up which confirms the redshift of a bright, high-ionizing object at z=12.3 and a high number of bright z~10 galaxies.

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Galassie e Cosmologia / **168**

Ongoing and Upcoming Breakthroughs in the Field of Galaxies and Cosmology

Author: Roberto Gilli[None]

Corresponding Author: roberto.gilli@inaf.it

Within INAF, research in the field of 'Galaxies and Cosmology' falls under the Scientific National Grouping 1 (Raggruppamento Scientifico Nazionale 1, RSN1). The scientific endeavors of RSN1 encompass both theoretical investigation and observational studies employing ground-based and space-borne telescopes. In this presentation, I will provide an overview of the primary activities undertaken by the RSN1 community, emphasizing ongoing advancements and anticipated breakthroughs in the forthcoming years.

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Galassie e Cosmologia

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The impact of stellar bars on quenching star formation: insights from a spatially resolved analysis in the local Universe

Author: Letizia Scaloni[1]

[1] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: letizia.scaloni@inaf.it

Stellar bars are present in about two-thirds of disc galaxies in the local Universe and are believed to play a crucial role in secular evolutionary processes, since they efficiently redistribute gas, stars and angular momentum within their hosts.
In this talk, I will present the main results obtained from a spatially resolved analysis of a sample

of six nearby barred galaxies, performed with the aim of exploring the potential impact of bars on quenching star formation at sub-kpc scales.
To this purpose, we collected multi-wavelength photometric data from the DustPedia archive and a SED fitting procedure was applied on square apertures of fixed angular size. For each galaxy we obtained the distributions of stellar mass and star formation rate surface densities and related them deriving the spatially resolved Main Sequence (MS) relation. Although galaxy-to-galaxy variations are in place, we revealed a common less star forming track in correspondence to the bar hosting region, which is in anti-correlation with respect to the best-fit MS.
Such a quiescent signature could be interpreted as the outcome of a bar-driven depletion of central gas resevoirs and a consequent halt of star formation, supporting the inside-out quenching scenario.
In the end, I will discuss future perspectives to extend these spatially resolved studies to larger samples of galaxies with different morphologies and at higher redshifts, exploiting JWST data. A proper selection and analysis of JWST data could also be crucial for identifying ideal extragalactic science cases to simulate the promising performances of MORFEO+MICADO at ELT.

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Low surface-brightness galaxy population in the Centaurus Cluster from the VEGAS survey

Author: Nicola Bellucco[1]

Co-author: Enrichetta Iodice [2]

[1] *Università degli Studi di Padova*

[2] *Istituto Nazionale di Astrofisica (INAF)*

Corresponding Author: nicola.bellucco.1@studenti.unipd.it

Low surface-brightness (LSB) dwarf galaxies and the subgroup of ultra-diffuse galaxies (UDGs) are an interesting class of objects as their evolutionary paths, contribution to the galaxy luminosity function, formation scenarios and dark matter content are still poorly constrained.
The study of LSB galaxies allows us to test the galaxy formation theories in a so far unexplored and unique parameter space. It also allows us to test gravity models because LSB galaxies have the lowest stellar mass content and are strongly affected by tidal forces.
A complete census of LSB galaxies is needed to test cosmological models and,
in particular, to investigate the missing satellite problem.
The upcoming large-sky surveys are going to explore the mu_g>30 mag/arcsec2 regime, providing a notable boost in the study of galaxy structure down to the LSB regime.
Using the deep imaging data from the VST Early Type Galaxy Survey (VEGAS),
I developed a new detection tool to identify and analyse LSB galaxies.
First promising results have been already obtained for the Centaurus cluster of galaxies, where I detected more than 200 new LSB galaxies, including UDGs.
This work is part of my PhD project, which aims at applying the detection tool on the entire VEGAS sample to obtain a census of more new ~5000 LSB galaxies. In this talk, I would like to briefly illustrate the detection tool and the preliminary results, and how it could be implemented for the future deep imaging surveys.

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