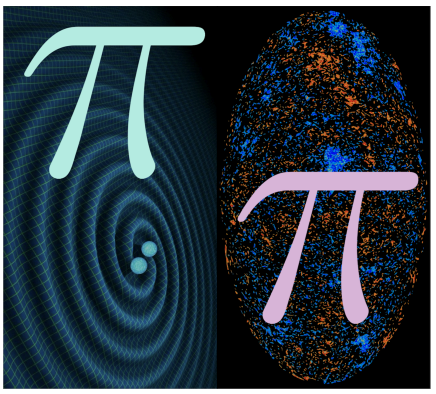


## The irrational squared "PIPI" meeting II

High Energy Processes and Compact Objects in the Universe

# Program and Book of Abstracts

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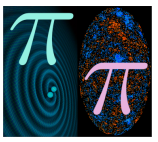
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# Program

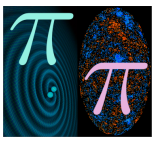
| | Wednesday, 4/11 | Thursday, 5/11 | Friday, 6/11 |
|---|---|---|---|
| 08:30 - 09:15 | Registration | | |
| 09:15 - 09:30 | Welcome remarks | | |
| 9:30 - 10:00 | Invited talk 1<br>Mariana Dutra | Invited talk 6<br>Ang Li | Invited talk 11<br>Ileana Andruchow |
| 10:00 - 10:30 | Invited talk 2<br>Melina Bersten | Invited talk 7<br>Marcelo Miller Bertolami | Invited talk 12<br>Florencia Vieyro |
| 10:30 - 11:20 | Coffee & Posters | | |
| 11:20 - 11:40 | Contributed talk 1<br>Belén Costanza | Contributed talk 6<br>Javier R. Martínez | Contributed talk 11<br>Arthur Almeida Franzon |
| 11:40 - 12:00 | Contributed talk 2<br>Federico García | Contributed talk 7<br>Loreany Ferreira de Araujo | Contributed talk 12<br>Francisco Plaza |
| 12:00 - 12:20 | Contributed talk 3<br>Ezequiel Zubieta | Contributed talk 8<br>Cristian Villavicencio | Contributed talk 13<br>A. Gabriela Grunfeld |
| 12:20 - 14:30 | Lunch | | *ChoriScience &*<br>*Pipi* Vucetich Award |
| 14:30 - 15:00 | Invited talk 3<br>Carlos Lousto | Invited talk 8<br>Ernesto Eiroa | |
| 15:00 - 15:30 | Invited talk 4<br>Germán Lugones | Invited talk 9<br>Gustavo Dotti | |
| 15:30 - 15:50 | Contributed talk 4<br>Marcos Celi | Contributed talk 9<br>Octavio Miloni | |
| 15:50 - 16:40 | Coffee & Posters | | |
| 16:40 - 17:10 | Invited talk 5<br>Jorge Horvath | Invited talk 10<br>Odilon Lourenço | |
| 17:10 - 17:30 | Contributed talk 5<br>Valentina Crespi | Contributed talk 10<br>Alcides Garat | |

# List of Invited Talks (click links to go to abstracts)

1. Mariana Dutra (Instituto Tecnológico de Aeronáutica, São Paulo, Brazil)
   *Dark-Fluid Cores in Neutron Stars: Stellar Structure, Stability, and Astrophysical Constraints*
2. Melina Bersten (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)
   *Stellar explosions in the era of large-scale surveys*
3. Carlos O. Lousto (Center for Computational Relativity and Gravitation-RIT, Rochester, Estados Unidos)
   *The Ultimate Collision of Black Holes: Maximal Gravitational Energy and Momentum Radiated*
4. German Lugones (Universidade Federal do ABC, São Paulo, Brazil)
   *Breaking the maximum-mass barrier: how out-of-equilibrium physics reshapes compact star stability*
5. Jorge Horvath (Instituto de Astronomia, Geofísica e Ciências Atmosféricas-Universidade de São Paulo, São Paulo, Brazil)
   *The mass of the neutron star*
6. Ang Li (Department of Astronomy, Xiamen University, Xiamen, China)
   *Constraints on EOS of Ultra-Dense Matter and the perspective of eXTP*
7. Marcelo Miller Bertolami (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)
   *White dwarfs as laboratories for fundamental physics*
8. Ernesto Eiroa (IAFE-CONICET-UBA, Buenos Aires, Argentina)
   *Black bounces: an interplay between black holes and wormholes*
9. Gustavo Dotti (FaMAF-UNC/CONICET, Córdoba, Argentina)
   *Geometric signatures of black holes*
10. Odilon Lourenço (Instituto Tecnológico de Aeronáutica, São Paulo, Brazil)
    *Neutron stars with dark matter content: description from short-range correlated models*
11. Ileana Andruchow (IAR-CONICET/FCAG-UNLP, La Plata, Argentina)
    *Relativity and Blazars: an observational point of view*
12. Florencia Vieyro (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)
    *Non-thermal emission and multi-messenger signatures from AGN jets*

# List of Contributed Talks (click links to go to abstracts)

1. Belén Costanza (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)
   *Machine learning-based Wiener Filtering for CMB polarization maps and power spectrum estimation: flat and curve sky*
2. Federico García (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)
   *Pulsar Monitoring from IAR: 10 years of the PuMA project*
3. Ezequiel Zubieta (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)
   *IAR's role in the constraints on gravitational waves emitted during the 2024 Vela pulsar glitch*
4. Marcos Celi (FCAG-UNLP/CONICET, La Plata, Argentina)
   *EVA-01: hadrons and quarks within a relativistic mean-field model*
5. Valentina Crespi (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)
   *Iron Kα signatures from accretion disks around fermionic dark matter cores*
6. Javier Rodrigo Martinez (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)
   *Large-scale emission from gamma ray binaries: the case of LS 5039*
7. Loreany Ferreira de Araújo (FCAG-UNLP/CONICET, La Plata, Argentina)
   *Possible interactions in the cosmological dark sector of the universe and aspects of formation and suppression of dark halos in neutron stars*
8. Cristian Villavicencio (Universidad del Bio-Bio, Concepción, Chile)
   *Axial-vector currents of pions and rho mesons in a magnetic field*
9. Octavio Miloni (UNLP, La Plata/UNAHUR, Hurlingham, Argentina)
   *Divergent Perturbation Series in Celestial Mechanics. From Poincaré to Resurgence*
10. Alcides Garat (Former Professor at Universidad de la República, Montevideo, Uruguay)
    *A new kinematic-electromagnetic Abelian gauge mechanism to explain dark energy and dark matter*
11. Arthur Almeida Frazon (Universidade Federal do ABC, São Paulo, Brazil)
    *Surface and Curvature Tension of Dense Hadronic Matter in a Relativistic Mean-Field Approach*
12. Francisco Plaza (FCAG-UNLP, La Plata, Argentina)
    *Unimodular Inflation with Higgs Seeds*



13. Ana Gabriela Grunfeld (IAFE-CONICET-UBA, Buenos Aires, Argentina)
    *Two regimes of universality in hybrid stars: global properties and quark cores*

# List of Posters (click links to go to abstracts)

1. Camila Celeste Carballo (FCAG-UNLP, La Plata, Argentina)
   *Efectos térmicos en proto-estrellas extrañas de quarks*
2. Juan Pablo Carlomagno (IFLP-CONICET, La Plata, Argentina)
   *Impact of hyperons and lepton fraction on hot isentropic hybrid neutron stars with color-superconducting quark matter*
3. Francisco De Gerónimo (IALP-CONICET-FCAG, La Plata, Argentina)
   *The composition of ultra-massive WDs*
4. Johanna Aylén Fandos (FCAG-UNLP, La Plata, Argentina)
   *Little Red Dots' under the lens of the fermionic dark matter model*
5. Griselda Figueroa-Aguirre (IAFE-CONICET-UBA, Buenos Aires, Argentina)
   *Thin-shell wormholes with charge: dynamical and thermodynamical analyses*
6. Guillermo Gancio (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)
   *Ten Years of Pulsar Monitoring at IAR: An Evolution in Radio Observation Techniques*
7. Nicolás Gómez Giménez (FCAG-UNLP, La Plata, Argentina)
   *Impacto ambiental en las propiedades de las galaxias satélite en cúmulos*
8. Tomás Tobías Mazzei (IALP-CONICET-FCAG, La Plata, Argentina)
   *Estudio de las condiciones iniciales de binarias progenitoras de ondas gravitacionales*
9. Juan Manuel Paez (IAFE-CONICET-UBA, Buenos Aires, Argentina)
   *Shadows in rotating black bounce spacetimes*
10. Nahuel Sánchez (FCAG-UNLP, La Plata, Argentina)
    *Análisis temporal y espectral de la fuente ultraluminosa de rayos X NGC 7456 ULX-1*
11. Julián Valdéz (FCAG-UNLP, La Plata, Argentina)
    *Energy Extraction from Cosmological Expansion: A Spring Gedanken Experiment in FLRW Spacetime*
12. Lautaro Zapata Soñez Altuna (FaMAF-UNC, Córdoba, Argentina)
    *Cuantización Asintótica de la Gravedad*

# Abstracts of Invited Talks

## Invited Talk #1

### *Dark-Fluid Cores in Neutron Stars: Stellar Structure, Stability, and Astrophysical Constraints*

Mariana Dutra (Instituto Tecnológico de Aeronáutica, São Paulo, Brazil)

We investigate the effects of short-range correlations (SRCs) on relativistic hadronic models at high densities and their consequences for neutron stars, both with and without dark matter. Two model versions are considered, differing in the treatment of the vector self-interaction: one includes terms up to second order, while the other also contains a fourth-order contribution. We find that SRCs soften the equation of state in the former case but produce a significant stiffening in the latter. This behavior is reflected in the corresponding mass-radius relations, with SRCs decreasing the maximum mass in the first model and increasing it in the second. We also study neutron stars containing a fermionic dark-matter component within a two-fluid formalism. The same qualitative trends persist, and the reduction of the maximum mass caused by increasing dark-matter content is partially compensated by SRC effects when the fourth-order vector interaction is included. The resulting stellar configurations remain compatible with current astrophysical constraints from NICER and GW190425.

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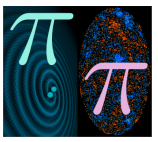
## Invited Talk #2

### *Stellar explosions in the era of large-scale surveys*

Melina Bersten (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)

Supernovae (SNe) are excellent laboratories for testing many aspects of stellar-evolution theory with strong implications on many various areas of astrophysics. Their light curves are extremely sensitive to the properties of their progenitor stars or systems and their environments. With the increasing amount and improved quality of current data, new types of SNe or unexpected features in normal events are being detected. These discoveries challenge our standard knowledge of how massive stars explode, as well as the mechanisms that power these events. In some cases, an emission before the explosion (or "precursor") has been detected, which opens a new window to explore these explosive events. In this talk, I will focus on our modeling efforts to understand the properties of normal and peculiar objects using one-dimensional radiation hydrodynamic calculations. In addition, I will present our numerical exploration of precursor emission for a wide range of progenitors and energies. Then, we will analyze their observational properties and discuss their potential detectability with upcoming wide-field surveys, such as LSST.

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## Invited Talk #3
### *The Ultimate Collision of Black Holes: Maximal Gravitational Energy and Momentum Radiated*

Carlos O. Lousto (Center for Computational Relativity and Gravitation-RIT, Rochester, Estados Unidos)

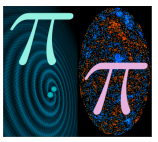
The collision of two black holes at relativistic speeds is the most extreme dynamical scenario in general relativity, of interest for tests of the area and radiation-bound theorems, for the physics of super-Planckian particle collisions and holography, and as the ultimate limit of how efficiently mass can be converted into gravitational waves. I will review a decade-long program of full numerical relativity simulations at RIT aimed at a simple question: how much energy and momentum can a black hole collision radiate? For head-on collisions of nonspinning, equal-mass holes, improved initial data with low spurious radiation content allow boosts up to v≈0.99c and place the maximum radiated energy at 13%±1% of the total mass, consistent with thermodynamic estimates. Grazing encounters radiate far more: a search over 769 simulations spanning impact parameter, initial momentum, and spin yields a maximum of about one third of the system's mass, roughly three times the quasicircular limit, together with remnant spins as high as 0.987, consistent with cosmic censorship. The net linear momentum, in contrast, depends strongly on spin: a search over 1381 simulations with in-plane opposite spins gives a maximum recoil of 28,562 km/s, about one tenth the speed of light. Finally, I will present new results on head-on collisions of spinning black holes, where the recoil is purely spin-driven and displays a pronounced antikick, with peak and final velocities obeying a near-universal proportionality, Vp≈7.4Vf. Analytic zero-frequency-limit expansions are used throughout to fit and extrapolate the numerical results toward the ultrarelativistic regime.

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## Invited Talk #4
### *Breaking the maximum-mass barrier: how out-of-equilibrium physics reshapes compact star stability*

Germán Lugones (Universidade Federal do ABC, São Paulo, Brazil)

The standard criterion for the radial stability of compact stars places the onset of instability at the maximum of the mass–radius relation. This criterion rests on an implicit assumption: every fluid element returns to beta equilibrium at each instant of a perturbation. In this talk I will show that dropping this assumption changes the stability picture substantially. When weak interactions are too slow to restore chemical equilibrium during the oscillation, new stable branches extend beyond the classical maximum-mass configuration. We find this in purely hadronic stars, in hybrid stars with a hadron–quark phase transition, and in self-bound quark stars. Solving the equations for radial oscillations, we find that the fundamental mode keeps a positive squared frequency along these branches, which confirms that these configurations are stable. I will discuss the microphysical mechanisms that damp the growth of



perturbations. I will close with possible observational signatures and the astrophysical implications of these objects.

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## Invited Talk #5
### *The mass of the neutron star*

Jorge Horvath (Instituto de Astronomia, Geofísica e Ciências Atmosféricas-Universidade de São Paulo, São Paulo, Brazil)

Once upon a time the community believed that the 1.4 $M_\odot$ was universal and called it “canonical”. However, in the last 20 years the situation changed substantially: the mass distribution was studied and proved to be at least bimodal. Measurements of actual objects forced to (reluctantly) increase the maximum value to some number above the $2M_\odot$ scale, and “low-mass” objects were confirmed. We discuss in this talk the new landscape, starting from the form and limits of the mass distribution, the expected formation channels and their relation to the mass problem, and the state-of-the art of the “mass gap” between 2-5 $M_\odot$ present in the literature. It is argued that the maximum mass must be at least 2.5 $M_\odot$ based on empirical evidence. Finally, we turn to the low-mass end and show that the two confirmed cases with M = 1.17 $M_\odot$ can not be produced by low-mass progenitors, but rather by the lightest ones that develop an iron core.

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## Invited Talk #6
### *Constraints on EOS of Ultra-Dense Matter and the perspective of eXTP*

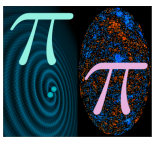
Ang Li (Department of Astronomy, Xiamen University, Xiamen, China)

Neutron stars provide a unique laboratory for exploring matter at densities beyond those accessible in terrestrial experiments. Precise pulsar masses, X-ray pulse-profile measurements, and gravitational-wave observations offer complementary constraints on the equation of state (EOS), yet the composition and phase structure of their cores remain uncertain. This talk will discuss how these observations constrain dense-matter physics, emphasizing the importance of mapping stellar structure across a range of masses to test high-density softening, additional degrees of freedom, and possible phase transitions. I will also introduce the prospects for eXTP to strengthen this program through X-ray timing, spectroscopy, and, for suitable targets, polarimetry. Particular attention will be given to target-dependent capabilities, modeling uncertainties, and the distinction between constraining the bulk EOS and identifying its microscopic origin.

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## Invited Talk #7
### *White dwarfs as laboratories for fundamental physics*

Marcelo Miller Bertolami (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)



To a first approximation, the evolution of white dwarfs can be understood as a gravothermal cooling process in which the basic ingredients are well identified. This peculiarity makes white dwarf stars, and collections of white dwarfs, very good candidates for testing physics beyond the Standard Model of Particle Physics. Any new physics that alters the cooling process through either heating or cooling of the white dwarf interior is expected to produce observable consequences that can help constrain or refute that new physics. Upcoming ground- and space-based observatories will offer an improved view of white dwarf stars both individually and as a population, improving our ability to use them as laboratories of fundamental physics. There are two main ways to test the cooling rate of white dwarfs. One is the so-called luminosity function of a white dwarf population, and the other is the period drift of individual white dwarfs that experience non-radial pulsations. In this presentation I will review the basic physics of WDs and present a brief summary of the works we have been doing at the Stellar Evolution and Pulsations Research Group in La Plata to test physics beyond the standard model with WD stars and populations.

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## Invited Talk #8
### *Black bounces: an interplay between black holes and wormholes*

Ernesto F. Eiroa (IAFE-CONICET-UBA, Buenos Aires, Argentina)

Black bounces are solutions of gravitational theory that interpolate between non-singular black holes and wormholes. These spacetimes, introduced in the literature a few years ago, possess a surface of minimal area denominated the bounce which is hidden inside an event horizon. The radial function shows a nontrivial bouncing behavior that results in bounded curvature invariants, so they are free from singularities. These objects allow congruences to re-expand beyond the throat in order to ensure geodesic completeness. Many articles exploring different sources or gravitational theories have been published. Rotating black bounces were obtained by using the modified Newman-Janis procedure. Recent works on gravitational lensing and shadows have considered black bounces as light deflectors. This talk presents a review on this topic.

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## Invited Talk #9
### *Geometric signatures of black holes*

Gustavo Dotti (FaMAF-UNC/CONICET, Córdoba, Argentina)

I will review the generalized singularity theorem for Compact Trapped subManifolds (CTMs), the role of CTMs as black hole geometric signatures and the relevance of future convex hypersurfaces to obstruct the formation of CTMs.

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## Invited Talk #10
### *Neutron stars with dark matter content: description from short-range correlated models*

Odilon Lourenço (Instituto Tecnológico de Aeronáutica, São Paulo, Brazil)

We investigate the effects of short-range correlations (SRCs) on relativistic hadronic models at high densities and their consequences for neutron stars, both with and without dark matter. Two model versions are considered, differing in the treatment of the vector self-interaction: one includes terms up to second order, while the other also contains a fourth-order contribution. We find that SRCs soften the equation of state in the former case but produce a significant stiffening in the latter. This behavior is reflected in the corresponding mass-radius relations, with SRCs decreasing the maximum mass in the first model and increasing it in the second. We also study neutron stars containing a fermionic dark-matter component within a two-fluid formalism. The same qualitative trends persist, and the reduction of the maximum mass caused by increasing dark-matter content is partially compensated by SRC effects when the fourth-order vector interaction is included. The resulting stellar configurations remain compatible with current astrophysical constraints from NICER and GW190425.

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## Invited Talk #11
### *Relativity and Blazars: an observational point of view*

Ileana Andruchow (IAR-CONICET/FCAG-UNLP, La Plata, Argentina)

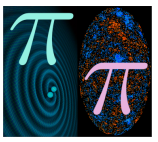
Blazars are a class of Active Galactic Nuclei (AGN). As such, they feature a jet of relativistic plasma that is launched from the central engine (a rotating supermassive black hole). In the case of blazars, this jet is aligned close to the line of sight. As a result, the emission from these objects appears to be affected by relativistic effects: Doppler boosting, superluminal velocities, and other phenomena are present. To understand the physics of emission in these objects, it is essential to understand the relativistic properties of the plasma, and for that, observations are crucial. In this respect, these objects are detected from radio waves up to very high energies, in TeV, highly variable in a non-periodic manner, with the presence of flares, across all wavelengths. In this talk, we will recount the observations that led to the characterization of these relativistic effects.

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## Invited Talk #12
### *Non-thermal emission and multi-messenger signatures from AGN jets*

Florencia Vieyro (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)

Relativistic jets from active galactic nuclei (AGN) are exceptional environments for studying non-thermal radiation and high-energy processes near supermassive black holes. In this talk, I will review the physical mechanisms responsible for thee broadband emission of AGN jets, from radio to gamma-ray energies. I will discuss the main leptonic and hadronic scenarios, including photohadronic ($p\gamma\$) and



proton–proton (pp) interactions as potential channels for high-energy gamma-ray and neutrino production, and their multi-messenger implications. I will also briefly discuss how current and forthcoming observations with Fermi-LAT, CTAO, LHAASO, and neutrino observatories can constrain jet-emission models.

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# Abstracts of Contributed Talks

### Contributed Talk #1

***Machine learning-based Wiener Filtering for CMB polarization maps and power spectrum estimation: flat and curve sky***

Belén Costanza (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)

In this talk, I will present a neural network designed to emulate Wiener filtering for polarization maps of the Cosmic Microwave Background (CMB). The network is trained to suppress the inhomogeneous instrumental noise present in the data while reconstructing the underlying B-mode signal. I will also show how the reconstructed maps can be used to estimate the power spectrum of an unknown signal through a simulation-based optimal quadratic estimator. Finally, I will discuss the different implementations developed for both flat- and curved-sky analyses, with a particular focus on current ground-based CMB experiments.

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### Contributed Talk #2

***Pulsar Monitoring from IAR: 10 years of the PuMA project***

Federico García (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)

Pulsars are magnetized neutron stars emitting highly regular radio pulses due to their rapid rotation. Their study provides key insights into the astrophysics of compact objects, ranging from the equation of state of nuclear-density matter to gravitational wave detection. In this context, the PuMA (Pulsar Monitoring in Argentina) project was established to create a sovereign facility dedicated to the continuous monitoring of astrophysically valuable bright pulsars, refurbishing the scientific capabilities of the 30-meter radio telescopes (Bajaja and Varsavsky) at the Argentine Institute of Radio Astronomy (IAR). In this talk, we present a review of the scientific achievements and milestones reached by PuMA a decade after its first observations (2016–2017). Key results include the systematic analysis of successive glitch events in pulsars such as Vela, long-term monitoring of magnetars, searches for Fast Radio Burst (FRB)-like single pulses, and high-precision timing of millisecond pulsars to provide ephemerides required for gravitational wave searches, in close collaboration with the LIGO-Virgo-KAGRA gravitational-wave interferometers.

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### Contributed Talk #3

***IAR's role in the constraints on gravitational waves emitted during the 2024 Vela pulsar glitch***

Ezequiel Zubieta (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)

Although pulsars are characterized by stable rotation, some experience sudden frequency increases from glitches: a phenomenon whose physical origin remains poorly understood. The Argentine Institute of Radioastronomy (IAR) monitors southern hemisphere pulsars daily. Thanks to its high-cadence monitoring, IAR first detected and characterized the Vela pulsar glitch on April 29, 2024, providing precise ephemerides for gravitational wave searches. Combined with LIGO-Virgo-KAGRA observations, an exhaustive search for transient gravitational wave signals was conducted. No significant candidates were found, but these non-detections established stringent upper limits on gravitational wave amplitude. These were the first direct constraints of their kind. Notably, these limits proved below the energy threshold expected from the glitch. This work presents IAR's high-cadence monitoring and its impact on gravitational wave searches associated with the 2024 Vela pulsar glitch and neutron star interior physics.

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## Contributed Talk #4

### *EVA-01: hadrons and quarks within a relativistic mean-field model*

Marcos Celi (FCAG-UNLP/CONICET, La Plata, Argentina)

Neutron stars are unique laboratories for matter at supranuclear densities, where a transition from hadronic to deconfined quark matter is expected to occur. Hybrid equation of state models are usually built by gluing together separate models for each phase, so the transition is imposed rather than predicted. In this talk I will present EVA-01, a new equation of state model that describes both hadrons and quarks within a single relativistic mean-field framework at finite temperature. An additional scalar field, inspired by effective QCD models, dynamically drives deconfinement. The model is consistent with nuclear physics constraints and with multimessenger observations: massive pulsars, gravitational waves from GW170817, and NICER mass–radius measurements. .I will briefly discuss the resulting QCD phase diagram and then focus on a first astrophysical application: the evolution of proto-neutron stars, modeled through isentropic snapshots from the hot, neutrino-trapped phase to the cold, catalyzed star. Finally, I will discuss the implications of this evolution for the stability of the most massive proto-neutron stars and for the formation of massive neutron stars.

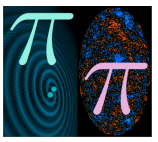
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## Contributed Talk #5

### *Iron Kα signatures from accretion disks around fermionic dark matter cores*

Valentina Crespi (IALP-CONICET/FCAG-UNLP, La Plata, Argentina)

The fluorescent iron line and its broadening due to relativistic effects are excellent probes to study the inner part of an accretion disk and, consequently, the space-time geometry near the compact object. We investigate the iron Kα line profile within the



extended Ruffini-Argüelles-Rueda (RAR) model, which describes a fermionic dark matter distribution on galaxy scales from first principles. The most general solutions are characterized by a compact and highly degenerate inner core able to mimic the central supermassive black hole, transitioning into an extended and dilute halo composed of the same particles. We contrast the resulting emission line morphologies in this scenario with those predicted by the standard Kerr black hole paradigm, and highlight their similarities and differences. In particular we choose the iconic Seyfert 1 galaxy MCG-06-30-15 where a broad iron line has been measured, and find good agreement with the observed broad features of the line profile provided the compactness of the fermion core is close to critical.

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## Contributed Talk #6

### *Large-scale emission from gamma ray binaries: the case of LS 5039*

Javier Rodrigo Martinez (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)

Gamma-ray binaries can produce non-thermal emission on scales much larger than their orbital separation. LS 5039 exhibits extended X-ray emission on scales of approximately 1 pc, whose origin and connection with the evolution of the system remain unclear. We study the large-scale emission produced by the interaction of an outflow formed by the mixed winds of the massive star and the non-accreting neutron star with the surrounding medium. We consider different evolutionary scenarios, from a young system producing an approximately spherical bubble to an older system whose motion through the environment leads to a bow shock. We model particle acceleration at the outflow termination shock and the resulting thermal and non-thermal emission across the electromagnetic spectrum, including radiation from escaping particles. We find that the extended X-ray emission can be explained by synchrotron radiation from multi-TeV electrons. Both bubble and bow-shock scenarios can approximately reproduce the current X-ray observations, while predicting different morphologies and emission at other wavelengths. These results show that large-scale emission from gamma-ray binaries can provide insights into the evolutionary state and environment of the system.

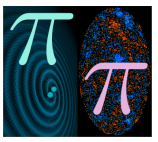
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## Contributed Talk #7

### *Possible interactions in the cosmological dark sector of the universe and aspects of formation and suppression of dark halos in neutron stars*

Loreany Ferreira de Araújo (FCAG-UNLP/CONICET, La Plata, Argentina)

Neutron stars are among the densest astrophysical laboratories known, offering a unique opportunity to investigate major mysteries of modern astrophysics: dark matter and dark energy, which together make up the vast majority of the Universe. In this talk,



we will explore how the presence of these components could alter the global structure of neutron stars, specifically their mass-radius relationships. We will demonstrate how a vacuum-like dark energy component softens the effective equation of state and significantly suppresses the formation of extended dark halos around neutron stars, features typically predicted by sub-GeV dark matter models. These results help constrain theoretical models and open new avenues for testing fundamental physics through multimessenger observations.

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## Contributed Talk #8

### *Axial-vector currents of pions and rho mesons in a magnetic field*

Cristian Villavicencio (Universidad del Bio-Bio, Concepción, Chile)

The effects of strong electromagnetic fields in relativistic heavy-ion collisions and in magnetars can induce nonstandard couplings, such as pionic vector currents and rho-meson axial-vector currents. We analyze the effective axial-vector currents of charged pions in the presence of an external magnetic field, with particular emphasis on the contribution of the rho meson, using finite-energy sum rules. We construct an effective pion model that preserves the PCAC Ward identity, in agreement with recent results from chiral perturbation theory. Using lattice QCD inputs for the relevant condensates, we investigate the behavior of the different pion decay constants and the effective pion mass, and compare our results with those obtained from the Nambu--Jona-Lasinio model, chiral perturbation theory, and lattice QCD. We also investigate the implications of the external magnetic field for chiral symmetry breaking. In the chiral limit, we find that the divergences of the axial-vector currents associated with the pion, the rho meson, and QCD vanish, indicating that the magnetic field does not modify the chiral symmetry-breaking pattern.

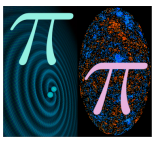
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## Contributed Talk #9

### *Divergent Perturbation Series in Celestial Mechanics. From Poincaré to Resurgence*

Octavio Miloni (UNLP, La Plata/UNAHUR, Hurlingham, Argentina)

In this talk, we revisit the classical problem of divergent perturbation series in celestial mechanics, from Poincaré's analysis to the difficulties introduced by small divisors and resonances. We discuss how resonant dynamics modifies the structure of perturbative expansions and how the resulting series can still contain valuable dynamical information beyond their apparent domain of convergence. We then compare these ideas with divergent perturbation theory in Quantum Field Theory (QFT), where factorial growth, Dyson's argument, Borel summation, and renormalization provide a different framework for dealing with asymptotic expansions. Our main goal is to explore how techniques widely used in QFT to extract information beyond perturbation



theory can be applied in the context of Celestial Mechanics. In particular, Borel summation, resurgence, and trans-series provide a framework for interpreting divergent asymptotic expansions and for uncovering non-perturbative information encoded in their large-order behavior.

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## Contributed Talk #10

### *A new kinematic-electromagnetic Abelian gauge mechanism to explain dark energy and dark matter*

Alcides Garat (Former Professor at Universidad de la República, Montevideo, Uruguay)

We will discuss an alternative theory for the origin of dark matter and dark energy based on the new concept of tetrad gauge states of spacetime. The new tetrads already introduced new physics since it has been proved that local electromagnetic gauge transformations can boost the local tetrad fields in a four-dimensional curved Lorentz spacetime. It is within this context that we will present a different qualitative explanation for the so-called dark matter and dark energy and new possible topological solutions of a galactic nature for Einstein–Maxwell spacetimes in its relation to dark matter and new possible topological solutions of a cosmological nature for Einstein–Maxwell spacetimes in its relation to dark energy.

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## Contributed Talk #11

### *Surface and Curvature Tension of Dense Hadronic Matter in a Relativistic Mean-Field Approach*

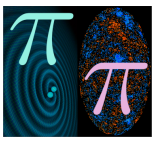
Arthur Almeida Frazon (Universidade Federal do ABC, São Paulo, Brazil)

We investigate the surface and curvature tension of cold, dense hadronic matter, composed of baryons and leptons in a state of electric charge neutrality and chemical equilibrium under weak interactions, employing a relativistic mean-field model with the inclusion of interactions mediated by $\sigma$, $\omega$, and $\rho$ mesons. To account for finite-size effects, we adopt the multiple-reflection expansion (MRE) framework and present our results for various droplet sizes. In particular, we analyze the role of the vector interactions and the appearance of hyperons. The results show that the presence of repulsive vector interactions significantly enhances $\sigma$ and $\gamma$, being the most important contribution to these quantities in comparison with the terms coming from the free kinetic and scalar parts.

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## Contributed Talk #12

### *Unimodular Inflation with Higgs Seeds*



Francisco Plaza (FCAG-UNLP, La Plata, Argentina)

In this work, we propose an alternative model of cosmic inflation based on unimodular gravity (UG), an alternative theory of gravitation to General Relativity. The key feature of our model is that the primordial inhomogeneities are generated directly by the Higgs field. By combining the distinctive properties of unimodular gravity with the well-established characteristics of the Higgs field, this framework is able to address the standard problems of the early Universe. In this talk, we present the main features of the predicted primordial scalar power spectrum and compare its predictions with the constraints derived from observations of the cosmic microwave background in order to assess the viability of the model.

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## Contributed Talk #13

### *Two regimes of universality in hybrid stars: global properties and quark cores*

Ana Gabriela Grunfeld (IAFE-CONICET-UBA, Buenos Aires, Argentina)

Universal, equation-of-state-insensitive relations are well established for hadronic neutron stars and for strange stars. Here we ask whether similar relations hold for the quark core of a hybrid star, and whether the core can be constrained from the surface. We describe quark matter with the MIT bag model with repulsive vector interactions, matched to the hadronic DD2 equation of state through a Maxwell construction, and scan the parameter space to obtain over one thousand hybrid equations of state compatible with current astrophysical constraints. We find that the global properties of hybrid stars follow the universal relations of hadronic stars, while their quark cores follow those of strange stars. However, learning about the core will require new observables beyond the global star properties.

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# Abstracts of Posters

## Poster #1

### *Efectos térmicos en proto-estrellas extrañas de quarks*

Camila Celeste Carballo (FCAG-UNLP, La Plata, Argentina)

Las observaciones modernas de estrellas de neutrones —provenientes de eventos de fusión con emisión de ondas gravitatorias, emisión de rayos X en estrellas de neutrones aisladas y púlsares binarios— imponen un escenario de tensión difícil de satisfacer para los modelos actuales. En este trabajo preliminar, estudiamos la posibilidad de que estos objetos compactos puedan ser descriptos a través de un modelo de estrellas extrañas, conformadas únicamente por materia de quarks u, d y s, considerando la hipótesis de estabilidad fundamental de este tipo de materia. En este contexto, nos enfocamos en estudiar los primeros estadios de proto-estrellas de quarks, en los primeros segundos luego de la formación del objeto, donde se deben considerar los efectos de altas temperaturas y de neutrinos atrapados. Para ello, adoptamos el modelo de Bolsa del MIT con interacciones vectoriales para construir la ecuación de estado de la materia de quarks y lo implementamos en el contexto de temperatura finita. Bajo este enfoque, construimos estrellas extrañas en equilibrio hidrostático en distintos estadios térmicos y analizamos nuestros resultados en el contexto de las restricciones astrofísicas actuales.

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## Poster #2

### *Impact of hyperons and lepton fraction on hot isentropic hybrid neutron stars with color-superconducting quark matter*

Juan Pablo Carlomagno (IFLP-CONICET, La Plata, Argentina)

We study hot isentropic hybrid neutron stars containing color-superconducting quark matter, focusing on the role of hyperons, lepton fraction, and neutrino trapping. Stellar sequences are constructed at fixed entropy per baryon and fixed lepton fraction. Quark matter is described within a nonlocal chiral quark model including a nonlocal vector interaction, while hadronic matter is modeled using density-dependent relativistic mean-field equations of state of the DD2 class. The hadron–quark transition is constructed through an isothermal Maxwell construction. We consider two scenarios characterized by the relative location of the hadron–quark transition and the onset of hyperons, allowing us to explore how the presence of hyperonic matter affects the properties of hybrid stars. For both scenarios, different values of the lepton fraction are considered, together with the limiting case of vanishing neutrino trapping. For the nonlocal vector interaction, the squared speed of sound in the quark phase reaches the conformal limit and displays a non-monotonic behavior across the quark matter region. We further investigate how the onset of hyperons, the lepton fraction,

and neutrino trapping modify the thermodynamic properties and stellar configurations. In particular, we analyze their impact on the speed of sound and mass–radius relations, as well as the differences between neutrino-trapped and neutrino-free matter in hot hybrid neutron stars.

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## Poster #3
### *The composition of ultra-massive WDs*

Francisco De Gerónimo (IALP-CONICET-FCAG, La Plata, Argentina)

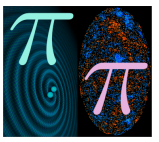
Understanding the internal composition of ultramassive white dwarfs (UMWDs; MWD >1.05M⊙) is essential for stellar evolution, asteroseismology, and supernova models. We explore how progenitor physics, nuclear uncertainties, and C-burning modeling dictate UMWD core structures. Single-star evolution incorporating core rotation or reduced mass loss enables the formation of ultra-massive carbon-oxygen (UMCO) cores, which cool significantly slower than oxygen-neon (ONe) cores. Re-evaluating C-burning microphysics demonstrates that previously reported Ne-dominated cores arise from inaccurate nuclear reaction networks; accounting for 23Na confirms ONe-dominated compositions, whereas convective boundary mixing quenches the C-flame, forming hybrid CO-Ne cores. Furthermore, uncertainties in the 12C+12C exit-channel branching ratios induce variations up to 17% in central 20Ne abundances. Partial carbon burning yields hybrid CONe cores with distinct thermal stratification, altering crystallization onset, cooling timescales, and the size of the solid core. These structural differences produce clear signatures in g-mode period spacings, providing a robust framework to unveil UMWD origins via asteroseismology.

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## Poster #4
### *Little Red Dots' under the lens of the fermionic dark matter model*

Johanna Aylén Fandos (FCAG-UNLP, La Plata, Argentina)

The James Webb Space Telescope (JWST) discovered point-like, red sources at high redshifts, not observed in the Local Universe. They are the so-called ‘Little Red Dots’ (LRDs). The evidence suggests that they could be obscured active galactic nuclei (AGN) since they exhibit broad emission lines, compatible with the accretion process onto a central mass in the 10^5-10^7 M⊙ range (Rusakov et al 2026). Moreover, their spectral energy distribution (SED) exhibits a distinctive V-shape optical-UV feature. In this work, we aim to explain the SED of this objects within the paradigm of the Ruffini-Argüelles-Rueda (RAR) model of fermionic dark matter, which proposes the existence of dense dark matter cores as an alternative to supermassive black holes in the mass range of LRDs. To this end, we apply the AGNFitter spectral energy distribution fitting tool to a sub-sample of LRD taken from Kokorev+2024, which gathers the most complete multiwavelength photometric information to date (HST and



JWST).

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**Poster #5**

***Thin-shell wormholes with charge: dynamical and thermodynamical analyses***

Griselda Figueroa-Aguirre (IAFE-CONICET-UBA, Buenos Aires, Argentina)

A family of charged thin-shell wormholes is constructed by cutting and pasting two Reissner-Nordström spacetimes. The throat is located at the shell and its charge is linearly related to the matter content. Radial perturbations are considered for the dynamical stability analysis. Two models for the entropy are proposed for the study of the thermodynamical stability. Configurations both dynamically and thermodynamically stable can be found for suitable values of the parameters.

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**Poster #6**

***Ten Years of Pulsar Monitoring at IAR: An Evolution in Radio Observation Techniques***

Guillermo Gancio (IAR-CONICET-CICPBA-UNLP, La Plata, Argentina)

Over the past ten years, the PuMA group at the Instituto Argentino de Radioastronomía (IAR) has built its pulsar monitoring capability through four generations of digital backends, moving from a low-cost software-defined receiver, to a higher-performance commercial platform, to an FPGA-based system developed within CASPER, an international collaboration dedicated to radio astronomy instrumentation, and most recently towards a new platform integrating capture, timing, and real-time processing. Alongside the receiver chain, this work required parallel development of antenna pointing and control systems and of the software pipelines for acquisition, calibration, and processing. This talk reviews the technical decisions, constraints, and trade-offs behind each generation, and what each transition revealed about the instrumentation requirements for pulsar timing at IAR.

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**Poster #7**

***Impacto ambiental en las propiedades de las galaxias satélite en cúmulos***

Nicolás Gómez Giménez (FCAG-UNLP, La Plata, Argentina)

Las galaxias en ambientes densos experimentan procesos físicos que modifican drásticamente sus propiedades (morfología, colores, fracción de gas, etc.). En este

trabajo analizamos cómo los efectos ambientales en cúmulos alteran el contenido de gas de las galaxias satélite. Usamos catálogos generados con el modelo semianalítico de formación y evolución de galaxias SAG aplicado sobre las simulaciones de materia oscura de cúmulos del proyecto The Three Hundred. Evaluamos la dependencia con la masa estelar de la fracción de galaxias satélite pasivas y empleamos diagramas de fase (gas frío/ caliente y presión de barrido) para interpretar los resultados. Estos hallazgos sirven de guía para introducir mejoras en el modelo con el objetivo de estudiar la evolución de la formación estelar en cúmulos.

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## Poster #8

### *Estudio de las condiciones iniciales de binarias progenitoras de ondas gravitacionales*

Tomás Tobías Mazzei (IALP-CONICET-FCAG, La Plata, Argentina)

El avance en la detección de ondas gravitacionales ha abierto una ventana de observación para el estudio de binarias con componentes compactas. La combinación de estos datos con modelos de evolución estelar y simulaciones de evolución binaria permite trazar los caminos evolutivos que llevaron a la formación de binarias compactas y su consecuente fusión. Esto no puede inferirse únicamente mediante observación electromagnética. Estudios recientes sugieren que una fracción importante de las fuentes de ondas gravitacionales se origina en binarias que experimentan episodios de transferencia de masa, por lo que comprender estos procesos es fundamental para describir la formación de sus progenitores. En este trabajo estudiamos como la eficiencia de acreción durante la transferencia de masa estable modifica las condiciones iniciales de los sistemas binarios que evolucionan hasta convertirse en progenitores de fuentes de ondas gravitacionales. Caracterizamos dicha eficiencia con el parámetro β, que representa la fracción de masa acretada respecto a la masa perdida por la donante. Para ello analizamos poblaciones sintéticas de binarias, identificando las regiones del espacio de parámetros iniciales que conducen a la formación de sistemas compactos coalescentes para distintos valores de β. Presentamos resultados preliminares que muestran cómo la eficiencia de acreción afecta los parámetros iniciales de la órbita de estos sistemas.

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## Poster #9

### *Shadows in rotating black bounce spacetimes*

Juan Manuel Paez (IAFE-CONICET-UBA, Buenos Aires, Argentina)

Black bounces are spacetimes that describe regular black holes or wormholes, depending on the values of the parameters of the model. In this work, we investigate the shadows produced by a family of rotating black bounces and explore how the

parameters modify their appearance. We find a variety of shadow shapes, including Kerr-like, highly distorted, elongated, and unusually small shadows. The analytically obtained shadows are verified through numerical ray-tracing images, which reproduce the same structures. In some configurations, the shadow boundary includes a contribution from the wormhole throat, arising from photons with a turning point there. Notably, this novel mechanism does not involve a photon sphere at the throat.

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## Poster #10

### *Análisis temporal y espectral de la fuente ultraluminosa de rayos X NGC 7456 ULX-1*

Nahuel Sánchez (FCAG-UNLP, La Plata, Argentina)

Las fuentes ultraluminosas de rayos X  son objetos extragalácticos, puntuales y no nucleares, con luminosidades isotrópicas aparentes superiores a 10^39 erg/s. En este trabajo presentamos un análisis temporal y espectral de observaciones de rayos X de la fuente NGC 7456 ULX-1, obtenidas con el observatorio \textit{XMM-Newton}. La emisión X en el rango de 0.3–12 keV muestra una marcada variabilidad, con cambios de flujo de hasta un factor \simeq5.5 durante la observación. Los espectros extraídos de las cámaras EPIC se ajustaron adecuadamente mediante un modelo compuesto por un disco de acreción multi-temperatura (\texttt{diskbb}), un plasma en equilibrio de ionización (*apec*) y una componente no térmica representada por una ley de potencias (*powerlaw*), todos modificados  por absorción fotoeléctrica interestelar. Del análisis del espectro los resultados muestran un flujo muy alto en la banda de energía $0.3-12$ keV, que se corresponde con una luminosidad intrínseca de $\simeq 1.55_{-0.10}^{+0.09} \times 10^{40}\, \text{erg s}^{-1}$ para la distancia a la que se encuentra el sistema. Finalmente, se presenta una interpretación física preliminar de los procesos responsables de la emisión observada, discutiendo los resultados en el contexto de la acreción super-Eddington y de los modelos actuales para fuentes ultraluminosas de rayos X.

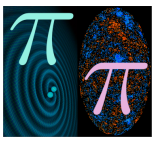
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## Poster #11

### *Energy Extraction from Cosmological Expansion: A Spring Gedanken Experiment in FLRW Spacetime*

Julián Valdéz (FCAG-UNLP, La Plata, Argentina)

The absence of a global timelike symmetry in Friedmann–Lemaître–Robertson–Walker (FLRW) spacetimes implies that a globally conserved notion of energy is, in general, unavailable. This raises the question of whether cosmological expansion can transfer energy into localized mechanical systems. Motivated by Harrison's (1995) cosmic-string gedanken experiment, we investigate an alternative mechanism consisting of two identical point masses connected by a massless spring embedded in



an expanding FLRW universe. Within the Newtonian approximation, we derive the equations of motion and determine the evolution of the system for two cosmological backgrounds: de Sitter expansion and a non-singular bouncing universe. We compute the mechanical energy of the oscillator and identify the conditions under which the expansion transfers energy to the system. The efficiency of the mechanism is compared across both cosmological models, highlighting how the extracted energy depends on the expansion history.

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## Poster #12
## *Cuantización Asintótica de la Gravedad*

Lautaro Zapata Soñez Altuna (FaMAF-UNC, Córdoba, Argentina)

En este trabajo se estudia la cuantización de la gravedad utilizando como teoría base la Formulación de superficies nulas (o NSF por su siglas en ingles) un formalismo de la relatividad general que para este tipo de trabajo se uso en el contexto de los espacio-tiempos asintóticamente planos. Para ello, se presenta una introducción detallada del formalismo matemático necesario para el desarrollo de la teoría del NSF. Posteriormente, se analizan los resultados del proceso de dispersión (scattering) de gravitones clásicos mediante desarrollos perturbativos hasta segundo orden en el marco del NSF. A continuación, se aplica el formalismo de cuantificación asintótica de Ashtekar para construir una descripción cuántica de los datos libres empleados en la formulación del NSF. Finalmente, se desarrolla el proceso de dispersión de dos gravitones para diferentes órdenes de perturbación. Los resultados obtenidos muestran consistencia con una posible formulación cuántica de la gravedad, lo que abre perspectivas prometedoras para investigaciones futuras.

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