Colloque national Action Dark Energy 2024 - 8ème édition

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Institut Henri Poincaré

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Impact of clusters' connectivity on their evolution and gas accretion

Matter distribution around clusters is highly anisotropic from their being the nodes of the cosmic web.The number of filaments they are connected to, i.e., their connectivity, should reflect the level of anisotropy in the matter distribution and must be, in principle, related to their physical properties.
In this presentation, I will first address the influence of the local connectivity of clusters on cluster properties, by using the hydrodynamical simulation IllustrisTNG.The mass of clusters mainly influences the geometry of the matter distribution: massive halos are significantly more connected to the cosmic web than low-mass ones. Beyond the mass-driven effect, cluster connectivity appears to trace different dynamical state with different accretion histories.
Secondly, I will focus on gas distribution in the same simulated cluster sample. Whereas hot plasma is virialised inside clusters, the warm hot inter-galactic medium (WHIM) is accumulating and slowly infalling at cluster peripheries. Inside clusters, hot gas traces cluster structural properties, such as substructure fraction and elliptical shape. In contrast, WHIM gas outside clusters follows the DM distribution by tracing cosmic filament patterns. Finally, these numerical predictions are compared to soft X-ray observations.

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TBD

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ARRAKIHS: The New ESA F-Class Mission to Investigate the Nature of Dark Matter

The "Analysis of Resolved Remnants of Accreted galaxies as a Key Instrument for Halo Surveys" (ARRAKIHS) mission will explore the ultra-low surface brightness universe to investigate the nature of Dark Matter. ARRAKIHS was selected in November 2022 as the next F-class mission at ESA for Phases 0/A/B, with an estimated launch date in 2030. The ARRAKIHS science consortium, led by IFCA (Spain) in partnership with several European research centers and space companies, is collaborating with ESA to launch an array of visible and infrared cameras on board a mini-satellite in Low Earth Orbit. The goal of ARRAKIHS is to test the predictions of different Dark Matter models

and baryon physics mechanisms on the halo structure as well as on the statistics of halo satellites and stellar streams for a representative sample of MW-type galaxies in the nearby Universe. In this talk, I will provide a progress report on the ARRAKIHS mission after successfully passing Phase 0/A and we continue working on Phase B that will end in early 2026 with the mission adoption.

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Modified gravity interpretation of the evolving dark energy in light of DESI data

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Weak lensing of strong lensing

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Euclid preparation: simulations and non-linearities beyond LCDM

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A Non-Gaussian Universe?

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Modifying the unconstrained small-scale initial conditions of the Universe could be a game changer for our understanding of cosmic structure formation and address challenges in small-scale galaxy formation. In this talk, I will present you my investigations of the effects of significant small-scale primordial non-Gaussianity (PNG). I have found that such PNGs introduce a distinct and potentially detectable feature in the matter power spectrum around the non-linear scale. This feature is promising to solve the S8 tension, which would then be a smoking gun of non-trivial inflationary physics. I will also demonstrate you that PNGs result in typical galaxy-sized halos reaching half of their present-day mass earlier and experiencing a quieter merging history for z<3 compared to the Gaussian case. At z=0, their environment between 0.5 to 4 virial radii, is less dense than in the Gaussian scenario, potentially affecting the universality of the NFW profile. This quieter merging history and less dense environment could have significant implications for the formation of bulges and bars in galaxies.Based on hydrodynamical simulations that I conducted, I will show that with all feedback prescriptions eing otherwise identical, simulations with a positively skewed distribution

form galaxies slightly later than in the standard ΛCDM model and lead to simulated galaxies with more disky kinematics than in the standard case. Thus, such small-scale PNG could potentially help alleviate simultaneous tensions in cosmology and galaxy formation.

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Quantum algorithm for collisionless Boltzmann simulation of self-gravitating systems

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