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MARIANGELA LISANTI

PRINCETON UNIVERSITY

Galaxies as Probes of the Particle Physics Nature of Dark Matter

Abstract: The hypothesis of Cold Dark Matter (CDM) has been spectacularly confirmed on the largest scales of the Universe and must now be stress-tested on sub-galactic scales. Many well-motivated and generic alternatives to CDM can leave spectacular signatures on precisely these scales, affecting the evolution of galaxies as well as their population statistics. Excitingly, over the course of the next decade, a flood of astrophysical data will open the possibility of searching for these distinctive imprints and shedding light on key questions about dark matter. In interpreting such results, systematic studies using both semi-analytic codes and numerical simulations will play a critical role in robustly disambiguating dark matter signals from other standard baryonic processes. As a concrete example, I will describe the consequences for galaxy formation when the dark matter can self-scatter, highlighting the scenario where the interactions are dissipative and a sub-component of the dark matter efficiently cools inside galaxies.

Mariangela Lisanti is a professor of physics at Princeton University and a research scientist in the Center for Computational Astrophysics at the Flatiron Institute. Her research activity on theoretical particle and astroparticle physics spans a vast spectrum of topics that range from particle colliders to dark matter distribution in the Milky Way. Recently, she has been investigating how variations of the Cold Dark Matter paradigm affect galactic and sub-galactic structures. The activity of Professor Lisanti is highly interdisciplinary with ideas from astrophysics and data science.