ASTROPHYSICS SEMINAR SERIES

Institut Spatial de McGill
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CRAQ
Understanding the Universe

Probing the Particle Nature of Dark Matter with Strong Gravitational Lensing

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The nature of dark matter is one of the most important outstanding questions in modern cosmology and astrophysics. Uncovering the properties of the dark matter particle could result in significant leaps in our understanding of fundamental physics and impact numerous astrophysical models. It is well understood that the microphysics of the dark matter particle impacts its clustering properties on different scales. The most widely accepted dark matter model, cold dark matter, has had tremendous success explaining the large-scale structure of the universe. However, it has faced many challenges for its predictions of the distribution of matter on small, sub-galactic scales, with some observations seemingly favoring a warm dark matter alternative. A definitive answer to this question can only be achieved by mapping the distribution of dark matter on small scales with a purely gravitational probe. Strong gravitational lensing is the only probe capable of doing this at cosmological distances. In this talk, I will discuss how the discovery of a new population of strong gravitational lenses, a new observatory, ALMA, and new advances in analysis methods are allowing us to map the distribution of dark matter on small scales with high precision. In the coming years, thousands of new lenses from large surveys (e.g., LSST), existing and new facilities (e.g., ALMA, JWST, TMT), and new analysis methods (machine learning) will transform this field, allowing us to understand the small-scale behavior of dark matter with unprecedented accuracy and precision, opening a new window for testing dark matter models in a previously inaccessible regime.

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