中央大學物理學系
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Colloquium

Using Gravitational Lensing to Study Dark Matter and Cosmology

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Abstract :
In the standard cosmological model, the matter content of the Universe is dominated by dark matter—an invisible component that governs the formation and evolution of cosmic structures. Despite its importance, the physical nature of dark matter remains one of the greatest mysteries in modern cosmology. While dark matter cannot be observed directly, its gravitational influence can be detected through the deflection of light from background sources, a phenomenon known as gravitational lensing.
In the first part of this talk, I will introduce how gravitational lensing serves as a powerful tool for mapping the distribution of dark matter and investigating its physical properties, particularly through observations of galaxy clusters. As the largest gravitationally bound structures in the Universe, galaxy clusters provide unique laboratories for studying dark matter and testing cosmological models. I will then present our recent work on a novel simulation-based inference (SBI) framework for galaxy cluster cosmology. By combining machine learning with forward modeling of galaxy cluster observations, including weak gravitational lensing and X-ray measurements, this approach provides an alternative to traditional likelihood-based methods for constraining cosmological parameters. This framework allows us to incorporate complex observational effects and astrophysical uncertainties into the inference process, providing a flexible approach to extracting cosmological information from galaxy cluster surveys.