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Measuring dark matter subhalos in strong lenses with truncated marginal neural ratio estimation

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Strongly-lensed galaxies are a unique laboratory for probing dark matter substructure and testing the fundamental assumptions of the ΛCDM paradigm. However, the statistical difficulties with analyzing such observations are formidable, requiring disentangling the source galaxy's light from the lens'mass distribution and marginalizing over different substructure configurations. In this talk I present a new approach to this problem based on a simulation-based inference method called truncated marginal neural ratio estimation (TMNRE). I will explain how TMNRE enables measuring both the properties of individual subhalos and directly the parameters of the subhalo mass function, overcoming limitations of likelihood-based analyses. I will show initial results based on mock data and argue that such techniques pave the way to measuring the fundamental properties of dark matter from both existing lensing images and the large amounts of data new telescopes will generate in the coming few years.

Collaboration name

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