

Neural simulation-based inference of dark matter substructure in JVAS B1938+666 strong gravitational lensing system

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Precision analysis of galaxy-galaxy strong gravitational lensing images provides a unique way of characterizing dark matter (DM) substructures and could allow us to uncover the fundamental properties of DM's constituents. In reality, this analysis is extremely challenging due to the high dimensionality of lensing observations and the richly-structured parameter space of lensing systems. Existing methods for marginalizing over this large parameter space to infer substructure properties are typically extremely time-consuming, necessitating the exploration of a very high-dimensional parameter space, which is often intractable, or require compressing observations into hand-crafted summary statistics.

In this talk, I will present the first application of *neural* simulation-based inference (SBI) technique to a strong-lensing observation, by reanalyzing JVAS B1938+666 system. This system is one of the few examples, so far, of substructure detection (Vegetti et al. 2012) using the gravitational imaging technique.

I will show how different analysis tasks of increasing complexity can be easily performed in the employed SBI technique, Truncated Marginal Neural Ratio Estimation (TMNRE) (Miller et al. 2022). With TMNRE we can recover existing results for subhalo parameter inference and source reconstruction. Moreover, since TMNRE makes it possible to increase the realism of the analysis without significantly altering the inference procedure, we are able to include lens light uncertainties, source light variations, and a population of substructure in the analysis (Anau Montel et al. 2022, Coogan et al. 2022).

These first results demonstrate our analysis method is able to extract the wealth of information regarding DM's nature contained in existing lensing data and in the large sample of lenses that will be delivered by near-future telescopes, such as the Rubin Observatory, Euclid, JWST and the Extremely Large Telescope.

Would you be interested in presenting a poster? (this will not impact the decision on your talk)

no

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