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Visibility-space Bayesian forward modeling of radio interferometric gravitational lens observations

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Gravitational lensing by galactic potentials is a powerful tool with which to probe the abundance of low-mass dark matter structures in the universe. Dark matter substructures or line-of-sight haloes introduce small scale perturbations to the smooth lensing potential. By observing detections (or non-detections) of such low-mass perturbers in lensed systems, we can place constraints on the halo mass function and differentiate between different particle models for dark matter.

The lowest detectable perturber mass is related to the angular resolution of the observation via its Einstein radius. Therefore, high angular resolution observations can place the strongest constraints on the low end of the halo mass function. In this talk, I will discuss the development of a fully Bayesian gravitational lens modeling code that directly fits large radio interferometric datasets from the Global Very Long Baseline Interferometry array (GVLBI). While the angular resolution is excellent (sufficient to detect haloes down to 10ˆ6 solar masses at z˜0.5-1.0), these data contain large numbers (>10ˆ9) of visibilities and therefore present unique computational challenges for modeling.

I will present the computational methods developed for this modeling process, as well as results from GVLBI observations of the lensed radio jet MG J0751+2716.

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