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Measurable Effects from Unresolvable Perturbations of Axion Dark Matter in the Critical Region of Gravitational Lenses

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Successful dark matter (DM) models have to predict the condensation of dark matter into haloes, reproducing the observed mass of galaxies and clusters in the Universe. Axionic DM, predicts an over-concentrated core 'soliton' residing within each of the haloes, which is a generic feature from models that effectively include interaction among the DM particles. This has been the major way to constrain axion parameter space from gravitational lens, and this aspect of axionic DM is not distinguishable with gravothermally collapsed self-interacting DM.

In this talk however, I would discuss utilising some exotic gravitational lenses to measure another prediction unique to axionic DM: the density modulations in the halo outskirt analogous to the excited states of hydrogen wavefunction. These density modulations are small and operate on a spatial scale below the resolution limit of the existing telescopes. Yet, they can be sustantially amplified in the 'near-critical region' of gravtational lens, thus resembling a cosmological 'transition-edge detector; Specifically, I would quantify the effect of axionic DM at the umbilic point of gravtational lens, revealing their unique imprint in terms of observable lens-magnified flux.
A recently executed proposal on JWST have observed such a special gravitational lens, the measurements of the fluxes distribution therein would soon give a stringent constraint, eventually narrowing down the axion parameter space."

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