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Cosmology with prompt cusps

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Every dark matter halo forms with a $\rho \propto r^{-1.5}$ density cusp at its center. This *prompt cusp* has a mass comparable to the cutoff scale in the spectrum of initial density perturbations. For warm and interacting dark matter models, prompt cusps significantly influence the structures of low-mass halos, so they are an important consideration for efforts to use satellite galaxies, strong lensing, and stellar streams to constrain the dark matter mass and interaction properties. For annihilating dark matter, prompt cusps amplify the annihilation rate an order of magnitude above previous predictions. I will present the basis for prompt cusps in simulations and theory, including new results showing how each halo's central cusp depends on the dark matter model. I will also discuss two observational tests of dark matter that prompt cusps enable: the measured kinematics of dwarf galaxies can strongly constrain warm dark matter, while gamma rays from galaxy clusters strongly constrain annihilating dark matter.

References

MNRAS 518, 3509 (2023); MNRAS 522, L78 (2023); JCAP 10, 008 (2023); Phys. Rev. D 109, 083512 (2024); arXiv:2501.14865; arXiv:2506.03240

Author: Dr DELOS, Sten (Carnegie Observatories)

Presenter: Dr DELOS, Sten (Carnegie Observatories)

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