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The first dark matter halos as probes of cosmology

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Through their observable properties, the first and smallest dark matter halos represent a rare probe of subkiloparsec-scale variations in the density of the early Universe. These density variations could hold clues to the nature of inflation, the postinflationary cosmic history, and the identity of dark matter. The first halos are understood to possess a uniquely compact central mass distribution in which density scales with radius as $\rho \propto r^{-3/2}$, but this property has been largely neglected owing to doubts about its persistence. I will show new results demonstrating how this feature can persist as a halo grows and evolves, and I will discuss why previous works underestimated its survival prospects. The compact central structure boosts microhalos' observational prospects, particularly in models where dark matter annihilates; for some models this effect can boost the annihilation rate by a factor of order 10. Additionally, the $\rho \propto r^{-3/2}$ structure is highly resistant to tidal stripping, so the abundance of microhalos inside larger halos (such as the Galactic halo) may be much greater than previously assumed. I will also discuss how as a probe of cosmology, the $\rho \propto r^{-3/2}$ feature is particularly convenient because its details are tightly connected to the properties of the primordial density field.

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