

Small-scale clumping of dark matter and the mean free path of ionizing photons at $z = 6$

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The power spectrum of primordial fluctuations is largely unconstrained at mass scales $\leq 10^9 M_\odot$. A number of alternatives to the cold, collisionless dark matter (CDM) paradigm have been proposed which either suppress or enhance power at these mass scales. The best limits on these models currently come from the Ly α forest flux power spectrum and strong gravitational lensing systems. I will discuss a potential complementary probe: the ionizing photon opacity of the intergalactic medium during reionization, as quantified by the mean free path (MFP). At high redshift, the MFP is directly affected by the presence of structure on $10^4 - 10^8 M_\odot$ scales, potentially offering a window into scales inaccessible to other probes, and at an earlier epoch of structure formation. Further motivating this investigation is the recently measured short MFP at $z = 6$ by Becker et al. (2021), which, if confirmed, may already provide evidence for small-scale power. I will discuss our efforts to model the $z \sim 6$ MFP in models with alternative dark matter cosmologies and comment on the usefulness of the MFP as a probe of small-scale structure in the universe.

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