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New robust constraints on Dark Photon Dark Matter from the intergalactic medium

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The ultralight dark photon is a well-motivated, hypothetical dark matter candidate. In a dilute plasma, they can resonantly convert into photons, and heat up the intergalactic medium between galaxies. In this talk, we explore the dark photon dark matter parameter space by comparing synthetic Lyman-α forest data from cosmological hydrodynamical simulations to observational data from VLT/UVES of the quasar HE0940-1050 (z = 3.09). We use a novel flux normalization technique that targets under-dense gas, reshaping the flux probability distribution. Not only do we place robust constraints on the kinetic mixing parameter of dark photon dark matter, but notably our findings suggest that this model can still reconcile simulated and observed Doppler parameter distributions of z ~ 0 Lyman-α lines, as seen by HST/COS. This work opens new pathways for the use of the Lyman-α forest to explore new physics, and can be extended to other scenarios such as primordial black hole evaporation, dark matter decay, and annihilation

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