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Discovery of a 4 σ deviation from the Concordance Model of Cosmology using the Hubble Diagram of Quasars.

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The cosmological concordance model (Λ CDM) well accounts for a wealth of observations, from the existence of Cosmic Microwave background (CMB) to the discovery of the accelerated expansion of the universe from Type Ia supernovae. Yet, it assumes a still unknown form of dark energy and matter and some tensions arose recently as, for instance, the discovery of a 3.4 σ discrepancy between the local (Riess et al. 2016) and Planck (Aghanim et al. 2016) measurement of H0. In addition, the Λ CDM model is poorly tested in the redshift interval between the farthest observed Type Ia supernovae (z~1.4) and that of the CMB (z~1100). We present new measurements of the expansion rate of the Universe in the redshift range z=0.5-5.5 based on a Hubble diagram of quasars. The distance of quasars have been estimated from the observed non-linear relation between the X-ray and ultraviolet emission, following a method developed by our group. The distance-redshift relation of quasars at z<1.4 is in agreement with that of supernovae and with the concordance model. Nonetheless, a deviation from the Λ CDM model emerges at higher redshift, with a statistical significance of ~4 σ . We found that, if an evolution of the dark energy equation of state is allowed, our data suggest a dark energy density increasing with time.

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