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

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The cosmological concordance model (ΛCDM) 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 3.4σ discrepancy between the local (Riess et al. 2016) and Planck (Aghanim et al. 2016) measurement of H0. In addition, the ΛCDM 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 ΛCDM model emerges at higher redshift, with a statistical significance of ~4σ. 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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