

New limit on a varying proton-to-electron mass ratio from high-resolution optical quasar spectra

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Abstract. Molecular transitions recently discovered at redshift $z_{\text{abs}} = 2.059$ toward the bright background quasar J2123–0050 are analysed to limit cosmological variation in the proton-to-electron mass ratio, $\mu \equiv m_{\text{p}}/m_{\text{e}}$. Observed with the Keck telescope, the optical spectrum has the highest resolving power and largest number (86) of H₂ transitions in such analyses so far. Also, (7) HD transitions are used for the first time to constrain μ -variation. These factors, and an analysis employing the fewest possible free parameters, strongly constrain μ 's relative deviation from the current laboratory value: $\Delta\mu/\mu = (+5.6 \pm 5.5_{\text{stat}} \pm 2.7_{\text{sys}}) \times 10^{-6}$. This is the first Keck result to complement recent constraints from three systems at $z_{\text{abs}} > 2.5$ observed with the Very Large Telescope.

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