Keck telescope constraint on cosmological variation of the proton-to-electron mass ratio


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APPENDIX B: SUPPORTING INFORMATION

Table B1 and Fig. B1 are the complete versions of Table 1 and Fig. 1. Captions for both Table B1 and Fig. B1 follow but only Fig. B1 is presented in this document. Table B1 is instead provided in machine-readable ASCII format in the online version of the paper.

REFERENCES

Ubachs W., Buning R., Eikema K.S.E., Reinhold E., 2007, J. Molecular Spectrosc., 241, 155

Table B1. Catalogue of the most accurate and precise laboratory parameters for fitting H2 absorptions lines. Represented are all allowed Lyman and Werner H2 transitions between the lowest 8 rotational levels in the ground and excited states with excited state vibrational quantum numbers up to 20 and 6 for Lyman and Werner transitions, respectively. The first column provides a short-hand notation for the transition: letters denote a Lyman (L) or Werner (W) line and the branch, where P, Q and R represent J' – J = −1, 0 and 1, respectively, for J and J' the ground state and excited state J-levels, respectively; the first integer is the excited state vibrational number and the second is J. The second column gives the most precise reported laboratory wavelength and its 1-σ uncertainty is given in the third column; the fourth column provides the reference: 1 = Bailly et al. (2009), 2 = Ubachs et al. (2007) (a suffix “a” refers to directly measured wavelengths while “b” refers to wavelengths calculated from directly measured lines via combination differences) and 3 = Abgrall et al. (1993) for the excited state energy levels with ground states derived directly from Jennings et al. (1984). Note that wavelengths with reference 3 are much less precise than those from references 1 and 2. The fifth column gives the oscillator strengths which were calculated from the Einstein A coefficients given by Abgrall et al. (1994). The sixth column gives the (natural) damping coefficients which were calculated from the total transition probabilities (A_k) in Abgrall et al. (2000). The final column gives the sensitivity coefficients calculated in Ubachs et al. (2007) which have estimated uncertainties of typically <5 × 10⁻⁴ (see main text).

Figure B1. All regions of the J2123–0050 Keck spectrum fitted simultaneously in our analysis. The spectrum (black histogram) is normalized by a nominal continuum (upper dotted line) fitted over large spectral scales. Local linear continua (upper dashed lines) and zero levels (lower dashed lines) are fitted simultaneously with the H2/HD and broader Lyman-α lines. The fits are shown with solid grey/green lines. H2/HD transitions are labelled and their constituent velocity components are indicated by grey/green tick-marks immediately above the spectrum. Higher above the spectrum are tick-marks indicating the positions of Lyman-α lines (blue) and Fe ii lines (red). Note that the metal-line velocity structure is constrained with the Fe ii ±1608 Å transition shown in the final panel of the figure. The residual spectrum (i.e. [data – fit]), normalized to the 1-σ errors (faint, horizontal solid lines), is shown above the tick-marks.
Figure B1 – continued
Constraint on the variation of $\mu$
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Figure B1 – continued

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