AN ALCOHOL TEST FOR DRIFTING CONSTANTS

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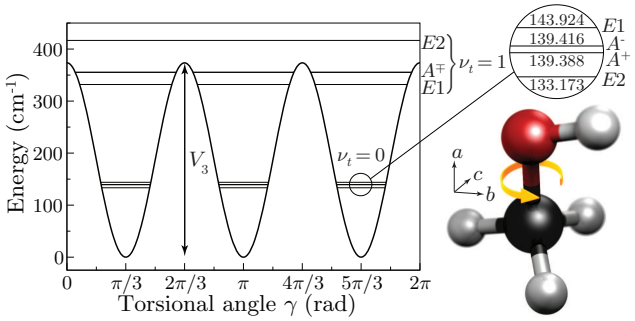

The Standard Model of physics is built on the fundamental constants of nature, however without providing an explanation for their values, nor requiring their constancy over space and time. Molecular spectroscopy can address this issue. Recently[a], we found that microwave transitions in methanol are extremely sensitive to a variation of the proton-to-electron mass ratio μ, due to a fortuitous interplay between classically forbidden internal rotation and rotation of the molecule as a whole. In this talk, we will explain the origin of this effect and how the sensitivity coefficients in methanol are calculated. In addition, we set a limit on a possible cosmological variation of μ by comparing transitions in methanol observed in the early Universe with those measured in the laboratory. Based on radio-astronomical observations of PKS1830-211, we deduce a constraint of $\Delta\mu/\mu = (0.0 \pm 1.0) \times 10^{-7}$ at redshift $z = 0.89$, corresponding to a look-back time of 7 billion years[b]. While this limit is more constraining and systematically more robust than previous ones, the methanol method opens a new search territory for probing μ-variation on cosmological timescales.

[a] P. Jansen, L.-H. Xu, I. Kleiner, W. Ubachs, and H.L. Bethlem *Phys. Rev. Lett.* **106**(100801) 2011.

[b] J. Bagdonaite, P. Jansen, C. Henkel, H.L. Bethlem, K.M. Menten, and W. Ubachs *Science* **339**(46) 2013.