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Bound on the variation in the fine structure constant implied by Oklo data

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Dynamical models of dark energy can imply that the fine structure constant α varies over cosmological time scales. Data on shifts in resonance energies E_r from the Oklo natural fission reactor have been used to place restrictive bounds on the change in α over the last 1.8 billion years. We review the uncertainties in these analyses, focusing on corrections to the standard estimate of $k_\alpha = \alpha\, dE_r/d\alpha$ due to Damour and Dyson. Guided, in part, by the best practice for assessing systematic errors in theoretical estimates spelt out by Dobaczewski et al. [in J. Phys. G: Nucl. Part. Phys. 41, 074001 (2014)], we compute these corrections in a variety of models tuned to reproduce existing nuclear data. Although the net correction is uncertain to within a factor of 2 or 3, it constitutes at most no more than 25\% of the Damour-Dyson estimate of k_α. Making similar allowances for the uncertainties in the modeling of the operation of the Oklo reactors, we conclude that the relative change in α since the Oklo reactors were last active (redshift $z \simeq 0.14$) is less than ~ 10 parts per billion. To illustrate the utility of this low-z bound, we consider its implications for the string-inspired runaway dilaton model of Damour, Piazza and Veneziano.

Oral or Poster Presentation

Poster

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