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Time-variability of alpha from realistic models of Oklo reactors[1]
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We reanalyze Oklo ^{149}Sm data using realistic models of the natural nuclear reactors. Disagreements among recent Oklo determinations of the time evolution of α, the electromagnetic fine structure constant, are shown to be due to different reactor models, which led to different neutron spectra used in the calculations. We use known Oklo reactor epithermal spectral indices as criteria for selecting realistic reactor models. Two Oklo reactors, RZ2 and RZ10, were modeled with MCNP. The resulting neutron spectra were used to calculate the change in the ^{149}Sm effective neutron capture cross section as a function of a possible shift in the energy of the 97.3-meV resonance. We independently deduce ancient ^{149}Sm effective cross sections, and use these values to set limits on the time-variation of α. Our study resolves a contradictory situation with previous Oklo α-results. Our suggested 2σ bound on a possible time variation of α over two billion years is stringent: $-0.11 \leq \frac{\Delta\alpha}{\alpha} \leq 0.24$, in units of 10^{-7}, but model dependent in that it assumes only α has varied over time.

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