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Comparisons of single-ion Yb^+ and Cs fountain clocks for searches for new physics[1] NILS HUNTEMANN, CHRISTIAN SANNER, RICHARD LANGE, BURGHARD LIPPHARDT, JOHANNES M. RAHM, STEFAN WEYERS, CHRISTIAN TAMM, EKKEHARD PEIK, Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig, Germany — We employ two single-ion Yb^+ optical clocks that use the $^2S_{1/2} \rightarrow {}^2F_{7/2}$ electric octupole (E3) transition as the reference. Because of their 3×10^{-18} uncertainty and the strong sensitivity of the transition frequency on the fine structure constant α, comparisons with other atomic clocks enable improvements in searches for temporal variations of α. A particularly suitable transition for such a comparison is the $^2S_{1/2} \rightarrow {}^2D_{3/2}$ electric quadrupole transition of the same ion, that we regularly use to test frequency shifts of the E3 transition induced by residual fields on a magnified scale. Besides investigations for variations of α, long-term comparisons between the Yb^+ and Cs fountain clocks, with their frequency being sensitive to the proton-to-electron mass ratio μ, allow us to improve present limits on the temporal variation of μ and use the data for searches for ultralight scalar dark matter.

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