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Reconstructing the evolution of dark energy with variations of fundamental parameters

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A popular candidate of dark energy, currently driving an accelerated expansion of the universe, is a slowly rolling scalar field or quintessence. A scalar field, however, must couple with other sources of matter. Consequently, its dynamical evolution can result in extra interactions between standard particles, which are mediated by the field, and to a variation in the fundamental parameters. Curiously, it has been reported that observations of a number of quasar absorption lines suggest that the fine structure constant was smaller in the past, at redshifts in the range $z = 1 - 3$ (Murphy *et al.* (2003), Murphy *et al.* (2004), but see also Srianand *et al.* (2007)). Could this indeed be the signature of a slowly evolving scalar field?

In this work we investigated how information can be obtained on the nature of dark energy from observational detection of (or constraints on) the variation of the fine structure constant and the proton to electron mass ratio. The reconstruction procedure is described with the purpose of forecasting the accuracy of proposed future spectrographs: ESPRESSO for VLT and CODEX for the E-ELT (Nunes & Lidsey (2004), Avelino *et al.* (2006), Avelino (2009)).

We discussed two parametrizations for the variation of alpha that satisfy the most stringent atomic clock constrains (Rosenband *et al.* (2008)) and that can also accommodate a large variation at redshift larger than unity. These parametrizations involve a sharp, recent transition in the dynamics of alpha, as well as non-trivial features in the shape of the scalar potential and the evolution of the equation of state parameter. Our results highlight the need for an independent confirmation of the quasar measurements.

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