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Searching for places where to test the variations of fundamental constants

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Abstract. It has been realised in the last few years that strong constraints on the time-variations of dimensionless fundamental constants of physics can be derived at any redshift from QSO absorption line systems. Variations of the fine structure constant, α, the proton-to-electron mass ratio, μ, or the combination, $x = \alpha^2 g_{\rm p}/\mu$, where $g_{\rm p}$ is the proton gyromagnetic factor, have been constrained. However, for the latter two constants, the number of lines of sight where these measurements can be performed is limited. In particular the number of known molecular and 21 cm absorbers is small. Our group has started several surveys to search for these systems. Here is a summary of some of the characteristics of these absorbers that can be used to find these systems.

Keywords. Galaxies: ISM - quasars: absorption lines - physics: fundamental constants

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The search for any variation of fundamental constants from high redshift quasar spectra. has been given tremendous interest recently with the advent of 10 m class telescopes. Since the amount of observing time required by the study of one absorption system is quite large (typically 10 to 20 hours of 10 m class telescope per quasar), the systems have to be selected carefully. In particular for μ and x, the small number of suitable systems may prevent the development of the field. We therefore have embarqued on several surveys to find these systems.

We searched for molecular hydrogen at high redshift with the VLT (Ledoux *et al.* 2003, Noterdaeme *et al.* 2008) in 77 DLAs/strong sub-DLAs (Damped Lyman-α systems), with $\log N(\text{H I}) \geqslant 20$ and $z_{\rm abs} > 1.8$. H_2 is detected in thirteen of the systems with molecular fractions as low as $f \simeq 5\times10^{-7}$ and up to $f \simeq 0.1$, with $f = 2N(H_2)/(2N(H_2)+N(\text{H I}))$ in the redshift range $1.8 < z_{\rm abs} \leqslant 4.2$.

For 21 cm absorbers at intermediate and high redshifts, we selected strong Mg II systems ($W_{\rm r} > 1$ Å) from the Sloan Digital Sky Survey in the redshift range suitable for a follow-up with the Giant Meterwave Telescope (GMRT), $1.10 < z_{\rm abs} < 1.45$. We detected 9 new 21 cm absorption systems (Gupta *et al.* 2009). This is by far the largest number of 21-cm detections from any single survey.

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