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Physics beyond the Standard Model from hydrogen molecules

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The hydrogen molecule is the smallest neutral chemical entity and a benchmark system of quantum physics and chemistry. The comparison between highly accurate measurements of transition frequencies and level energies with quantum calculations including all known phenomena (relativistic, vacuum polarization and self energy) provides a tool to search for physical phenomena in the realm of the unknown: are there forces beyond the three included in the Standard Model of physics plus gravity, are there extra dimensions beyond the 3+1 describing space time? Comparison of laboratory wavelengths of transitions in hydrogen may be compared with the lines observed during the epoch of the early Universe to verify whether fundamental constants of Nature have varied over cosmological time. These concepts, as well as the precision laboratory experiments and the astronomical observations used for such searches of new physics will be discussed.

Primary author: UBACHS, Wim (VU University Amsterdam)

Presenter: UBACHS, Wim (VU University Amsterdam)

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