Precision measurements on molecules for tests of fundamental physics

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Due to the increased precision in frequency measurements, the development of ultra-stable lasers, extremely accurate atomic and molecular clocks, and techniques to produce and control ultracold samples of molecules, spectroscopic methods are now being employed to test our physical understanding of the universe as laid out in General Relativity and the Standard Model. Molecules, and molecular spectroscopy, is currently shifting to the forefront, because some phenomena and effects searched for are specifically enhanced in some of the nearly infinite variety of molecular species. Molecules and molecular spectroscopy is a testground to effectively probe variation of the proton-electron mass ratio, on a cosmological time scale; examples from optical spectroscopy and radio astronomy are presented setting bounds on drifting constants. Highly accurate laboratory measurements on the hydrogen molecule can be interpreted as test of QED in chemically bound systems, as well as probes to detect fifth forces.