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The Relation Between Fundamental Constants and Particle Physics Parameters

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Astronomical observations provide constraints on the time variation of the fundamental constants, the proton to electron mass ratio and the fine structure constant. These constants are dependent on particular combinations of the Quantum Chromodynamic Scale, the Higgs Vacuum Expectation Value and the Yukawa Couplings. The coefficients of these particle physics parameters are model dependent but can be calculated from the model. The observational constraints on the time variation of the two fundamental constants therefore constrain the time variation of the combination of the three particle physics parameters. The proton to electron mass ratio and the fine structure constant provide two equations in the three particle physics parameters therefore one of the parameters can be eliminated providing a two parameter constraint. Both fundamental constants depend on the Quantum Chromodynamic Scale and the sum of the Higgs VEV and the Yukawa coupling. This makes it possible to solve for the QCD Scale and the sum of the Higgs VEV and Yukawa coupling separately placing a direct constraint on the QCD scale. Candidates for a third equation to constrain the Higgs VEV and Yukawa coupling individually will be discussed. Even with just the two equations the fundamental constants provide significant restrictions to the parameter space of theories that postulate that the particle physics parameters should be time variable.

Summary

This presentation describes the constraints on the time variation of the Quantum Chromodynamic Scale, the Higgs Vacuum Expectation Value and the Yukawa coupling imposed by the current constraints on the time variation of the proton to electron mass ratio and the fine structure constant.

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