



A Semiclassical Derivation of the QCD Coupling

By

David Batchelor

UMUC, SCIP

david.a.batchelor@nasa.gov

July 2009

UMUC Working Paper Series – Number 2009-018

Abstract

The strength of the fundamental nuclear strong force is characterized by the QCD coupling α_s . In this paper the measured value of the QCD coupling α_s at the energy M_Z^0 , the variation of α_s as a function of energy in QCD, and classical relativistic dynamics are used to investigate virtual pairs of quarks and antiquarks in vacuum fluctuations. For virtual pairs of bottom quarks and antiquarks, the pair lifetime in the classical model agrees with the lifetime from quantum mechanics to good approximation, and the action integral in the classical model agrees as well with the action that follows from the Uncertainty Principle. This suggests that the particles might have small de Broglie wavelengths and behave with well-localized pointlike dynamics. It also permits α_s at the mass energy twice the bottom quark mass to be expressed as a simple fraction: $3/16$. This is accurate to approximately 10%. The model in this paper predicts the measured value of $\alpha_s(M_Z^0)$ to be 0.121, which is in agreement with recent measurements within statistical uncertainties.

Keywords

Quantum mechanics, quarks, quantum chromodynamics, vacuum fluctuations

This work was supported by the NASA Goddard Space Flight Center