Understanding the Interaction of Ultra High Intensity Laser Pulses with Extremely Small Physical Systems of Importance in Biological and Environmental Research from a Purely Quantum Point of View

Milton Dean Slaughter
Department of Physics
Florida International University
Miami, FL 33199

Abstract

Over the past decade or so, research at the fundamental and empirical level in attempting to understand how extremely small (molecular, atomic, nuclear, and elementary) physical systems which interact with ultra high intensity laser pulses of very short time duration has increased dramatically providing exciting glimpses into a future where one may finally begin to describe such systems in a very well defined fashion which implies quantum corrections which may well manifest themselves even at the macroscopic level. We outline possible theoretical and phenomenological ways to deal with such systems which automatically take into account quantum effects as opposed to typical investigations which may be generally classified as semi-classical methodology.

Theory and Applications

Technological advances in constructing ultra high intensity laser pulses of very short time duration has proceeded at a very rapid pace. Indeed, it is probable that quantum field theoretic corrections may be required in order to understand how extremely small (molecular, atomic, nuclear, and elementary) physical systems, (i.e. nano-systems) interact with such laser pulses.

To illustrate how science and technology has arrived at this point, we outline---beginning with purely classical formulations and ending with methodologies based upon quantum field theory---attempts to truly understand and calculate processes involving short time duration ultra high intensity laser pulses at the nano-scale.