Abstract for an Invited Paper
for the PSF09 Meeting of
The American Physical Society

Space-time resolved quantum field theory[1]

R. GROBE, Intense Laser Physics Theory Unit, Illinois State University

We have solved simplified model versions of the time-dependent Dirac and Yukawa equation numerically to study the time evolution of electrons, positrons and photons with full spatial resolution. The goal is to better understand how various particle creation and annihilation processes that require quantum field theory can be visualized. There are many open ended questions that we will address. Are particles and their antimatter companions created instantly, or do they require a certain minimum amount of time? Are they created at precisely the same location? What is the difference between a bare and a physical particle? Forces between two particles are usually understood on a microscopic level as the result of an exchange of bosonic particles. How can the same microscopic exchange mechanism lead to a repulsion as well as an attraction? Do these force intermediating particles "know" about the charges of the two interacting particles? How can one visualize this exchange? Does it really make sense to distinguish between virtual and real particles? We also examine how a bare electron can trigger the creation of a cloud of virtual photons around it.

In collaboration with R. Wagner, Intense Laser Physics Theory Unit, Illinois State University; C. Gerry, Lehman College and ILP-ISU; T. Cheng and Q. Su, Intense Laser Physics Theory Unit, Illinois State University.

[1]Supported by the NSF and Research Corporation.