**Nonlinear Electrodynamics in Astrophysics**

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Strong electromagnetic fields drastically modify the Maxwell theory. When the lowest Landau level in a strong magnetic field is equal to or greater than the Bohr atomic energy (B0 = 2.4 x 109 G), then electrons of the atom arrange themselves according to the Landau levels. Further when the cyclotron energy (Landau spacing) is equal to the rest mass of the electron (Bc = 4.4 x 1013 G known as the Schwinger field), then the field changes the Dirac vacuum and the nonlinear correction (Heisenberg-Euler-Schwinger QED action) plays a role for the nonlinear electrodynamics. Analogously, when the electric field energy density per unit Compton volume is equal to the rest mass of electron (Ec = 1.3 x 1016 V/cm), then electron-positron pairs are created from the Dirac vacuum.

Ultra-strong magnetic fields abound in astrophysics: highly magnetized neutron stars, particularly, magnetars have magnetic fields stronger by one or two order than the Schwinger field and mergers of neutron stars. The recent development of intense lasers via CPA (Chirped Pulsed Amplification) introduced by Mourou and Strickland has opened a new window to probe the fundamental physics in strong electromagnetic fields. CoReLS is the current champion of intense lasers (I = 1.1 x 1023 W/cm2). The physics in such ultra-strong fields differ from the weak field theory. Photon’s propagation undergoes birefringence and the polarization vector rotates as in dielectric media with magneto-electric effect. This talk will address the novel aspects of nonlinear electrodynamics: the Heisenberg-Euler-Schwinger QED action, the photon propagation, Schwinger pair production, nonlinear Compton scattering etc.