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Towards an effective nonlinear Quantum Mechanics for High Energy-density (HED) Matter[1]

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A relativistic quantum framework is presented for dealing with high energy density matter, in particular, an assembly of particles in the field of an electromagnetic (EM) wave of arbitrary magnitude. Two different approaches are presented: 1) A Statistical Mechanical model for the HED matter is developed - Principal steps involve solving the eigenvalue problem for a quantum relativistic particle in the presence of arbitrary strength EM field. The resulting energy eigenvalue (dependent on the magnitudes A, ω and k) defines the appropriate Boltzmann factor to construct expressions for physical variables for a weakly interacting system of these field-dressed particles. The fluid equations are the conservation laws, 2) Second, an equivalent nonlinear quantum mechanics is constructed to represent a hot fluid with and without internal degrees of freedom (like spin). Representative initial results are displayed and discussed: 1) fundamental changes in the particle energy momentum relationship 2) The EM wave induces anisotropy in the energy momentum tensor, 3) the EM wave splits the spin-degenerate states, 4) the propagation characteristics of the EM wave are modified by thermal and field effects causing differential self-induced transparency, 5) Particle trapping and "pushing" by the high amplitude EM wave. Attempts will be made to highlight testable predictions.

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