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Semi-Relativistic Schroedinger-Poisson System of Equations with Long-Range Interactions

The evolution of the density matrix of interacting many-body quantum particles in the mean-field limit is given by the Hartree-von Neumann equation. Using the properties of the density matrix, this is equivalent to a system of infinitely coupled nonlinear PDEs, the Schroedinger-Poisson system of equations. The semi-relativistic Schroedinger-Poisson system of equations describes the mean-field dynamics of interacting quantum particles with very high velocities, such as in plasmas. I discuss the derivation of the semi-relativistic Schroedinger-Poisson system of equations with long-range interactions and its global well-posedness in appropriate Sobolev spaces. I also describe the asymptotics of the solution as the mass of the particles tends to zero and to infinity, respectively.