Filamentation In Spin Polarized Magnetized Quantum Plasma

Punit Kumar
Department of Physics, University of Lucknow, Lucknow – 226007, India
e-mail : punitkumar@hotmail.com

The plasma, where the inter-particle distance approaches the de-Broglie wavelength, or the temperature goes below the Fermi temperature, plasma particles obey Fermi-Dirac statistics and degeneracy starts playing a significant role. In such cases, study of quantum effects become important due to the important applications of quantum plasma ranging from plasmonics, astrophysics, ultracold plasmas, inertial confinement fusion (ICF), future generation compression based plasma experiment, quantum well to quantum x-ray free electron laser and laser-solid density plasma experiments. There is a great motivation to investigate collective phenomenon in quantum plasma where Bohm potential, Fermi pressure and electron spin as well as certain quantum electro-dynamical effects have been accounted for. Filamentation in quantum plasma have been studied by various authors but all the previous studies considered electrons as a single fluid of macroscopically averaged spin-1/2 plasma. These papers did not show a full picture as they didn't took spin-up and spin-down interaction force into account. Very recently, a modified separate spin evolution (SSE) treatment of electrons in accordance with Pauli equation has been developed. In the present paper, using the modified model the filamentation of a short laser pulse in a magnetized quantum plasma is presented. Spin-up and spin-down electrons have been taken to be separate species of particles and spin-spin interaction picture has been developed. The effects of quantum Bohm potential, electron Fermi pressure and spin have also been taken into account. The direction of the external field has been taken to be along the direction of electron beam propagation in the first case and oblique in the second case. The dispersion for both the cases have been obtained and growth rate evaluated. The results of both the cases have been compared and analyzed.