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Instabilities in Strongly Interacting Electron Liquids SANKAR DAS SARMA, CMTC, Department of Physics, University of Maryland, College Park, MD 20742, YING ZHANG, CMTC, Department of Physics, University of Maryland, College Park, MD 20742 — We show that the low-density strongly interacting electron liquid, interacting via the long-range Coulomb interaction, could develop two types of instabilities that fundamentally change the magnetic and dispersion properties of the ground state of the system. As the electron density decreases, both the 2D and 3D paramagnetic electron liquids first experience a magnetic instability which may be of either Bloch or Stoner type. These instabilities suggest a first or second order quantum phase transition into a ferromagnetic Fermi liquid. As the electron density further decreases, both 2D and 3D electron liquids develop a dispersion instability at a critical density associated with the approximate flattening of the quasiparticle energy dispersion. At the critical density the quasiparticle effective mass diverges at the Fermi surface, but the signature of this Fermi surface instability manifests itself away from the Fermi momentum at higher densities. For densities below the critical density the system is unstable since the quasiparticle velocity becomes negative. We show that one physical mechanism underlying the dispersion instability is the emission of soft plasmons by the quasiparticles. We discuss the implications of the magnetic and dispersion instabilities for experiments at low electron. This work is supported by by the US-ONR and NSF.

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