Melting of the 2D Wigner Crystal

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Wigner crystals (i.e. a solid composed of only electrons) have been suggested to be stable in semiconductor interfaces, on the surface of liquid helium, and in graphene bilayers but there have been no direct studies of its stability taking Fermi statistics into account. We have performed restricted path integral Monte Carlo (PIMC) simulations [1] for the spin-polarized and unpolarized homogeneous electron gas in two dimension at low densities and low temperatures. We obtain the conditions for stability of the Wigner crystal by directly observing freezing and melting. The phase diagrams show both thermal and quantum melting. The thermal melting is mediated by a hexatic phase. A Pomeranchuk effect is found for unpolarized case. This complements the previous study of the melting of the Boltzmannon Coulomb crystal [2]. We will discuss the method to perform these Path Integral simulations and compare with previous estimates for the 2D Wigner crystal stability.

References

1. D. M. Ceperley, *Phys. Rev. Lett*. **69** (1992) 331.

2. B. K. Clark, M. Casula, and D. M. Ceperley, *Phys. Rev. Lett.* **103** (2009), 055701.