Chez Pierre

Presents ...

Special Chez Pierre Seminar

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''Composite fermion liquid: from 2DEG to topological insulator surface''

It is strongly believed that the quantum Hall fluid at filling factor \nu = ½ realizes the composite fermion liquid - an exotic phase of matter with emergent excitations - composite fermions - forming a Fermi-surface. The original theory of this state proposed by Halperin, Lee and Read (HLR) in 1993 is well supported by experiments. However, one aspect of HLR theory has continued to puzzle theorists for the past 20 years: an apparent lack of particle-hole symmetry expected to emerge in the lowest Landau level. Recently, D. Son has conjectured a surprising resolution of this puzzle, proposing that the composite fermion is a Dirac fermion. I will give a derivation of this conjecture by making a connection between the physics of a half-filled Landau level and the surface of a 3d topological insulator (TI). The derivation will proceed via a dual theory of the single Dirac cone on the TI surface, given by quantum electrodynamics (QED_3) with a single dual Dirac fermion coupled to a fluctuating gauge field. Finally, I will present smoking-gun numerical evidence for the Dirac nature of the composite fermion coming from DMRG simulations of quantum Hall fluid at \nu = ½.