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Paired Quantum Hall States at Weak Coupling: Phenomenology[1]

S.A. PARAMESWARAN, University of California, Berkeley, S.A. KIVELSON, Stanford University, S.L. SONDHI, Princeton University, B.Z. SPIVAK, University of Washington — Paired quantum Hall states such as the Pfaffian exhibit a weak-coupling regime much like that of BCS superconductivity. In this regime their lowest energy excitations are neutral fermions – Bogoliubov quasiparticles constructed from the composite fermions – and not the charged vortices which generally govern the behavior of quantum Hall states. We discuss a rich set of phenomena which follow from this observation. At finite temperatures of order the pairing scale these include (i) an almost sharp phase transition (ii) a new finite-temperature length scale for the penetration of longitudinal electric fields, and (iii) the existence of a new collective excitation in paired QH states which is a cousin to the well known Artemenko-Volkov-Carlson-Goldman-Schmid-Schon mode in conventional superconductors. At lower temperatures, we find (i) a proximity effect between the paired states and their ancestor metals, which in turn mediates (ii) 'Josephson' couplings between paired QH droplets separated by metallic regions and leads to (iii) a distinctive response of such states to disorder; and finally, we also comment on (iv) an analog of Andreev reflection in these systems.

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