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Exotic Excitations of Composite Fermions

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The low-energy physics of the fractional quantum Hall effect (FQHE) is marked by the emergence of weakly correlated quasiparticles called composite fermions that are qualitatively distinct from the original strongly correlated electrons. A composite fermion (CF) is an electron bound to an even number of quantum mechanical vortices of the many-body wave function where the number of vortices characterizing the CF is called its flavor. Inelastic light scattering has played a crucial role in understanding the different types of excitations in the FQHE regime. While the lowest energy neutral excitations are accurately described as single CF particle-hole pairs, other types of interesting higher energy excitations are possible. We describe two such excitations. (i) Composite fermion flavor changing excitations (Peterson and Jain, PRL 93, 046402(2004), Wojs and Quinn, Philos. Mag. B 80, 1405(2000)): The lowest energy excitations are such that the flavor of the excited CF remains constant. We show that, in addition, there is a new class of excitations where the excited CF loses some of its vortices, i.e., it changes its flavor. Further, we suggest that these flavor changing excitations are relevant to the experimental observation of Hirjibehedin *et al.* (PRL, 91, 186802(2003)) of co-existing excitation modes of differently flavored CFs in the filling factor range $1/3 > \nu \geq 1/5$. (ii) Electronlike CF excitations (Jain and Peterson, PRL 94, 186808(2005)): We show that the electron is not irretrievably lost in the FQHE regime. In particular, we find that the electron (hole) couples to a complex high energy bound state of CF quasiparticles (holes). Experimental consequences of this complex bound state will be discussed.