Condensed Matter Seminar Series

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The fractional quantum Hall effect at filling factor 5/2: finite thickness, topological degeneracy, particle-hole symmetry, and bilayers

Monday, Oct. 12

4:00 P.M.

304 Robeson

One of the most important discoveries in physics in the past 25 years is the fractional quantum Hall effect (FQHE): a many-body strongly interacting system exhibiting the emergence of topological quasiparticles with fractional charged excitations and statistics and, perhaps, even non-Abelian quasiparticles for the FQHE in the second orbital Landau level at even-denominator filling factor 5/2. The 5/2 FQHE is currently motivating scientists partly due to its potential role in topological quantum computation and the fact that it still is quite mysterious after nearly 20 years. In this talk, I discuss the actual physical reality of the proposed topological non-Abelian Moore-Read Pfaffian description of the 5/2 FQHE. Specifically, theoretically it is found that the quasi-two-dimensional nature of the experimental FQHE systems, i.e., the finite width, produces a physical environment sufficient to stabilize the Moore-Read Pfaffian state (based on exact diagonalization using the spherical and torus geometries). Our results suggest the possibility of creating optimal experimental systems for the 5/2 FQHE state which are more likely to be described by the Pfaffian ansatz. I also mention the possibility of using FQHE bilayer systems to further shed light on the physical reality of the Pfaffian description at 5/2. Lastly the role of the three-body interaction Hamiltonian that produces the Moore-Read Pfaffian as an exact ground state and particle-hole symmetry in the FQHE at 5/2 will be discussed.

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