



Jainendra K. Jain

Department of Physics, Pennsylvania State University

Time: 4:00pm, October 23, 2015 (Friday)

2015 10 23

4:00

Venue: Room W563, Physics Building, Peking University

563

Abstract

Composite fermions are emergent topological particles that arise as a result of interaction between electrons confined to two dimensions and exposed to a strong magnetic field. They were postulated to explain the phenomenon of the fractional quantum Hall effect as the integer quantum Hall effect of composite fermions. After a brief pedagogical introduction, I will come to some recent puzzles regarding a remarkable manifestation of composite fermions at the half filled Landau level, namely their Fermi sea, which arises as a non-perturbative consequence of emergent gauge fields in a system where there was no Fermi sea to begin with. An intuitive picture suggests two equally plausible Fermi seas that appear to be topologically distinct and occupy different areas. We provide theoretical evidence that these are in fact dual descriptions of the same state. We calculate the Fermi wave vector in a particle-hole symmetric theory, and find our results to be generally consistent with the experimental results of Kamburov et al. [Phys. Rev. Lett. 113, 196801 (2014)]. Most remarkably, we predict that the area of the CF Fermi sea slightly violates the cherished Luttinger's area rule of Fermi liquids. This work [A. C. Balram and C. Toke arXiv:1506.02747 (2015)] was supported by the US Department of Energy.

About the Speaker

Jainendra Jain is a theoretical physicist interested in unexpected quantum mechanical reorganizations that occur when a large number of particles interact. He is best known for work leading to the discovery of exotic particles called "composite fermions," which he had postulated to explain the fractional quantum Hall effect, one of the most remarkable topological states of matter. For this work, Jain was a co-recipient of the American Physical Society's Oliver E. Buckley Prize in 2002, the highest award in the United States in the field of condensed-matter physics. Jain has received Fellowships from the American Physical Society, the John Simon Guggenheim Memorial Foundation, and the Alfred P. Sloan Foundation. He was elected a Fellow of the American Academy of Arts and Sciences in 2008, and of the American Association for the Advancement of Science in 2012. He received the Distinguished Postdoctoral Alumnus Award from the University of Maryland in 2004, the ACIPA Distinguished Scholar Prize of the Indian Physics Association in 2008, and the Distinguished Alumnus Award from the Indian Institute of Technology in Kanpur in 2010. He is a co-author of more than 200 scholarly articles and the author of a monograph titled "Composite Fermions," and has delivered more than 250 invited lectures at universities and international conferences. He is currently the Evan Pugh Professor and Erwin W. Mueller Professor at Penn State, and also holds the Raman Visiting Chair and Infosys Visiting Chair Professorships in India.