Condensed Matter Theory Center Seminar

Tuesday, May 12
11:00 am – 12:00 pm
2205 Toll Physics Building

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"Universal Quantum Computation from Bilayer Quantum Hall States"

The possibility of realizing non-Abelian statistics and utilizing it for topological quantum computation (TQC) has generated widespread interest. However, the non-Abelian statistics that can be realized in most accessible proposals is not powerful enough for universal TQC.

In this talk, I will consider a simple bilayer fractional quantum Hall system with 1/3 Laughlin state in each layer. Then I will show that a certain type of interlayer couplings which are experimentally relevant in higher Landau levels can drive a topological phase transition to an exotic non-Abelian state with famous `Fibonacci' anyon, whose non-Abelian statistics is powerful enough for universal TQC.

Finally, I will present our recent numerical results on exact diagonlization of the model Hamiltonian for up to 14 electrons on sphere and torus geometries where we consider interlayer tunneling as well as modified Coulomb interaction. We find 6-fold ground-state degeneracy on the torus when the hollow-core component of the interlayer Coulomb interaction is dominant. To identify the topological nature of this phase we measure orbital-cut entanglement spectrum, quasi-hole counting, topological entanglement entropy and wave-function overlap. Comparing the numerical results to the theoretical predictions, I will argue that this 6-fold ground-state degeneracy phase is the non-Abelian bilayer Fibonacci state.

References:

1- Z. Liu, A. Vaezi, K. Lee, and E.-A. Kim, arXiv:1502.05391 (2015)

2- A. Vaezi, and M. Barkeshli, Phys. Rev. Lett. 113, 236804 (2014)

3- A. Vaezi, Phys. Rev. X, 4, 031009 (2014)

Host: Sriram Ganeshan

Web: http://www.physics.umd.edu/cmtc/seminars.html