Condensed Matter & Biophysics Seminar

Superfluids and low-dimensional electrons: On the road to hybrid quantum systems

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THURSDAY

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4:00 P.M.

RM 184 NSH

Creating and controlling novel quantum states of matter is at the forefront of modern condensed matter physics. I will discuss two examples of this "create and control" paradigm from my experiences. First, I will describe how we have utilized anisotropic disorder, in the form of high porosity aerogel, to create new chiral superfluid states of 3He. The understanding of these states has broad implications regarding the general stability of chiral superconductivity. In the second part of my talk I will discuss our experiments on controlling the orientation of two-dimensional (2d) liquid crystalline states existing in ultra-clean semiconductor heterostructures. These fascinating states, known as quantum Hall nematics, exhibit a mysterious broken rotational symmetry in the 2d plane. We have found that this symmetry can be experimentally controlled by engineering the device structure; thereby demonstrating a unique technique for controlling the orientation of these exotic quantum states. Finally, I will remark on how the lessons learned from studying superfluid 3He and 2d electrons can be harnessed to create hybrid quantum systems composed of free electrons floating on the surface of liquid helium coupled to nanoscale structures or topological states of matter. These systems provide a unique platform for studying the fundamental physics of low dimensional quantum systems and their potential quantum computing applications.