



# PHYSICS AND ASTRONOMY COLLOQUIUM

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## **“THE QUANTUM HALL EFFECT: APPLIED SCIENCE’S GIFT TO FUNDAMENTAL SCIENCE”**

### Abstract

The discoveries of the integer and fractional quantum Hall effect (IQHE/FQHE), in a two-dimensional system of electrons in 1980-82 gave rise to the field of topological matter. They brought about a revolution in our understanding of the physics of condensed matter and resulted in six scientists winning the Nobel Prize in Physics.

Since the original discovery, the two-dimensional electron system subjected to a large perpendicular magnetic field has become a veritable goldmine for the condensed matter physicist. Completely unexpected and exotic phenomena such as fractionalization of electronic charge, composite particles, Abelian and non-Abelian quantum states, and topological phases have entered the lexicon of quantum condensed matter. In addition, the system has provided new examples of previously known exotic phenomena such as topological spin excitations and charge density wave phases, the latter coming in several incarnations such as electron crystals, bubble crystals, and striped phases.

Behind this amazing discovery lies the story of painstaking development of semiconductor heterostructures, a field motivated in large part by its technological importance. This was but one in a series of success stories involving the vast field of semiconductor technology, starting with the original discovery of the transistor by physicists at Bell Laboratories in 1947. Without these developments in applied research, the IQHE and FQHE would scarcely have been discovered, and our understanding of the richness of nature would have been that much poorer.

This talk will trace this interplay of science and technology in the context of semiconductor heterostructures, culminating in the discovery of the FQHE, and unfolding of its complex, hierarchical structure. Following that, I will give an overview of the fascinating phenomena that QHE exemplifies. Finally, I will discuss ongoing research on new materials and new phases as part of our unending quest to dig deeper into fundamental physics uncovered as a consequence of the surprising and unexpected discoveries made almost four decades ago.

Wednesday, October 16, 2019  
3:30 p.m.  
Bob Wright Centre A104