MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

Physics Colloquium

Friday, February 16, 2018
4:10 – 5:00 PM
Barnard Hall (EPS) 103

Mesoscopic superconductivity: A bridge between topology and symmetry breaking

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Abstract:

Superconducting materials show unique electronic properties that are indispensable in the realization of modern quantum technologies, e.g. quantum computers and devices. These superconducting materials are often experimentally realized as thin-film circuits or hybrid structures operating in the mesoscopic regime, i.e. the intermediate regime between the microscopic scale of the atomic lattice and the macroscopic scale of bulk materials. Our basic understanding is however far from complete when it comes to how superconductivity behaves on this length scale, what properties arise and how they can be fully exploited in such quantum devices. Mesoscopic superconductivity therefore proves ripe for fundamental research.

The main challenge is that traditional theories used to study superconductivity tend to become intractable on the mesoscopic scale. To overcome this challenge, we use a computational framework that employs high-performance computing through extreme parallelization on graphics processing units. In this talk, the computational framework is used to study the interplay between topology and spontaneous symmetry breaking, in a new novel superconducting phase where circulating currents and magnetic fields spontaneously appear at the interface of certain superconductors [1]-[3]. We will study how and why this phase arises, and discuss its significance to quantum devices as well as the possibility of experimental verification.

References: [1] M. Håkansson, T. Löfwander, and M. Fogelström, Nat. Phys. 11, 755 (2015).
[2] P. Holmvall, A. Vorontsov, M. Fogelström, and T. Löfwander, arXiv:1711.07946 (2017)
[3] P. Holmvall, T. Löfwander, and M. Fogelström, arXiv:1706.06165 (2017)

Host: Anton Vorontsov

**** Refreshments served in the Barnard (EPS) second floor atrium at 3:45 ****