



# 第23回トポロジカル物質科学セミナー Topological Material Science Seminar (23)

## **Anomalous Hall effects in Chiral Superfluids**

**Prof. James A. Sauls**

Department of Physics & Astronomy  
Northwestern University, Evanston, USA

**Place: Room A304**, Department of Materials Engineering Science,  
Graduate School of Engineering Science,  
Engineering Science Bldg., Osaka University (Toyonaka Campus)

**Date : November 8 (Tuesday), 2016**

**Time: 10:30-**

### **Abstract:**

The superfluid phases of  $^3\text{He}$  are paradigms for spontaneous symmetry breaking in quantum field theory and condensed matter physics. The microscopic physics underlying the phenomenology of  $^3\text{He}$  - that of an interacting Fermi system with strong-coupling between Fermions to *paramagnons* - provided the basic theoretical model for spin-triplet superconductivity in  $\text{Sr}_2\text{RuO}_4$  [1]. The phases of bulk superfluid  $^3\text{He}$  are also paradigms for topological order and the subject of intense theoretical and experimental research [2]. I discuss signatures of broken space-time symmetries - particularly, parity and time-reversal (BTRP) - and the implications for topological order of chiral superfluids. I highlight signatures of BTRP in  $^3\text{He-A}$  [3], and chiral superconductors [4]. I summarize the theory for the anomalous Hall effect for electron transport in chiral superfluids, and show that the experimental results for electron transport in superfluid  $^3\text{He-A}$  provide direct evidence for the spectrum of Weyl Fermions in  $^3\text{He-A}$  [5]. I conclude with a discussion of BTRP in chiral superconductors.

[1] T. M. Rice and M. Sigrist, J. Phys. Cond. Mat., **7**, L643 (1995).

[2] T. Mizushima. et al., J.Phys.Soc. Jpn. **85**, 022001 (2016).

[3] H. Ikegami, Y. Tsutsumi, and K. Kono, Science **341**, 59 (2013).

[4] E. R. Schemm, et al. Science **345**, 190 (2014).

[5] O. Shevtsov and J. A. Sauls, Phys. Rev. B **96**, 064511 (2016).