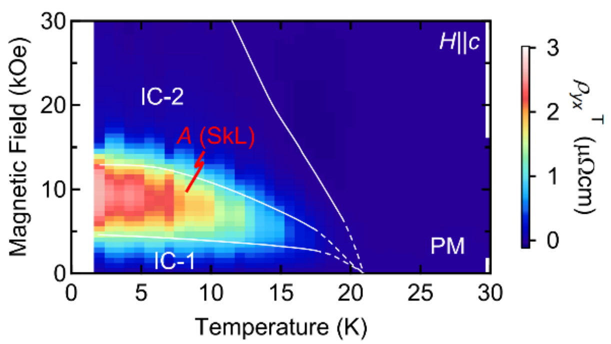
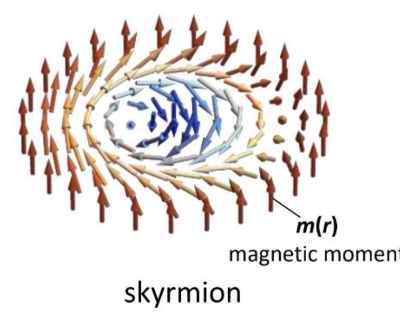
Skyrmion lattice in frustrated triangular lattice magnet R_2PdSi_3 (R = Gd and other RE)

Skyrmions are topological swirls of magnetic spins that behave like particles. They are nanometer-sized quasiparticles currently regarded as next-generation information carriers with potential applications in high-density, low-power, robust data storage and transfer devices **[1]**. Its theoretical model was developed in 1962 **[2]** but was first experimentally found in 2009 **[3]**. Skyrmions are generally found in the non-centrosymmetric B20 class of materials **[1,3,4,5]**, such as MnSi, FeGe, Cu_2OSeO_3 etc., but recently, they have also been found in centrosymmetric materials as well **[6]** where magnetic frustration leads to stabilization of skyrmion lattice **[6,7]**. A recent study observed that the application of pressure significantly modifies the distribution of magnetic phase pockets in the magnetic field-temperature phase diagram for B20 material **[8]**. We want to study the effects of hydrostatic pressure on the magnetic phase boundaries of R_2PdSi_3.

We are looking for students who would be interested in this experimental project and work on the growth of candidate materials (using the optical floating zone method) as well as investigate magnetic properties as a function of temperature, magnetic field and pressure.



(Fig 1: Phase diagram showing skyrmion A-phase in Gd_2PdSi_3)



(Fig 2: Skyrmion spin structure)

References:

***[1]** "Skyrmion devices for memory and logic applications"; S Luo and L You, APL Materials 9, 050901 (2021). **[2]** "A unified field theory of mesons and baryons"; T H R Skyrme, Nuclear Physics vol 31, p 556-569 (1962). **[3]** "Skyrmion lattice in a chiral magnet"; S. Mühlbauer et al., Science, Vol 323, Issue 5916 pp. 915-919 (2009). **[4]** "Magnetic Skyrmions and Quasi Particles: A Review on Principles and Applications"; B A Kolech et al, DOI:10.5772/intechopen.110448 (2023). **[5]** "Multiple low-temperature skyrmionic states in a bulk chiral magnet", L J Bannenberg et al., npj Quantum Materials volume 4, Article number: 11 (2019). **[6]** "Skyrmion lattice with a giant topological Hall effect in a frustrated triangular-lattice magnet"; T Kurumaji et al., Science 365, 914–918 (2019). **[7]** "Multiply periodic states and isolated skyrmions in an anisotropic frustrated magnet"; A O Leonov and M Mostovoy, Nat. Commun 6, 8275 (2014). **[8]** "Room-temperature skyrmion phase in bulk Cu_2OSeO_3 under high pressures"; L Deng et al., PNAS 117 (16) 8783-8787 (2020)*

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