Exploring room temperature chiral magnetic structures in Mn_4Ga_2Sn

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 could lead to stabilization of skyrmion lattice **[6,7]**. Mn_4Ga_2Sn is one such centrosymmetric material which is also a kagome ferromagnet and hosts tunable skyrmions up to room temperature **[8]**.

We are looking for students who would be interested in this experimental project and work on the crystal growth of polycrystalline/ single-crystalline samples as well as investigate magnetic properties as a function of temperature, magnetic field and pressure.

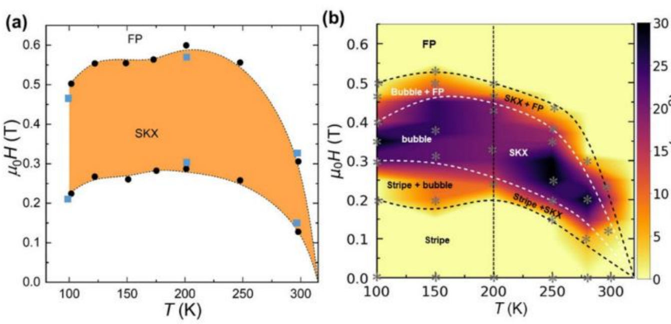

Fig 1: *H-T phase diagram constructed using the (a) magnetization data of polycrystalline Mn_4Ga_2Sn sample and (b) LTEM data* ***[8]****.*

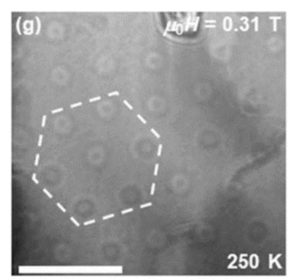

Fig 2: *overfocused LTEM images of magnetic textures*

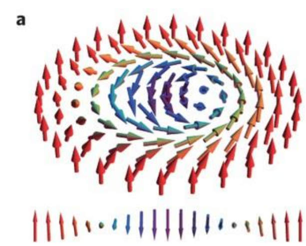

Fig 3: *Skyrmion spin structure*

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]*** *"Tunable room temperature magnetic skyrmions in centrosymmetric kagome magnet Mn4Ga2Sn" D Chakrabartty et al., Nature Commun Phys 5, 189 (2022)*

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