

PHELIQS / IMAPEC

Quantum internship – Academic year 2025-2026

Magnetic Skyrmion lattice in GdRu₂Si₂

Level : Master, 1st year

General Scope : Recent years have seen the discovery of topological properties in numerous condensed matter systems, ranging from 2D electron gases and topological insulators to Weyl/Dirac semimetals and superconductors. This exploration has extended to topological spin textures, where the complex interplay between magnetism and topology offers a fertile ground for uncovering unique physical effects. A prominent example of these phenomena is the magnetic skyrmion a non-collinear spin arrangement characterized by particle-like, topologically protected states which has been first observed in the helical magnet MnSi. This protection confers exceptional stability even at the nanoscale, positioning skyrmions as possible particles for next-generation data storage, such as racetrack memory devices. While both bulk materials and thin films serve as viable platforms for skyrmion stabilization, bulk systems offer access to unique physical regimes, novel phases, and distinct interaction mechanisms. Furthermore, the recent identification of nanometric skyrmions in bulk crystals provides a rare opportunity to investigate quantum signatures in spin dynamics and topological Hall-like effects.

Research topic and facilities available : In a noncentrosymmetric crystal, it is widely believed that competition between the ferromagnetic exchange interaction J and Dzyaloshinskii-Moriya (DM) interaction \mathcal{D} stabilizes a magnetic skyrmion. Recently the formation of a skyrmion lattice has been observed in several Gd based materials, including GdRu₂Si₂. This material is in contrast centrosymmetric and crystallizes in the tetragonal ThCr₂Si₂ structure composed of alternating Gd square lattice and Ru₂Si₂ layers. Although there is no geometrical frustration, nor lack of symmetry, a skyrmion lattice of small size has been observe. In this internship we want to study the magnetic phase diagram of GdRu₂Si₂ by electrical transport and investigate the topological properties by Hall effect measurements.

Required skills : solid knowledge of condensed matter physics, taste for experiment

Starting date and duration : 18/05/2026, 8 weeks

Contact :

Name : Georg Knebel

Laboratory : Pheliqs / Imapec

Phone : 04 38 78 08 32

e-mail : georg.knebel@cea.fr