TECHNISCHE UNIVERSITÄT DRESDEN

Institut für Festkörper- und Materialphysik

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IFMP Seminar

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Speaker **Takeshi Matsumura**
Hiroshima University

Title **Helical and cyloidal magnetic orderings in noncentrosymmetric Eu*T*Ge₃ (*T*=Ir, Ni, Rh)**

Abstract In noncentrosymmetric magnetic materials, various types of nontrivial magnetic structures are realized as a result of competition among symmetric magnetic exchange interaction, Dzyaloshinskii-Moriya–type antisymmetric exchange interaction, and Zeeman energy in external magnetic fields, especially in Gd and Eu compounds with weak crystal-field anisotropy. In many cases, they are non-collinear or non-coplanar structures associated with incommensurate spiral ordering. In this talk, I focus on the tetragonal EuTGe$_3$ family without an inversion center but with mirror planes including the c axis (space group $I4mm$). From our recent studies on EuIrGe$_3$, EuNiGe$_3$, and EuRhGe$_3$, using circularly polarized resonant x-ray diffraction to investigate magnetic helicities, it was clarified that each compound exhibits distinctive ordering phenomena reflecting competing interactions. In EuIrGe$_3$, successive transitions take place from sinusoidal ($\boldsymbol{m}\|c$) to cycloidal ($\boldsymbol{m}\|ac$ or bc) structures with a tiny reorientation of the propagation vector from $\boldsymbol{q}$=(0 0 0.792) to (0.017 0 0.792). Each of the four cycloidal domains has its own helicity. In EuNiGe$_3$, single-$\boldsymbol{q}$ helical ordering at zero field with $\boldsymbol{q}$=(0.26 0.053 0) transforms into a triple-$\boldsymbol{q}$ distorted-triangular skyrmion-lattice state in a magnetic field. Surprisingly, the original helicity at zero field is reversed to form a skyrmion lattice with unified helicity. In EuRhGe$_3$, in contrast, the helical order propagating along the c axis is free from the antisymmetric interaction.

[1] T. Matsumura *et al*., J. Phys. Soc. Jpn. **91**, 073703 (2022). (arXiv:2206.06596)
[2] K. Kurauchi *et al*., J. Phys. Soc. Jpn. **92**, 083701 (2023). (arXiv:2306.12669)
[3] T. Matsumura *et al*., J. Phys. Soc. Jpn. **93**, 074705 (2024). (Open Select)

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