



Datum: 07.01.2020

Joint IFMP/SFB/IFW Seminar

When: **31 January 2020, 14:00 h**

Where: **IFW / D2E.27**

Speaker: **Prof. Shintaro Ishiwata**
Osaka University, Japan

Title: **Topological and helical spin structures in centrosymmetric perovskite-type oxides**

Abstract:

Topological spin texture consisting of a multiple- q spin spiral is of great interest for novel quantum transport phenomena and spintronic functions. A recent interesting example is a magnetic skyrmion, which is a topologically stable spin texture discovered in noncentrosymmetric systems with Dzyaloshinskii-Moriya (DM) interaction [1]. A cubic perovskite SrFeO_3 is a promising candidate of the centrosymmetric compound hosting a novel type of topological spin texture in the absence of the DM interaction. While the magnetic ground state has been believed to be a simple proper-screw-type spin order for long time, we have found that the magnetic phase diagram of SrFeO_3 hosts a rich variety of helimagnetic phases, two of which show novel topological helimagnetic orders [2].

In this seminar, after the brief review of our recent works, I will show the topologically nontrivial helimagnetic phases in the simple cubic perovskite SrFeO_3 , which were discovered by small angle neutron scattering (SANS) measurements. We found that SrFeO_3 shows two kinds of multiple- q helimagnetic structures: an anisotropic double- q spin spiral and an isotropic quadruple- q spiral hosting a three-dimensional lattice of topological singularities [3]. As a related topic, our recent discoveries of novel helimagnetic phases in the perovskites $\text{Sr}_{1-x}\text{Ba}_x\text{CoO}_3$ [4] and $\text{Sr}_{1-x}\text{Ca}_x\text{CoO}_3$ [5] will be also presented. By magnetization measurements, the magnetic phase diagrams of $\text{Sr}_{1-x}\text{Ba}_x\text{CoO}_3$ and $\text{Sr}_{1-x}\text{Ca}_x\text{CoO}_3$ were established. As for $\text{Sr}_{1-x}\text{Ba}_x\text{CoO}_3$, the ferromagnetic order tends to be suppressed by the Ba substitution and eventually replaced by a helimagnetic state. Based on the first-principles calculations, the results will be discussed in terms of the competing magnetic order in the Co-O lattice. These results indicate that centrosymmetric perovskite-type transition-metal oxides obtained at high pressures are fruitful show cases for nontrivial helimagnetic phases.

[1] S. Mühlbauer *et al.*, *Science* **323**, 915 (2009).

[2] S. Ishiwata *et al.*, *Phys. Rev. B* **84**, 054427 (2011).

[3] S. Ishiwata *et al.*, arXiv:1806.02309.

[4] H. Sakai, S.I. *et al.*, *Phys. Rev. Mater.* **2**, 104412 (2018).

[5] T. Osaka, S.I. *et al.*, *Phys. Rev. B* **95**, 224440 (2017).