MS24-P06 | Probing The Magnetic Ground-States Of Rare-Earth Compounds By Single Crystal Neutron Diffraction

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New materials exhibiting complex physical behaviors related to magnetism may play a paramount role in future technologies. Such systems often require detailed analysis of their crystalline and magnetic structures in the ground states and/or when submitted to multi-extreme conditions.

Laue diffraction can probe large reciprocal space areas, imaging the rich physics frequently found in these systems, manifested as incommensurability, diffuse scattering and magnetoelastic effects. The characterization of the magnetic phases can be completed with higher resolution data from monochromatic diffraction.

In rare-earth-based intermetallic compounds, the oscillatory character of the RKKY (Ruderman-Kittel-Kasuya-Yosida) exchange causes competing interactions which often frustrate magnetic moments. It is the case of the compounds belonging to the families $R_3Ru_4Al_{12}$ (R is a rare-earth element), $R_2Co_3Al_9$ and RFe_5Al_7. They display multiple spontaneous and induced phase transitions and complex magnetic structures that provide an opportunity to study the interplay among magnetic frustration, exchange interactions, and magnetic anisotropy. Here, we will present studies of the magnetic ground states using the neutron Laue diffraction combined with monochromatic neutron diffraction.

The Ho atoms in $Ho_3Ru_4Al_{12}$ form a kagome lattice and their magnetic ordering below the Néel temperature is not complete. Furthermore, Laue diffraction images taken in the antiferromagnetic state indicate that the magnetic structure needs to be described by two independent propagation vectors. Similarly, the $TmFe_5Al_7$ compound exhibits an incommensurate magnetic ground state and the propagation vector is determined from the Laue data despite the very weak magnetic scattering and the presence of a large twin crystal on the sample.