Magnetic diffraction: Exploring hidden magnetic symmetries

Magnetic materials are found everywhere and in all sorts of applications in the society today and new applications are constantly being developed. Some examples are generators in windmills and electrical motors and magnetic cooling. In addition, to effectively operate a generator, it requires several types of specialised magnetic materials. To understand materials magnetic behaviour, good knowledge of its structure is required, something that diffraction methods can provide. Neutrons weak interaction with matter, given their uncharged state, makes them interact with the nuclei and in a non-magnetised material, the nuclear structure can be explored. However, given that neutrons also carries a magnetic moment, they will interact with unpaired electrons in a material, giving an additional scattering feature, i.e. magnetic scattering. In the non-magnetised paramagnetic state, this additional scattering will be diffuse, whereas in a magnetised state sharp Bragg peaks will occur.

In this talk, I will explore a variety of magnetic materials with different magnetic interactions and guide you through how the magnetic structures where resolved. To do so, the basics of magnetic symmetries and their relation to conventional symmetries and space groups will be covered. The shown scientific examples will cover both materials with interesting magnetic interactions as well as materials that has a potential to be used in applications as permanent magnets or magnetic refrigeration.