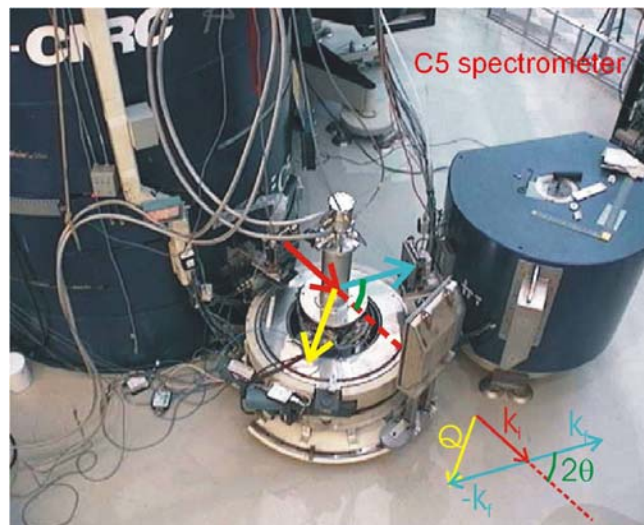


# C5 spectrometer demonstration

## Elastic and inelastic magnetic properties of $\text{MnF}_2$

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$\text{MnF}_2$  is one of the best-studied antiferromagnets in condensed matter physics. It has a tetragonal bcc-like structure with magnetic Mn ions at the corner and body-centered tetragonal positions, see Figure 1. Below the antiferromagnetic Néel temperature of 68 K the magnetic moments of the two  $\text{Mn}^{2+}$  ions in the body-centered tetragonal lattice are opposite to each other and aligned along the tetragonal axis of the rutile structure as shown in Figure 1.



In this demonstration we will:

1. Introduce you to the triple axis spectroscopy. This will include main components of a triple-axis set-up such as the monochromator, analyzer, detector, filters, and collimations.
2. Show you how neutron scattering can be used to determine not only whether a material is magnetically ordered or not but also what the nature of ordering is i.e. ferromagnetic or antiferromagnetic. We will discuss how the build up of spatial correlations between the magnetic ions results in the appearance of magnetic scattering in form of Bragg peaks in the elastic channel. We will also show how the orientation of magnetic moments can be determined.
3. Study spin-waves (collective magnetic excitations) due to the ordered magnetic moments in  $\text{MnF}_2$  by means of inelastic neutron scattering. Such studies provide information (i.e. exchange parameters) about magnetic interactions between neighbouring ions.

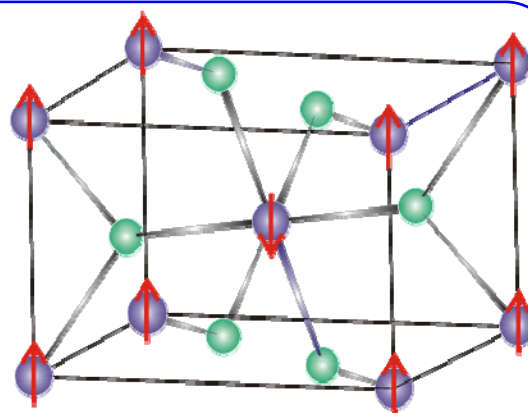


Figure 1: The antiferromagnetic structure of  $\text{MnF}_2$  below 68 K.

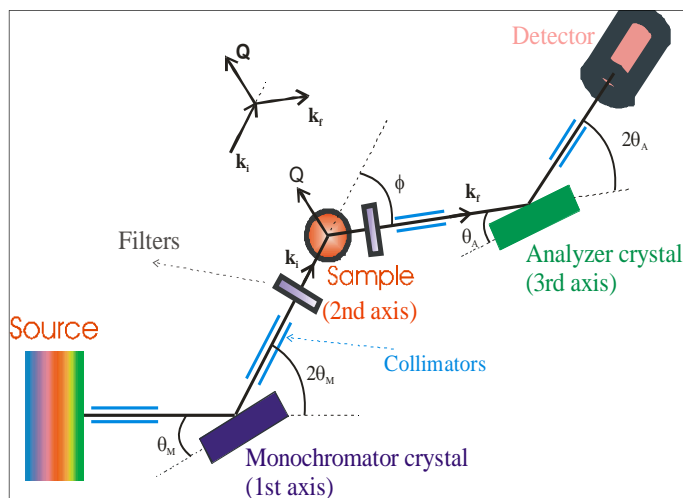


Figure 2: A schematic layout of a TAS is shown. A white beam is extracted from the reactor. A single crystal monochromator (1st axis) selects neutrons with a specific wavelength from this white beam. The monochromated beam is shone onto the sample (2nd axis) where it interacts with the sample via both nuclear and magnetic interactions. The neutrons scattered by the sample are Bragg reflected from the single crystal analyzer (3rd axis) to determine their final energy. Finally, neutrons reflected by the analyzer are detected by the neutron detector. The angular divergence of the beam is controlled by the collimators placed at different locations in the neutron path (and also indirectly by the mosaic of monochromator, analyzer, and sample). Different types of filters are used to cut the fast neutron background and higher harmonics.