Single Crystal Alignment on ALF

A good way to annoy a neutron instrument scientist, is to turn up for an experiment with an un-aligned crystal. This is especially true for experiments on chopper spectrometers, where pre-alignment of crystals is essential, as there is very little access, or adjustment of the crystals possible in the beam.

By the end of this session you should be able to orient a cubic single crystal, with a given vertical axis. Unfortunately, not all single crystals are cubic - but it makes things considerably easier if they are.

ALF

ALF (the ISIS crystal **AL**ignment **F**acility) consists of a wide incident beam, an adjustable sample table for orienting the crystal and an array of 3He position sensitive detectors.
It is commonly used at ISIS for aligning crystals prior to inelastic neutron experiments - but it's also used as a detector test facility.

Part A: Heusler Alloy

Cu_2MnAl
symmetry: fcc
lattice constant: 5.953 Å

Heusler alloy, Cu_2MnAl (discovered by Friedrich Heusler in 1903) is ferromagnetic, and is often used as a neutron beam polarizer. It was the first known ferromagnetic metal which contained only "non-magnetic" constituents.

1) Position the Heusler crystal in the beam, and determine the crystal direction normal to the surface
2) What are the crystal directions perpendicular to the flat face?
3) Is the crystal reflection from the flat face likely to be:
- **a.** Magnetic
- **b.** Nuclear
- **c.** Nuclear and magnetic

4) Why does the crystal need to be magnetized to produce a polarized beam?

Part B: MnO

symmetry: fcc
lattice constant: 4.445 Å

MnO was the first known, and experimentally verified "antiferromagnet" - a fact which was determined using neutron scattering

1) Position the MnO crystal in the beam
2) By looking for perpendicular planes, align the MnO crystal with (110) vertical
3) Verify your alignment by predicting the rotation angle of another peak in the plane