Physics with neutrons 2

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Exercise sheet 8
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EXERCISE 8.1

Derive the equation

$$\vec{M}_{\perp}^{*} \cdot \vec{M}_{\perp} = \sum_{\alpha,\beta} \left(\delta_{\alpha\beta} - \hat{Q}_{\alpha}\hat{Q}_{\beta}\right) \cdot M_{\alpha}^{*} M_{\beta} \tag{1}$$

EXERCISE 8.2

1. Consider magnetic scattering on a single crystal of Ni (fcc). Evaluating equation (C.5.20) from the lecture for a ferromagnet and using eq. 1, the ferromagnetic cross-section reads

$$\frac{\mathrm{d}\sigma}{\mathrm{d}\omega} = N\frac{(2\pi)^3}{v_0}(\gamma r_0)^2 e^{-2W(\vec{Q})} F^2(\vec{(Q)})\langle \hat{S}^z \rangle^2 \sum_{\vec{G}} \langle 1 - \left(\hat{\vec{Q}} \cdot \hat{\vec{M}}\right)^2 \rangle \delta(\vec{Q} - \vec{G}). \tag{2}$$

   Calculate the contributions of the magnetic domains, which are aligned along the <111> directions, to the (111) Bragg peak. What are the contributions to the (111) peak for a completely isotropic distribution of the spins?

2. For the orthorhombic UGe_2 the magnetic moments are all aligned along the [100] direction. Considering a powder sample: Which lines contain magnetic contributions and are most suitable for magnetic scattering?

EXERCISE 8.3

1. Plot the magnetic form factors for 3d (e.g. Fe) and 4f electrons.

2. How much does the magnetic form factor diminish the magnetic scattering in the (110) peak of Fe?