Physics with neutrons 2

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Exercise sheet 3
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EXERCISE 3.1

Draw the elongations for transverse acoustic and optic modes both at the center and at the boundary of the Brillouin zone for a simple cubic crystal. Discuss the possibility to excite longitudinal and transverse optic modes in an ionic crystal, e.g. NaCl, with neutrons and with light.

EXERCISE 3.2

Draw the reciprocal lattice planes and indicate the positions for measuring the individual longitudinal and transverse phonon branches of chromium (bcc) considering the respective selection rules.
Phonon measurements for Cr have been performed by Shaw and Muhlestein and can be found here: `http://dx.doi.org/10.1103/PhysRevB.4.969`.

EXERCISE 3.3

Explain why the frequencies of the aluminium (fcc) phonon modes are identical at the boundary of the Brillouin zone, i.e.

$$\omega_q^T\,(100) = \omega_q^{T1}\,(110) = \omega_q^L\,(110)\,. \tag{1}$$

Measurements of the phonon dispersion relation for Al performed by Stedman and Nilsson can be found here: `http://dx.doi.org/10.1103/PhysRev.145.492`.