3.24: Resonant scattering

The elementary theory of the scattering of X-rays by atoms, leading to the real atomic scattering factor f_o, applies only for X-radiation whose wavelength is far removed from that of any natural (resonant) frequency of the atom. When this condition does not hold, one needs to use as physical model for the scattering that of a forced damped harmonic oscillator. This leads to resonant-scattering terms in the full, now complex, scattering factor of an atom, represented by:-

$f = f_o + f' + if''$.

The real and imaginary terms, f', f'', in the atomic scattering factor are independent of sin(θ)/λ and in general small compared to f_o. The values of f' and f'' change most at the absorption edge of the element in question.

In the older literature the term *anomalous dispersion* was used for resonant scattering. In macromolecular crystallography the term *anomalous scattering* is used widely in place of resonant scattering.

History

The resonant scattering of X-rays was theoretically predicted by Waller (Waller, I., 1928, *Über eine verallgemeinerte Streuungsformel*. *Z. Phys.* **51**, 213-231.) and first calculated by Hönl (Hönl, H., 1933, *Zur Dispersionstheorie der Röntgenstrahlen*. *Z. Phys.* **84**, 1-16; Hönl, H., 1933, *Atomfactor für Röntgenstrahlen als Problem der Dispersionstheorie (K-Schale)*. *Ann. Phys.* (Leipzig), **18**, 625-657.

Contributors