3.4: Anomalous scattering

The history of the description of the scattering of an atom when illuminated with X-rays is that initially wavelength dependencies were ignored. This was initially referred to as 'normal scattering'. The wavelength dependencies were then corrections to the normal scattering and also called anomalous. These had to describe changes in amplitude and phase, respectively initially given the symbols $\Delta f'$ and $\Delta f''$. Thus the X-ray scattering factor of an atom is described by the equation:-

$$f = f_o + \Delta f' + i\Delta f''$$

The nomenclature changed when tunable synchrotron sources became available and whereby the Δ prefixes were removed because changes between two wavlengths would then have required a double Δ label, which is cumbersome. Thus the $\Delta f'$ now means the change in f'between two wavelengths. The Δ prefix to f'' is dropped for consistency even though its use is based on its value at a single wavelength.

The values of f' and f'' change most at the absorption edge of the element in question. Thus this resonance effect sometimes leads to the term being refererred to as 'resonant scattering'. However, since the off resonance f'' effect is extensively used in crystal structure determination of the hand of a molecule (its chirality) 'anomalous scattering' is the best *i.e.* most widely embracing term. Another commonly used term is Multiple-wavelength Anomalous Dispersion ('MAD'), which involves measurements made at the resonance condition and at more than one wavelength obviously.