3.12: Ewald sphere

The Ewald sphere, or sphere of reflection, is a sphere of radius $1/\lambda$ passing through the origin *O* of the reciprocal lattice. The incident direction is along a radius of the sphere, **IO** (Figure 1). A reflected direction, of unit vector $\mathbf{s_h}$, will satisfy the diffraction condition if the diffraction vector $\mathbf{OH} = \mathbf{IH} - \mathbf{IO} = \mathbf{s_h}/\lambda - \mathbf{s_o}/\lambda$ ($\mathbf{s_o}$ unit vector in the direction **IO**) is a reciprocal lattice vector, namely if *H* is a node of the reciprocal lattice (see Diffraction condition in reciprocal space) . If other reciprocal lattice nodes, such as *G*, lie also on the sphere, there will be reflected beams along **IG**, etc. This construction is known as the Ewald construction. When the wavelength is large, there are seldom more than two nodes, *O* and *H*, of the reciprocal lattice simultaneously on the Ewald sphere. When there are three or more, one speaks of multiple diffraction, multiple scattering or *n*-beam diffraction. This situation becomes increasingly frequent as the wavelength decreases and is practically routine for very short wavelengths such as those of γ-rays and electrons. The curvature of Ewald sphere then becomes negligible and it can often be approximated by a plane. Many reflections must then be taken into account at the same time.

When the wavelength changes, the radius of the Ewald sphere changes. If the incident beam is a white beam, with a wavelength range $\lambda_{min} \leq \lambda \leq \lambda_{max}$, there will be a nest of Ewald spheres of radii $1/\lambda_{max} \leq 1/\lambda \leq 1/\lambda_{min}$.