APPENDIX A

A More Detailed Look at Diffraction

Reflection of X-rays from parallel planes of atoms creates constructive interference, referred to as the Bragg diffraction condition. As a result of the angle of incidence equaling the angle of reflection, if the atomic planes are separated by a distance, d, then X-rays reflected at a given angle, θ, relative to the plane will arrive at a detector in phase, provided the additional distance traveled by the lower light ray relative to the upper light ray is an integral number of wavelengths, nλ (n = 1, 2, 3, …). Using trigonometry, this extra path length that the lower light ray travels is 2(dsinθ), leading to Bragg's law, 2(dsinθ) = nλ.

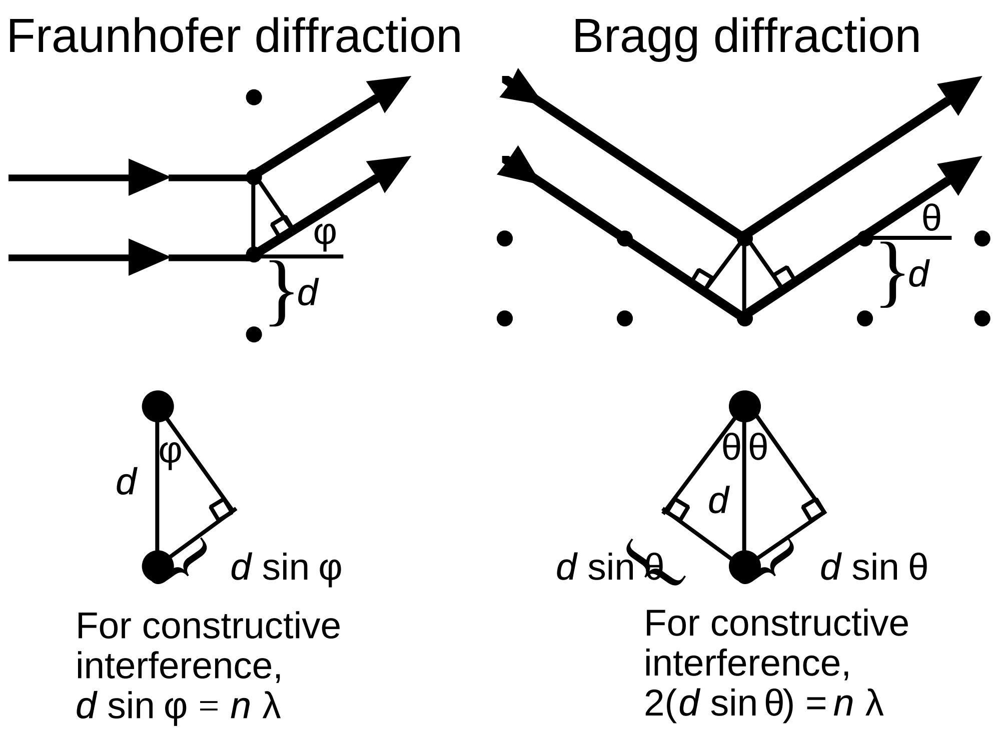

Figure 1. A comparison of Fraunhofer and Bragg diffraction.

The optical transform experiment, based on visible light, is an example of Fraunhofer diffraction. If the light transmitted through an array of scattering centers is viewed at what is effectively infinite distance, the condition for constructive interference is dsinφ = nλ, where the spacing, d, between the atoms and the scattering angle, φ, are shown in the figure. The scattered rays are in phase if the lower ray travels an additional distance (dsinφ) that is an integral number of wavelengths, λ.