Channeling effects in the electron microscope

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Electron channeling patterns come in many forms: electron backscattering patterns in the scanning electron microscope, electron channeling patterns in the scanning transmission electron microscope, and Kikuchi patterns in the transmission electron microscope. All have a common physical origin, and can be described either through a wave picture (diffraction) or a particle picture (channeling). I will present the physical basis of these phenomena, attempting to portray the correct quantum mechanical viewpoint in a non-mathematical manner, introducing the concepts of Bloch waves, diffraction channeling and a localized scattering event. This will be sufficient to explain the similarity of electron channeling patterns and electron backscattering patterns through the principle of reciprocity. These patterns are formed using a large detector to integrate over the scattered electron distribution, and are seen even from thin specimens. Kikuchi lines in transmission electron diffraction require thicker specimens to “fill in” between the sharp diffraction spots through multiple scattering events which then allow the channeling effects to be seen.