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Cherenkov Excitation of Waveguide Modes in the Electron Microscope DAVID KORDAHL, Centenary College of Louisiana — The classical physics of the Cherenkov effect is well-known, whereby charged particles traveling faster than the speed of light in a material radiate energy in an electromagnetic shock wave. Such effects can be observed using electron energy loss spectroscopy in the scanning transmission electron microscope (STEM-EELS). But while Cherenkov energy losses for charged particles are traditionally derived for bulk samples (leading to the Frank-Tamm formula), one can also derive expressions for particle energy loss in dielectric geometries where the electron beam runs parallel to defined surfaces. For dielectric slabs, well-established loss models imply that transverse electric (TE) and transverse magnetic (TM) modes may be directly imaged using STEM-EELS. Likewise, recent experimental measurements of dielectric modes in silicon discs may be interpreted in terms of waveguide modes of a dielectric cylinder. A quantized model for STEM-EELS measurements of a dielectric cylinder reveals which waveguide modes may be excited, and which modes contribute most strongly to spectral maps.

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