Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Energy Loss by Photons and Charged Particles in Metals to Insulators[1] DAVID Y. SMITH, University of Vermont & Argonne National Laboratory, WILLIAM KARSTENS, St. Michael's College — We have used composite sets of optical data to compare the energy-loss of photons and charged particles in metals, semiconductors and insulators. For small momentum transfers in a dielectric-continuum, these losses are proportional to Im $\varepsilon(\omega)$ and Im[-1/$\varepsilon(\omega)$], respectively. The first involves excitation of transverse E-M modes; the second excitation of longitudinal collective modes. Both involve dissipation *via.* electric-dipole transitions, but their absorption spectra are remarkably different. Low-frequency absorptions prominent in optical spectra are suppressed in charged-particle energy loss, whereas high-frequency transitions are strongly enhanced. In metals the latter appear as plasmon absorptions. The total oscillator strength is found to be the same for both transverse and longitudinal modes, verifying the f-sum rule. The spectral shift and strength redistribution are essentially inertial effects. This is apparent as dispersion in the experimental collective-mode screening functions: At low frequencies, electrons follow the charge's field responding in phase to *reduce* the charge's field, whereas above the collective-mode resonance, their motion falls behind the field by 180° *enhancing* the charge's field.

[1]Work supported in part by US Department of Energy, Office of Nuclear Physics under contract DE-AC02-06CH11357.

David Y. Smith
University of Vermont & Argonne National Laboratory

Date submitted: 22 Nov 2009 Electronic form version 1.4