Our semi-classical approach to screening assumes that the potential is slowly varying on the scale of the electron’s wavelength. For rapidly varying potentials (in space and time), a more sophisticated approach is needed. See Ashcroft and Mermin for a discussion of the Lindhard theory.


For potentials that vary rapidly in space and time, a “dynamic screening” treatment is needed. See Ridley for a discussion of how these effects are treated in semiconductors.


We have discussed two different approaches to ionized impurity scattering – the Brooks-Herring approach (screened Coulomb potential) and the Conwell-Weisskopf approach (unscreened Coulomb potential). Ridley discusses how to reconcile these two approaches so that we get the correct answer in the two limits and a reasonable answer in between.


For a discussion of modulation doping, screening in 2D, and remote impurity scattering in 2D, see Chapter 8 in: