Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Hall of Mirrors Scattering from Impurities in Quantum Waveguides J. Y. VAISHNAV, Harvard University Department of Physics, A. ITSARA, Harvard College, E. J. HELLER, Harvard University Department of Physics and Harvard University Department of Chemistry and Chemical Biology — We develop a scattering theory to examine how a point impurity affects transport through multimode quantum wires. While some of our new results apply specifically to hard-walled wires, others are more general; for example, an effective optical theorem which we derive for two- dimensional waveguides. Using the method of images, we examine the hard-walled guide, explicitly showing the effect of each reflection from the impurity on the wire's conductance. We express the effective cross section of a confined s-wave scatterer entirely in terms of the empty waveguide's Green's function, suggesting a way in which to use semiclassical methods to understand transport properties of smooth wires. In addition to predicting some new phenomena, our approach provides a simple physical picture for previously observed effects such as conductance dips and confinement-induced resonances. We discuss generalizations of this work to include higher partial waves, as well as the case of two interacting particles confined in other geometries, such as nanotubes and tori.

J. Y. Vaishnav
Harvard University Department of Physics

Date submitted: 30 Nov 2005 Electronic form version 1.4