

QUANTUM REFLECTION AND SCATTERING OF ULTRACOLD ATOMS
FROM NANOSTRUCTURES

Javier Madronero

Physics Department T30

Technische Universität München, James-Frank-Straße 1, D-85747 Garching, Germany

Collisions of ultracold atoms with walls and nanostructures are, at sufficiently low energy, dominantly influenced by quantum effects, e.g. quantum reflection in the nonclassical region of an attractive atom-surface potential and dominance of low partial waves in the elastic scattering by nanospheres. Such effects can be exploited to probe atom-surface potentials or to trap and guide atoms without the help of auxiliary fields. We particularly study elastic scattering of ultracold atoms by a conducting sphere. Loss of flux through inelastic reactions and adsorption is described in an unambiguous and model-independent way by incoming boundary conditions in the semiclassical region near the surface of the sphere. The near-threshold behaviour of the differential scattering cross section and of the asymmetry Σ is determined by a small number of parameters which are properties of the potential tail beyond the semiclassical regime. It depends sensitively on the characteristic lengths β_6 and β_7 which describe the strength of the nonretarded van der Waals and the retarded Casimir parts of the potential. These lengths can be tuned to probe various regions of the atom-sphere interaction by appropriate choice of the radius of the sphere.