Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Quantum Defect Theory for Long-range Anisotropic Interactions[1]

BRANDON P. RUZIC, JOHN L. BOHN, JILA, University of Colorado and National Institute of Standards and Technology, Boulder, CO, CHRIS H. GREENE, Department of Physics, Purdue University, West Lafayette, IN — Quantum Defect Theory (QDT) is a numerically efficient and accurate tool for studying a wide variety of ultracold atomic collisions, where the asymptotic behavior of the atoms is well described by a set of simple parameters. However, analytic formulas for these parameters only exist for the pure $-1/R^6$ potential. The long-range parameters are given by simple power law equations in the collision energy, and the bound state energies of different partial waves are simply related. We extend these formulas to encompass all potentials of the form $-1/R^n$, where $n > 2$. Moreover, the accuracy of QDT is limited by long-range anisotropic interactions, which, for example, play an important role in collisions of dysprosium or erbium atoms. We present our recent developments on numerically treating this type of interaction within perturbation theory.

[1]This work is supported by the US Department of Energy.

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Date submitted: 31 Jan 2014 Electronic form version 1.4