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Electron-Atom Ionization Calculations using Propagating Exterior Complex Scaling

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The exterior complex scaling method (*Science* **286** (1999) 2474), pioneered by Rescigno, McCurdy and coworkers, provided highly accurate *ab initio* solutions for electron-hydrogen collisions by directly solving the time-independent Schrödinger equation in coordinate space. An extension of this method, propagating exterior complex scaling (PECS), was developed by Bartlett and Stelbovics (*J. Phys. B* **37** (2004) L69, *J. Phys. B* **39** (2006) R379) and has been demonstrated to provide computationally efficient and accurate calculations of ionization and scattering cross sections over a large range of energies below, above and near the ionization threshold. An overview of the PECS method for three-body collisions and the computational advantages of its propagation and iterative coupling techniques will be presented along with results of: (1) near-threshold ionization of electron-hydrogen collisions and the Wannier threshold laws, (2) scattering cross section resonances below the ionization threshold, and (3) total and differential cross sections for electron collisions with excited targets and hydrogenic ions from low through to high energies. Recently, the PECS method has been extended to solve four-body collisions using time-independent methods in coordinate space and has initially been applied to the s-wave model for electron-helium collisions. A description of the extensions made to the PECS method to facilitate these significantly more computationally demanding calculations will be given, and results will be presented for elastic, single-excitation, double-excitation, single-ionization and double-ionization collisions.