

# BENCHMARK STUDIES OF ELECTRON (POSITRON) – MOLECULE (ATOM) SCATTERING

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This talk will attempt to review the current state of low energy electron and positron collision physics with an emphasis on where the field is with regard to “benchmark” studies. A well-known example of such a benchmark would be low energy elastic electron scattering from helium. Are there many others?

Benchmark measurements and calculations in a field such as ours are essential in providing a basis for assessing and improving experimental techniques, and for developing new theoretical tools and approximations. The capacity for accurate absolute measurements lies at the heart of these advancements, and in assessing the worth of such measurements in applied fields such as discharge technology, atmospheric processes and radiation biology. Benchmark measurements in ‘simple’ systems, which can be tested against the best available theoretical calculations, also provide some rationale for the extension of the calculations to more complex, reactive, or transient species, which are often difficult to study experimentally.

Experimentally, we have made significant advances in the last 10 years or so in the measurement of the simpler scattering processes, such as elastic scattering. For electrons, results from various groups around the world largely agree to within 20% on measured differential cross sections for a large range of atoms and molecules. Advances such as the Manchester magnetic angle changer have enabled the extension of DCS measurements to large angles to provide for a better comparison with theory and a better estimate of integral and momentum transfer cross sections. For inelastic collisions the situation is much more complex. The absolute scale is usually set by measuring the inelastic scattering intensity relative to that for the elastic channel. In doing so the energy dependence of the scattered electron analyser must be carefully determined, particularly for measurements close to threshold (the most interesting region!).

For positron scattering there are fewer ‘benchmarks’, although that is likely to change in the near future, as there have been major experimental developments in the field in recent years. Sophisticated techniques are being applied to the measurement of differential and integral cross sections, as well as measurements of positronium formation, ionization and annihilation.

In this talk I will attempt to cover some of the recent advances that have been made in experimental measurements and theoretical calculations for electron and positron interactions with atoms and molecules. Targets of interest will include He, N<sub>2</sub>, NO, CO<sub>2</sub>, CH<sub>4</sub>, and if time permits, some recent measurements on electron scattering from laser-cooled and trapped, He (2<sup>3</sup>S) atoms will also be discussed. Possible candidates for future ‘benchmark’ measurements will also be speculated upon.

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