Electron Collisions with Atoms, Ions, and Molecules: Experiment, Theory, and Applications

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Electron collisions with atoms, ions, and molecules represent one of the very early topics of quantum mechanics. In spite of the field's maturity, a number of recent developments in detector technology (e.g., the "reaction microscope" or the "magnetic-angle changer") and the rapid increase in computational resources have resulted in significant progress in the measurement, understanding, and theoretical/computational description of few-body Coulomb problems. Close collaborations between experimentalists and theorists worldwide continue to produce high-quality benchmark data, which allow for thoroughly testing and further developing a variety of theoretical approaches. As a result, it has now become possible to reliably calculate the vast amount of atomic data needed for detailed modeling of the physics and chemistry of planetary atmospheres, the interpretation of astrophysical data, optimizing the energy transport in reactive plasmas, and many other topics – including light-driven processes, in which electrons are produced by continuous or short-pulse ultra-intense electromagnetic radiation.

In this talk, I will highlight some of the recent developments that have had a major impact on the field. This will be followed by showcasing examples, in which accurate electron collision data enabled applications in fields beyond traditional AMO physics, including planned studies in quantum information, open problems and challenges for the future will be outlined.