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**"Reaction Microscopes": New Frontiers in Atomic and Molecular Collisions**

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"Reaction Microscopes" – the "cloud chambers" of atomic and molecular physics – are based on novel many-particle imaging methods combined with cooling techniques for the preparation of the target. Determining in coincidence the complete vector momenta of several electrons and ions after the fragmentation of atoms, molecules or clusters, they allow to explore, for the first time, quantum dynamics at its very basic, thus fundamental and still unresolved level of a few interacting quantum particles on ultra-short time scales of atto- to femtoseconds ($10^{-18}$ s – $10^{-15}$ s). In a unique combination, large solid angles close to $4\pi$ and superior momentum resolutions around a few percent of an atomic unit are reached corresponding to energy resolution of sub-$\mu$eV for ions and meV for electrons. Hence, so-far unreachable frontiers in atomic and molecular many-particle quantum dynamics have become accessible! In the talk the working principle as well as the performance of newest machines will be highlighted. Forefront-experiments will be presented which image the complete final-state many-particle momentum-state for electron, ion and ultra-short laser pulse impact. For charged-particle induced single ionisation, such measurements have revealed troubling discrepancies between experimental results and state-of-the-art predictions. For electron-impact double-ionization of He, the strongly correlated four-particle Coulomb continuum has been explored, just 24 eV above threshold. Simultaneous ionisation and excitation was investigated in a first kinematically complete experiment and laser-assisted electron collisions have become accessible. Laser-assisted collisions, laser driven wave packets recolliding with their parent ions along with ultra-short pump-probe techniques point into the future direction where one might envision controlling quantum motion on an attosecond time scale.