

DAMOP06-2006-000493

Abstract for an Invited Paper
for the DAMOP06 Meeting of
the American Physical Society

Novel Studies of Electron-Impact Induced Ionization of Atoms and Molecules

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Reaction microscopes allow to measure the momentum vectors of all fragments produced in ionization processes. We have developed such a multi-particle spectrometer for the investigation of electron scattering processes in the low to medium energy range. Here studies of fundamental few-body reactions will be presented which have not been feasible before. For single ionization of helium by fast ($E = 1000$ eV) and by slow ($E = 105$ eV) electron-impact the three-dimensional electron emission patterns show structures which, so far, are not understood and which have not been observed in conventional experiments. Kinematically complete experiments for double ionization of helium by electrons with an energy ($E = 106$ eV) close to the threshold enable for the first time a detailed insight into the behaviour of three strongly interacting continuum electrons in the field of the residual ion. Finally we present results for single ionization of H_2 molecules where the dependence of the ionization dynamics from the alignment of the molecular axis with respect to the incoming projectile beam is studied.