

CDW and CDW-EIS calculations of simultaneous ionization in collisions between dressed projectiles and atomic targets

J M Monti^{†1}, D Fregenal^{§2}, P D Fainstein[§], G Bernardi[§], R Schuch[‡], S G Suárez[§], R D Rivarola[†], J Fiol[§]

[§] Centro Atómico Bariloche, Comisión Nacional de Energía Atómica, 8400 San Carlos de Bariloche (Río Negro) and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina

[†] Laboratorio de Colisiones Atómicas, Instituto de Física Rosario (CONICET-UNR) and Facultad de Ciencias Exactas, Ingeniería y Agrimensura, Univ. Nac. de Rosario, Av. Pellegrini 250, 2000 Rosario, Argentina

[‡] Department of Physics, Stockholm University, AlbaNova University Center, SE-106 91 Stockholm, Sweden

Synopsis The role of simultaneous electron emission in collision between dressed ions and atoms is discussed. Methods of calculations within quantum-mechanical Continuum-Distorted-Wave (CDW) and Continuum-distorted Wave-Eikonal-Initial-State (CDW-EIS) models are revisited and improved within a semiclassical probabilistic approach.

In collisions of atoms or dressed-ions with atoms and molecules, simultaneous ionization (SI) of both projectile and target accounts for an important fraction of the observed electron emission spectra. In recent publications, it has been shown that simultaneous ionization plays a major role in collision systems in which target and projectile have bound electrons with similar ionization energies, i.e. in symmetric collisions [1,2,3]. In certain cases, comparison of experimental data with Classical Trajectory Monte Carlo (CTMC) and quantum-mechanical CDW and CDW-EIS theories has shown that SI is the most important ionization mechanism for electrons emitted in the forward direction with velocities that match the initial projectile velocity [1,2,4].

In previous works, using either CDW or CDW-EIS models, the doubly differential cross sections (DDCS) for simultaneous ionization was approximated as a weighted average of target and projectile ionization DCCSs, where the weight factors are proportional to the total ionization cross section of each aggregate. This simple estimation of a two-electron process in terms of single-electron cross-sections has shown to provide sound results in a few systems but lacks real

justification in more general cases.

In this work we revisit the calculation of simultaneous ionization cross-sections within a probabilistic approach, in order to obtain a more realistic and precise description of this process. In a semiclassical approach we calculate the ionization probability as a function of the impact parameter in the CDW and CDW-EIS approximations and obtain the SI probability by considering the ionization from each center as independent events. The cross-sections are finally evaluated by summing over all possible impact parameters. Details of the calculations, comparison with experimental data and with four-body CTMC results for specific systems will be presented at the conference.

References

- [1] J M Monti *et al.* 2013 *Phys. Scr.* **T156** 014031
- [2] D Fregenal *et al.* 2014 *J. Phys. B: At. Mol. Opt. Phys.* **47** 155204
- [3] D Fregenal *et al.* 2014 *J. Phys.: Conf. Ser.* **488** 082014
- [4] D Fregenal *et al.* 2015 *J. Phys.: Conf. Ser.* **583** 012013

¹E-mail: monti@ifir-conicet.gov.ar

²E-mail: fregenal@cab.cnea.gov.ar

