Contribution ID: **45** Type: **contributed**

Electron and positron collisions with atoms and molecules

Tuesday, 16 July 2024 14:20 (20 minutes)

Accurate electron and positron-impact excitation cross sections for collisions with atoms and molecules are important for modelling various plasmas with applications ranging from medical sciences and plasma processing to astrophysics and fusion. This talk will review recent progress at the Curtin University research group in developing collision codes and their use in modelling collision processes. To study positron collisions with atoms, a general atomic structure code has been developed and combined with the positron scattering formulation of the convergent close-coupling method. A comprehensive set of positron impact cross sections has been obtained for the range of light atoms (C, O, F, Ne, Ar,$\cdots$) [1] . With the use of the independent atom model, the cross sections for various reaction processes have been estimated for a large selection of molecules (O_2, CO, CO_2, F_2, $\cdots$) [2]. For electron collisions, the emphasis has been on providing a detailed set of rovibrationally resolved cross sections for molecular hydrogen and its isotopologues. These cross sections have been reported in four papers in Atomic Data and Nuclear Data Tables [3] and are available from the HCDB database hosted by the International Atomic Energy Agency and from the dedicated database mccc-db.org. The codes for collisions with molecules have been extended to more complex molecules such as HeH^+, LiH, and H_3^+. A cross section dataset was produced for HeH^+ molecular ions [4]. New data will be presented for LiH and H_3^+ molecules.

[1] N. A. Mori et al., EPJD 78(2024)19; EPJD 77(2023)182; Phys. Rev. A 107(2023)032817

[2] N. A. Mori, I. Bray, and D.V. Fursa. EPJD 78(2024)58

[3] L. H. Scarlett et al., ADNDT 137(2021)101361; 139(2021)101403; 148(2022)101534; 151(2023)101573

[4] L. H. Scarlett et al., Phys. Rev. A 106(2022)042818

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Session Classification: A+M modelling