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Argonization method to deal with inelastic processes in SiH_4, PH_3 and SH_2 by impact of protons

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Synopsis We describe the eighteen-electron molecules SiH_4, PH_3 and SH_2 with a central potential forming an Argon-type atom. Ionization cross sections and stopping power are calculated using the full first Born approximation and the continuum-distorted-wave eikonal-initial-state approximation.

In a previous article [1] we introduced a method to deal with hydrides of the second line of the periodic table. Using the fact that CH_4, NH_3, H_2O have ten electrons, we assimilated these molecules with a Neon-type atom, and so it was called *neonization* model. It proved to be quite effective in the description of most of the inelastic collisional magnitudes of experimental interest: differential and total ionization cross sections, stopping power, energy-loss straggling and mean excitation energy [1].

In this work we deal with *argonization*, that is we extend the same concepts to the hydrides of the third line of the periodic table, SiH_4, PH_3 and SH_2. We have done a shortcut in relation with our previous work: First, the molecular wave functions of SiH_4, PH_3 and SH_2 reported by Moccia [2] were spherically averaged. Then, the central potentials for each *nlm*-state were directly determined, describing so an Argon-type atom.

Using this potential the ionization cross sections (upper figure) and inelastic (ionization) stopping power cross sections (lower figure) were rigorously calculated using the first Born approximation and the Continuum-Distorted-Wave Eikonal-Initial-state (CDW-EIS). As expected the CDW-EIS converge to the first Born approximation, which holds at high impact proton energies.

The interesting point to note here is that the theoretical treatment of these targets is especially necessary since these molecular hydrides are very difficult to manage in the laboratory because they are corrosive or explosive.

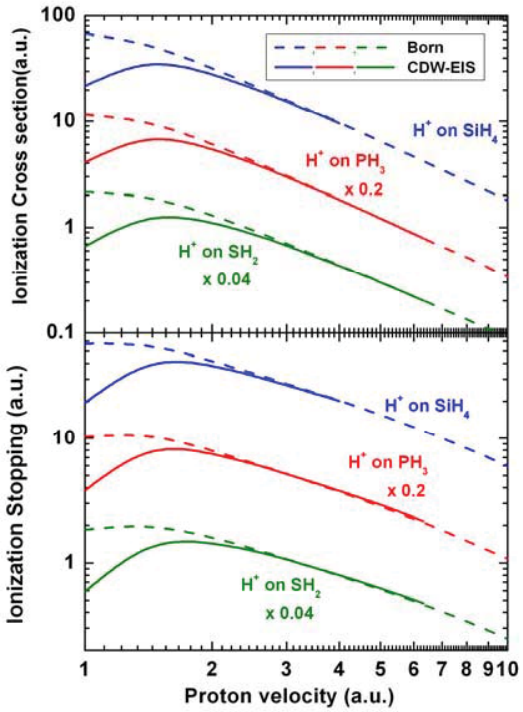

Figure 1. Ionization (upper) and stopping (lower) cross sections in first Born approximation (dashed-lines) and CDW-EIS approximation (solid-lines).

References

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