Quasi-resonant electron capture at very low energies involving hydrogen isotopes

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Plasma facing components (PFCs) are subject to sputtering by plasma particles and contaminate core plasmas of magnetic confinement fusion devices. The use of lower-Z materials for the PFCs could be preferable to keep the radiation loss powers of the core plasmas below sustainable level. It is evident that, in D-T burning plasmas, atomic collisions of hydrogen isotope ions with atoms sputtered from the PFCs play a very important role in the particle transport and charge-state distribution of impurity atoms. Recent calculations [1,2] of quasi-resonant electron-capture (EC) cross sections involving hydrogen isotopes and its ions show that at very low energies (around 10-100 eV/u) the isotope effect can be very large reaching up to a few orders of magnitude. The heavier is the hydrogen isotope the larger is EC cross section. The difference found is explained by the strong influence of the rotational coupling in a quasi-molecule on the capture probability. In the present work, similar calculations are performed for EC cross sections in H^+, D^+, T^+ + Li, Be, C collisions and inverse reactions using the ARSENY code [3] based on the adiabatic approximation. A typical example of calculated capture cross sections for H^+, D^+, T^+ + Li and Li^+ + H, D, T collisions is shown in the figure. As is seen, at energies between 5 and 40 eV/u the isotope effect is very large. With ion energy increasing, the cross sections become nearly the same for all isotopes and correspond to EC cross sections for H^+ + Li and Li^+ + H collisions, respectively, which are compared with experimental data [4] and [5].

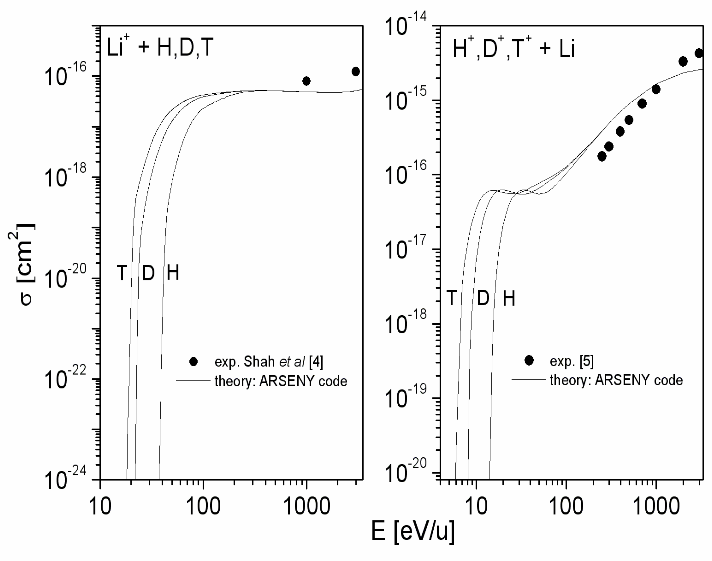

Figure caption: EC cross sections for H^+, D^+, T^+ + Li and Li^+ + H, D, T collisions. Experiment: solid circles - [4] and [5] for Li^+ +H and H^+ + Li collisions, respectively. Theory: ARSENY code, present work.

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