CALCULATIONS OF POSITRON INTERACTIONS WITH ONE- AND TWO-ELECTRON ATOMS

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A number of computational methods have, over the past decade, been successfully applied to the study of various positronic atoms [1]. We report here on the recent results from three different approaches; the configuration-interaction (CI) method, a hybrid CI-Kohn method, and the hyperspherical close-coupling (HSCC) method.

The CI method has become one of the most successful approaches towards solving positron-atom bound-state problems, but it suffers from slow convergence due to the presence of localised electron-positron pairing. Building on the study of Gribakin and Ludlow [2], we have used our CI and CI-Kohn calculations to examine the partial-wave convergence of positron-electron systems [3]. Armed with this knowledge, and recently parallelised computer code, we also present improved CI calculations of the alkali-metal positronic atoms [4]. Current CI (and other) estimates of the positronic atom binding energies are summarised in Figure 1.

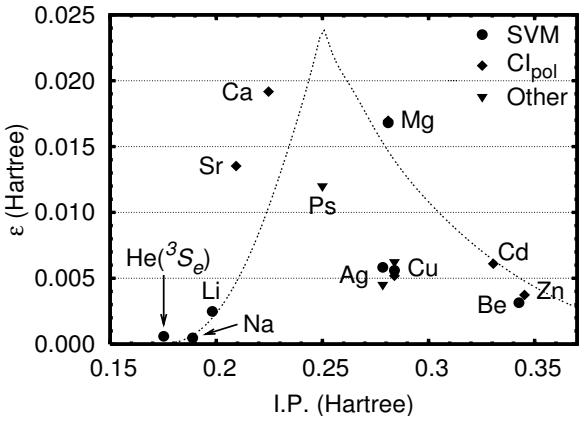

Fig. 1. Estimated binding energies of the known neutral atoms that bind a positron (c.f. Fig. 3 of Ref. [1]).

We also report on the results of HSCC calculations of positron scattering from both sodium and lithium in the low-energy range [5]. This was motivated by a recent experiment that measured the Ps-formation cross sections [6]. This experiment found strong disagreement with previous Ps-formation calculations [7, 8] for energies near and below 1 eV. Speculation arose in [6] that the calculations were not converged as sodium was later shown to be a positronic atom. Our results for sodium, as shown in Figure 2, find broad agreement with previous calculations and disagreement with the experimental data below 2 eV. The accurately-known $PsNa^+$ binding energy [1] is reproduced by our calculations, and hence, our low-energy results are reliable.

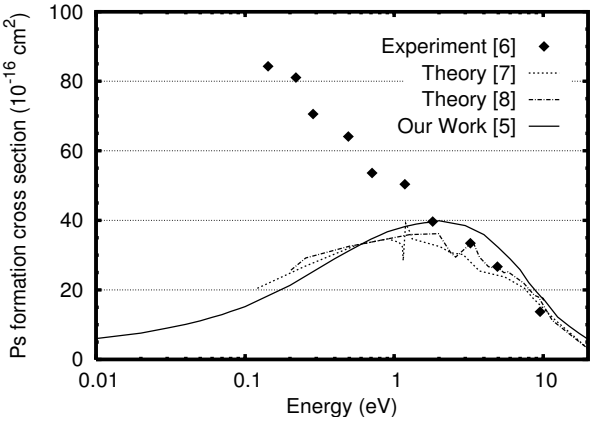

Fig. 2. Positronium formation cross sections for e^+-Na scattering (only the lower experimental limits of Ref. [6] are shown).

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