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Many-body theory of positron-atom interactions

GLEB GRIBAKIN, Queen's University Belfast, UK

The interaction of low-energy positrons with atoms is characterised by strong electron-positron correlation effects. For example, they increase the positron annihilation rate in collisions with Xe atoms by three orders of magnitude! We have developed a many-body theory approach [1] which accounts for all major correlation effects, i.e, polarization of the atom by the positron, virtual positronium formation, and short-range enhancement of the electron-positron contact density. The first two give rise to strong positron-atom attraction. It affects positron elastic scattering and promotes positron-atom binding. The third effect determines positron-atom annihilation rates and spectra of annihilation gamma quanta [2]. Thus, a good quantitative understanding of positron-atom interactions has been achieved. This gives hope of understanding a much more difficult problem of positron annihilation with polyatomic molecules, where molecular vibrational degrees of freedom play an important role [3,4].

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