Two-state approximation applied to hydrogen formation by proton impact on positronium

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(Received 13 June 2008 ; in final form 22 February 2009)

Abstract
Although there is no experimental data available for antihydrogen formation following antiprotons impact on positronium atoms, as a charge transfer reaction, at incident energies which are suitable for antimatter high-precision spectroscopic studies, measurements were carried out for its charge-conjugate reaction; i.e. hydrogen formation, by protons impact on positronium. In this study, a two-state approximation method is applied to charge exchange process in proton-positronium collision system. The nonorthogonality of initial and final states and its effects on the angular distribution of the differential cross sections is taken into account by using this method. The state-to-state differential cross sections are reported for transition from ground state of positronium into the ground and a few lowest excited states of the formed hydrogen. Integrated cross sections are presented as well.

Keywords: hydrogen formation, antimatter, two-state approximation, cross sections, charge-conjugation reaction

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