Convergence and Momentum Dependence of the Correlation Correction to the Amplitude of Positron Annihilation on Atoms

GLEB GRIBAKIN, Queen’s University Belfast, UK, BRENDAN MCGRATH — Positron annihilation rates in solids and in gases are strongly affected by electron-positron correlations. Observed rates exceed those evaluated in the independent-particle approximation many times. In solids this effect is usually taken into account through an enhancement factor (EF), which depends on the electron density [1]. Correlations also affect the momentum distribution of the annihilating electron-positron pairs, which determines the shape of the annihilation gamma spectrum. This effect is beyond the EF approximation and is often neglected [1]. Using a many-body theory framework [2] we analyse the convergence of the 1st-order correction to the annihilation amplitude with the orbital angular momentum $l$ of the intermediate electron and positron states. We find that these contributions converge as $(l + 1/2)^{-2}$, and have a distinctly different momentum dependence compared with the 0th-order amplitude, narrowing the annihilation spectra.