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An Accurate Allowance for Initial and Final State Interections in The Treatment of The alpha-alpha Bremsstrahlung

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One of motivations in studying the $\alpha+\alpha \to \alpha+\alpha+\gamma$ bremsstrahlung is to get a supplementary information on a strong part of the $\alpha-\alpha$ interaction [1]. We find some correlation function, in which one of the outgoing alphas is detected in coincidence with the emitted photon, depends consid-erably on the strong interaction in the entrance and exit channels (see Fig.1 for $d^5\sigma/dE_\gamma d\Omega_i d\Omega_f$ in the lab. frame and coplanar momenta disposal, where the photon momentum is directed along the Z-axis and the rest lie in the XZ-plane, viz., $\hat{k}_{1i} = (\theta_{1i}, 0)$, $\hat{k}_{1f} = (\theta_{1f}, \pi)$ at energies of the incident α-particle $E_i = 10$ MeV and photon $E_\gamma = 1$ MeV). As before, our depar-ture point in describing electromagnetic (EM) interactions with nuclei is to use the Fock-Weyl cri-terion (see [2] and refs. therein). According to [3], the cross section can be expressed through the charge form factor of α-particle $F_{CH}(q)$ depending on the stretched photon momentum $q = \lambda k_\gamma$ ($0 \leq \lambda \leq 1$) and the overlap integral $I = \langle \chi^{(-)}_{k'} | e^{iq\rho} | \chi^{(+)}_{k} \rangle$, where the ingoing $\chi^{(+)}_{k}$ and out-going $\chi^{(-)}_{k'}$ solutions for the $\alpha-\alpha$ scattering induced with interaction $V = V_C + V_S$ that consists of the repulsive Coulomb potential V_C and its strong counterpart V_S. The Nordsieck-type integral I_C in the partition $I = I_C + I_{CS}$, which determines the purely Coulomb mechanism of the bremsstrah-lung, is given by (10) in [6] while the radial integrals in fast-convergent series of the mix integral I_{CS} in partial waves have been calculated via the contour integration method [7]. When collision energy increasing the cross sections become more sensitive to distinctions between the two phase-equivalent $\alpha-\alpha$ potentials.

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