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# Astrophysical S-factor and reaction rate of the direct 12C(p,γ)13N capture process

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The direct 12C(p,γ)13N radiative capture reaction is the starting point of the CNO cycle in the hydrogen burning process in stars, more massive than the Sun, especially in low mass Asymptotic Giant Branch (AGB) and Red Giant Branch (RGB) stars[1]. The astrophysical S-factor and reaction rate were studied in the framework of the two-body potential cluster model [2, 3]. Comparative analysis of the S factor was performed for various values of the empirical values of the asymptotic normalization coefficients (ANC) of the 13N(1/2-) ground state. The Woods-Saxon type two-body p12C-potential was employed [3, 4], with the central, spin-orbital and Coulomb parts. The geometric parameters of the potential are fitted to the experimental phase shifts of p12C-scattering in the S, P and D-partial waves, as well as the empirical ANC value and the ground (P1/2) state energy of the 13N nucleus. The number C1/2=1.63±0.13 fm-1/2 [5] was chosen among the empirical ANC values from the literature on the basis of the theoretical analysis of the reaction rates. The proposed potential model describes the experimental astrophysical S factors for the direct 12C(p,γ)13N radiative capture reaction at the whole energy region. Furthermore, the reaction rate for this process was estimated in the stellar temperature interval. The obtained theoretical results are in excellent agreement with the new results of the LUNA collaboration [6].

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