AGB fluorine nucleosyntesys studied by means of Trojan-horse method: the case of ^{15}N(p,α)^{12}C

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The astrophysically relevant ^{15}N(p,α)^{12}C has been investigated at very low sub-Coulomb energies down to 20 keV by means of the Trojan-horse Method [1,2,3] applied to the ^{2}H(^{15}N,α^{12}C)n reaction at E_{beam}=60 MeV. The reaction rate of this two-body process is considered among the primary sources of uncertainty in predicting the fluorine abundance in AGB stars [4,5], whose chemical evolution is strongly influenced by the reactions belonging to the production/destruction path of ^{19}F. In particular, the ^{15}N(p,α)^{12}C reaction competes with the ^{18}O(p,α)^{15}N reaction since it removes both protons and ^{15}N nuclei from ^{19}F production chain. The astrophysical S(E)-factor for the ^{15}N(p,α)^{12}C process was extracted by selecting the quasi free mechanism from the chosen ^{2}H(^{15}N,α^{12}C)n reaction, and compared to the direct data available down to 70 keV. A good agreement is found. Below 70 keV, where no direct data exist, the Trojan Horse S(E)-factor provides a rate which confirms that obtained through the extrapolation procedure. An independent R-matrix calculation has been performed in this relevant region, introducing also destructive interference terms between ^{16}O levels with $J^{\pi}=1^{-}$. The novelty of this calculation is the introduction of the $J^{\pi}=1^{-}$ sub-threshold state at 9.585 MeV excitation energy. The result of the calculation strongly confirms the behavior of Trojan Horse data.

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