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Direct measurement of the 19F(p,α)16O reaction

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The ^{19}F(p,α)^{16}O reaction is important for understanding the fluorine abundance in the outer layers of asymptotic giant branch (AGB) stars and it might also play a role in hydrogen-deficient post-AGB star nucleosynthesis. Up to now, theoretical models overproduce F abundances in AGB stars with respect to the observed values, thus calling for further investigation of the reactions involving fluorine. Indeed, in the last years, new direct and indirect measurements improved significantly the knowledge of the ^{19}F(p,α)^{16}O cross section at deeply sub-Coulomb energies (below 0.8 MeV). Nevertheless, those data are larger by a factor of about 1.4 with respect to the previous data reported in the NACRE compilation in the energy region 0.6-0.8 MeV. In order to solve these discrepancies we present here a direct experiment performed at INFN-LNS using a silicon strip detector array (LHASA - Large High-resolution Array of Silicon for Astrophysics). Our results clearly confirm the trend of the latest experimental data in the energy region of interest. ^{19}F(p,α)^{16}O reaction rate is the sum over the (p,α_0), (p,α_π) and (p,α_γ) channels. While the (p,α_0) rate is well constrained by the present existing data, down to the lowest energies, almost nothing is known from experiments on the (p,α_π) and (p,α_γ) rates. Despite its importance, the S-factors and the branching ratio between the α_0, α_π and α_γ outgoing channels in the ^{19}F(p,α)^{16}O reaction are still largely uncertain at astrophysical energies, emphasizing the need for better measurements. Thus, a direct measurement using the new detector, ELISSA (Extreme Light Infrastructure –Silicon Strip Array), coupled with LHASA will be performed in September 2022 at IFIN-HH. This setup is allowing us to discriminate the (p,α_π) and (p,α_γ) reaction rates at very low energies.

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