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Stellar carbon-burning via the Trojan Horse Method

The 12C+12C fusion channel at low energy plays a critical role in astrophysics to understand stellar burning scenarios in carbon-rich environments [1-4]. The temperature for carbon burning to occur ranges from 0.8 to 1.2 GK, corresponding to center-of-mass energies from 1 to 2 MeV. The dominant evaporation channels below 2 MeV are alpha and proton, leading respectively to 20Ne, 23Na. In spite of the considerable efforts devoted to measure the 12C(12C,α)20Ne and 12C(12C,p)23N cross sections at astrophysical energies, they have been measured only down to 2.14 MeV, still at the beginning of the astrophysical region [5]. As known, direct measurements at lower energies are extremely difficult. Moreover, in the present case the extrapolation procedure from current data to the ultra-low energies is complicated by the presence of possible resonant structures even in the low-energy part of the excitation function. For these reasons the Trojan Horse Method [6,7] can represent a unique way for an accurate investigation at the relevant energies. This has been done recently by measuring the 12C(14N,α20Ne)2H and 12C(14N,p23Na)2H three-body processes at 30 MeV of beam energy in the quasi-free (QF) kinematics regime, where 2H from the 14N Trojan Horse nucleus is spectator to the 12C+12C two-body processes. The cross section experiences a strong resonant behaviour with resonances associated to 24Mg levels. As a consequence, the reaction rate is strongly enhanced at the relevant temperatures. Results, which have been recently accepted for publication in Nature, will be presented and discussed.

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