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Uncovering carbon burning in stars

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C-burning plays a pivotal role in astrophysics to understand stellar burning scenarios in carbonrich environments [1-4]. The temperature for carbon burning to occur is greater than 0.4 GK, corresponding to center-of-mass energies exceeding 1 MeV. The dominant evaporation channels below 2 MeV are α and proton, leading to 20Ne and 23Na, respectively. In spite of the considerable efforts devoted to measure the 12C(12C,α)20Ne and 12C(12C,p)23Na 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 enhanced at the relevant temperatures. Results, which have been recently published in Nature [8], will be presented and discussed.

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