^{15}N(α,γ)^{19}F measurement for ^{19}F production in AGB stars

J.W. Frost-Schenk[a], A. Lennarz[b], D. Bardayan[c], D. Blankstein[c], D. Connolly[b], B.Davids[b], C.Aa. Diget[a], S. Fox[a], S.A. Gillespie[b], D. Golton[a], U. Greife[d], M.R. Hall[c], D. Hutcheon[b], J. Karpesky[d], A. Laird[a], J. Liang[e], M. Lovely[d], P. Machule[b], A. Psaltis[e], C. Ruiz[b] and M. Williams[ab].

[a]*University of York, UK,* [b]*TRIUMF, BC, CA* [c]*University of Notre Dame, IN, USA* [d]*Colorado School of Mines, CO, USA,* [e]*McMaster University, ON, CA.*

^{15}N(α,γ)^{19}F is known to be one of the key formation mechanisms of ^{19}F in AGB stars [**?**]. ^{19}F may also be produced through this reaction in other stars such as Wolf-Rayet stars [**?**]. The ^{19}F abundance observed in the stellar spectra strongly depends on the conditions in the astrophysical site. Its nucleosynthetic origin has been debated for several decades, however the understanding of the ^{15}N(α,γ)^{19}F reaction rate within the Gamow window at 200 MK for AGB stars is incomplete. Discrepancies in strength and energy exist between previous measurements in one of the key resonances, at $E_{c.m.}$=1.323 MeV. Furthermore, the direct-capture, non-resonant cross-section has never been directly measured.

The DRAGON recoil separator at TRIUMF was utilised to perform an inverse kinematics measurement of the ^{15}N(α,γ)^{19}F reaction. Recoiling ^{19}F nuclei leaving the windowless helium gas target were separated using DRAGON's electromagnetic mass separator and detected in a DSSSD. Emitted gamma-rays from the de-excitation of the compound nucleus were detected in a BGO array surrounding the target and used for a coincidence analysis. We have measured the strength and energy of the $E_{c.m.}$=1.323 MeV resonance in the ^{15}N(α,γ)^{19}F reaction as well as the direct-capture cross section down to an energy of $E_{c.m.}$=0.96 MeV. The 2017 ERNA measurement by Di Leva et al. [**?**] was the first time ^{15}N(α,γ)^{19}F was measured in inverse kinematics; two strong reference resonances were measured. This measurement at DRAGON is the second inverse kinematics measurement. Our new measurement of the $E_{c.m.}$=1.323 MeV resonance will help in solving the existing discrepancies regarding its strength, and provides an independent measurement of its energy, as well as the first measurement of the direct-capture contribution in the low-energy regime. This measurement will reduce uncertainties in ^{15}N(α,γ)^{19}F reaction rate, especially in the direct-capture component where no previous measurements exist, thus helping to refine our understanding of AGB models and ^{19}F production.

References

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