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Inverse kinematics studies of 20,21Ne(p,γ)21,22Na relevant to 22Na production in oxygen-neon novae with DRAGON

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Oxygen-neon (ONe) novae are cataclysmic events resulting from thermonuclear runaway on the surfaces of accreting oxygen-neon white dwarfs in close binary systems, and can reach peak temperatures in the range of T = 0.1 − 0.4 GK [1]. The radioisotope 22Na can be produced and subsequently ejected into the interstellar medium during such events. Sodium-22 β-decays (t1/2 = 2.6 y) primarily to the first excited state in 22Ne, which transitions to its ground state via emission of a 1.275 MeV γ-ray. The combination of long half-life and characteristic γ signature makes 22Na a possible probe of the nuclear physics of novae [2], as γ-rays of this energy are detectable with current orbiting satellite observatories [3]. To date, observation of a 1.275 MeV γ signal from novae has been elusive. The lack of a verifiable detection of a 1.275 MeV γ signal gives an accepted upper limit on the production of 22Na in novae of 3.7E-8M⊠ [4]. The next generation of orbital observatories are expected to have the sensitivity required to detect a galactic 22Na β-decay signal [5], thus minimization of uncertainties underlying 22Na production in novae is desirable for an accurate comparison of novae nucleosynthesis models with astronomical observations. During ONe novae, production of 22Na can proceed via the reaction path20Ne(p,γ)21Na(β+νe)21Ne(p,γ)22Na, which comprises a portion of the neon-sodium cycle in hydrogen burning. Considerable uncertainties exist in the 20,21Ne(p, γ)21,22Na reaction rates. New measurements of 20,21Ne(p, γ)21,22Na have been performed in inverse kinematics using the DRAGON recoil separator [6], with the aim of reducing experimental uncertainties in the thermonuclear reaction rates. Experimental methods and preliminary results will be discussed.

Summary

The reactions 20,21Ne(p,γ)21,22Na (which influence the production of the astrophysically important radioisotope 22Na in oxygen-neon novae) have been studied in inverse kinematics using the DRAGON recoil separator at TRIUMF. The aim of these new measurements was to reduce experimental uncertainties in the thermonuclear reaction rates in order to make accurate comparisons between novae nucleosynthesis models and astronomical observations. Experimental methods and preliminary results will be discussed.

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