Study of the Destruction of ^{18}F in Novae with an Inverse (*d,p*) Reaction at the HRIBF

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The degree to which the (p,γ) and (p,α) reactions destroy ^{18}F at temperatures 1-4×10^8 K is important for understanding the synthesis of nuclei in nova explosions and for using the long-lived radionuclide ^{18}F, a target of γ-ray astronomy, as a diagnostic of nova mechanisms. The reactions are dominated by low-lying proton resonances near the ^{18}F+p threshold (E_x=6.411 MeV in ^{19}Ne). To gain further information about these resonances, we have used a radioactive ^{18}F beam from the Holifield Radioactive Ion Beam Facility (HRIBF) to selectively populate corresponding mirror states in ^{19}F via the inverse ^{2}H($^{18}F,p$)^{19}F neutron transfer reaction. The beam energy was 108.5 MeV (~6 MeV/u) and the target was a 160 μg/cm^2 CD_2 foil. Proton-recoil coincidence data were taken for both α-decaying and particle-stable final states using strip detector arrays and the Daresbury Recoil Separator (DRS) [1]. Neutron spectroscopic factors were measured for states in ^{19}F in the excitation energy range 0-9 MeV[2]. Widths for corresponding proton resonances in ^{19}Ne were calculated using a Woods-Saxon potential. The results imply a significant lowering of ^{18}F$(p,\gamma)^{19}$Ne and ^{18}F$(p,\alpha)^{15}$O reaction rates, thereby increasing the prospect of observing the 511-keV annihilation radiation associated with the decay of ^{18}F in the ashes ejected from novae[3]. Other recent and future experiments on the A=19 system at the HRIBF include measurements of proton resonances in ^{19}Ne via the ^{2}H($^{18}F,^{15}O\alpha$)n reaction[4] and additional measurements of the ^{18}F$(p,\alpha)^{15}$O excitation function[5]. Using a radioactive ^{26}Al beam at the HRIBF, techniques similar to those used in the ^{2}H($^{18}F,p$)^{19}F experiment will be employed for the ^{2}H($^{26}Al,p$)^{27}Al reaction to study the ^{26}Al$(p,\gamma)^{27}$Si reaction rate in stellar environments[6].

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