

NEW ^{19}Ne RESONANCE OBSERVED WITH A THICK TARGET $^{18}\text{F}(p, p)^{18}\text{F}$ MEASUREMENT*

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The rates of the $^{18}\text{F}(p, \alpha)^{15}\text{O}$ and $^{18}\text{F}(p, \gamma)^{19}\text{Ne}$ reactions in astrophysical environments are important for determining the synthesis of the long-lived radioisotope ^{18}F in novae and the extent through which heavy elements are produced through the reaction sequence $^{18}\text{F}(p, \gamma)^{19}\text{Ne}(p, \gamma)^{20}\text{Na}(p, \gamma)^{21}\text{Mg} \dots$ in X-ray bursts. These reaction rates are uncertain, however, because of the uncertain level structure of ^{19}Ne above the proton threshold at $E_x = 6.411$ MeV. Despite numerous studies, there still exist ~ 8 levels in the mirror nucleus, ^{19}F , for which analogs have not been observed in ^{19}Ne in the relevant excitation energy range $E_x = 6.4 - 7.6$ MeV. To search for these missing levels, we have made the first measurement of the $^{18}\text{F}(p, p)^{18}\text{F}$ excitation function over the entire energy range of interest for astrophysics. A 24-MeV ^{18}F beam was stopped in a thick polypropylene CH_2 target. Scattered protons from the $^1\text{H}(^{18}\text{F}, p)^{18}\text{F}$ reaction were detected in a double-sided silicon strip detector. The $^{18}\text{F}(p, p)^{18}\text{F}$ excitation function was extracted in the energy range $E_{c.m.} = 0.3 - 1.3$ MeV by measuring the proton energy spectrum as a function of angle and making a small correction for energy loss in the target. From an R -Matrix analysis of our data, we have identified and extracted the properties of a newly observed ^{19}Ne level at $E_x = 7.420 \pm 0.014$ MeV, which is most likely the mirror to the $J^\pi = \frac{7}{2}^+$ ^{19}F level at 7.56 MeV. We have also found a significant discrepancy with a recent compilation for the properties of a ^{19}Ne state at $E_x = 7.500$ MeV. Finally, we have set upper limits on the proton widths of ^{19}Ne levels still missing. The experimental technique, analysis, and astrophysical implications will be presented.

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