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\(\beta\)-delayed \(\gamma\) decay of \(^{20}\text{Mg}\) and the \(^{19}\text{Ne}(p,\gamma)^{20}\text{Na}\) breakout reaction in Type I X-ray bursts\(^1\) BREN'T GLASSMAN, Michigan State Univ —

Certain astrophysical environments such as thermonuclear outbursts on accreting neutron stars (Type-I X-ray bursts) are hot enough to allow for breakout from the Hot CNO hydrogen burning cycles to the rapid proton capture (rp) process. An important breakout reaction sequence is \(^{15}\text{O}(\alpha,\gamma)^{19}\text{Ne}(p,\gamma)^{20}\text{Na}\) and the \(^{19}\text{Ne}(p,\gamma)^{20}\text{Na}\) reaction rate is expected to be dominated by a single resonance at 457 keV above the proton threshold in \(^{20}\text{Na}\). The reaction rate depends strongly on whether this \(^{20}\text{Na}\) state at excitation energy 2647 keV has spin and parity of \(1^+\) or \(3^+\). Previous \(^{20}\text{Mg}\) \((J^\pi=0^+)\) \(\beta^+\) decay experiments have relied almost entirely on searches for \(\beta\)-delayed proton emission from this resonance in \(^{20}\text{Na}\) to limit the log \(ft\) value. However there is a non-negligible \(\gamma\)-ray branch expected that must also be limited experimentally to determine the log \(ft\) value and constrain \(J^\pi\). We have measured the \(\beta\)-delayed \(\gamma\) decay of \(^{20}\text{Mg}\) to complement previous \(\beta\)-delayed proton decay work and provide the first complete limit based on all energetically allowed decay channels through the 2647 keV state. Our limit confirms a \(1^+\) assignment for this state is highly unlikely.

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