$^{26}$Al/$^{30}$P(d,n) REACTIONS FOR KEY ASTROPHYSICAL RESONANCES IN EXPLOSIVE HYDROGEN BURNING


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$^{26}$Al(d,n)$^{27}$Si and $^{30}$P(d,n)$^{31}$S transfer reactions have been studied in inverse kinematics at the National Superconducting Cyclotron Laboratory to obtain information on the strength of key astrophysical resonances in $^{27}$Si and $^{31}$S. These are relevant for abundance calculations of the cosmic gamma-ray emitter $^{26}$Al, and for the abundances of heavy elements (e.g. silicon), highly dependent on the $^{30}$P(p,γ)$^{31}$S reaction, observed in novae ejecta. A primary beam of $^{36}$Ar (150 MeV/A) impinging on a Be target produced around 30-MeV/u beams of $^{26}$Al and $^{30}$P, which were separated by the A1900 fragment separator [1]. The radioactive $^{26}$Al and $^{30}$P beams bombarded a 10 mg/cm$^2$-thick CD$_2$ target surrounded by the Gamma-Ray Energy-Tracking In-beam Nuclear Array GRETINA [2]. The $^{27}$Si and $^{31}$S ions were analyzed by the S800 spectrograph [3] and identified by energy-loss and time-of-flight measurements. The γ-rays from the decays of excited states in $^{27}$Si and $^{31}$S were detected in coincidence with the recoiling $^{27}$Si and $^{31}$S ions using GRETINA. By measuring the number of coincident events, and correcting for the angular distributions of the gamma rays, this provides an angle integrated measurement of the (d,n) cross-sections, and a measure of the proton partial widths for the key astrophysical resonances in $^{27}$Si and $^{31}$S.