Branching ratio measurements of low-lying p- and α-unbound states in ^{30}S

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This project aims to measure proton and α branching ratios of astrophysically-relevant states in ^{30}S to determine ^{26}Si$(\alpha,p)^{29}$P and ^{29}P$(p,\gamma)^{30}$S reaction rates in novae and Type I X-ray bursts (XRBs). These phenomena occur in binary star systems that include a hydrogen-rich, main-sequence star and a dense companion star (white dwarf in novae and neutron star in XRBs). The gravitational field of the companion star leads to an accretion of material from the main-sequence star, which builds up on its surface and eventually triggers rapid thermonuclear runaways. Such explosive astrophysical events are characterized by a rapid increase in the X-ray luminosity of the companion star over short time scales ($\sim$ 10—100 s), with the synthesized material violently ejected into the interstellar medium. Therefore, reliable estimates of such critical nuclear reactions are important to understand the elemental abundances of several heavier elements synthesized in novae and Type I XRBs, and r-process sites in neutron star mergers. In this work, we study relevant excited states in ^{30}S produced using the ^{32}S$(p,t)^{30}$S reaction and the $K600$ magnetic spectrometer at iThemba LABS, together with a segmented silicon detector array (called the CAKE) and 6 $LaBr_3$ detectors. The CAKE and $LaBr_3$ detector arrays provide a powerful tool to obtain accurate angular-distribution information on competing decays from states in ^{30}S. The data obtained from this experiment are anticipated to robustly test nova models and Type I XRBs.