A Proposal to the High Intensity Gamma-Ray Source (HIγS) PAC-09

Measurement of the Cross Section of the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ Reaction via the Photodissociation of $^{16}\text{O}$

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Abstract

We propose to measure the cross section of the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ reaction by measuring the inverse reaction of the photo-dissociation of $^{16}\text{O}$. The measurements will utilize a unique Optical Readout Time Projection Chamber (O-TPC) that has been constructed over the last five years, operating with CO$_2$(80%) + N$_2$(20%) gas mixture. First engineering runs were successfully completed and publishable data (on stellar formation of $^{12}\text{C}$ at high temperature) were obtained during these engineering runs. In this proposal we only contemplate Phase 1 of the measurement that will extend down to gamma energies of 8.73 MeV ($E_{cm} = 1.57$ MeV). The experiment will resolve nagging discrepancies of measured data (on resonance) with predictions based on unitarity and it will allow for precise measurement of the $S_{E2}/S_{E1}$ ratio. The lowest energy data points will already allow us to distinguish between various predictions for the $S_{E2}$ and $S_{E1}$ astrophysical cross section factor that need to be known at 300 keV.