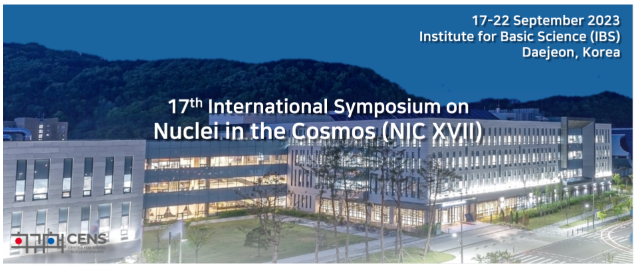

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Insight to the Explosion Mechanism of Core Collapse Supernovae Through γ-ray Spectroscopy of ^{46}Cr

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Currently, the explanation behind the explosion mechanism of core collapse supernovae is yet to be fully understood. New insight to this phenomena may come through observations of ^{44}Ti cosmic γ rays; this technique compares the observed flux of cosmic ^{44}Ti γ rays to that predicted by state-of-the-art models of supernova explosions. In doing so, the mass cut point of the star can be found, a key hydrodynamic property of supernova that provides an understanding of the material that is either ejected from the explosion or bound to the residual neutron star or black hole. However, a road block in this procedure comes from a lack of precision in the nuclear reactions that destroy ^{44}Ti in supernovae, most notably the reactions ^{44}Ti$(\alpha, p)^{47}$V and ^{45}V$(p, \gamma)^{46}$Cr. Therefore, this study aims to better understand the ^{45}V$(p, \gamma)^{46}$Cr reaction by performing γ-ray spectroscopy of ^{46}Cr with the aim of identifying proton-unbound resonant states.

The experiment was conducted at the ATLAS facility at Argonne National Laboratory, using the GRETINA+FMA setup. A beam of 120-MeV ^{36}Ar ions are impinged onto a ~200 μg·cm^{-2} thick ^{12}C target, producing ^{46}Cr via the fusion-evaporation reaction ^{12}C(^{36}Ar,2n). The cross section for producing ^{46}Cr, in this reaction, is estimated to be in the μb range. Nevertheless, with the power of the GRETINA+FMA setup, we show that it is possible to cleanly identify γ rays in ^{46}Cr. These include decays from previously unidentified states above the proton-emission threshold, corresponding to resonances in the ^{45}V + p system. This represents the state-of-the-art for in-beam γ ray studies for full spectroscopy up to the excitation energy region relevant for astrophysical burning.

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