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Identifying the Origin of Presolar Grains: Gamma-Spectroscopy of 35Ar

Classical novae are the second most common explosive stellar phenomena in the Universe [1] and, as such, play an important role in the enrichment of the interstellar medium and chemical abundances we observe in the galaxy. One observable, which is key to understanding the processes that drive classical novae, is presolar grains. It is, therefore, important that we are able to characterise the origin of presolar grains based on their isotopic ratios. One issue that still remains is being able to distinguish between grains of nova and supernova origin.

It has been suggested that the ^{34}S/^{32}S isotopic ratio could be used, in conjunction with the well-known ^{32}S/^{33}S ratio [2], in order to distinguish between solar and novae presolar grains [3,4]. The abundance of ^{34}S is dependent on the ^{34g,m}Cl(p,γ)^{35}Ar rp-process reaction rate. In order to determine this reaction rate, one has to know the energy, spin and parity of the contributing resonances in ^{35}Ar. The energies of all states above the proton threshold have been measured [3], however almost all of the spins and parities remain unknown.

Here, we report a gamma-spectroscopy measurement of ^{35}Ar with the aim of observing gamma decay from states above the proton-emission threshold. This experiment was conducted at Argonne National Laboratory' s ATLAS facility. States in ^{35}Ar were populated via the ^{9}Be(^{28}Si,2n)^{35}Ar fusion-evaporation reaction. The excited states decay via the emission of gamma rays, which are detected using Gammasphere, in coincidence with the recoils at the focal plane of the Fragment Mass Analyzer (FMA).

This measurement represents the first observation of gamma decays from states above the proton threshold in ^{35}Ar and led to more precise measurements of the resonance energies of the key states. The gamma-decay branches enable restrictions to be placed on the spin-parity quantum numbers. Further refinements to the spin-parity assignments can be made using the measured angular distributions of the gamma rays. This represents an important step to determining the ^{34g,m}Cl(p,γ)^{35}Ar reaction rate and the ^{34}S/^{32}S isotopic ratio from novae.

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