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# Key Resonances in $^{3}5$Ar and their importance for determining the origin of presolar grains

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%%%
\AUTHORS{R.S. Ilieva[1], G. Lotay[1], D. Seweryniak[2], K. Auranen[2], R.S. Wilkinson[1], S. Hallam[1], M.P. Carpenter[2], R.V.F. Janssens[2], T. Lauritsen[2], R. Talwar[2], S. Zhu[2]}

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{\small \it

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Classical novae are among the most common explosive stellar events and therefore provide a wealth of astronomical observational data. Presolar grains are microscopic grains embedded within primitive meteorites which provide a snapshot of nucleosynthesis within a specific astrophysical site. As such, they can be used to investigate distributions of elemental abundances and allow a comparison between the predictions of theoretical models and astronomical observations. However, without accurately classifying their specific stellar origin, interpreting data from presolar grains can be difficult, as novae grain signatures are ambiguous with those from supernovae. Sulphur abundances are a key part of accurately classifying presolar grains as being of nova origin. Yet, due to large uncertainties in the nuclear processes involved in classical novae, a number of key aspects of nova nucleosynthesis remain unclear. Therefore, it is essential to obtain detailed knowledge of the nuclear reactions that are responsible for isotopic abundance signatures in presolar grains. A detailed theoretical study by Iliadis and \textit{et al.} [1] investigated the effect of nuclear reaction rate uncertainties in novae nucleosynthesis and highlighted the $^{34}$Cl$(p,\gamma)^{35}$Ar as one of only a handful of reactions to significantly affect the final production of $^{34}$S produced in ONe novae. Constraining this reaction rate is vital for the classification of presolar grains, as the $^{32}$S/$^{34}$S ratio is a key identifier of nova origins.
In these environments, the $^{34}$Cl$(p,\gamma)^{35}$Ar reaction is expected to be dominated by resonant capture to excited states above the proton threshold in $^{35}$Ar. However, only limited experimental information exists on the properties of the states observed in this energy range [2]. A detailed $\gamma$-ray spectroscopy study of $^{35}$Ar was performed using the Digital Gammasphere array in combination with the Argonne Fragment Mass Analyser in order to study resonant states for the $^{34}$Cl$(p,\gamma)^{35}$Ar reaction. Excited levels in $^{35}$Ar have been identified and their spins and parities constrained, and their astrophysical implications will be discussed.

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\noindent [1] C. Iliadis \textit{et al.}, Astrophys. J Suppl. Ser. {\bf{142}}, 105 (2002) ;

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[2] C. Fry\textit{et al.}, Phys. Rev. C {\bf{91}}, 015803 (2015) }
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