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Measurement of key resonance states for the ^{30}P(p,γ)^{31}S reaction rate

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\AUTHORS{A. Kankainen^{1,2}, P.J. Woods^{1}, H. Schatz^{3,4,5}, T. Poxon-Pearson^{3,4,5}, D.T. Doherty^{1}, V. Bader^{3,4}, T. Baugher^{3}, D. Bazin^{3}, B.A. Brown^{3,4,5}, J. Browne^{3,4,5}, A. Estrade^{1}, A. Gade^{3,4}, J. Jos\'{e}^{6,7}, A. Kontos^{3}, C. Langer^{3}, G. Lotay^{1}, Z. Meisel^{3,4,5}, F. Montes^{3,5}, S. Noji^{3}, F. Nunes^{3,4,5}, G. Perdikakis^{5,8}, J. Pereira^{3,5}, F. Recchia^{3}, T. Redpath^{8}, R. Stroberg^{3,4}, M. Scott^{3,4}, D. Seweryniak^{9}, J. Stevens^{3,5}, D. Weisshaar^{3}, K. Wimmer^{8}, R. Zegers^{3,4,5}}

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{\small \it
\AFFILIATION{1}{University of Edinburgh, Edinburgh EH9 3JZ, United Kingdom}
\AFFILIATION{2}{University of Jyvaskyla, P.O. Box 35, FI-40014 University of Jyvaskyla, Finland}
\AFFILIATION{3}{National Superconducting Cyclotron Laboratory, Michigan State University, \\East Lansing, Michigan 48824, USA}
\AFFILIATION{4}{Department of Physics and Astronomy, Michigan State University, \\East Lansing, Michigan 48824, USA}
\AFFILIATION{5}{JINA Center for the Evolution of the Elements, Michigan State University, \\East Lansing, Michigan 48824, USA}
\AFFILIATION{6}{Departament de F\'{i}sica, EEBE, Universitat Polit\`{e}cnica de Catalunya, E-08019 Barcelona, Spain}
\AFFILIATION{7}{Institut d'Estudis Espacials de Catalunya, E-08034 Barcelona, Spain}
\AFFILIATION{8}{Central Michigan University, Mount Pleasant, Michigan 48859, USA}
\AFFILIATION{9}{Argonne National Laboratory, Argonne, Illinois 60439, USA}

}
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% Enter contact e-mail address here.

\centerline{Contact email: {\it anu.kankainen@jyu.fi}}

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%%% Abstract proper starts here.
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Lack of knowledge of the rate of proton capture on radioactive ^{30}P is the most prominent nuclear physics uncertainty in models of oxygen neon (ONe) nova explosions [1,2]. Recently, the $^{30}\mathrm{P}(p,\gamma)^{31}$S reaction has been studied using the $d(^{30}\mathrm{P},n)^{31}$S reaction as a surrogate [3]. A primary beam of ^{36}Ar (150 MeV/A) impinging on a Be target was used to produce the $\approx$ 30-MeV/u ^{30}P beam, which was separated with the A1900 fragment separator [4] at the National Superconducting Cyclotron Laboratory. The radioactive ^{30}P beam bombarded a 10.7(8)-mg/cm^2-thick CD$_2$ target surrounded by the Gamma-Ray Energy-Tracking In-beam Nuclear Array GRETINA [5]. The ^{31}S ions were analyzed by the S800 spectrograph [6] and identified by energy-loss and time-of-flight measurements. The γ-rays from the decays of excited states above the proton threshold in ^{31}S were detected in coincidence with the recoiling ^{31}S ions. Angle-integrated cross sections for the key resonances were determined and compared with theoretical (d,n) cross sections.

In this contribution, I will discuss the first experimental constraints on spectroscopic factors and strengths of key resonances in the $^{30}\mathrm{P}(p,\gamma)^{31}$S reaction. In general, negative-parity states have been found to be most strongly produced but the absolute values of spectroscopic factors are typically an order of magnitude lower than predicted by the shell-model calculations employing WBP Hamiltonian for the negative-parity states. The results clearly indicate the dominance of a single $3/2^-$ resonance state at 196 keV in the region of nova burning $T \approx 0.10 - 0.17$~GK, well within the region of interest for nova nucleosynthesis. Hydrodynamic simulations of nova explosions have been performed to demonstrate the effect on the composition of nova ejecta.

\bigskip
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\noindent [1] C.~Iliadis, R.~Longland, A.~Champagne, A.~Coc, and R.~Fitzgerald, Nucl. Phys. A 841, 31 (2010);

\noindent [2] J.~Jos\'{e}, A.~Coc, and M.~Hernanz, Astrophys. J. 560, 897 (2001);

\noindent [3] A. Kankainen, P.J. Woods et al., Phys. Lett. B (2017);

\noindent [4] D.J. Morrissey et al., Nucl. Instrum. Meth. Phys. Res. B 204, 90 (2003);

\noindent [5] S. Paschalis et al., Nucl. Instrum. Meth. Phys. Res. A 709, 44 (2013);

\noindent [6] D. Bazin et al., Nucl. Instrum. Meth. Phys. Res. B 204, 629 (2003).}
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Primary author: Dr KANKAINEN, Anu (University of Jyväskylä)

Presenter: Dr KANKAINEN, Anu (University of Jyväskylä)

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