**Nuclear Astrophysics with DRAGON:**

**studying explosive stellar environments in the lab**

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**Recent measurements related to isotopic observables in novae:**

**How fast do novae burn $^{18}$F?**

$^{18}$F($p,\gamma$)$^{19}$Ne $\rightarrow$ C. Akers et al. Phys. Rev. Lett. 110, 262502 (2013)

The isotope $^{18}$F is thought to be the major source of 511 keV and continuum γ-ray emission shortly after a nova outburst. Comparisons of future observations of this γ-ray emission with the results from astrophysical models can provide insight into physical conditions inside novae. To have sufficiently precise models however we need experimental information on the reactions that produce and destroy $^{18}$F in novae.

Currently the main uncertainty in the final abundance of $^{18}$F depends on its destruction rate via the $(p,\gamma)$ and $(p,\alpha)$ pathways. The rate of the $(p,\gamma)$ reaction is thought to be dominated by two resonances at 330 and 665 keV. DRAGON has made the first successful direct measurement of the 665 keV resonance.

With $1.0(18) \times 10^{12}$ $^{18}$F ions on target over the course of a week of beam time, 2 recoil events were measured in the ionization chamber at the end of the DRAGON separator.

This results in a resonance strength 14 times weaker than currently used in nova models. As a consequence, we now know that this resonance plays a negligible role in the destruction of $^{18}$F at temperatures associated with oxygen-neon novae.

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**Is there $^{33}$S from novae in meteorites?**

$^{33}$S($p,\gamma$)$^{34}$Cl $\rightarrow$ J. Fallis et al. Phys. Rev. C 88, 045801 (2013)

The $^{33}$S($p,\gamma$)$^{34}$Cl reaction is of interest in the study of oxygen-neon novae as $^{33}$S has the potential to be an important isotope for the classification of presolar grains found in meteorites. Currently the classification of novae grains is ambiguous as supernova models might explain the observed isotopic abundances. As $^{33}$S isn’t overproduced in supernovae its presence could be a ‘smoking gun’ for proving nova origins. Previous nova models predicted an over-abundance of $^{33}$S compared to solar values of between 1.5 – 450. Our goal was to reduce this uncertainty by measuring all of the states within the Gamow window below the previously measured state at 432 keV.

By setting experimental upper limits on all of these previously unmeasured states and by finding and measuring resonance strengths of two new states we have reduced the uncertainty on the $^{33}$S over-production factor in novae by 73%, confirming the $^{33}$S over-abundance.

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**Also ask me about:**

**Measurements related to the p-process in Supernovae**

- $^{76}$Se($a,\gamma$)$^{80}$Kr – First science measurement scheduled for this December
- $^{58}$Ni($p,\gamma$)$^{60}$Cu – Separator transmission and beam suppression tests
- $^{84}$Kr($a,\gamma$)$^{88}$Sr – Separator transmission and beam suppression tests

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**Collaborating institutions:**

- Simon Fraser University (CA)
- McMaster University (CA)
- U. Northern BC (CA)
- University of York (UK)
- Michigan State University (USA)
- University of Edinburgh (UK)
- UPC Catalunya (ES)
- ETH Zurich (CH)
- China Institute for Atomic Energy (CN)

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