Experimental investigation of the reactions $^{25}Mg(\alpha,n)^{28}Si$, $^{26}Mg(\alpha,n)^{29}Si$ and $^{18}O(\alpha,n)^{21}Ne$

Recent results from meteoritic grain measurements and stellar models indicate that an enhanced experimental data set of the reactions $^{25}Mg(\alpha,n)^{28}Si$, $^{26}Mg(\alpha,n)^{29}Si$ and $^{18}O(\alpha,n)^{21}Ne$ would unveil a clearer picture on their role toward stellar nucleosynthesis.

The current level of uncertainty in the reaction rates reduces the ability to determine their impact. Varying the rates within the uncertainties produces noticeable variations in the isotopic abundance patterns calculated by stellar nucleosynthesis models.

At the Nuclear Sciences laboratory of the University of Notre Dame the experiments were performed using the KN VdG accelerator. The experimental challenges were adressed by designing a highly efficient neutron detection system based on ^{3}He proportional counters. The design process involved computational simulations based on MCNP5 and GEANT4. These were validated by the measurement of the reaction $^{51}V(p,n)^{51}Cr$. Target production methods based on electrolysis and thermal evaporation were utilized[1],[2].

While data analysis is still ongoing, the first results show a promising trend toward new details being unveiled about the impact of $^{25}Mg(\alpha,n)^{28}Si$, $^{26}Mg(\alpha,n)^{29}Si$, $^{18}O(\alpha,n)^{21}Ne$ on stellar nucleosynthesis.

The new reaction rates will be implemented into stellar models and the resulting isotopic abundance patterns then compared to measured isotopic abundance patterns in meteoritic inclusions.

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[1] Falahat et al., 2009, AIP Conference Proceedings, vol 1090, p. 303
[2] Best et al., 2010, in preparation

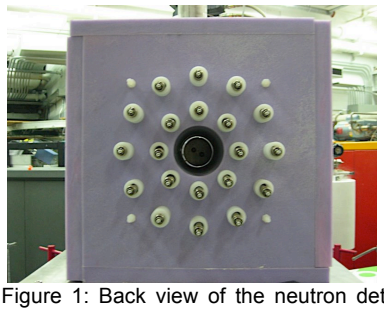

Figure 1: Back view of the neutron detection system.

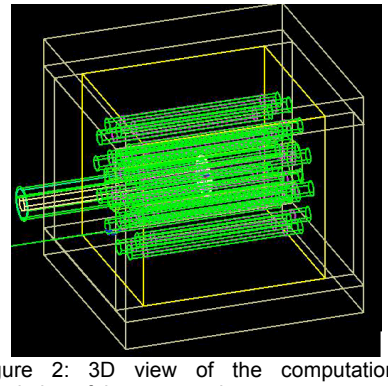

Figure 2: 3D view of the computational simulation of the neutron detector.

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