Underground Measurements of the $^{16}O(p,\gamma)^{17}F$ Reaction at LUNA

Duncan Robb[1] on behalf of the LUNA collaboration[2]

[1] *School of Physics and Astronomy and SUPA, University of Edinburgh, Edinburgh, UK*

[2] *http://luna.lngs.infn.it*

The $^{16}O(p,\gamma)^{17}F$ reaction is the slowest proton-induced reaction in the CNO cycle [1]. This is due to the fact that at energies of astrophysical interest it has no resonances, making it an example of a pure direct capture reaction [2]. The ratio of $^{16}O/^{17}O$ in stars depends strongly on the rate of this reaction. This ratio is an important probe of nucleosynthesis and mixing processes in the interior of stars, as it can be measured directly [3]. At astrophysical energies, i.e. centre of mass energies below around 500 keV, there is little experimental data for this reaction, and the data that exists tends to have relatively large uncertainties [4]. In addition, Bayesian estimations of the reaction s-factors carried out by Iliadis et al. in [4] do not closely match the low energy experimental data, particularly for direct capture to the ground state.

An experimental campaign has been carried out at the LUNA underground accelerator at Gran Sasso National Laboratory in Italy, aiming to measure the cross section for $^{16}O(p,\gamma)^{17}F$. The very low background in the underground laboratory combined with lead shielding allows for direct measurements of this weak reaction to be carried out. Protons were accelerated onto a tantalum oxide target, and the resulting prompt gamma rays were detected using two cerium bromide scintillators and a high-purity germanium detector.

I will report on the characterisation of the setup and the data that has been taken.

[1] C. Iliadis, Nuclear Physics of Stars, 2007

[2] C. Iliadis et al., Phys. Rev. C 77 (2008) 045802

[3] T. Lebzelter et al., arXiv:1504.05377 [astro-ph.SR] (2015)

[4] C. Iliadis et al., Phys. Rev. C 106, 055802