Direct measurement of the 17O(p,α)14N reaction at energies of astrophysical interest at LUNA

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The 17O(p,α)14N reaction plays a key role in several astrophysical scenarios, including classical novae and AGB stars. In classical novae 17O(p,α)14
N influences the production of 18F, unstable to β+decay. Gamma rays generated by the annihilation of the positrons, if observed by space telescopes, would help constrain theoretical models and simulations
[1]. In AGB stars 17O(p,α)14N depletes 17O, which is used as a tracer for extra-mixing processes such as the Cool Bottom Process (CBP) [2]. A better knowledge of the abundance of 17O would improve our understanding of the nature of CBP. At relevant temperatures (T=0.03-0.4 GK), the cross-section of 17O(p,α)14N is dominated by two narrow and isolated resonances at Ep= 70 and 193 keV in the laboratory frame. The latter resonance is reasonably well-known [3-4], but the picture painted in the literature [5-6]for the 70 keV resonance is incomplete because of the resonance's extreme weakness. The precise measurement of the strengths for both the 70 and the 193 keV resonances is the final objective of an ongoing experimental campaign at the underground LUNA-400kV accelerator in Gran Sasso Laboratory, Italy. Measurements were carried out using the thick-target yield direct technique. Protons were accelerated onto a solid Ta2O5target, 95% enriched in 17O, and outgoing alpha particles were detected usingan array of silicon detectors. Results for the 193 keV resonance strength have been obtained and will be presented. Preliminary results will be presented for the 70 keV resonance as well.

[1] J. José and M. Hernanz, J. Phys. G 34 (2007) R431
[2] K.M. Nollet et al., Astrophys. J. 582 (2003) 1036
[3] A. Chafa et al., Phys. Rev. C 75 (2007) 035810
[4] J. Newton et al., Phys. Rev. C 75 (2007) 055808
[5] C. Angulo et al., Nucl. Phys. A 656 (1999) 3-183
[6] M.L. Sergi et al., Phys. Rev. C 82 (2010) 03288