^{35}K test run

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One the most important questions that nuclear physics is trying to address is the origin and abundance of the elements in the universe. Proton-gamma capture reactions, X(p, γ)Y, play an important role in the creation of elements in processes like X-ray bursts or novae explosions [1-3]. The main focus of this work is the reaction ^{34g,m}Cl(p,γ)^{35}Ar. In novae, production of ^{34}S depends on the amount of ^{34}Cl which β-decays into ^{34}S with a half-life $T_{1/2}$=1.5266 s. Sulfur isotopic ratios can be used for classification of presolar grains which can be found in the meteorites. One way to destroy ^{34}Cl is the reaction ^{34g,m}Cl(p,γ)^{35}Ar. The rate of this reaction will eventually determine how much ^{34}Cl will be left for the creation of ^{34}S. To be able to accurately predict the reaction rate of ^{34}Cl(p,γ)^{35}Ar, one needs to know the resonances in ^{35}Ar, including their energy, spin-parity, and proton width. We chose to study this reaction

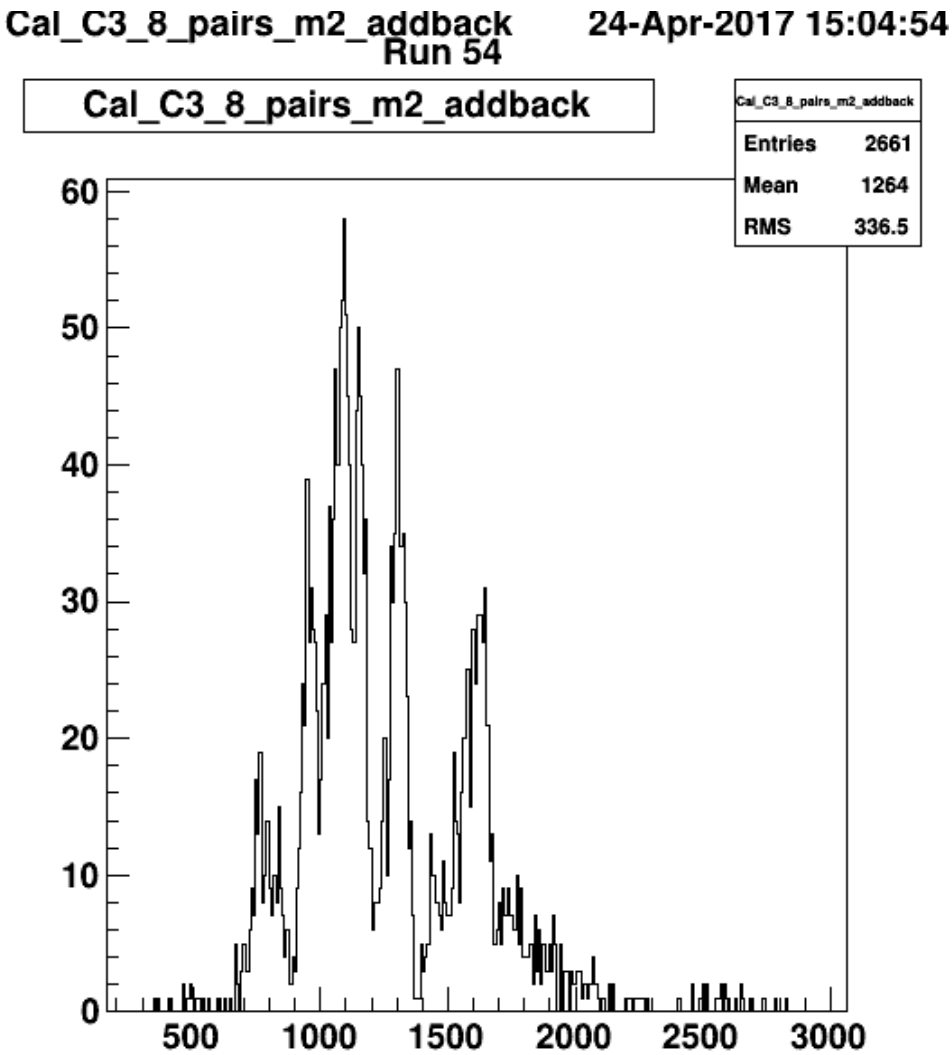

FIG. 1. A proton spectrum obtained in the AstroBoxII following β-decay of ^{35}K.

by means of an indirect method where we populate states in ^{35}Ar just above proton threshold S_p and observe them decaying into the ground level of ^{34}Cl + proton. Therefore detection of low energy protons becomes a challenge. The AstroBoxII was built to address this problem [4] [6]. To test our system, an experiment was conducted in March 2017. A beam of ^{36}Ar at 36 MeV/u was obtained from the K500 cyclotron. In the target chamber of MARS [5] an H_2 gas target was used. Through the reaction ^{1}H(^{36}Ar,^{35}K)2n we created a secondary beam of ^{35}K was made and then implanted into the AstroBoxII. After doing gain matching for the AstroBoxII anode pads, two HPGe detectors were calibrated with ^{137}Cs and ^{152}Eu sources. The estimated production rate for ^{35}K was 2.77 event/nC. An Al degrader (13 mil) on a rotary mechanism was used to control the position for the implantation of ^{35}K in the AstroBoxII. Due to a number of technical issues the beam time was very limited with only about 6 hours of data available. Nonetheless a proton spectrum was obtained (Fig 1.) and it is in good agreement with a similar spectrum that was obtained in 2014, but with the silicon detectors instead of the AstroBoxII.

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