Elemental abundance anomalies in globular clusters - II

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Another reaction important to globular cluster nucleosynthesis is ^{39}K(p,γ)^{40}Ca. This reaction destroys potassium, changing the MgK anticorrelation. The reaction has been directly measured with the DRAGON recoil separator at TRIUMF in 2019. A beam of around 10^{11} ^{39}K ions per second was incident on a windowless hydrogen gas target. Recoiling ^{40}Ca ions were transported through the DRAGON magnetic-electric-magnetic-electric dipole separator sequence to a focal plane consisting of a silicon detector placed within an ionisation chamber. An array of Bismuth Germanate detectors (BGOs) around the target position were used to detect resulting gamma rays. Recoils of interest were identified through their time of flight through the DRAGON.

The analysis of the data is substantially complete but two outstanding tasks remain. The first is the simulation of the efficiency of the detection of γ rays at the DRAGON target and the transmission of heavy recoils through the DRAGON recoil separator and the second is the measurement of the charge-state distributions of the ^{40}Ca ions leaving the windowless gas target. The simulations are currently in progress and should be complete during the summer of 2023. The ongoing analysis has shown that the literature γ-ray decays of ^{40}Ca do not describe the present data well, suggesting that the literature branching ratios are incorrect. The charge-state distributions will be measured using a ^{44}Ca beam at the end of July 2023. A publication will be submitted before the end of the year.

Fig. 1 shows the separator time-of-flight spectrum for the E_r=606-keV resonance in the ^{39}K(p,γ)^{40}Ca reaction.

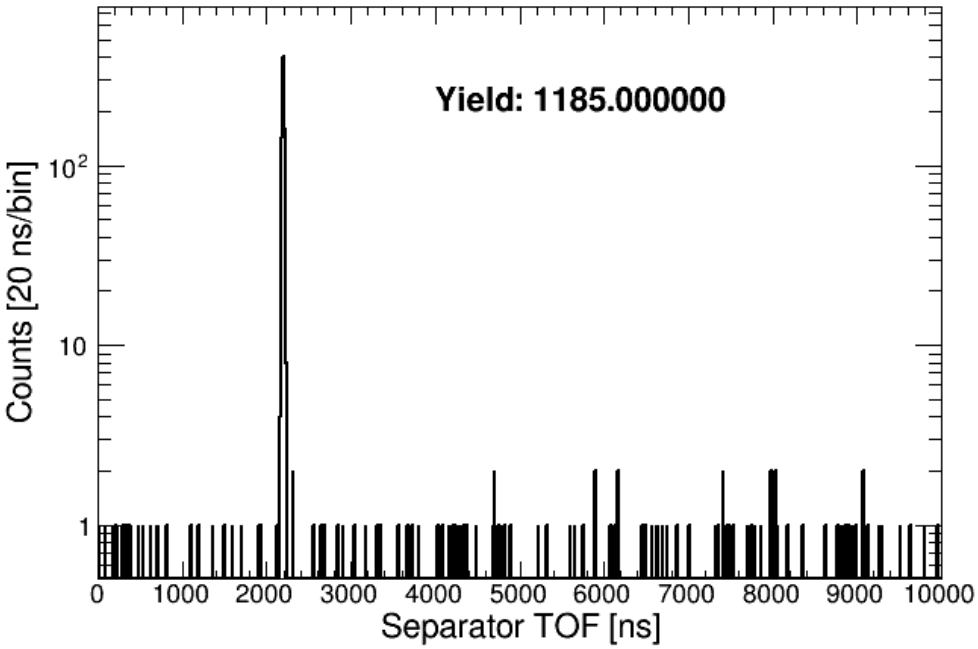

Fig. 1. The separator time-of-flight spectrum for the E_r = 606-keV resonance. This time-of-flight is between a hit in the BGO detectors around the DRAGON target and the heavy recoil hitting the focal plane. The large peak corresponds to ^{40}Ca recoils and the rest of the spectrum corresponds to "leaky" ^{39}K beam.