Elemental abundance anomalies in globular clusters - III

P. Adsley,[1,2] P. Jones,[3] L. Donaldson,[3] S. Jongile,[3] S. Binda,[3] A. Bahani,[3] A. Netshiya,[3] S. Mthembu,[3] J. W. Brummer,[3] E. Lawrie,[3] K. Malatji,[3] and R. Neveling[3]
[1]*Cyclotron Institute, Texas A&M University, College Station, Texas 77843, USA*
[2]*Department of Physics and Astronomy, Texas A&M University, College Station, Texas 77843, USA*
[3]*iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa*

The MgK anticorrelation does not only depend on the destruction of ^{39}K but also on its production. We have previously constrained one of the most important reactions along this path, ^{30}Si(p,γ)^{31}P, using the ^{30}Si(^{3}He,d)^{31}P reaction at Munich with the Q3D spectrograph[1]. However, a lack of spectroscopic information on the compound nuclei of other important reactions. Notably, the ^{37}Ar(p,γ)^{38}K and ^{38}Ar(p,γ)^{39}K reactions, which proceed through excited states in ^{38}K and ^{39}K are poorly constrained. The lack of spectroscopic information on these nuclei is so profound that it is not even clear which resonances must be measured to properly constrain the rate.

In an attempt to identify potential astrophysically important resonance, an experiment was performed at iThemba LABS in South Africa in October 2022 using a proton beam on a natural calcium target. Gamma rays resulting from the interaction of the beam with the target were observed in the AFRODITE array of high-purity germanium detectors. These gamma rays will be used to deduce spectroscopic information relevant to the ^{37}Ar(p,γ)^{38}K and ^{38}Ar(p,γ)^{39}K reactions and provide guidance for future direct experimental studies at facilities such as DRAGON.

The analysis is currently underway with a number of low-energy gamma rays in ^{36,37,38}Ar, ^{38,39}K and ^{39,40}Ca currently identified. Some example online spectra, using only two clovers from 2% of the total data are shown in Fig. 1.

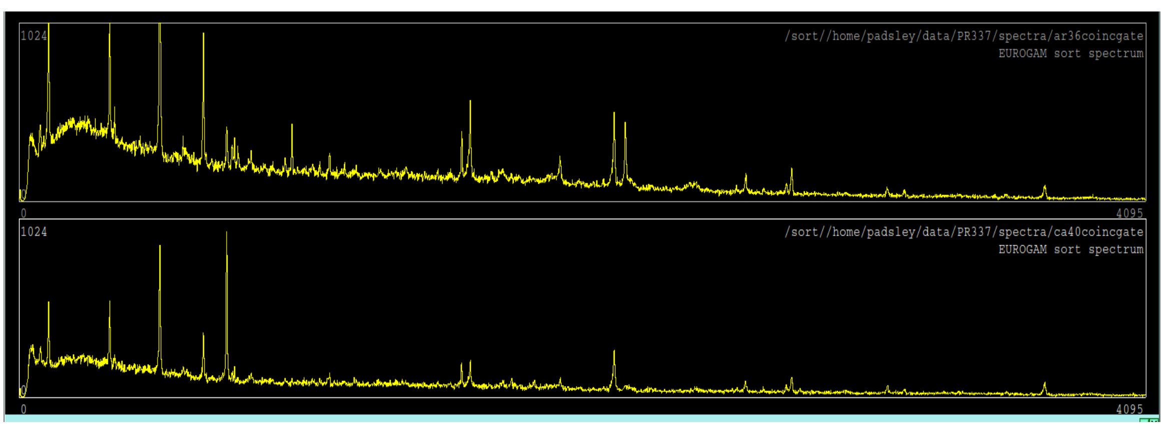

Fig. 1. γ-ray spectra gated on ^{36}Ar and ^{40}Ca transitions.

[1] D. S Harrouz *et al.* Phys. Rev. C **105** 015805 (2022).