Statement of Work

Dr. G.P.Gilfoyle

08-17-22 through 05-07-23

Dr. Gilfoyle is requested to furnish his non-personal services to support the operations of the Hall B CLAS12 study of the prototype pixelated micro-well detector (MWD) and to develop and deploy software for the operation of the MWD and/or the analysis of data collected with it. The central goal is to measure and characterize the performance of the prototype.

The motivation is to use a MWD in the CLAS12 detector to increase its operational luminosity and bring new physics within reach. A micro-well detector consists of an array of individual micro-patterned gas proportional counters opposite a planar drift electrode. The well anodes and cathodes may be connected in crossed strips to provide two-dimensional imaging. The third dimension can be extracted from the drift time of the charge collected in the wells of each strip. Full, 3D reconstruction with large volumes is possible. Readout is done with a pixelated ASIC. This technology has been used to build fast, efficient, and precise gas tracking detectors and it can be used to construct large-area devices with a low material budget [1,2]. This low material budget reduces the impact of multiple scattering on the track resolution in CLAS12. The time is ripe for this project. The group at the University of Virginia is developing a prototype MWD for fall, 2022 that could be used by Run Group C (one of the CLAS12 run groups).

The plan of work starts with software to read the data coming from the prototype MWD and transform it into a format that can be accessed with the CLAS12 Common Tools. The reconstruction of those data is next which will likely be the main focus of the work. We need to map the hardware addresses onto the appropriate data bank definitions that will be used by the reconstruction and the simulation codes. Simulations will be done with the CLAS12 *gemc* program which is built on the geant4 engine. On the simulation side we will also include the parameters of the hardware performance in the digitization step. For both software efforts (simulation and prototype data reconstruction) we need an accurate and precise model of the MWD geometry that will be stored in the CLAS12 database CCDB. Our experience has shown getting the geometry right is an essential early step in building the reconstruction code. The next step is to perform pattern recognition on the hits from the MWD and make the initial estimates of the

track parameters. These data are then passed to a generic Kalman filter that has already been developed by Dr. V. Ziegler and the track parameters determined. The final goal will be to characterize the MWD performance with real and simulated data.

This work will be done in the context of the CLAS12 Software Group which has the responsibility to manage and guide the CLAS12 software effort. It will be performed by G.P.Gilfoyle of the University of Richmond. Dr. Gilfoyle is a longtime member of the CLAS Collaboration and the CLAS12 Software Group.

His on-site sponsor will be Dr. S.Stepanyan, who will also monitor the effort outlined above. Dr. Gilfoyle will provide his expertise for the period August 17, 2022 through May 7, 2023.

1. F. Bloser, S. D. Hunter, J. M. Ryan, M. L. McConnell, J. R. Macri, "Gas micro-well track imaging detectors for gamma-ray astronomy," Proc. SPIE 5898, UV, X-Ray, and Gamma-Ray Space Instrumentation for Astronomy XIV, 58980L (18 August 2005); doi: 10.1117/12.617585

2. L. Shekhtman et al 2017 JINST 12 C07037

Sole Source Justification
Non-personal services
Gerard P Gilfoyle
University of Richmond
08-17-2022 through 05-07-2023

We recommend a sole source non-personal services contract be awarded to Gerard P Gilfoyle for the provision of efforts described in the attached statement of work. Gilfoyle will provide the expertise for a period of nine months, beginning August 17, 2022 through May 7, 2023.

Gilfoyle is a long-time member of the CLAS Collaboration with experience in data analysis (CLAS6 GMn experiment) and is the contact person for the CLAS12 GMn experiment (E12-07-104) experiment which is currently being analyzed. He has worked on a variety of CLAS12 software development projects including programing the geometry of the CLAS12 Silicon Vertex Tracker SVT which involved converting design drawing into a from readablefor the CLAS12 Common Tools. He has also been responsible for implementing the paddle structure of the electromagnetic calorimeters (EC inner and outer) in gemc, reconstruction unit tests, the TOF reconstruction software, measuring the drift chamber performance, real-time monitoring of CLAS6, and recently extracting the reconstruction resolution of CLAS12 reconstruction.

Dr. Gilfoyle has a deep knowledge of the CLAS12 detector operations and has the necessary programming expertise to translate that knowledge into code.

Dr. Gilfoyle has been a JLab user from many years and has served several times as Run Coordinator (most recently in January, 2020). His contribution has always been highly appreciated by collaborators and Hall-B staff members.

For the aforementioned reasons, a sole source subcontract to Dr. Gilfoyle to provide his expertise is justified.