This document is a proposal by G.P.Gilfoyle from the University of Richmond to develop and deploy software for the operation of a prototype pixelated gas micro-well detector (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 device could be used as a high-luminosity alternative to the CLAS12 drift chambers.

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). This time coincides with Gilfoyle's planned, sabbatical year at JLab. During that time he will have funds from the DOE Medium Energy Nuclear Physics subprogram to support a masters student. This is a joint program between the University of Richmond and the University of Surrey in the UK. Students work for ten months on a project that will form their masters thesis.

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 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 final 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 software effort. This project will be performed by G.P.Gilfoyle of the University of Richmond. Dr. Gilfoyle is supported by DOE and is a longtime member of the Software Group.

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