

Development of Large Area μ RWELL Detectors for CLAS12 High Luminosity Upgrade at Jefferson Lab

Kondo Gnanvo

On behalf of CLAS12 Upgrade for High Luminosity Operations Task Force Report

At the current luminosity of $L = 0.6 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$, the reconstruction efficiency of charged particles in the forward region of the CEBAF Large Acceptance Spectrometer (CLAS12) is at the level of 75% and limited in part by drift chambers inability to handle high occupancy, in the first tracking region (DC-R1) of the Forward Detector. The reconstruction efficiency is expected to drop even lower at higher luminosities with the current tracking technology. The high-luminosity upgrade of the CEBAF Large Acceptance Spectrometer (CLAS12) will significantly enhance the physics reach of experiments in Hall B at JLab.

Various options under consideration to achieve the desired performance at a higher luminosity of $L = 2 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$ include the addition of faster tracking layers to complement DC-R1 or the replacement of DC-R1 with a different tracking detector technology altogether. In either case, a novel generation of compact, simple and robust Micro-Pattern Gaseous Detector (MPGD) known as the Resistive Micro-Well detector (μ RWELL) is the ideal candidate to satisfy the requirements in terms of timing O (10 ns) and position O (100 μm) resolutions. A large μ RWELL prototype, combined with a two-dimensional U-V strip readout layer based on the novel concept of capacitive-sharing approach has been developed as a proof of principle for fast tracking capabilities in the forward region of CLAS12 high-luminosity upgrade.

In this talk, we will present the technical aspects of the design choices of the large μ RWELL prototype under development and report on the detector assembly process and preliminary performance characteristic tests. We will also discuss on the plans for the test and characterization of the prototype in beam condition in Hall B at Jefferson Lab during spring 2023 CEBAF run. Finally, we will report on ongoing R&D efforts on small prototypes with the goal to improve rate capability, spatial resolution performance and minimize material thickness.