# The Forward Drift Chamber System for the GlueX Detector

Simon Taylor for the GlueX Collaboration

May 8, 2007

The GlueX experiment is a major part of the 12–GeV upgrade to the Thomas Jefferson National Accelerator Facility. The experiment is designed to study the excitation of the gluonic field binding quark–anti-quark pairs into mesons via photo-production reactions in order to further our understanding of confinement. The experiment entails building a new experimental hall housing a new large-acceptance spectrometer on the Jefferson Laboratory site. As illustrated in figure 1, the core of the GlueX detector is a large 2.2 T superconducting solenoidal magnet enclosing a liquid-hydrogen target, tracking chambers, and lead-scintillator calorimetry modules for photon reconstruction and time-of-flight measurements. Forward-going particles are detected via a Cerenkov detector, a wall of scintillators used for time-of-flight measurements, and an array of lead-glass blocks. Upstream of the target, backward-going photons are tagged with the Upstream Veto Counter, another lead-scintillator sandwich. The focus of this paper is the choice of technology for tracking forward-going particles. These tracking chambers (Forward Drift Chambers, or FDC) need to provide angular coverage down to very small angles with respect to the beam direction to maximize solid angle coverage and to be constructed with minimal material in the active area to reduce Coulomb multiple scattering and energy loss effects. Our goal is to achieve a total thickness of 1–1.5% of a radiation length in the active area over the four packages. To reduce the probability of photon conversions in the inactive portions of the FDC, the design seeks to minimize the material thickness in the chamber support frames. The chambers will also have to operate at high efficiency in a high-rate environment. The design goal for the position resolution is $< 200\ \mu$m for each coordinate.

The Forward Drift Chambers (FDC) are composed of cathode strip chambers – planar drift chambers with cathode readout. The combination of cathode readout and drift information enables measuring a three-dimensional "space-point" for each wire plane. Each drift chamber unit consists of a wire plane with alternating field and sense wires at 10 mm pitch flanked on either side by cathode planes divided into strips. Six chamber units are assembled together to form a "package". To aid in pattern recognition, adjacent layers are rotated by 60 degrees with respect to each other. The packages are arranged with equal distances between adjacent packages along the beam line downstream of the

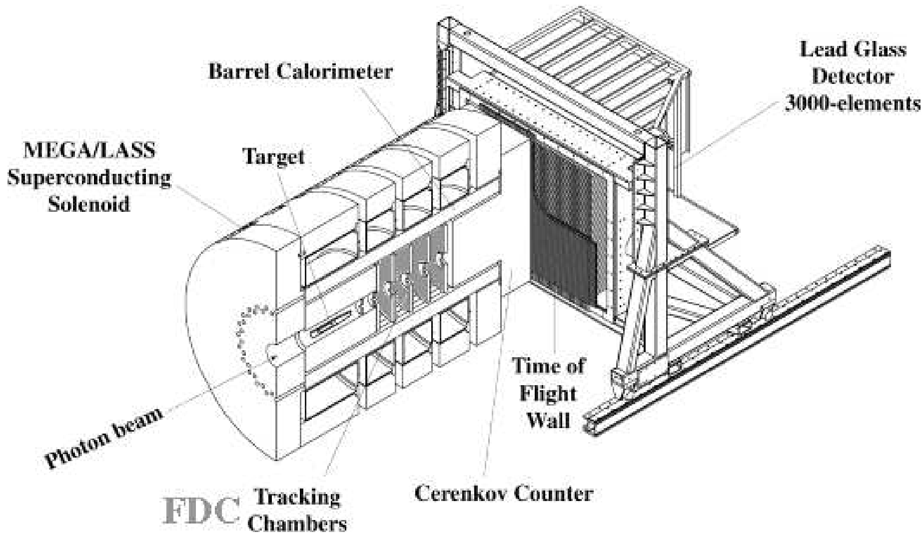


Figure 1: The GlueX detector. The Forward Drift Chambers (FDC) are highlighted in gray.

target.

We have designed and built a small–scale prototype of a single cathode-anode-cathode unit with an active area of $\sim 7'' \times 7''$ and a modular design that allows us to exchange wire planes and cathode planes easily. The strips in the cathode planes are oriented at a fixed angle (with opposite sign for each side) with respect to the wires. We use the centroid information from both cathodes to reconstruct the avalanche position. Since the avalanche occurs within a few radii of the sense wire firing in a given event, we can thereby image the wires and deduce the position resolution. For a configuration where the wires and strips are at $\pm 45°$ with respect to each other, the resolution deduced from Gaussian fits to the reconstructed wire positions is $\sim$180 $\mu$m. Extensive studies are underway or in the planning stages to vary the angle between the strips and wires, to optimize the gas mixture, and to understand the performance of the detector in large magnetic fields.