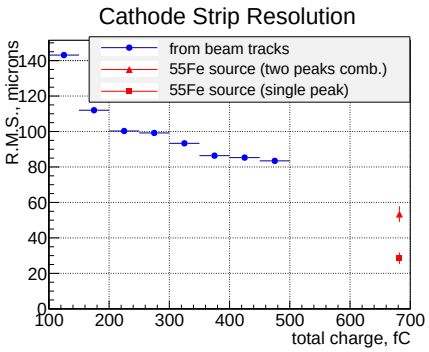
Cathode Drift Chambers for the GlueX experiment at Jefferson Lab (L. Pentchev)

The cathode drift chamber system has been successfully built and operated for more than a year in the GlueX experiment that is already giving physical results. The resolution has been studied by reconstructing the wire positions using signals from the strips of the two cathodes oriented at $75°/105°$ w.r.t. the wires. The cathode resolution depends mostly on the signal-to-noise ratio (Fig.1 left). Therefore, to investigate the chamber performance we used ^{55}Fe source achieving extremely high resolution as demonstrated in Fig.1 right which shows the 2D transverse distribution of the avalanches around the wire, as viewed by the charges induced on the strips. Corrections to the reconstructed positions as a result of the induced charge distortion due to the proximity of the avalanche to the wire were calculated (not applied in the plot). We have proved a simple geometrical relation between the cathode/wire pitch, angles and wire positions that minimizes the systematic uncertainties. Cluster counting technique has been studied with full scale 3 cm-drift-gap chambers,



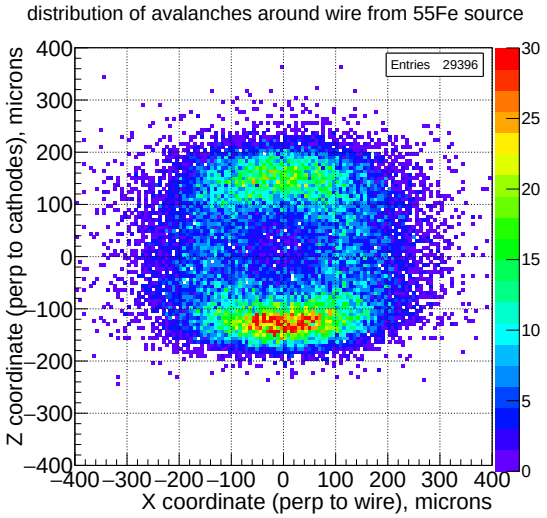


Figure 1: Left: cathode resolution vs total charge from track hits and ^{55}Fe source. Right: avalanches reconstructed from strip crossing (horizontal) and cathode charge ratio (vertical); ^{55}Fe source placed at bottom side.

achieving gains up to 10^5, high single-electron efficiency (Fig.2) and Oxygen contamination < 25 ppm. Space charge effects within the same track result in strong suppression of the cluster number for tracks perpendicular to the wire (Fig.3). For the studies we used $Ar, CO_2(40-60\%)$ mixtures, 20 μ-diameter wires, ASIC pre-amp with 10 ns peaking time.

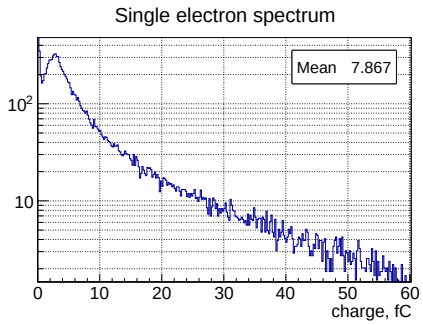


Figure 2: Charge distribution of individual primary electrons well separated in time.

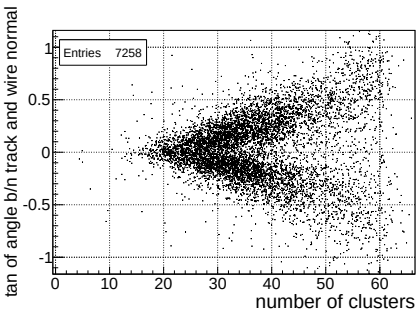


Figure 3: Number of clusters (reconstructed by time separation) vs tangent of the angle between the track and the normal to the wire.