1 EXECUTIVE SUMMARY

Hall D and the GlueX Experiment The GlueX experiment will be housed in a new above-ground experimental hall (Hall D) located at the east end of the CEBAF north linac. A collimated beam of linearly polarized photons (with 40% polarization) of energy 8.5 to 9 GeV will be produced via coherent bremsstrahlung with 12 GeV electrons. This requires thin diamond crystal radiators (no more than 20 μ thick). The scattered electron from the bremsstrahlung will be tagged with sufficient precision to know the photon energy to within 0.1%.

The GlueX detector (see Fig. 1) uses an existing 2.25 T superconducting solenoid that is currently being refurbished. An existing 3000-element lead-glass electromagnetic calorimeter will be reconfigured to match the downstream aperture of the solenoid. The collaboration is currently looking at a DIRC design based on the SLAC BaBar detector for the Cerenkov system. Design work is being carried out with consultation with experts from SLAC. The DIRC Cherenkov Counter is followed by a scintillator time-of-flight (TOF) wall which in turn is followed by a lead glass calorimeter for detecting photons. Inside the full length of the solenoid, a lead and scintillating fiber electromagnetic calorimeter will provide position and energy measurement for photons and TOF information for charged particles. A simple start counter will surround the $30\,cm$ long liquid hydrogen target. This in turn will be surrounded by a cylindrical straw-tube drift-chambers which will fill the region between the target and the cylindrical calorimeter. Planar drift chambers will be placed inside the solenoid downstream of the target to provide accurate track Reconstruction for charged particles going in the forward direction.

This detector configuration has 4π hermeticity and momentum/energy and position information for charged particles and photons produced from incoming $9\,GeV$ photons. This detector has been carefully optimized to carry out partial wave analysis of many particle final states. Extensive Monte Carlo studies for a wide variety of final states have been carried out to certify the design parameters and the suitability of the detector for carrying out the final analysis. In particular, the acceptance of the detector for final state particles is typically above 95% and is quite uniform over the detector. A well understood acceptance is crucial to being able to carry out precision partial wave analysis.

An active program of R&D has been underway now for several years on each of the detector subsystems. Rocking curve measurements of diamond wafers have been performed in the UK, and the coherent bremsstrahlung technique has been successfully demonstrated in Hall B at Jefferson Lab. Prototypes of tracking elements and the cylindrical calorimeter have been built and more are planned. Beam tests in Russia on TOF prototypes have resulted in a finalized design. Prototype flash ADCs have been built and tested as have TDCs based on F1 chips. Work on optimizing electronics continues and more beam tests are planned. The magnet is currently being refurbished at the Indiana University Cyclotron Facility.

The GlueX detector has undergone several reviews carried out by experts from outside the JLab community. The electronics was reviewed in the summer of 2003, while the entire detector was carefully looked at in the Fall of 2004. Finally, a a review was performed on the refurbished magnet. All of these reviews have led to both improvements and optimizations of the GlueX detector. The primary characteristics of the detector are summarized in Figure 1. The hermetic design for the detector makes it an ideal tool to determine the masses and quantum numbers of mesons in the mass range of 1.5 to $2.5\,GeV/c^2$. The detector will be sensitive to hybrid mesons

produced with cross sections as low as a few percent of well known mesons and can also be used to map out both normal mesons and the poorly known spectra of $s\overline{s}$ mesons.

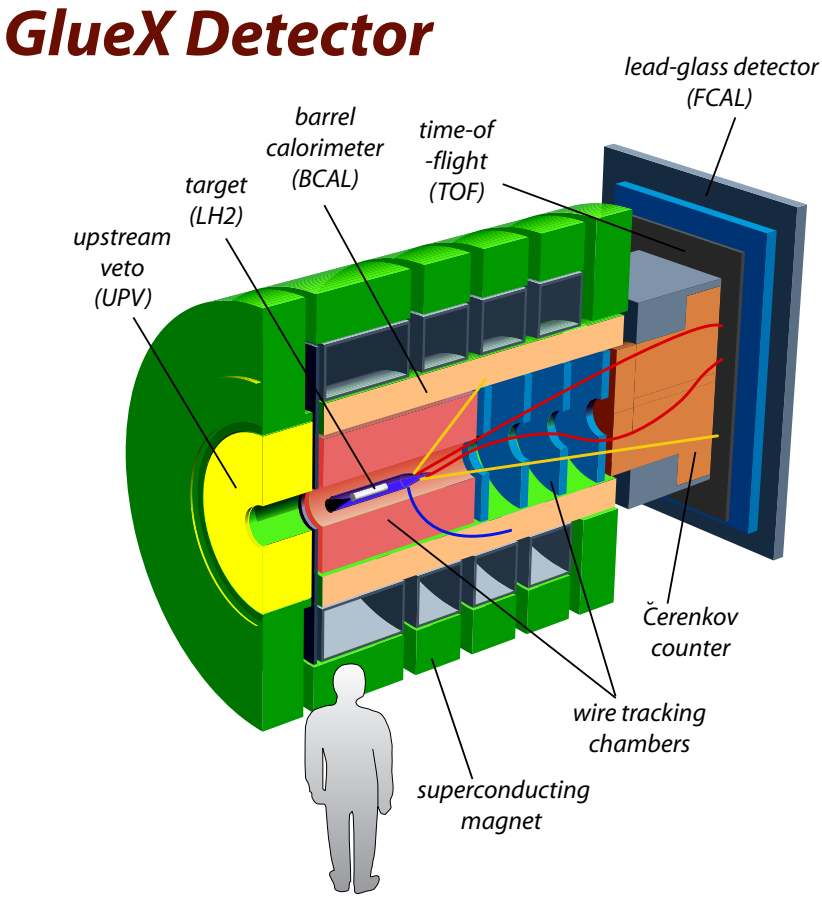

Figure 1: The GlueX detector in HallD. The detector is nearly hermetic for both charged particles and photons. The figure shows a sliced open view of the detector with all elements visible. A brief description of the detector parametsr are listed on the left-hand side of the figure.

Table 1: Summary of the GlueX detectorperformance in HallD.

Parameter	***GlueX Performance***
Charged Particle Detection	
Coverage	$1^\circ < \theta < 170^\circ$: $\sigma(p)/p = 1 - 2\%$
Position Resolution:	$\sigma = 150 - 200 \mu m$
dE/dx measurements:	$20 \leq \theta \leq 140^\circ$
BCAL time resolution:	$sigma(t) = 250\, ps$
TOF time resolution:	$sigma(t) = 60\, ps$
π/K Separation (Cerenkov)	$\theta < 14^\circ$
Photon Detection	
Energy measurments:	$2 \leq \theta \leq 120^\circ$
Veto:	$\theta \geq 120^\circ$
BCAL resolution ($E_\gamma \geq 20 MeV$):	$\sigma(E)/E = (2 + 5/\sqrt{E})$
BCAL resolution ($E_\gamma \geq 100 MeV$):	$\sigma(E)/E = (3.6 + 7.3/\sqrt{E})$
BCAL position resolution	$\sigma(x) = 1\, cm$
LGD position resolution	$\sigma(x) = 1\, cm$
DAQ/Trigger	
Level 1:	$200 kHz$
Event Rate:	$15 kHz$ to tape
Data Rate:	$100 MB/s$
	Electronics
Fully pipe-lined	FADCs and TDCs
Photon Flux	
Initially: $10^7 \gamma/s$	Final: up to $10^8 \gamma/s$

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