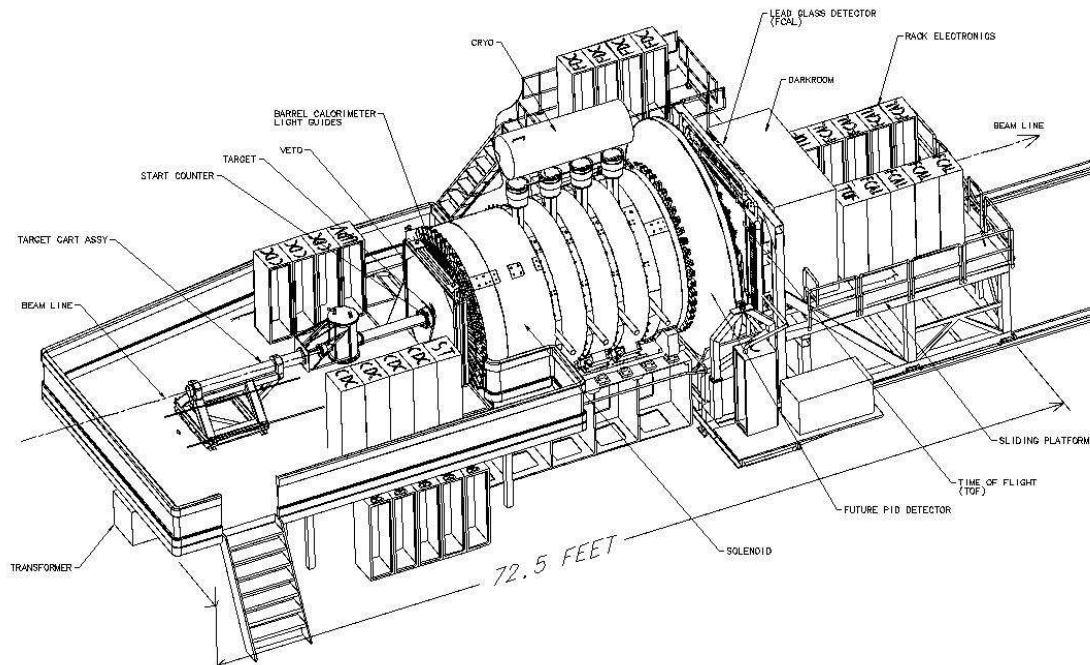


# The Forward Drift Chamber System for the GlueX Detector

Simon Taylor

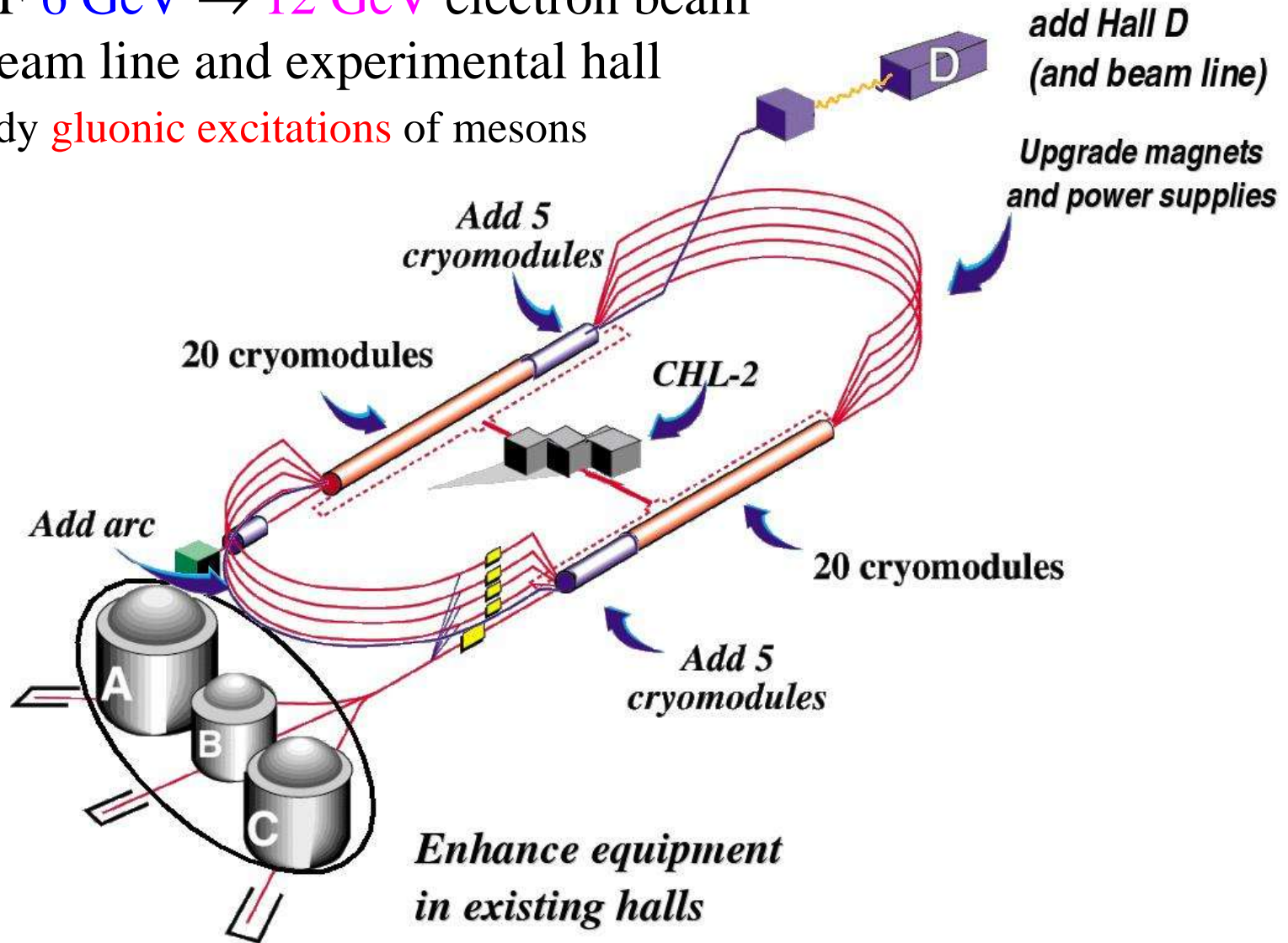
*Jefferson Lab, Newport News, VA, USA*

On behalf of the GlueX Collaboration

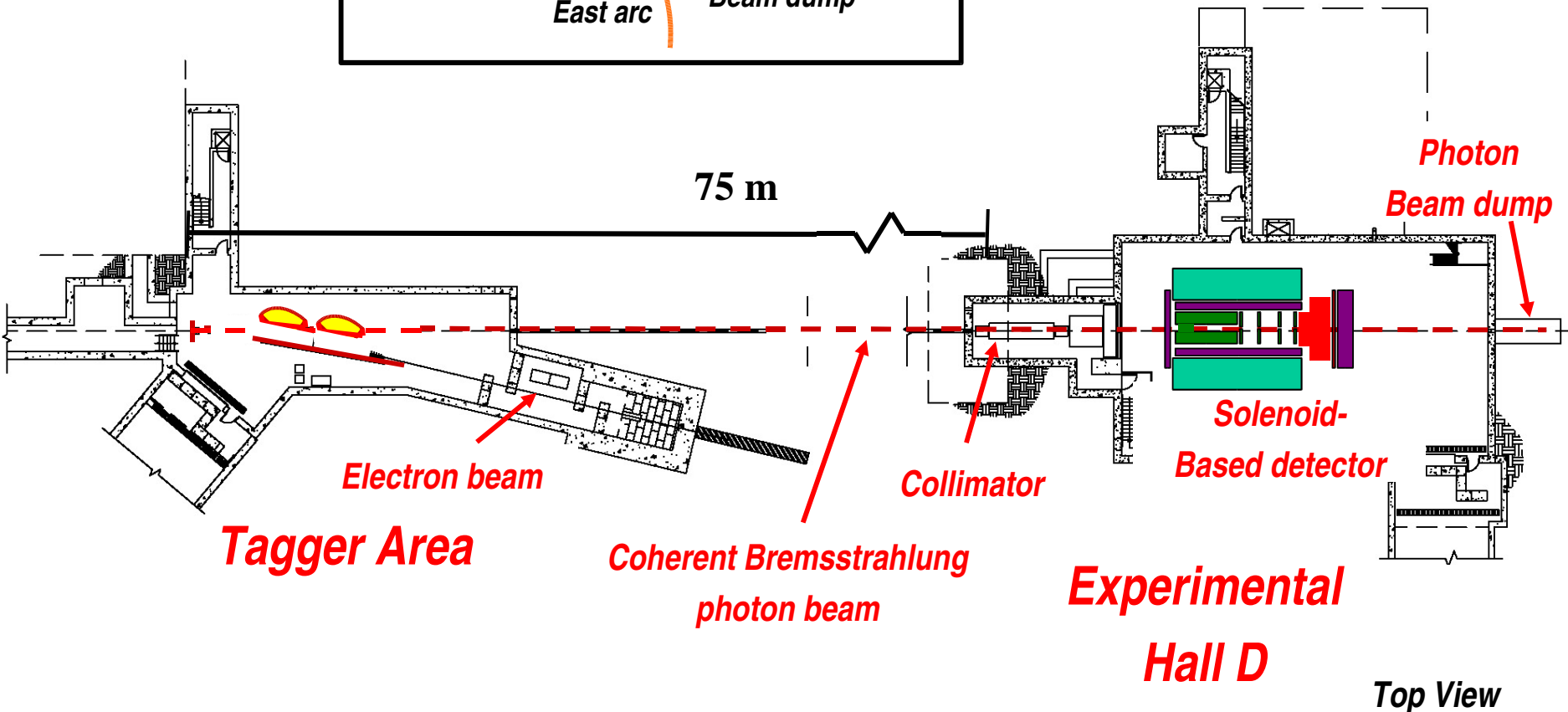
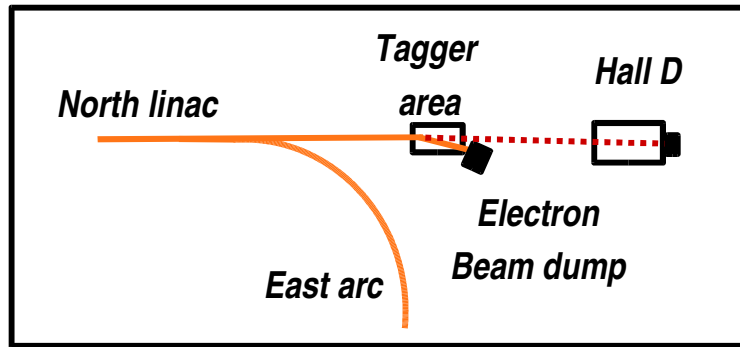


# 12 GeV Upgrade

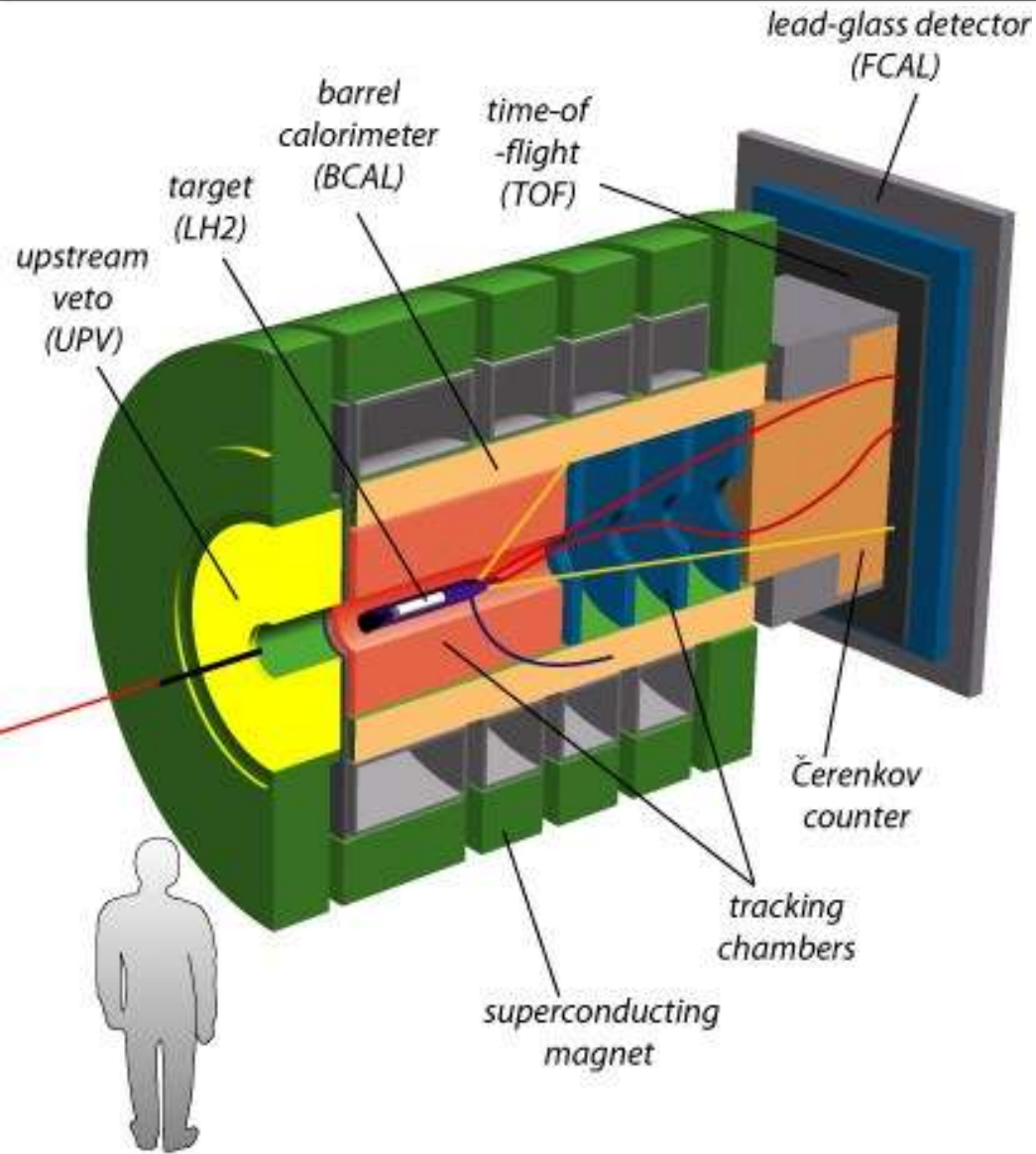
- CEBAF 6 GeV  $\rightarrow$  12 GeV electron beam
- New beam line and experimental hall
  - $\rightarrow$  study **gluonic excitations** of mesons



# The Hall-D Complex

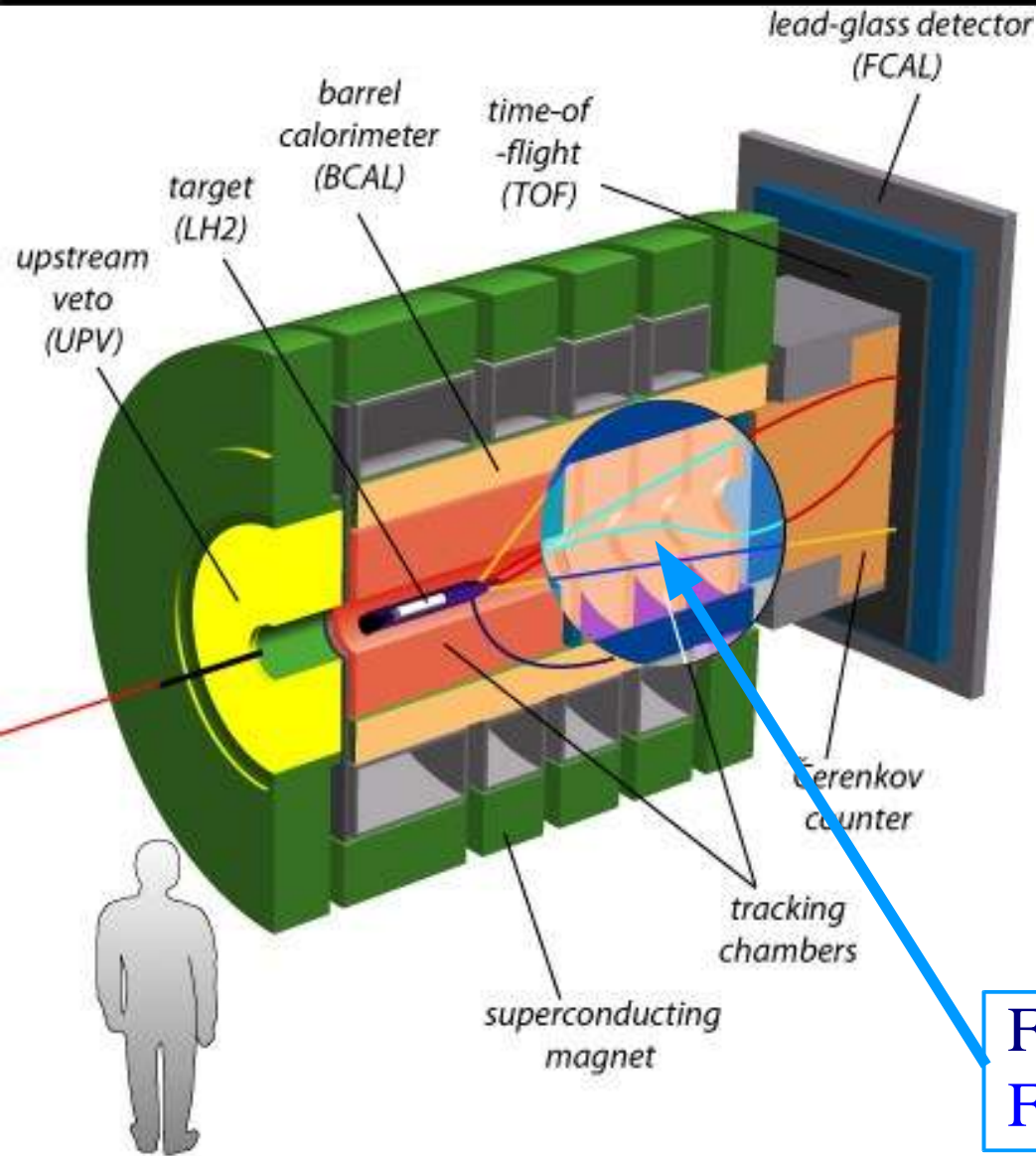


# The Detector



- Solenoid magnet ~ **2.2 Tesla**
- Angular coverage
  - Charged particles:  $1^\circ < \theta < 140^\circ$
  - Neutral particles:  $2^\circ < \theta < 170^\circ$
- Photon energy resolution
  - BCAL:  $\sigma_E/E = (3.6 + 7.3/\sqrt{E})\%$
  - FCAL:  $\sigma_E/E = (2 + 5/\sqrt{E})\%$
- Momentum resolution
  - $\sigma_p/p \sim 1-3\%$  ( $5^\circ - 140^\circ$ )
- Trigger rate
  - 200 kHz
- Fully-pipelined electronics

# The Detector

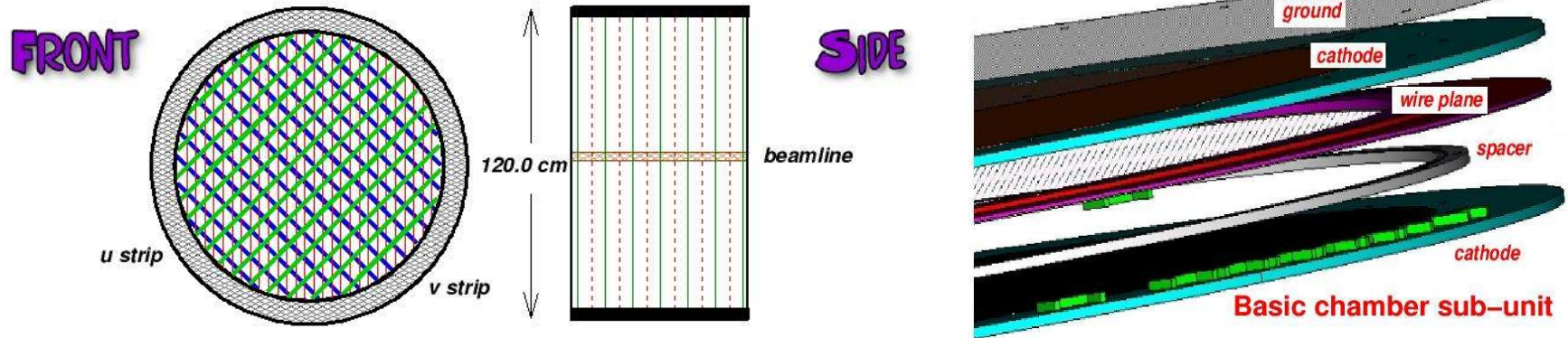


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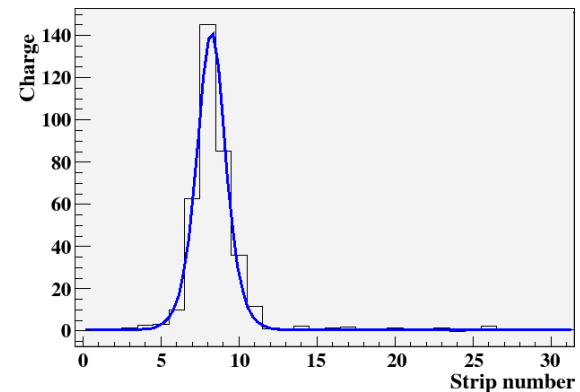
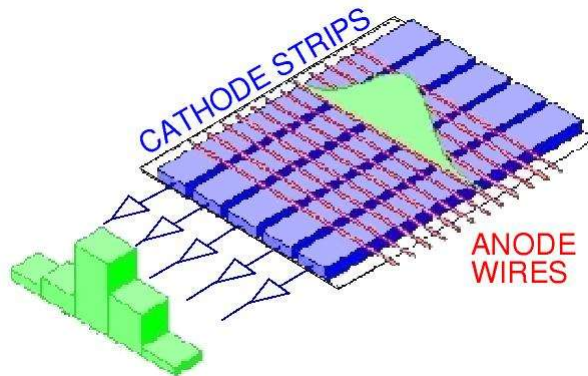
Focus of this talk:  
Forward Drift Chambers (FDC)

# The Forward Drift Chambers

- Purpose: track forward-going ( $\theta < 20^\circ$ ) charged particles
- Design: 4 packages each containing 6 cathode strip chambers

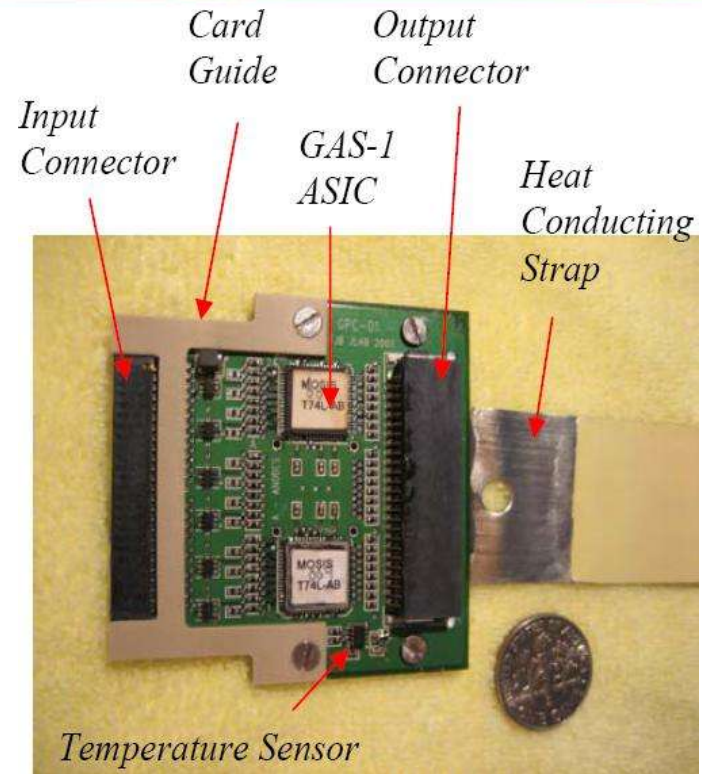


- Cathode strip chamber: cathode plane / wire plane / cathode plane
  - Cathode planes divided into strips oriented at  $\pm 75^\circ$  with respect to wires
  - Each chamber rotated with respect to its neighbor by  $60^\circ$

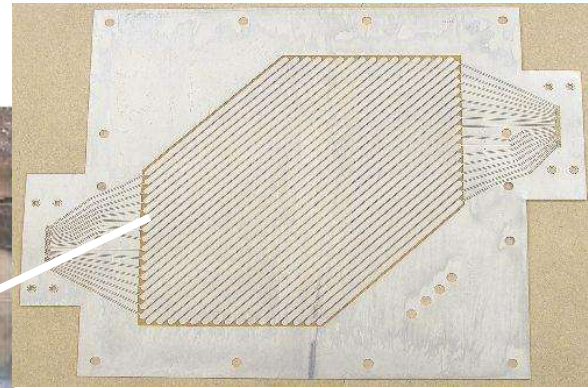
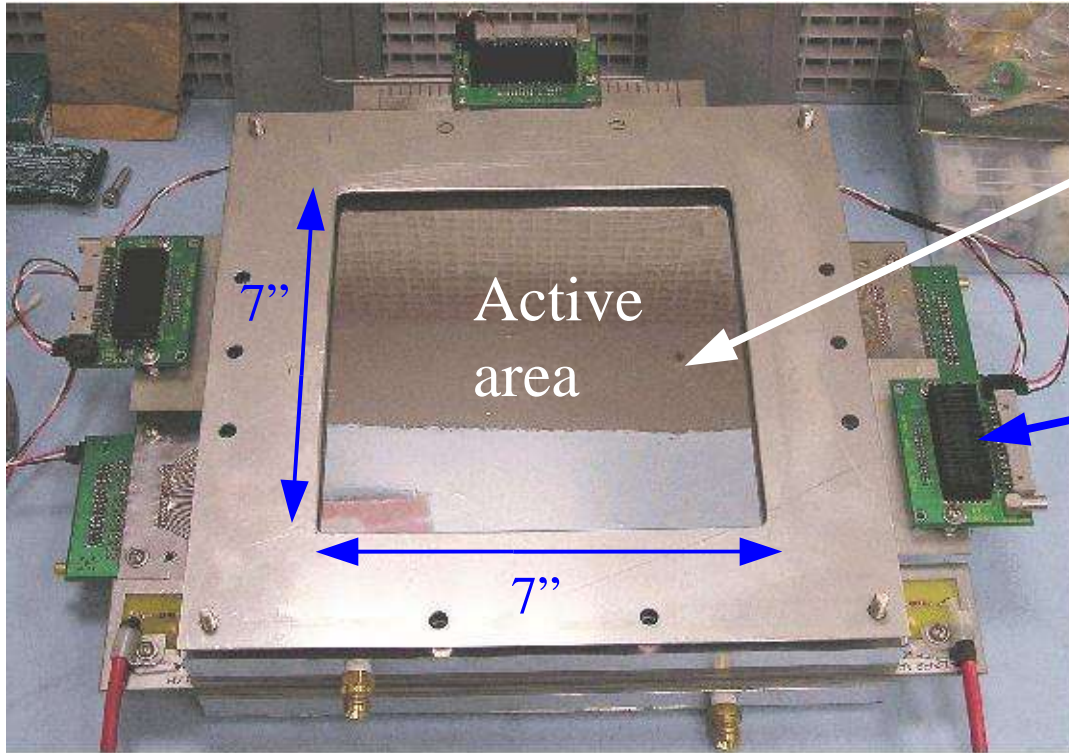


# Readout Electronics

- Significant number of channels
  - 10368 strips, 2304 anode wires
- ASICs → amplification of cathode/anode signals at chamber
  - Pulse-shaping with tail cancelation
  - 2 mV/fC gain for anode signals, 10 mV/fC gain for cathode signals
- Preamplifier daughter boards allow for easy maintenance
- Signal digitization
  - Anode wires: F1 TDCs (120 ps LSB)
  - Cathode strips: 125 MS/s Flash-ADCs



# Small-scale prototype



- Readout for cathode strips: CAEN V792 charge-integrating ADCs
- Readout for sense wires: CAMAC discriminator / F1 TDC

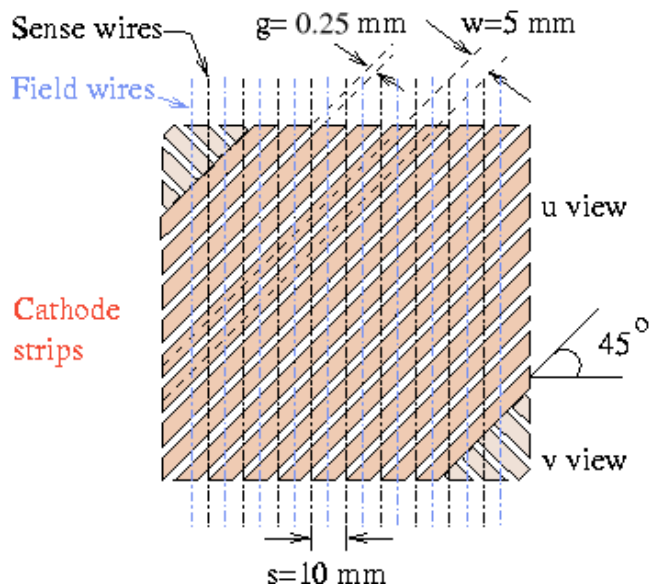
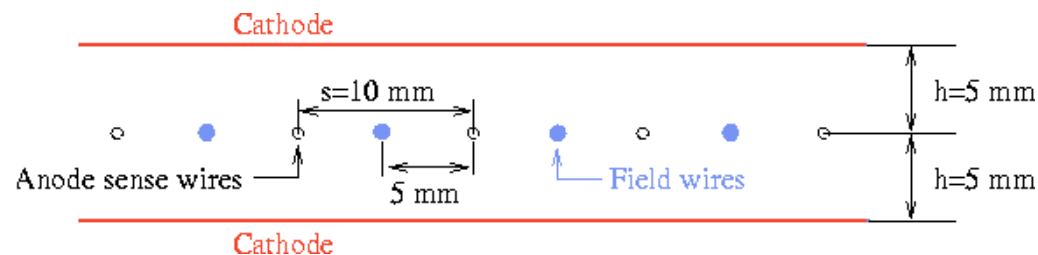
- Preamplifier boards: SIPs
  - Gain  $\sim 2.3 \text{ mV}/\mu\text{A}$
  - No pulse shaping
  - No tail-cancellation
- Gas mixture:  
40% Ar / 60% CO<sub>2</sub>



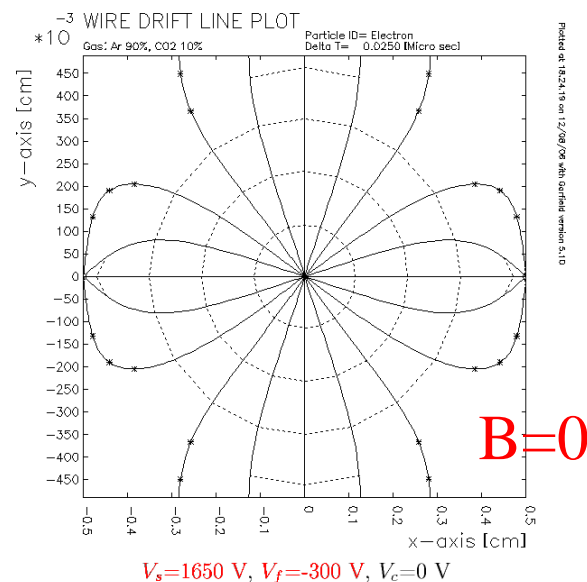
# Electrode Configuration

- Our design: **sense** and **field-shaping wires**
- Drift time + cathode data → **space point (x,y,z)**

- **2 cathode layers**, 5 mm strip pitch, +/- 45° with respect to wires
- **16 sense wires** (10 mm pitch)
- **15 field wires** (10 mm pitch)

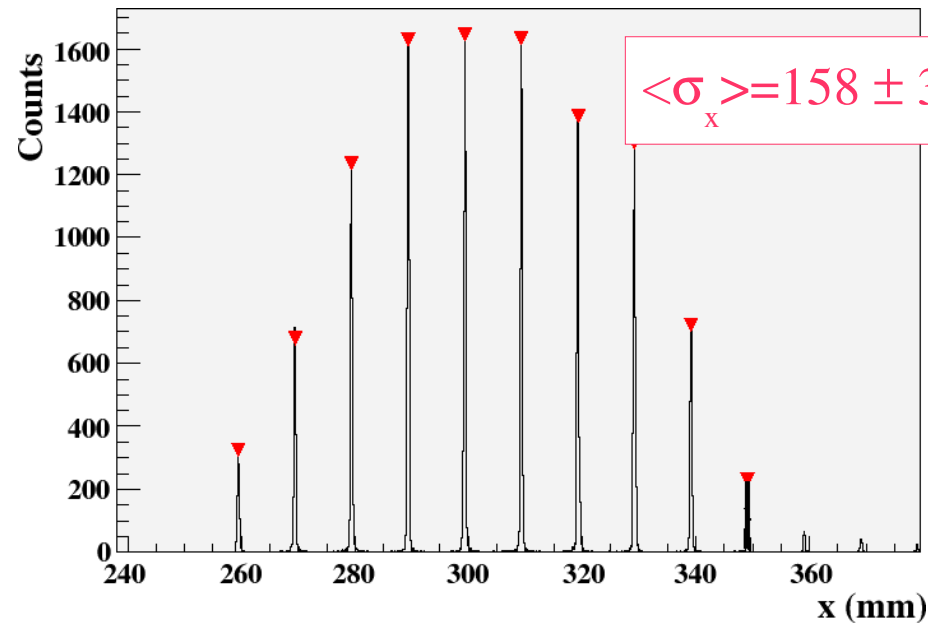


**Goal:** *measure space point with  $< 200 \mu\text{m}$  resolution in each coordinate*

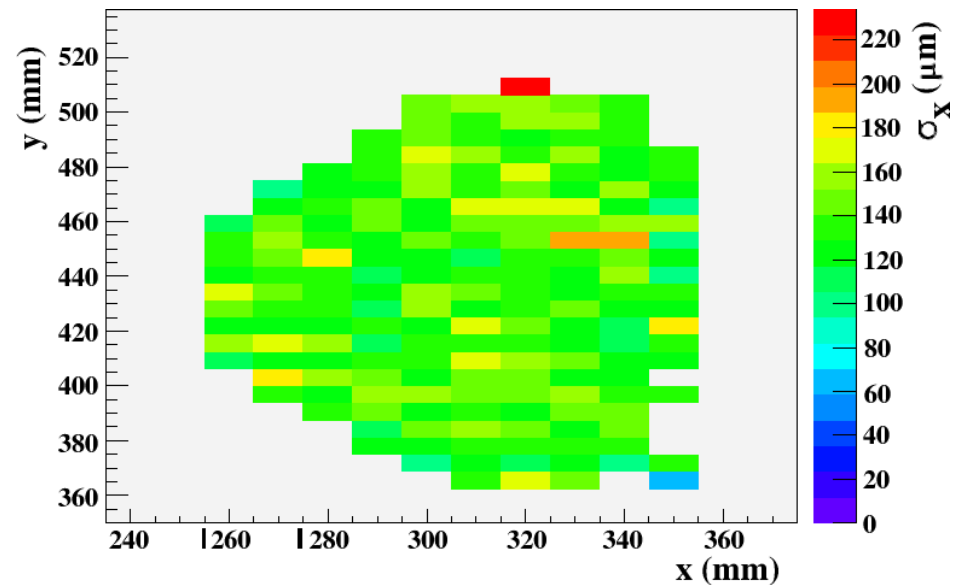
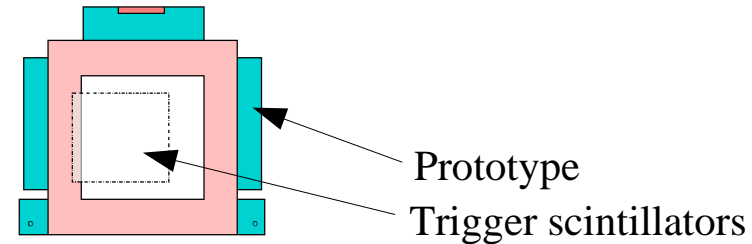


# Imaging the wires

- Use centroids on both views to reconstruct wire positions
  - Avalanche occurs near wire  $\rightarrow$  x-positions quantized
  - $x_{\text{wire}} \propto 1/\sqrt{2} (\langle u \rangle + \langle v \rangle)$  using cathode data only
  - Gaussian fits to reconstructed wire positions  $\rightarrow$  resolution



Strip lengths vary between  
12.8 cm and 27.8 cm

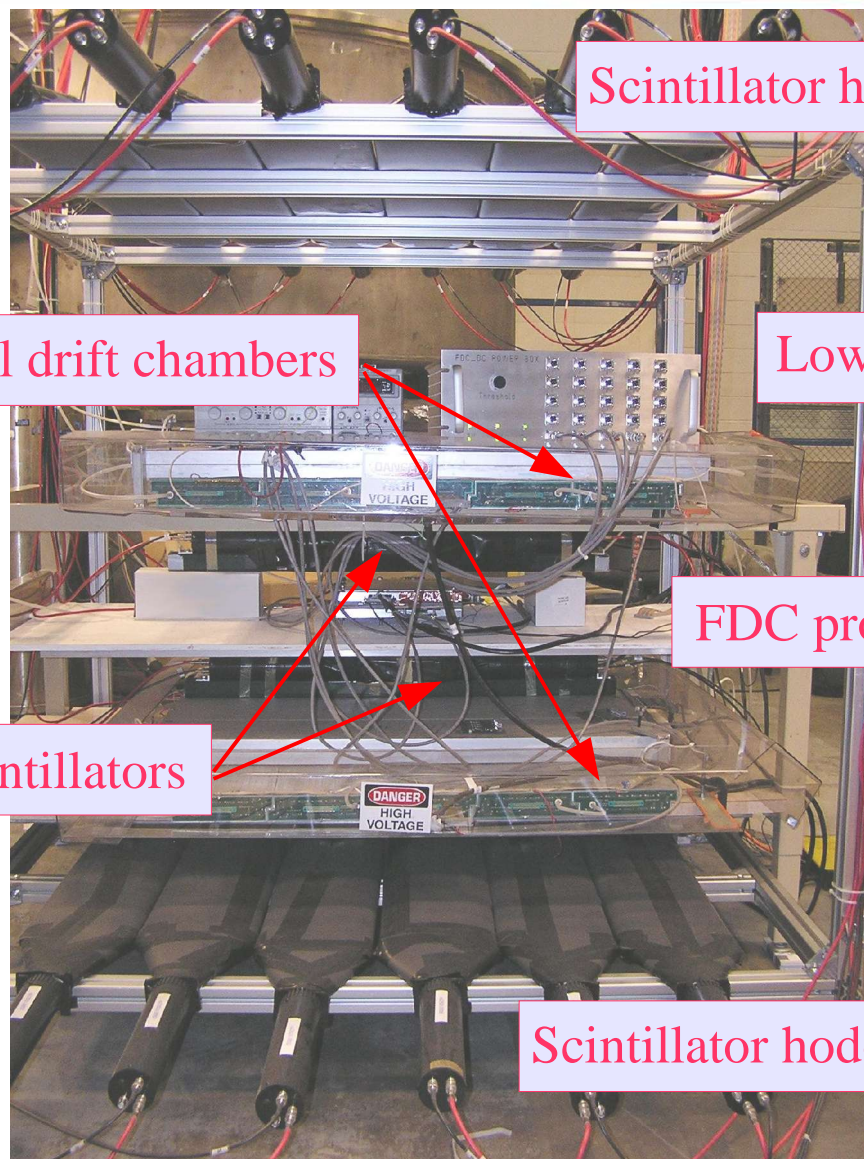


# Summary

- JLab's 12 GeV upgrade → new experimental hall and detector
- **GlueX** in Hall D → large acceptance based on solenoidal design
  - **Forward Drift Chambers** track forward-going particles with **Cathode Strip Chambers**
    - On bench achieved design goal  $\sigma_y < 200 \mu\text{m}$  along wire
    - Design of full-scale prototype underway...



# Experimental Setup



Scintillator hodoscope

External drift chambers

Low-voltage supply

Trigger scintillators  
define normally  
incident tracks

FDC prototype

Trigger scintillators

Scintillator hodoscope