# GlueX Electronics Status

Collaboration Meeting
November 10, 2005

P. Smith

# Since May:

- June 1: Drift Chamber Conference Call: GlueX-doc-519
- July 1: Meeting at IU: GlueX-doc-524
- September 9: Conference Call: GlueX-doc-531
- October 4: Tracking Workshop at Ohio U: GlueX-doc-534
- October 5: Preamp Conference Call: GlueX-doc-535
- November 9: Meeting at JLab

GlueX-doc-412

# Summary of GlueX Detector Subsystems

**12 October 2005 P. Smith**

| Detector | Photon tagger | Pair spectrometer | Upstream Photon veto | Start counter | Central drift | Forward drifts | DIRC | Time-of-flight | Barrel calorimeter | Forward calorimeter |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Scintillator | Si microstrip | Scintillator | Scintillator | Straw tube | Planar chamber | Quartz | Scintillator | Sci fibers | Lead glass |
| **Channel count** | 140 fixed<br>120 movable | 2048 | 112 | 40 | 3240 | 2,856 anode<br>11,424 cathode | 2000 TDC<br>32 FADC | 168 | 2112 | 2500 |
| **Signal source** | PMT fixed<br>SiPMT movable | Silicon microstrip | PMT | PMT | Straw tube | anode wires<br>cathode strips | Multi-anode PMT | PMT | SiPMT | PMT |
| **Physics signal** | 100 pe | 22000 e | 100 pe | 100 pe | 338 e | 94 e | 25 pe | 500 pe | 250 pe/GeV | 250 pe/GeV. |
| **Energy resolution** | 0.1%<br>(segmentation) | N/A | 10%/√E | N/A | 15% | 15% | N/A. | N/A | 2% +<br>5%/√E | 3.6% +<br>7.3%/√E |
| **Time resolution** | 100 ps | 25 ns | 1 ns | 350 ps | 2 ns | 2 ns | 200 ps | 80 ps | 150 +<br>50/√E ps | 400 ps |
| **Gain in detector** | $10^6$ | 1 | $10^6$ | $10^6$ | $2 \times 10^4$ | $10^5$ | $10^6$ | $10^6$ | $8 \times 10^5$ | $8 \times 10^5$ |
| **Typical charge** | 16 pC | 3.5 fC | 16 pC | 16 pC | 1 pC | 1.5 pC anodes<br>0.3 pC cathodes | 4 pC | 80 pC | 32 pC/GeV | 32 pC/GeV |
| **Signal range** | 5 | 10 | 100 | 10 | 3 pC max<br>100 fC min | Anodes:<br>0.3 pC → 3 pC<br>Cathodes:<br>10 fC → 1 pC | 10 | 10 | 160 pC max<br>1.6 pC min<br>0.16 pC lsb | 160 pC max<br>1.6 pC min<br>0.16 pC lsb |
| **Preamp gain** | no | $10^4$ | no | no | 250 | 250 | 10 | no | no | no |
| **Maximum single channel rate** | 5 MHz | 1 MHz | 1 MHz | 10 MHz | 600 KHz | 140 KHz | 250 KHz | 6 MHz | 1.4 MHz | 2 MHz |
| **Discrimination** | constant fraction | no | no | constant fraction | no | Maybe? (anode)<br>no (cathode) | yes | constant fraction | yes | no |
| **FADC** | 8 bits<br>250 Msps | 12 bits<br>62.5 Msps | 8 bits<br>250 Msps | 8 bits<br>250 Msps | 10 - 12 bits<br>125 Msps | Anodes:?<br>Cathodes:<br>12 bits<br>62.5 Msps | 8 bits<br>250 Msps | 8 bits<br>250 Msps | 8 bits<br>250 Msps<br>0.5 V fs | 8 bits<br>250 Msps<br>0.5 V fs |
| **TDC** | 62 ps | no | no | 62 ps | no | Anodes?:<br>125 ps | 125 ps | 62 ps | 62 ps | no |
| **Level 1 trigger** | yes<br>(low rate runs) | no | no | track count | no | no | no | track count | energy sum | energy sum |

GlueX-doc-413 Summary of GlueX Detector Crates & Racks 8 November 2005 P. Smith

| Detector | Type | Channels | Modules | Crates | Racks |
|---|---|---|---|---|---|
| **Photon Tagger** | 6U, 16 channel, 8 bit, 250 Msps FADC | 260 | 17 | 1 DAQ | 2 |
| | 6U, 32 channel, 62 ps TDC | 260 | 9 | 1 DAQ | |
| | High voltage | 150 | 13 | 1 HV | |
| | 8 channel CFD | 250 | 32 | 2 DISC | |
| **Pair Polarimeter** | 6U, 64 channel, 10 bit, 62.5 Msps FADC | 2048 | 32 | 2 DAQ | 1 |
| **Upstream Photon Veto** | 6U, 16 channel, 8 bit, 250 Msps FADC | 24 | 2 | 1 DAQ | 1 |
| | High voltage | 24 | 2 | | |
| **Start Counter** | 6U, 16 channel, 8 bit, 250 Msps FADC | 40 | 3 | | |
| | 6U, 32 channel, 62 ps TDC | 40 | 2 | | |
| | High voltage | 40 | 4 | | |
| | 8 channel CFD | 40 | 5 | 1 DISC | |
| **Central Drift** | 6U, 16 channel, 125 Msps FADC | 3240 | 203 | 13 DAQ | 5 |
| | High voltage | 60 | 2 | | |
| | Gas | | | | 2 |
| **Forward Drift anodes** | 6U, 16 channel, 125 Msps FADC | 2900 | 182 | 12 DAQ | 5 |
| | High voltage | 300 | 7 | 1 HV | |
| **Forward Drift cathodes** | 6U, 64 channel, 10 bit, 62.5 Msps FADC | 11,400 | 179 | 12 DAQ | 4 |
| | Gas | | | | 2 |
| **DIRC** | 8 channel CFD | 2000 | 250 | 16 DISC | 4 |
| | 6U, 16 channel, 8 bit, 250 Msps FADC | 32 | 2 | 2 DAQ | 1 |
| | 6U, 64 channel, 125 ps TDC | 2000 | 32 | | |
| | High voltage | 32 | 3 | 1 HV | |
| **Time of Flight** | 8 channel CFD | 168 | 21 | 2 DISC | 2 |
| | 6U, 32 channel, 62 ps TDC | 168 | 6 | 1 DAQ | |
| | 6U, 16 channel, 8 bit, 250 Msps FADC | 168 | 11 | | |
| | High voltage | 168 | 14 | 1 HV | |
| **Barrel Calorimeter** | 6U, 16 channel, 8 bit, 250 Msps FADC with energy sum | 2112 | 132 | 9 DAQ | 11 |
| | 6U, 32 channel, 62 ps TDC | 2112 | 66 | 5 DAQ | |
| | 8 channel CFD | 2112 | 264 | 17 DISC | |
| **Forward Calorimeter** | 6U, 16 channel, 8 bit, 250 Msps FADC with energy sum | 2500 | 157 | 10 DAQ | 4 |
| | Cockcroft Walton control, misc | | | 1 DISC | 1 |
| **Level 1 Trigger** | | | | 3 DAQ | 1 |
| **Totals** | | | | 115 | 46 |

# Detector electronics R&D issues:

- Beamline: Pair Spectrometer, Polarimeter ?  Details needed.
- CDC: # of primary electrons, gain in chamber
  Channel count for beam tests?  Sampling rate?
- FDC: # of primary electrons, gain in chamber
  dE/dX: cathodes, anodes, TDC, ADC
  Channel count for beam tests?  Sampling rates?
- DIRC vs Gas Cerenkov ?
- BCAL: channel count, photodetectors
  Discs, TDCs ?
- Trigger: energy sums, "track" count(s), other?
  Level 1 algorithm
- Electronics & DAQ: clocking, trigger, event building, etc.
- Tagger: JLab F1 TDC  with/without accelerator clock sync

# Money:

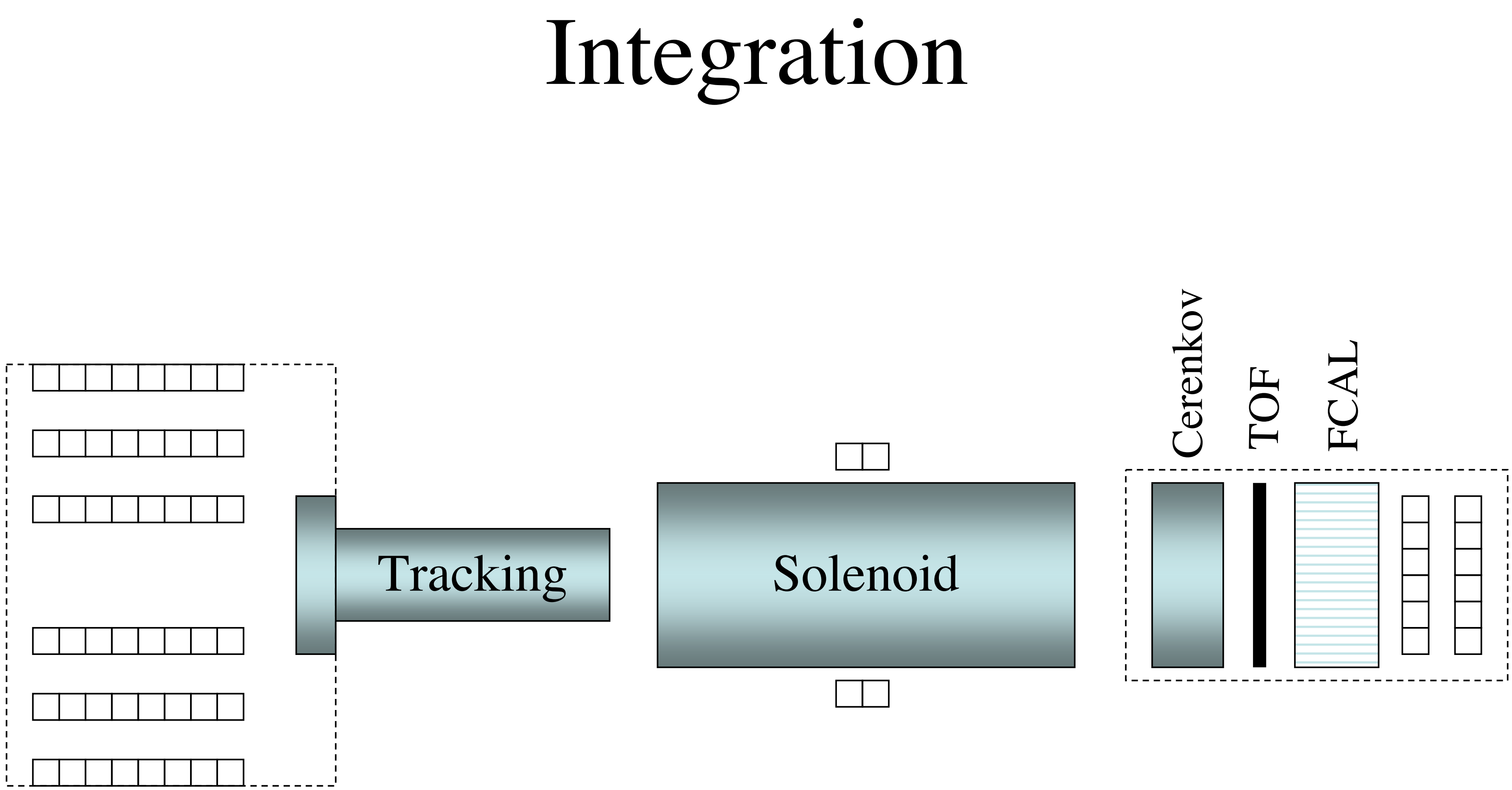
- Struck SIS3320 200 Msps VME FADC - 2? @ $7k - anodes
- Struck SIS3300 100 Msps VME FADC - 3? @ $5k - cathodes
- Preamps:
  - Design @ $31k??
  - MOSIS prototype @ $27k??? (40 chips)
  - Production @ $120k???? (2400 chips)
- VME Test crates, CPUs - 5? @ $12k?
- JLab F1 TDCs @ $3.7k, fADCs @ $4k
- IUCF Tracking fADCs - 5 @ $37k

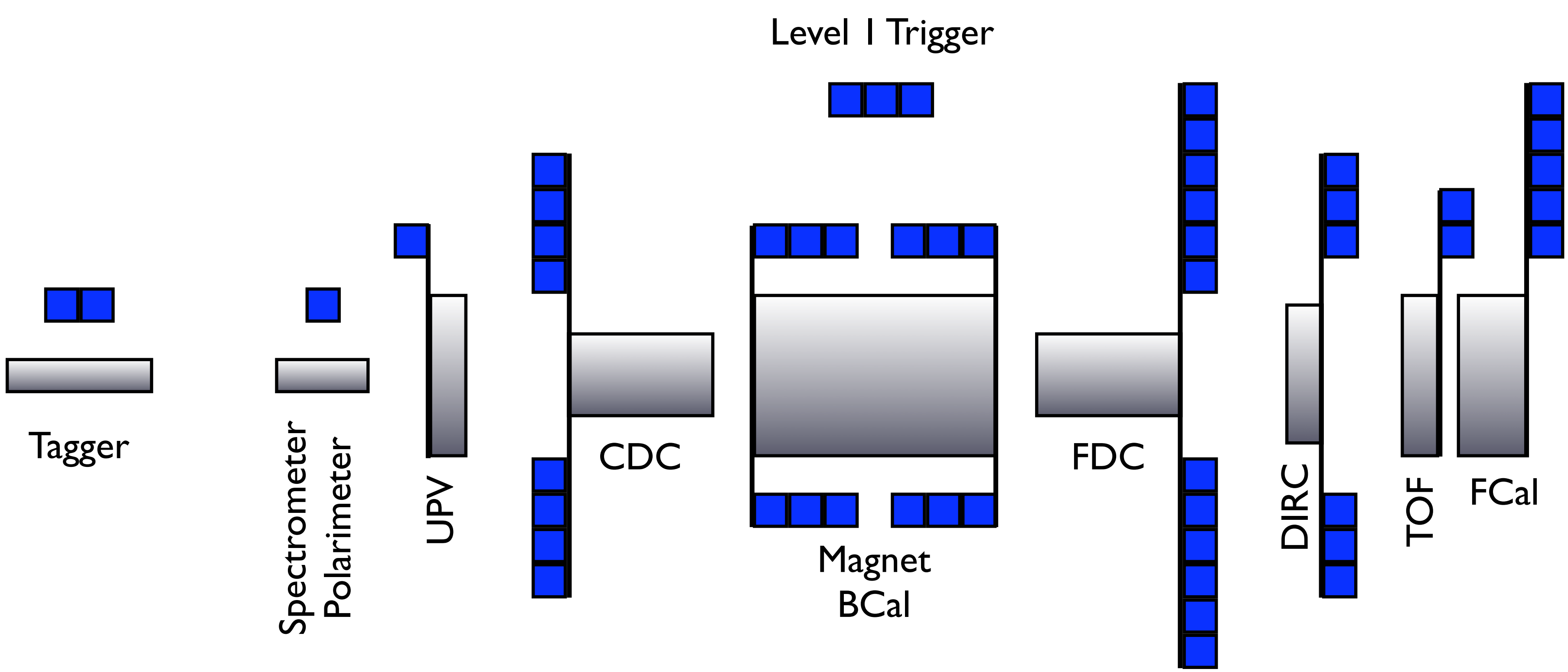
# “Civil”

- Cables:
  - From CDR chapter 6: “All detector electronics will be located near the detector itself. This will minimize cable lengths and eliminate the need for large cable runs from the detector to electronic racks far from the detector. The racks of electronics servicing the inner detectors will be located on a platform upstream of the magnet with ample space for access. A possible Access Platform is shown in Fig.6.90 with the **primary aim being that detectors can be operated both inside and outside the solenoid without making any disconnections**. This implies that either the cabling for start detector, cdc and fdc will have enough slack so that they can be moved in or out of the magnet without any disconnections, or that the electronics will themselves move along with the detector elements. **It is crucial that the detectors can be operated in the extracted position for testing and the installed position during normal operation without wiring changes**.”
  - From CDR chapter 7: “The readout electronics will be located as close to the detector as possible to minimize signal cable runs. Note that the Tagger electronics will be be located in a separate building 80 meters upstream of the main detector. The Time of Flight and Forward Calorimeter electronics will be downstream of these detectors. Cabling from detectors inside the solenoid will exit at the upstream and downstream ends of the magnet and connect to nearby electronics. Fiber optic cables will transport the data from the crate readout processors to the level 3 trigger processor farm in the counting house.”
  - Clock, Reset, Trigger, Test Pulse distribution: optical fibers
  - Tagger to/from L1 Trigger: optical fibers
  - DAQ: Fibers to/from Counting House
- Tracking preamp heat: 1000? watts inside magnet

# “Civil”

(Slide from December 2003):






# GlueX "exploded" with racks

P. Smith
9 Nov 2005