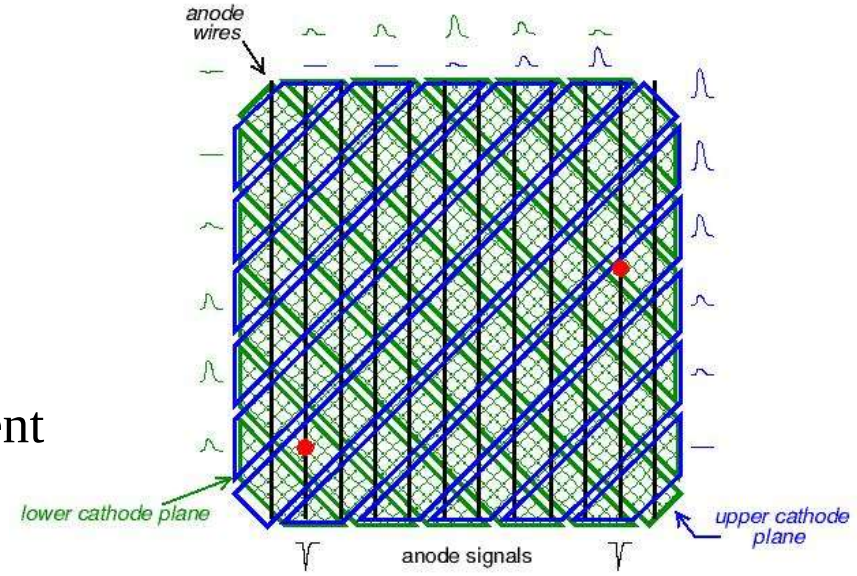
FDC Technology Choice

- Current FDC design: Cathode Strip Chambers
  - Cathode planes divided into strips oriented at ±75° with respect to wires
    - Determine position of avalanche along the wire
    - Image wire positions
  - Read out wires with TDCs → coordinate transverse to the wire
  - Advantages of current design:
    - Cathode+anode readout → **3D space points**
    - Strips and wires easily associated with each other due to self-calibrating properties of cathode data
    - Aids in pattern recognition – more localized hit matching
    - Improved track-finding efficiency (locally and globally) in high rate/high background environment



Limitations of Current Design

- Three main issues with cathode strip chamber design:
  - Material in active region
    - 2 μm Cu on 25 μm Kapton/cathode plane
    - Answer→ Total thickness in radiation lengths of all 4 packages is comparable to thickness of target
  - Material in inactive region – photon conversions...
    - Answer→ All frames now composites – practical minimum material
    - Current design factor of ~2.5 thinner in both active and inactive regions than design presented to DC review committee
      - Material in frames ~0.33 of a rad. length per package
      - Material in active area with 2 mm foam backing ~0.55% of a rad. length per package
  - Performance in high magnetic field – Lorentz effect
    - Answer→ Can model and correct for deflection of avalanche position
    - How much is the cathode resolution degraded?

But... what is acceptable for GlueX???

Alternative Technologies

- Time Projection Chamber (TPC)
  - Could replace both the CDC and FDC
  - dE/dx measurements possible
  - Minimal material in active region
  - High multiplicity/low rate device? (long clearing times)
  - Little or no expertise in collaboration
- Resistive Plate Chambers (RPCs)
  - Based on layers of glass → too much material
- Gas Electron Multiplier Chambers (GEMs)
  - Copper+Kapton+Copper amplification layers + pad readout →too much material...
  - Would probably need to be tiled – no one has built a GEM our size
- Silicon micro-strips
  - Very good resolution attainable but very large number of channels
  - Again too much material
- Micro-drift chambers
  - Close pitch, no field wires – many wire channels, material issues?
- Scintillating fibers?
- Single gas volume drift chambers (interesting possibility, issues with tracking eff.)

Choosing a technology

- Multiple technologies are available – several might possibly work for GlueX
  - But Cathode Strip Chambers present a reasonably low-risk choice that is likely to work, but there are issues that we still need to address...

Important simulation work and algorithm development still needed

- Here “better” might be the enemy of “good enough”
  - Current FDC design is reasonably cost-effective
  - Time for R&D is rapidly disappearing...

Simulation/Reconstruction Questions I

- What is the momentum resolution and angular resolution that can be obtained using only the wire information?
  - Replace cathode planes with aluminized Mylar

- What is the momentum resolution and angular resolution that can be obtained with the current FDC design including the cathode information without Lorentz corrections?

- What is the momentum resolution and angular resolution that can be obtained with the current FDC design including the cathode information with the corrections for the Lorentz affect?
  - Quantify ability of the cathodes to resolve L/R ambiguities on the sense wires or to improve overall and local tracking efficiency in a realistic rate environment (supposedly one of the important advantages of CSCs...)

Simulation/Reconstruction Questions II

- Should we consider a hybrid design with wire readout for all planes + cathode readout on a subset of planes in a package?

- With the current design, what are the resolution issues associated with field gradients/local non-uniformity (essentially as a function of r and z)?

- Is the material in the active area of the FDCs acceptable from the standpoint of multiple scattering and energy loss?

- Is the material in the inactive area of the FDCs acceptable from the standpoint of photon conversions?

Need final design specs for allowable material in FDC system