The D0 Silicon Track Trigger

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  - Kevin Black, Sarosh Fatakia, Lorenzo Feligioni, Alex Zabi
  - Eric Hazen, Bill Earle, Shouxiang Wu
- Columbia University
  - Hal Evans
  - Georg Steinbrück
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  - Bill Lee, Sylvia Tentinto-Repond
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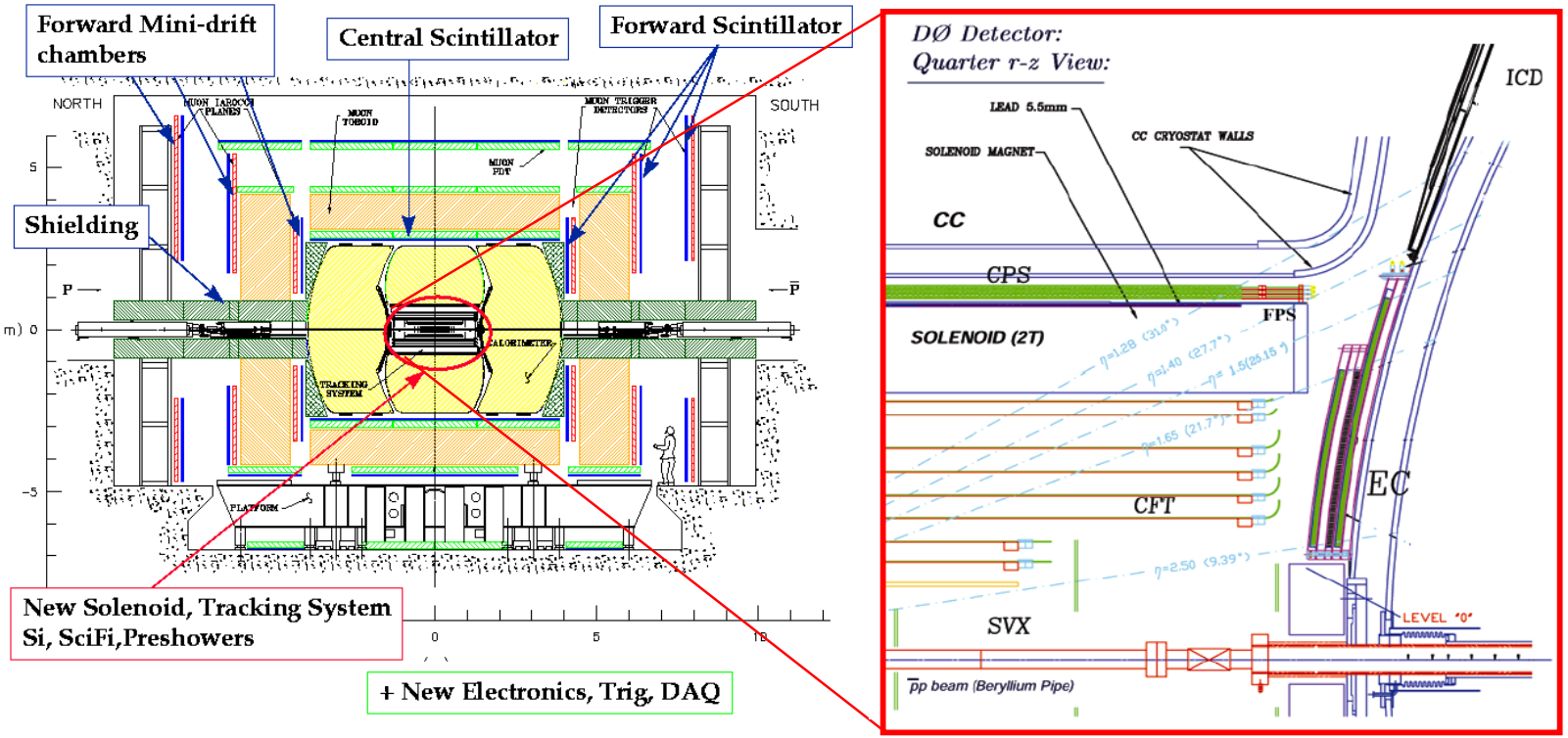
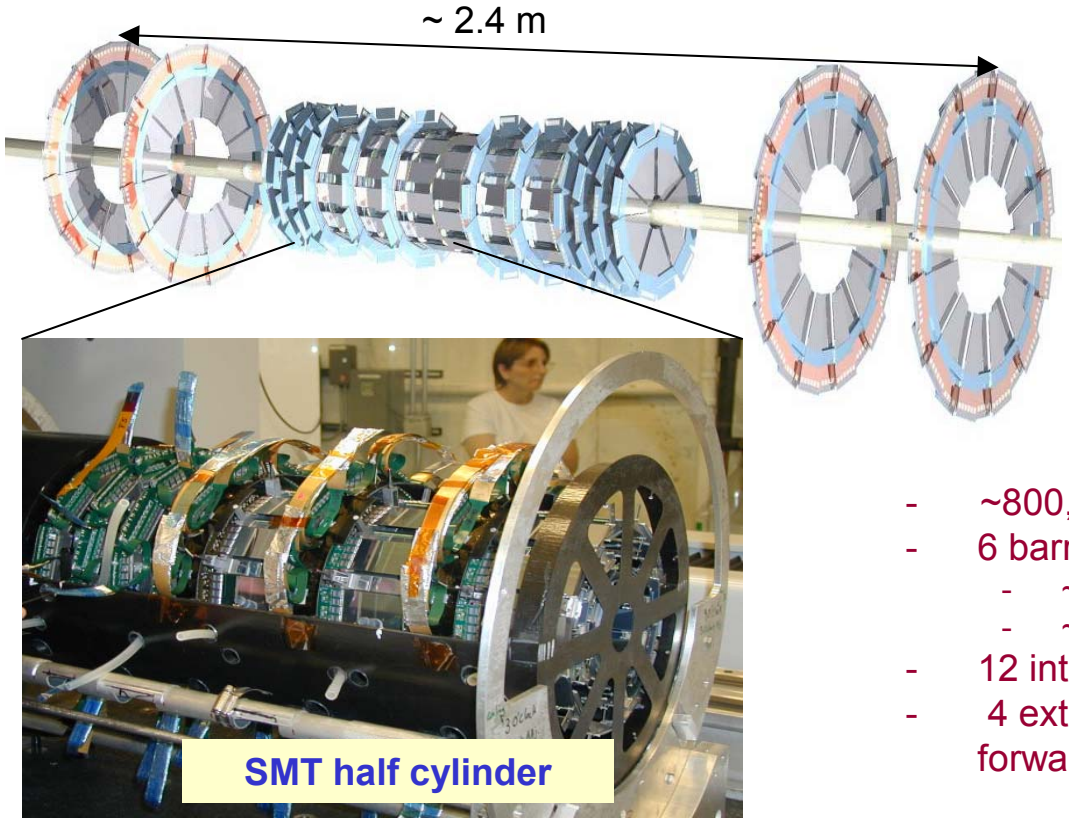
  - John Hobbs
  - Wendy Taylor
  - Huishi Dong
  - Chuck Pancake, Bonnie Smart, Jane Wu

D0 Central Detector Upgrade

- New silicon tracker, new fiber tracker, new preshower, and a new 2T superconducting solenoid.



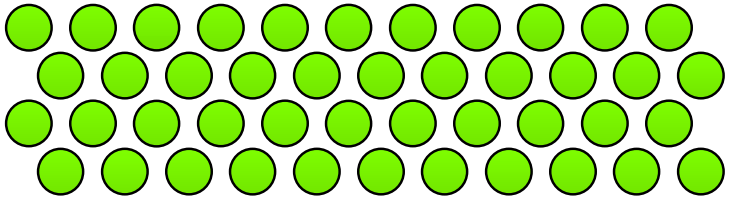
Silicon Microstrip Tracker (SMT)

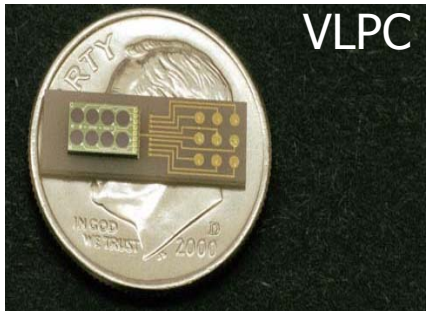


- ~800,000 total readout channels
- 6 barrels (4 layers)
  - ~390,000 axial channels
  - ~220,000 stereo channels
- 12 interspersed (F-)disks
- 4 external large area (H-)disks for forward tracking ($2 < |\eta| < 3$)

D0 Central Fiber Tracker (CFT)

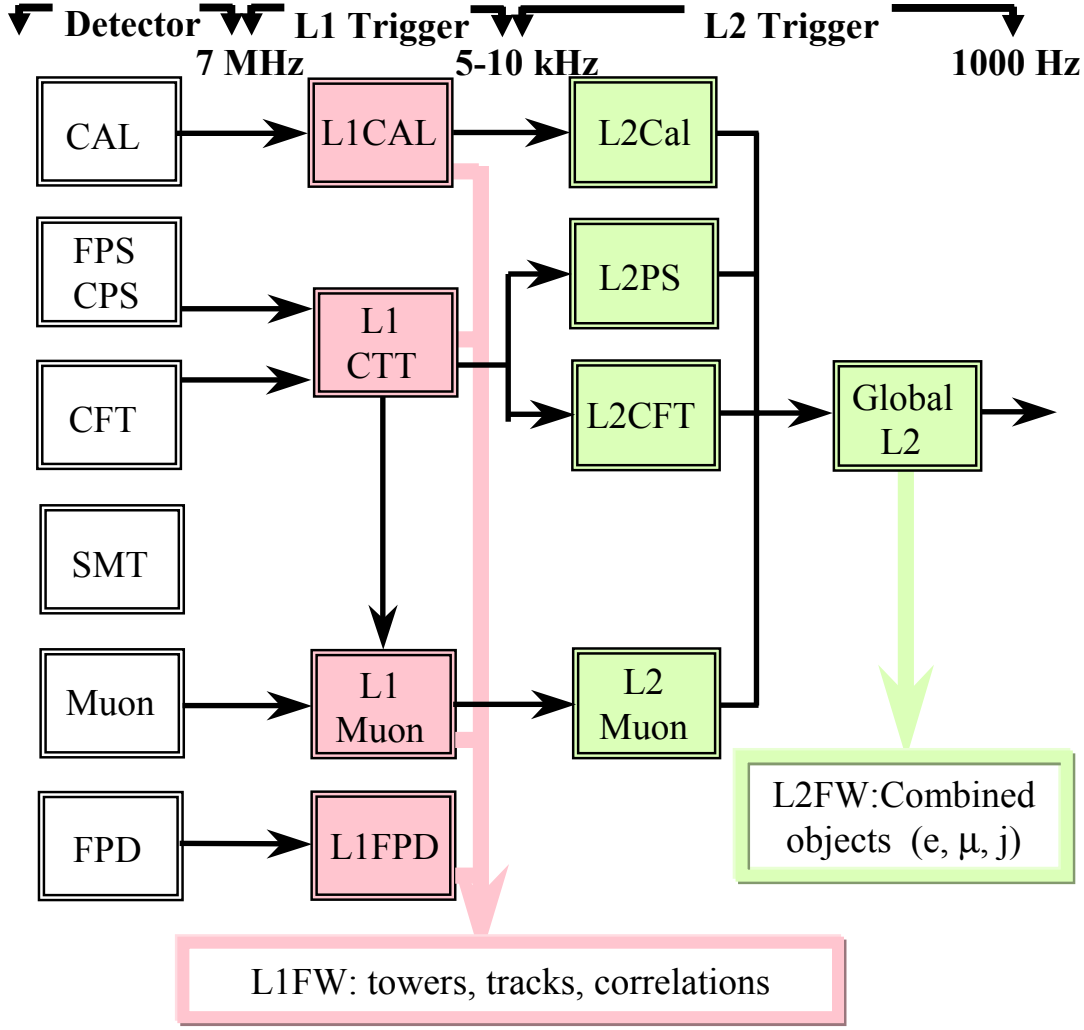
- ~12m long clear light-guides to Visible Light Photon Counters (VLPC) under detector
- 8 layers of axial and stereo fibers (20 < r < 51 cm), 77k channels





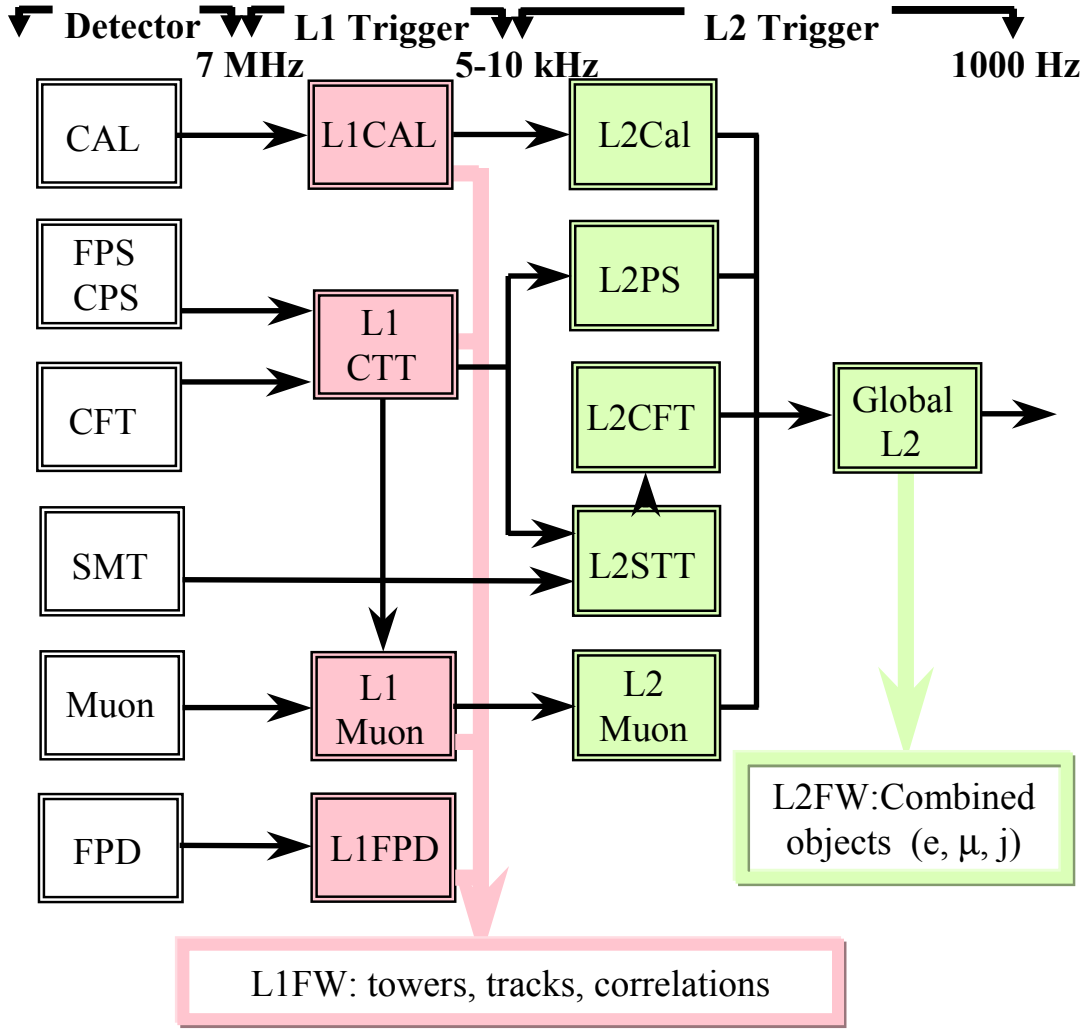
D0 Trigger System

- L1CTT
  - Provides tracks from axial CFT fibers
- SMT unused until L3



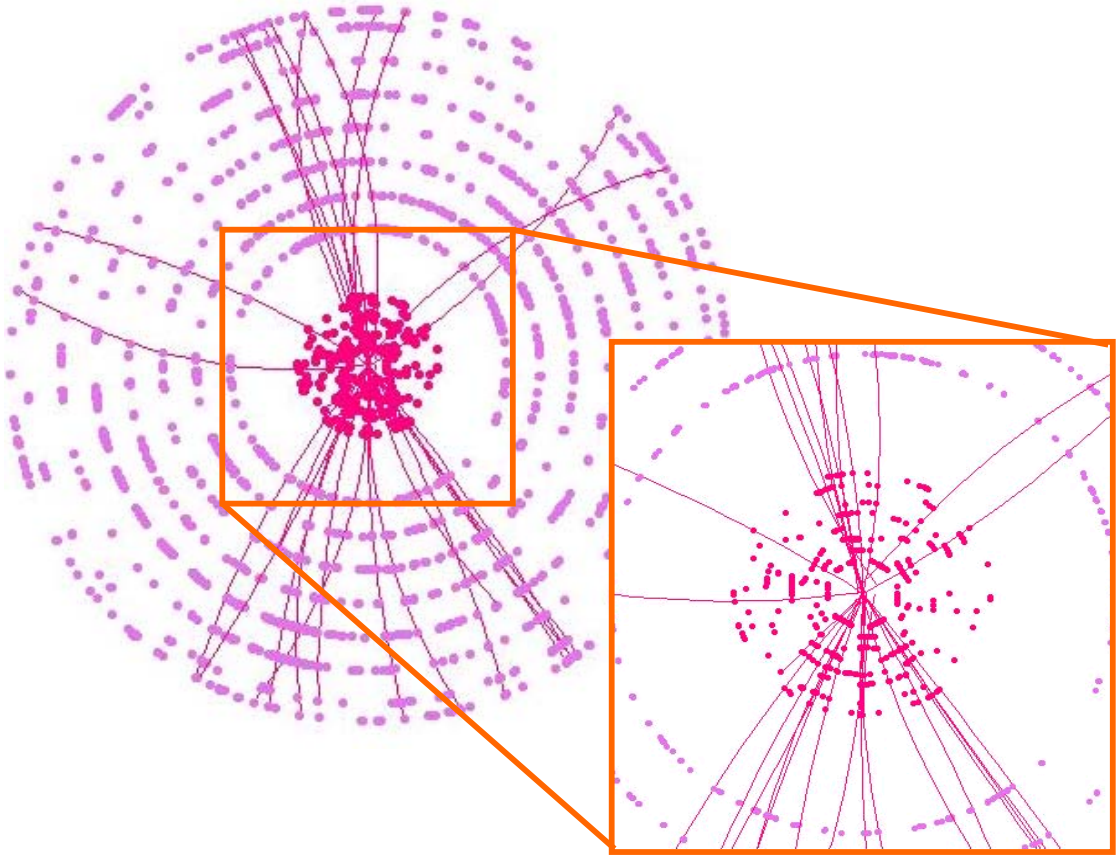
Trigger System with STT

- What if we used the SMT to improve the tracks from the CTT?

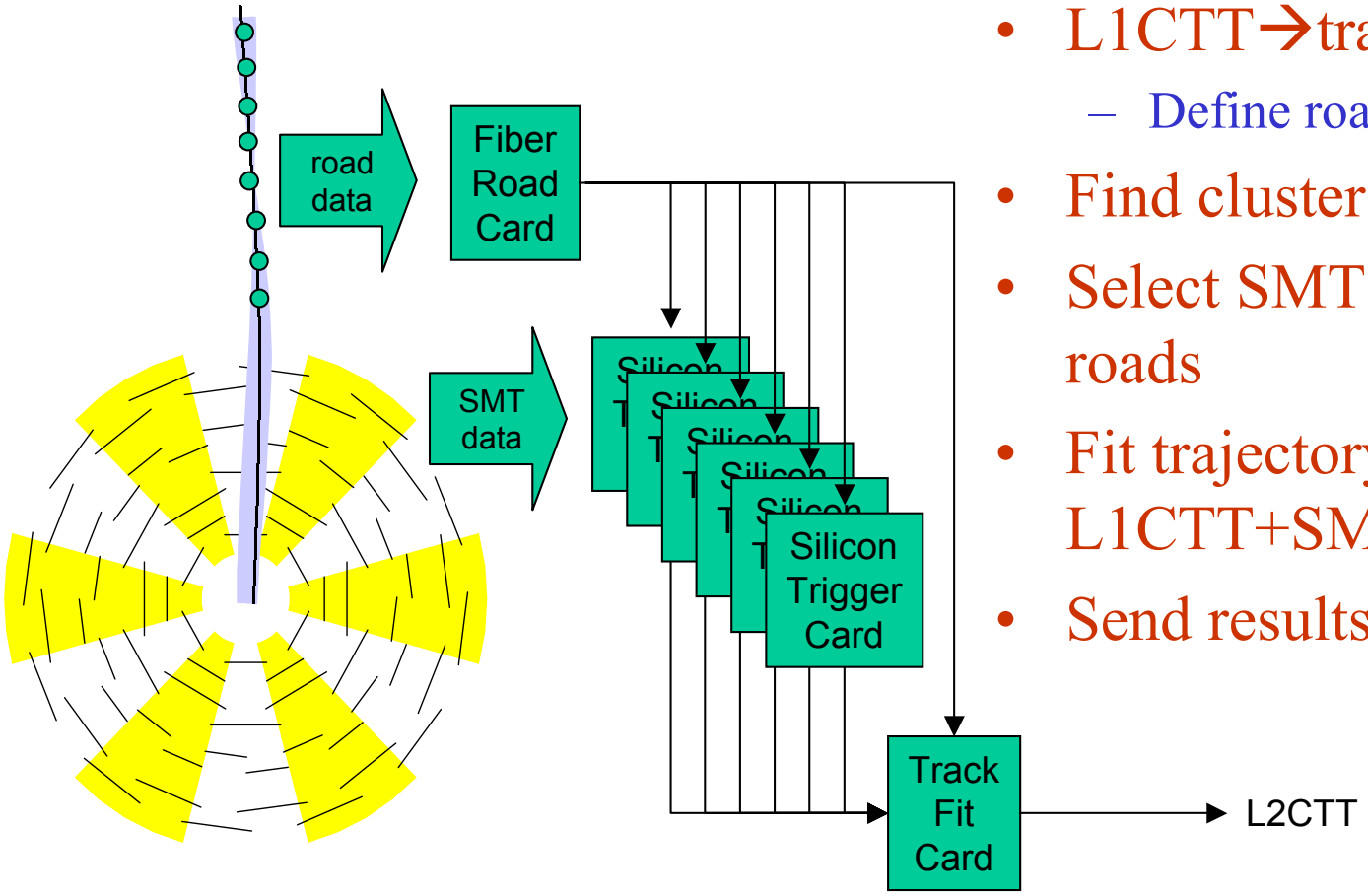


Track Reconstruction at L2

- We could get:
  - Impact parameter
  - Improved p_T resolution
  - Fake track reduction



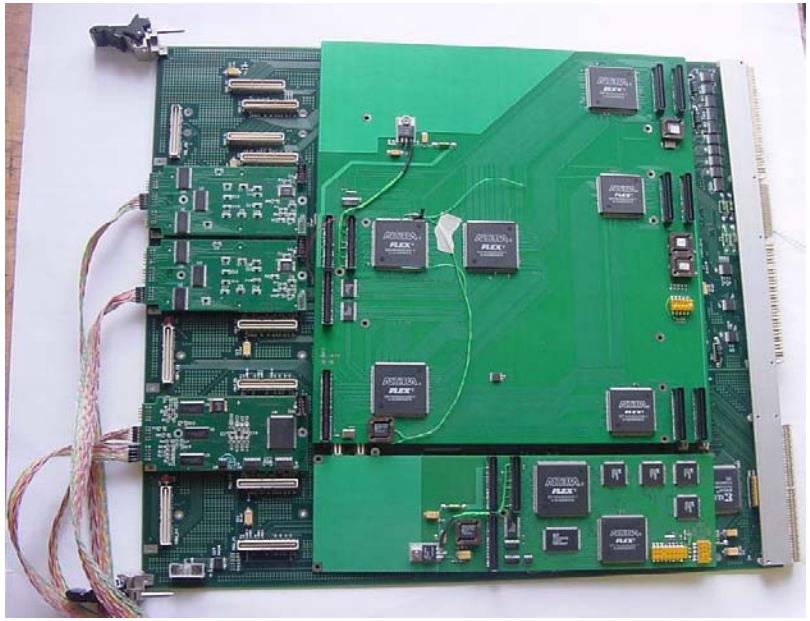
Conceptual Design



- L1CTT→tracks in CFT
  - Define road in SMT
- Find clusters in SMT hits
- Select SMT clusters in roads
- Fit trajectory to L1CTT+SMT hits.
- Send results to L2

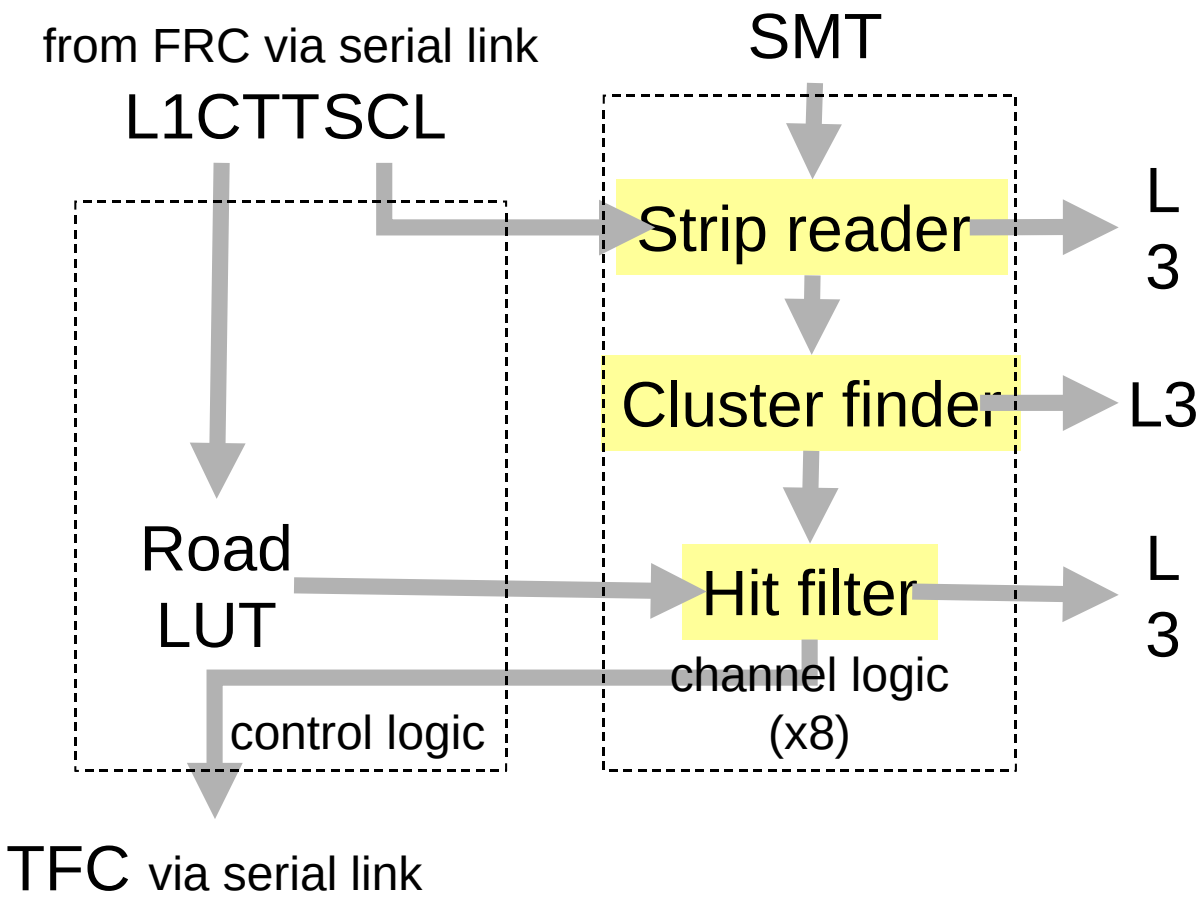
Fiber Road Card (FRC)

- Communicates with trigger framework and broadcasts control info to other cards.
- Fans out track data to all other cards
- manage L3 buffers
  - Controls the readout to L3

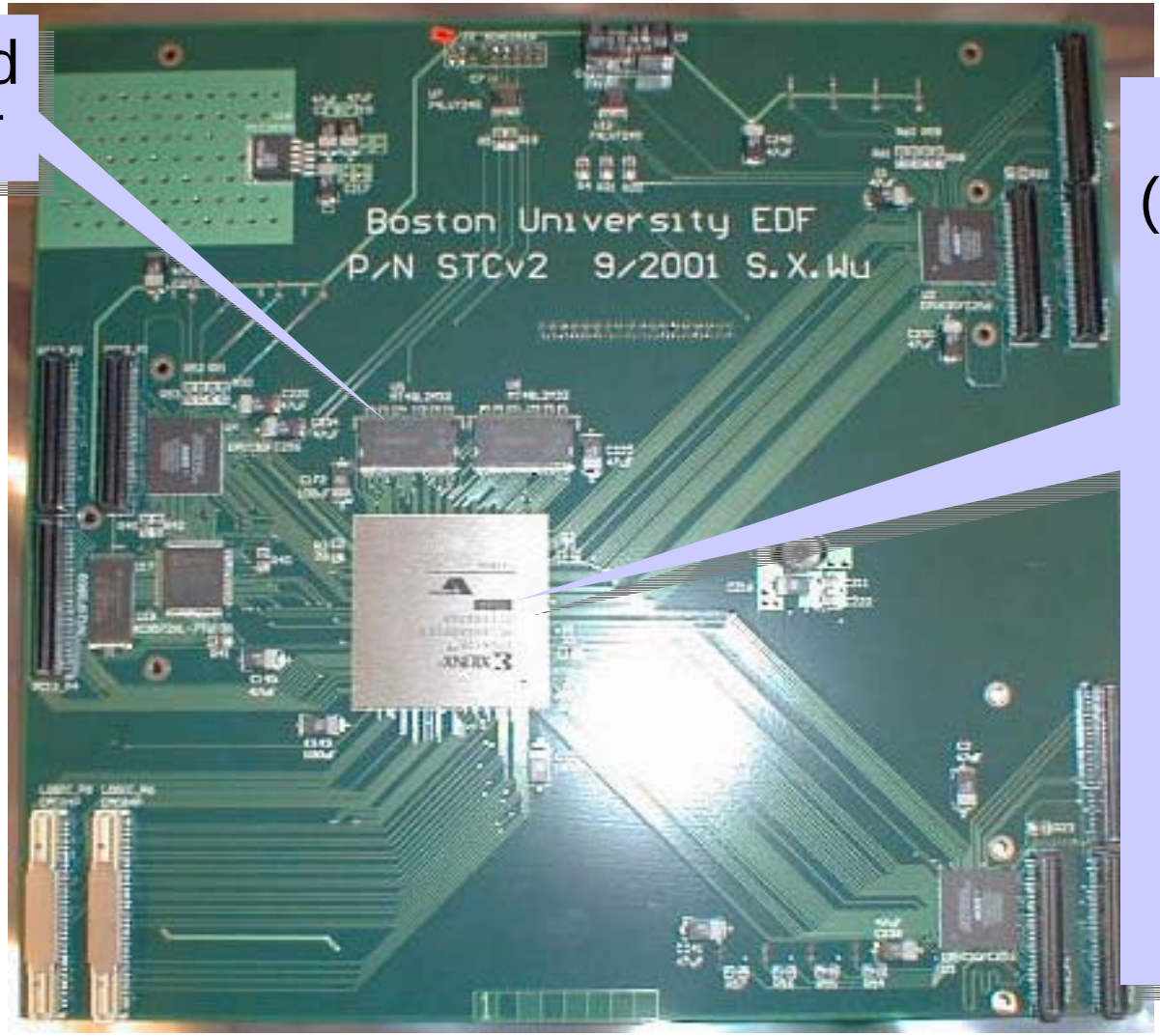


Silicon Trigger Card

- Receives raw data from SMT
- Finds clusters in axial and stereo strips
- Associates tracks with axial clusters
- Outputs clusters with tracks



STC Prototype

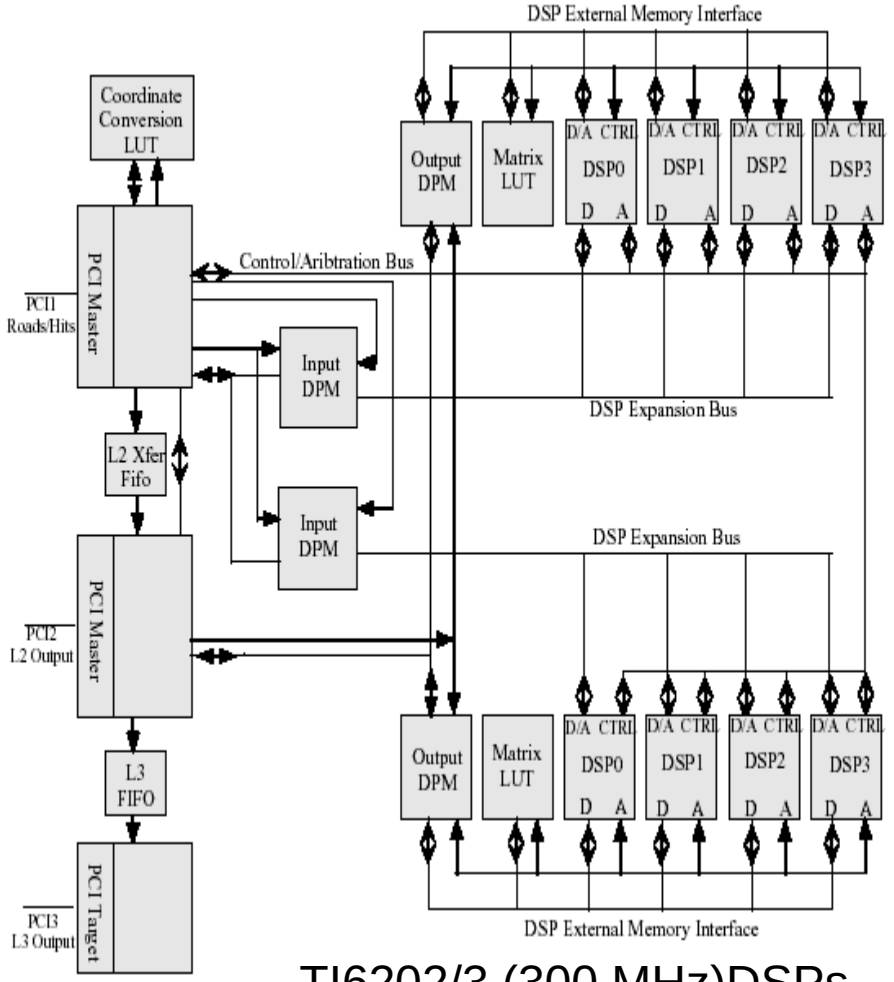


control logic
(8x) channel logic
(Xilinx Virtex E)
800k gates
1.1 Mbits RAM
560 pin BGA

accommodates
all 8 channels
→need 1/STC

Track Fit Card (TFC)

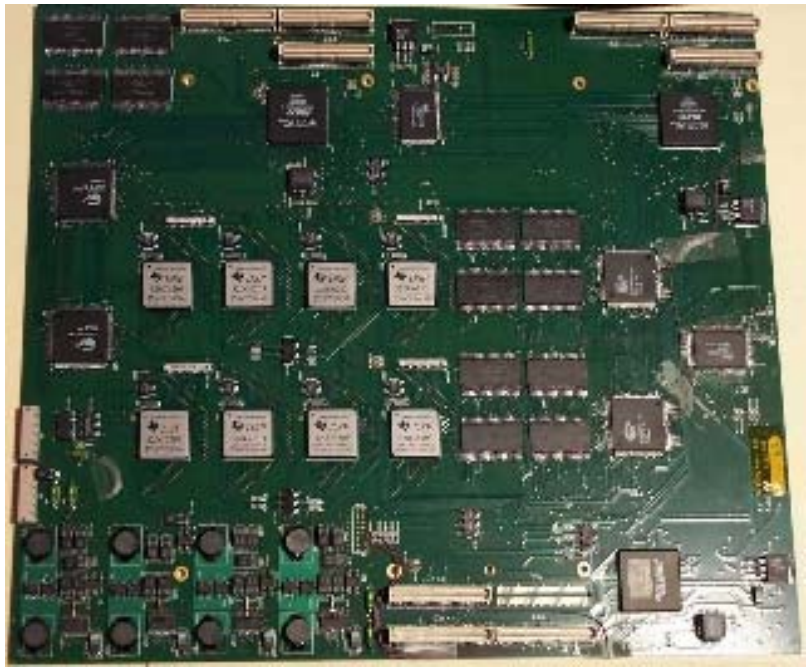
- One per 30 degree sector
- Inputs tracks from FRC and associated clusters from STC
- Farms each track out to one of eight DSPs
- Outputs input track list and expanded track list to L2



TI6202/3 (300 MHz)DSPs

Track Fit Card (TFC)

- require hits in
  - at least 3 of the 4 SMT layers
  - in same 30 degree sector
  - in at most 2 adjacent barrels
- choose hits
  - closest to trajectory defined by CFT and origin
- linearized χ^2 fit
  - $\phi(r) = b/r + \kappa r + \phi_0$
  - drop worst hit and refit if 4-hit χ^2 bad



Summary

- STT will provide D0 with the ability at L2:
  - to reduce the background signal
  - to improve p_T resolution
  - to cut on an impact parameter
- Production of boards is underway.
- Our goal is to be operational in early summer.