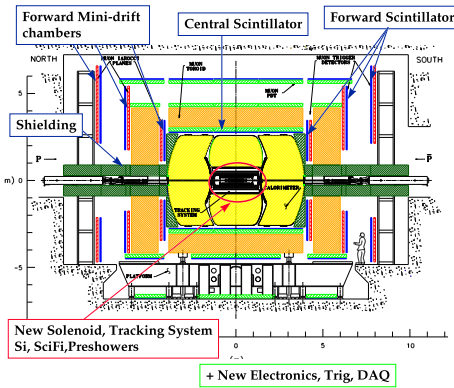


## DØ Run 2 detector

Linac upgrade, main injector, new antiproton storage ring  
Extensive upgrade of DØ detector



## The DØ Silicon Track Trigger

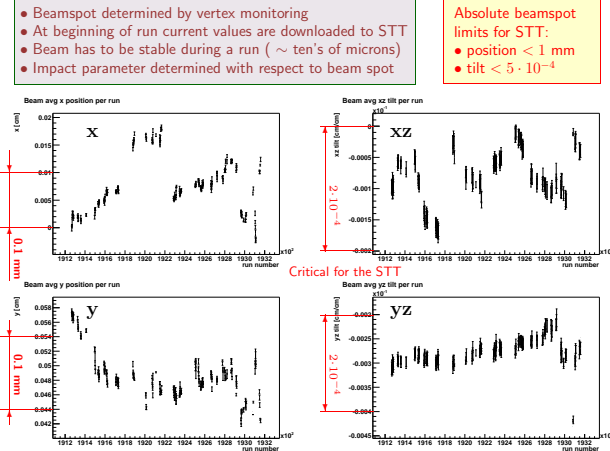


Lars Sonnenschein  
Boston University



The Level-2 Silicon Track Trigger preprocessor (L2STT) of the DØ detector in Run II is presented. It performs a precise reconstruction of charged particle tracks in the Central Fiber Tracker (CFT) and the Silicon Microstrip Tracker (SMT). Events with displaced tracks originating from the decay of long lived particles such as  $B$  hadrons are triggered on. The presence of  $b$  quarks contained in such hadrons is relevant for  $B$  physics and a signature of top quark decays and Higgs boson decays.

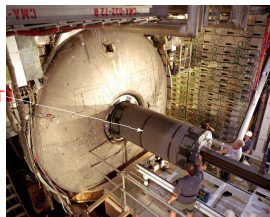
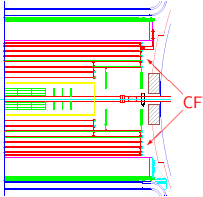
## Beamspace Monitoring and Correction



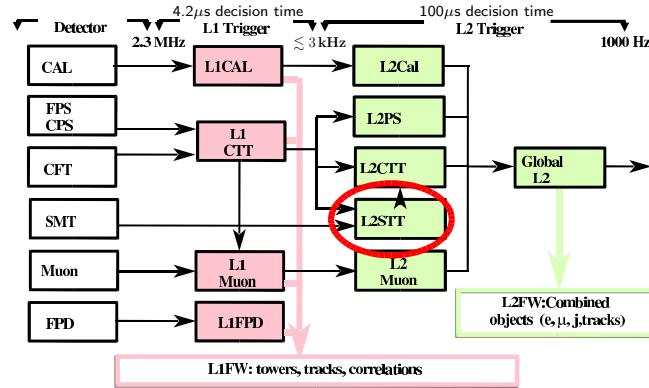
## Central Fiber Tracker (CFT)

Light from fibers converted into electrical pulses by cryogenic photon detectors

- Scintillating fibers ( $\phi = 830 \mu\text{m}$ )
- Up to  $|y| = 1.7$
- $20 \text{ cm} < r < 51 \text{ cm}$
- 8 double layers
- 77 000 channels
- Hit resolution  $\sim 100 \mu\text{m}$

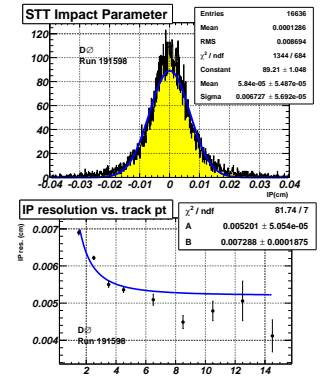


## DØ Trigger system



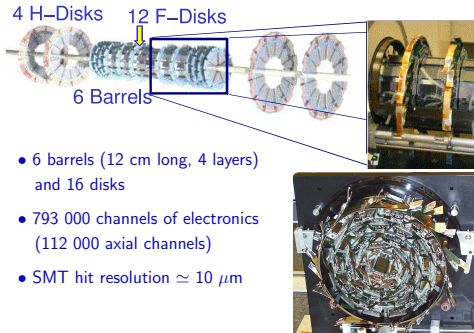
## Impact parameter resolution

The top plot shows the impact parameter of STT tracks obtained from data taken with the DØ detector. The bottom plot shows the impact parameter resolution of STT tracks as a function of their track transverse momenta.

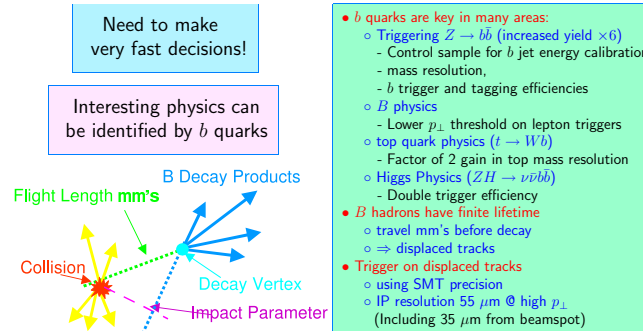


## Silicon Microstrip Tracker (SMT)

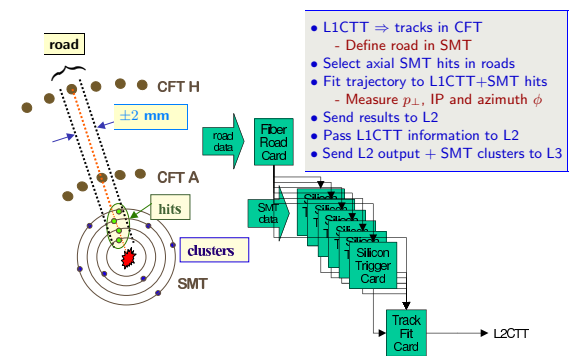
High resolution measurements of particle tracks, charged particle momenta and secondary vertices for heavy flavour identification



## Idea and Expected benefits



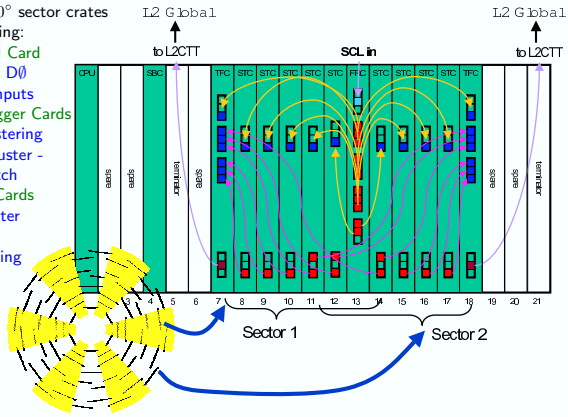
## STT Conceptual Schematic



## STT Crate Layout

6 identical 60° sector crates

- each containing:
- 1 Fiber Road Card
  - sync with D0
  - L1CTT inputs
  - 9 Silicon Trigger Cards
  - SMT clustering
  - Coarse cluster - road match
  - 2 Track Fit Cards
  - Final cluster selection
  - Track fitting



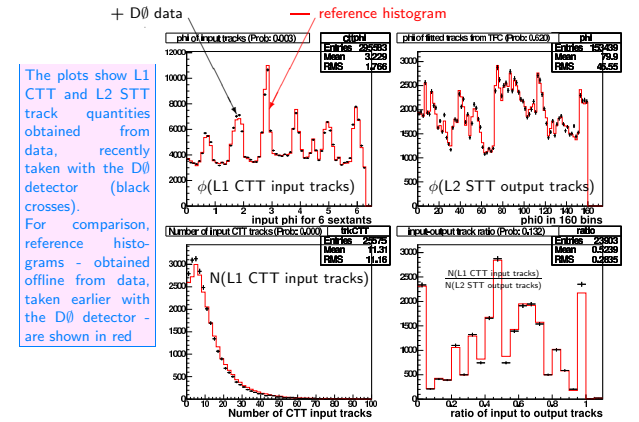
## The D0 Silicon Track Trigger (II)



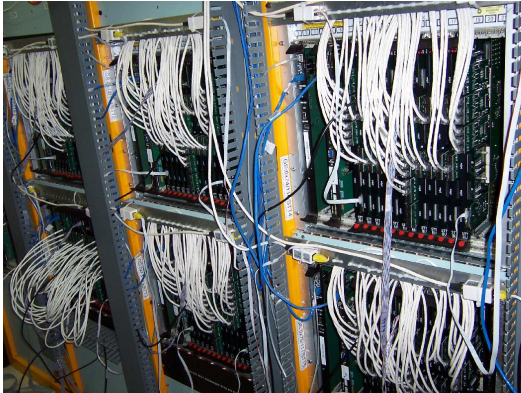
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Boston University



## STT online data monitoring plots

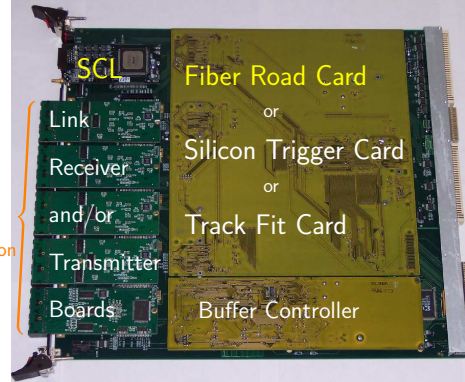


## All six 60° sector crates installed



Serial board links for inter-communication

## STT mother- and daughterboards



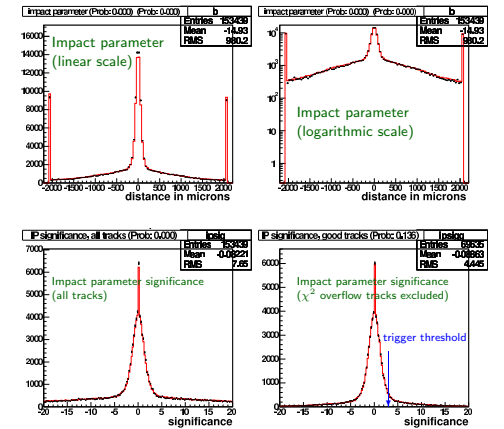
### The Fiber Road Card

Receives tracks from L1 Central Track Trigger

Communicates with trigger framework (TF) via serial command link (SCL) receiver card

Transmits tracks and trigger info to other cards

Manages L3 buffering and readout via Buffer Controller (BC) daughter cards on each motherboard



## Silicon Trigger Card (STC) Design



### The Silicon Trigger Card

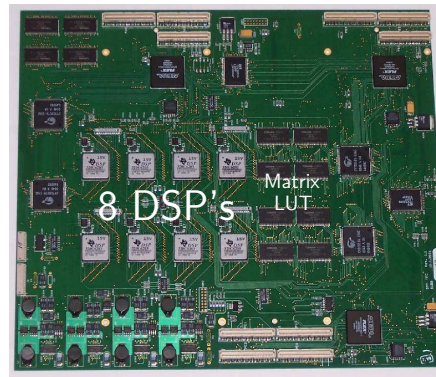
Performs silicon clustering and cluster-road matching

Clusters adjacent SMT hits (axial and stereo)

Axial clusters are matched to  $\pm 2$  mm-wide roads around each fiber track via precomputed LUT

Masks bad strips and applies pedestal/gain corrections (via LUT)

## Track Fit Card (TFC) Design



### The Track Fit Card

Performs final SMT cluster filtering and track fitting

Receives 2 CFT hits and axial SMT clusters in CFT road

Selects clusters closest to road center and performs linearized track fit using precomputed matrix elements stored in on-board LUT

$$\phi(r) = \frac{b}{r} + kr + \phi_0$$

Requires only 3 out of 4 silicon layers

Output to L2CTT via Hotlink Transmitter cards

