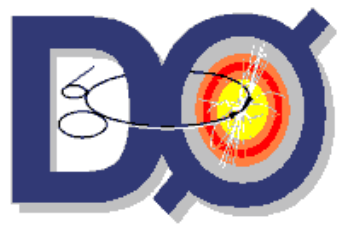
The D0 Experiment



Thomas Hebbeker
RWTH Aachen
March 2002

Fermilab

FNAL =

Fermilab

(Enrico Fermi)

1967

Tevatron = TEV machine 1983

The Tevatron

$$\sqrt{s} = 2\,TeV$$

$$L \sim 10^{32} / cm^2 / s$$

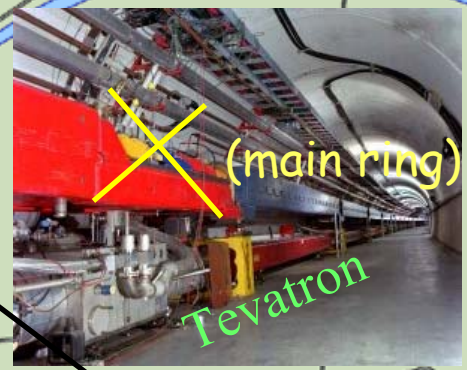
bunches: every 396 ns

8 -> 150 GeV main injector

new

recycler

collects antiprotons



$p\,\bar{p}$

2 km

150 -> 1000 GeV

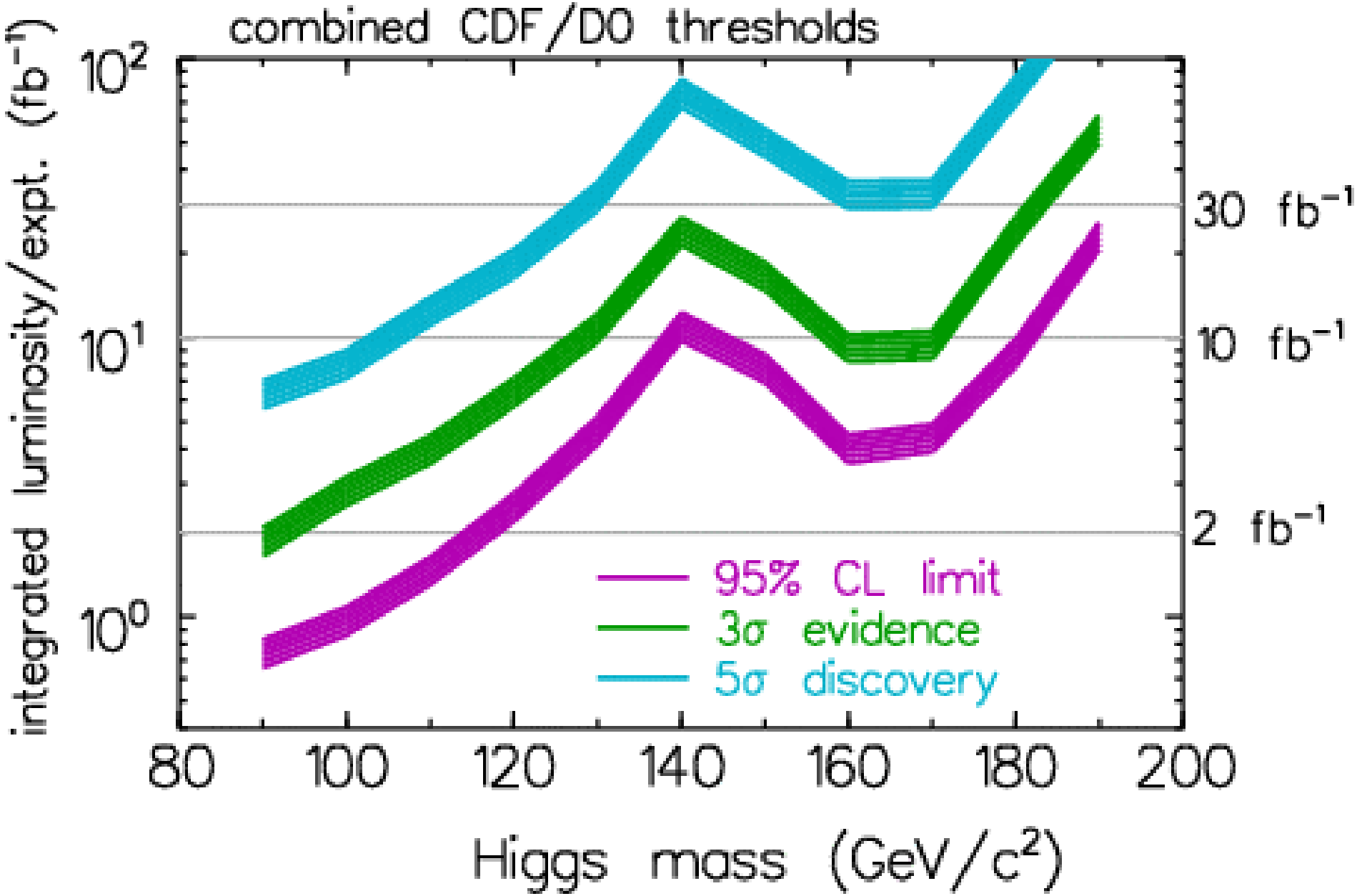
History/Future

- 1987: CDF = Collider Detector at Fermilab
- 1987-1989: Run 0: 1.8 TeV $L \sim 10^{30} / cm^2 / s$
- 1992: D0 = Detector in shaft D0
- 1992-1996: Run I: $L \sim 10^{31} / cm^2 / s$
  total ~ 100/pb per detector
  > 100 publications per experiment

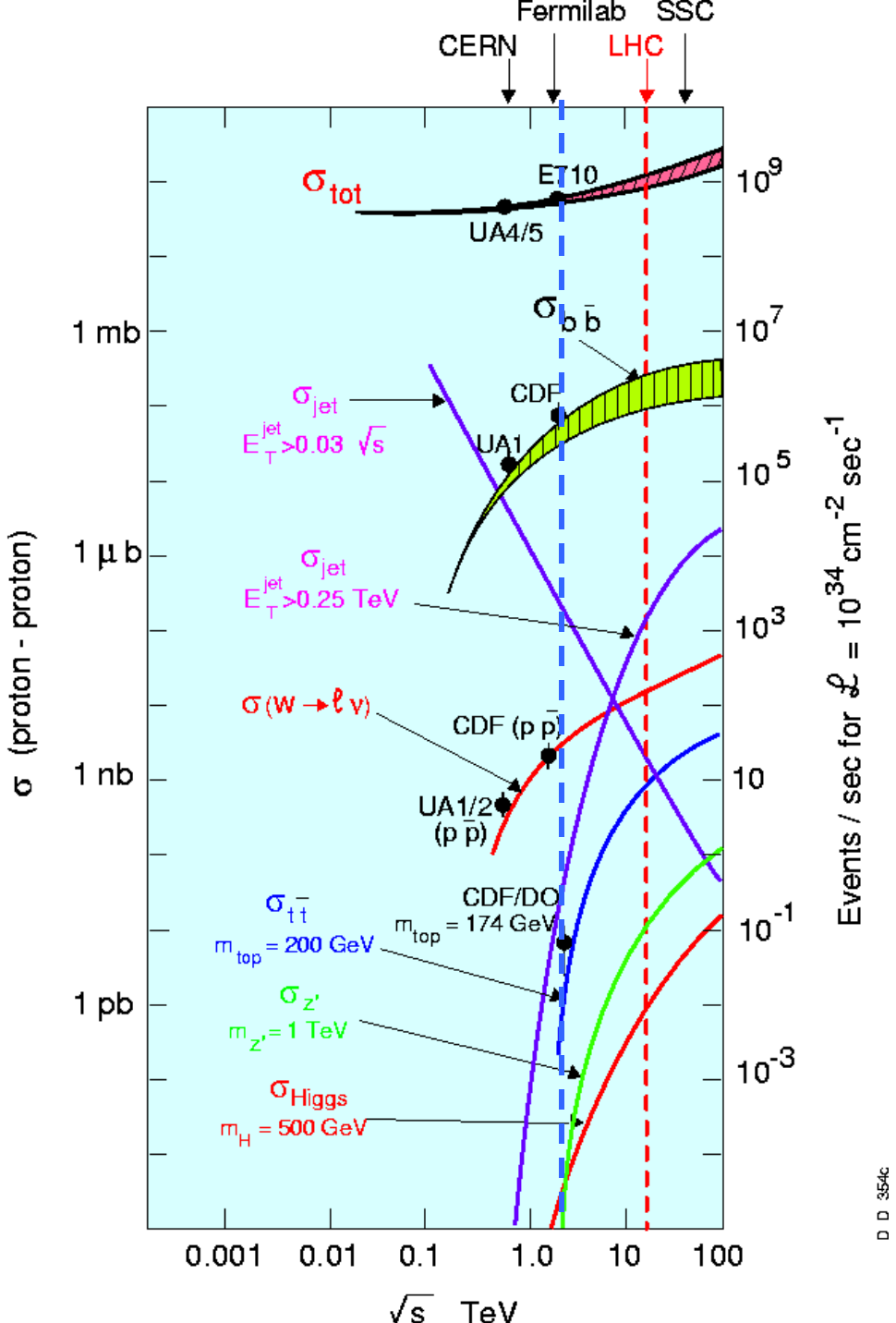
- 2001-2004: Run II a: 2.0 TeV $L \sim 10^{32} / cm^2 / s$
  total ~ 2/fb per detector
- 2005-2007: Run II b:
  total ~ 15/fb per detector

Higgs-Suche

T.Hebbeker



Cross Sections at Hadron Colliders



Run I results - highlights

- Top (1995) :

  CDF + D0 combined: ~ 100 events

  $$m = 174.3 \pm 5.1\, GeV$$

- W boson (1992-1996):

  CDF + D0 combined: ~ 100000 events

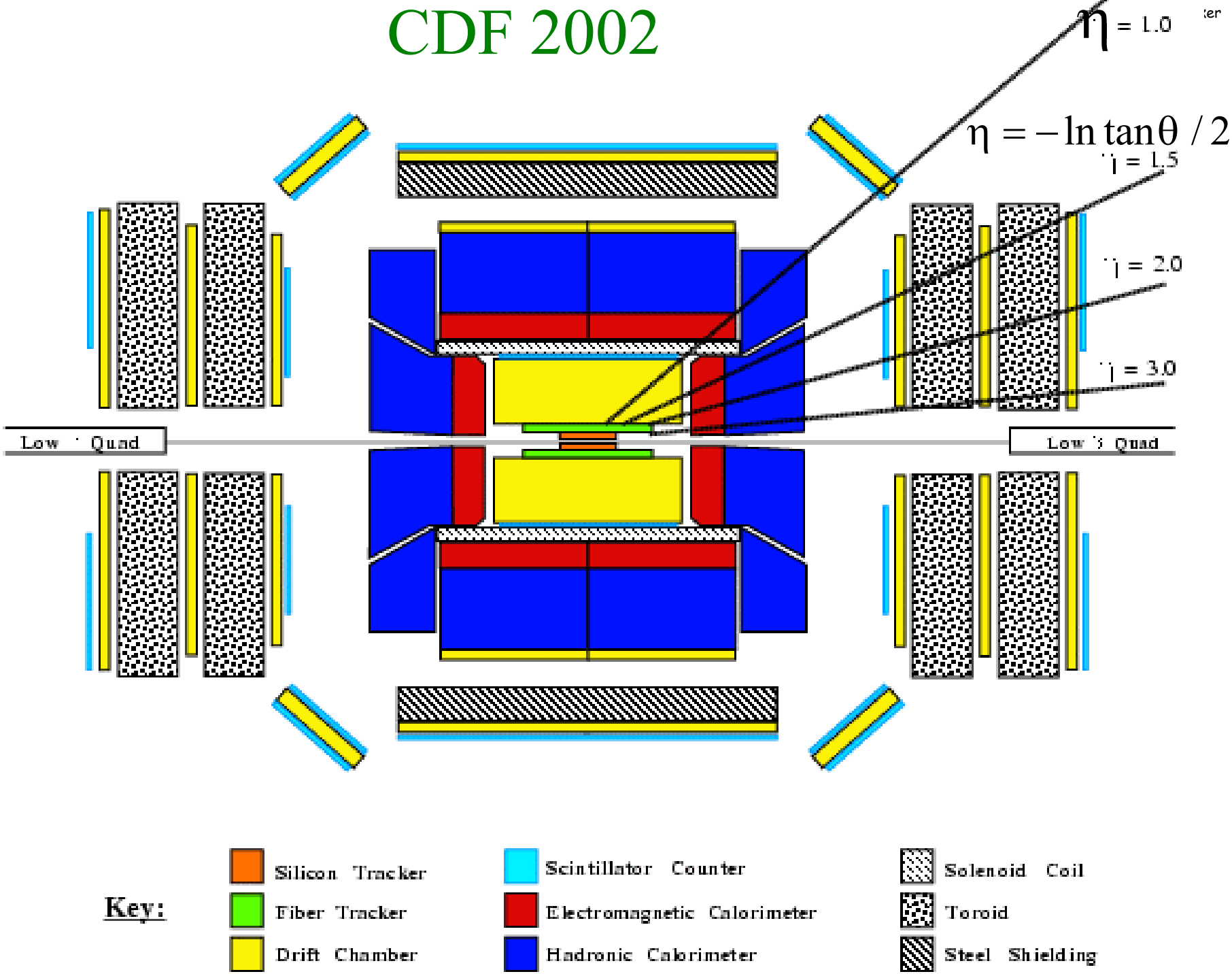
  $$m = 80.454 \pm 0.060\, GeV$$

- Jet physics (QCD)

- Bottom physics (mainly CDF): xsection, CP violation ...

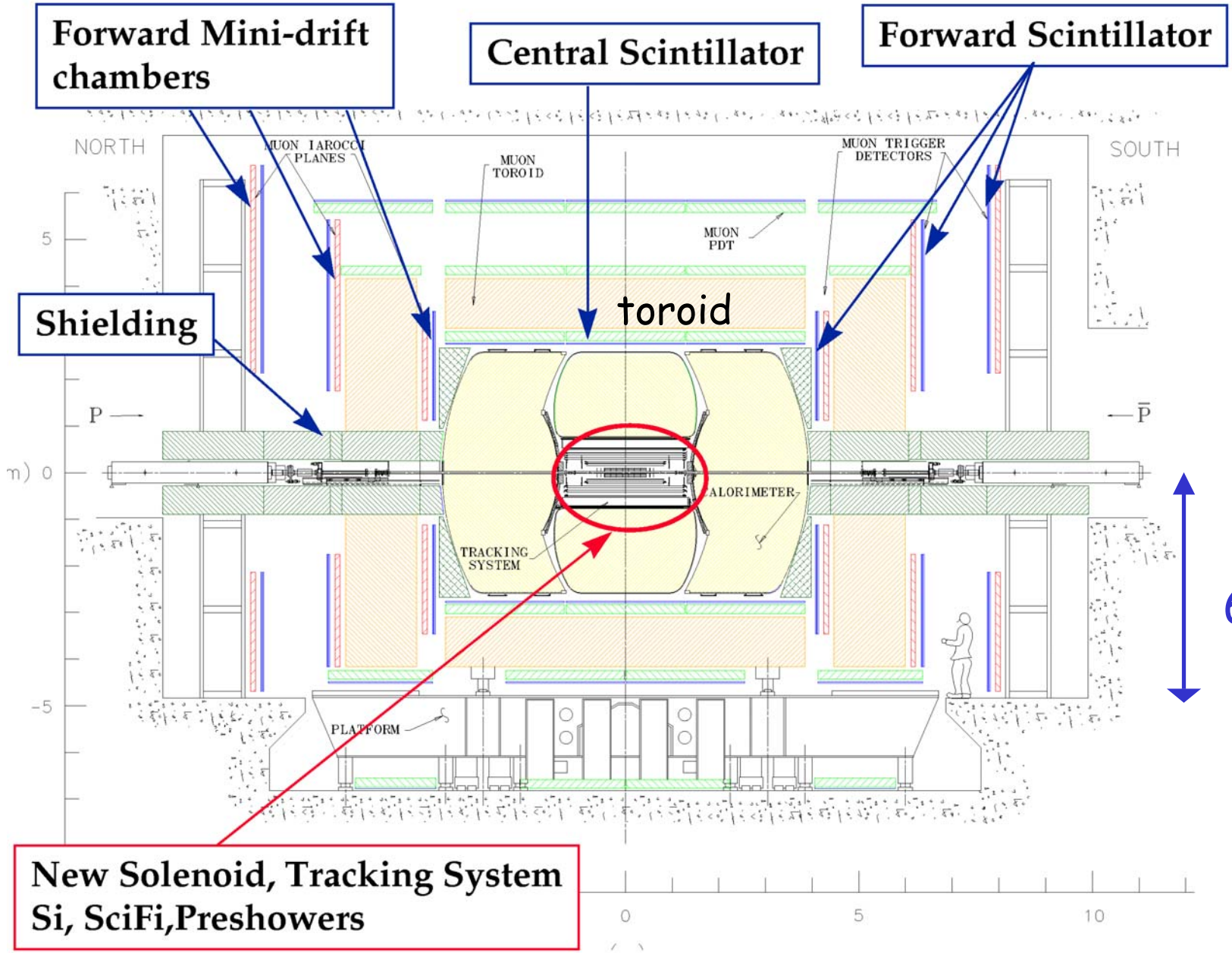
- Searches (SUSY, Leptoquarks, Higgs....)

CDF 2002


η = 1.0
η = −ln tanθ / 2
η = 1.5
η = 2.0
η = 3.0
Low η Quad
Low η Quad
Key:
Silicon Tracker
Fiber Tracker
Drift Chamber
Scintillator Counter
Electromagnetic Calorimeter
Hadronic Calorimeter
Solenoid Coil
Toroid
Steel Shielding

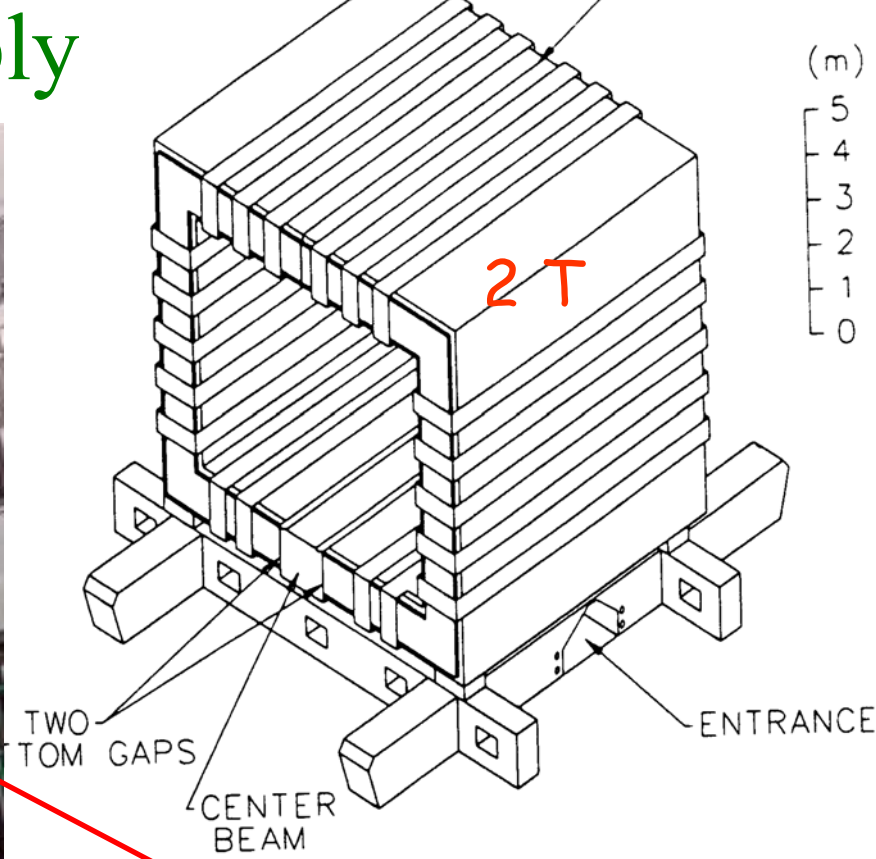
T.Hebbeker

D0 2002



D0 Collaboration

D0 assembly

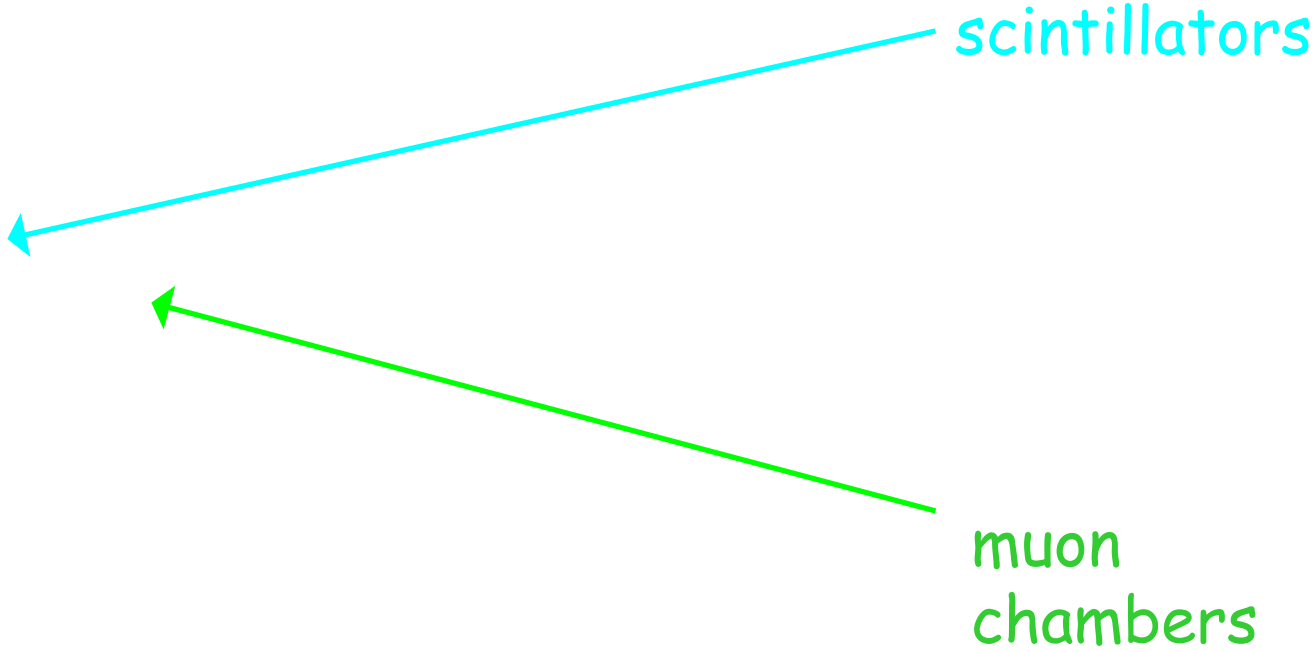


toroid

liquid argon
calorimeter

muon chambers

D0 detector



D0 tracker

new

VLPC =

Visible

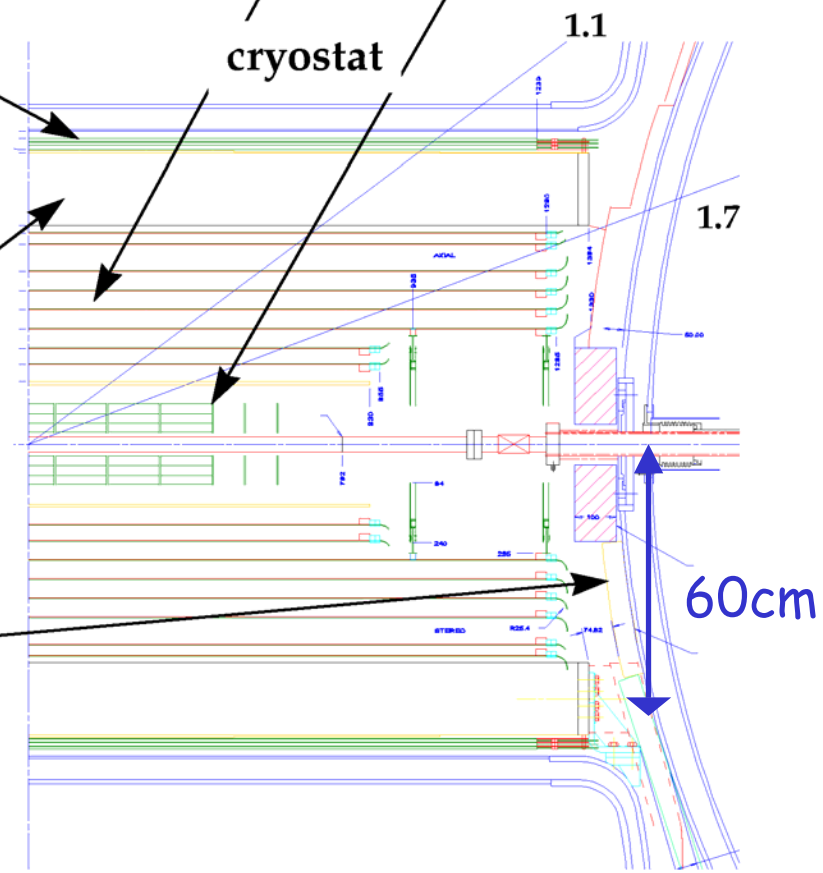
Light

Photon

Counter

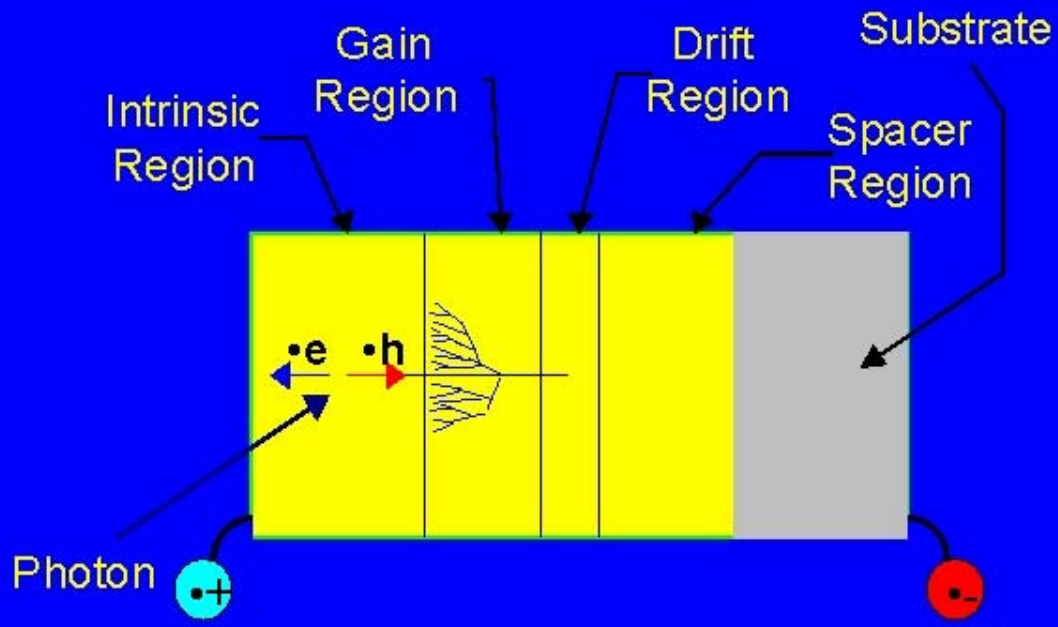
(4 K)

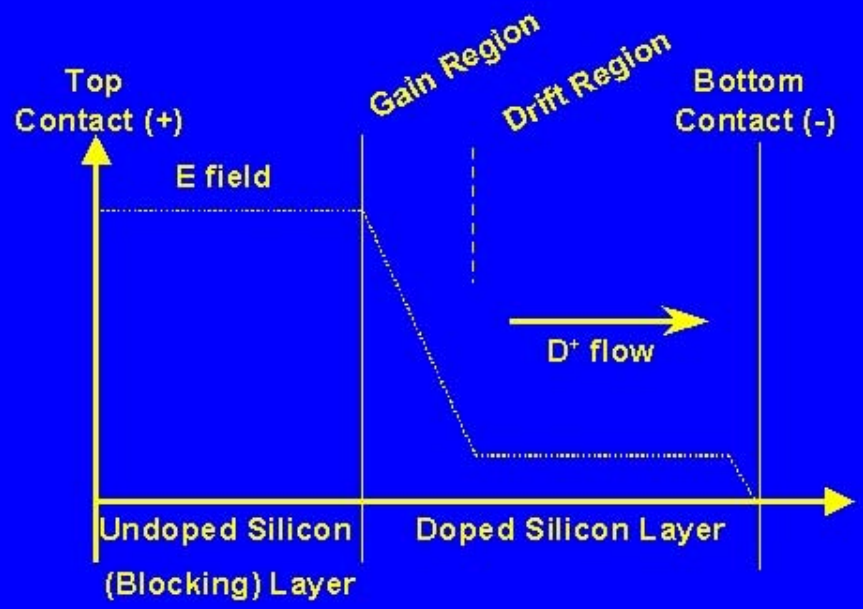
- **Silicon Tracker**
  - Four layer barrels (double/single sided)
  - Interspersed double sided disks
  - 840,00 channels
- **Fiber Tracker**
  - Eight layers sci-fi ribbon doublets (z-u-v, or z
  - 74,000 830um fibers w/ VLPC readout
- **Central Preshower**
  - Scintillator strips, WLS fiber readout
  - 6,000 channels
- **Solenoid**
  - 2T superconducting
- **Forward Preshower**
  - Scintillator strips, stereo, WLS readout
  - 16,000 channels



VLPC Operational Principles

- Photon is converted in the intrinsic region, creating an electron-hole pair.
- Hole drifts into the drift region, where it knocks an electron out from an atom.
- Electron accelerates back through gain region, knocking electrons from atoms as it goes.
- Spacer region and substrate are for mechanical support and field shaping.
- Thus each photon generates a pulse of many electrons. Gains of ×20,000 – 60,000 are achievable.





Don Lincoln

Liquid argon calorimeters

gas -> drift chamber

liquid -> calorimeter or drift chamber!

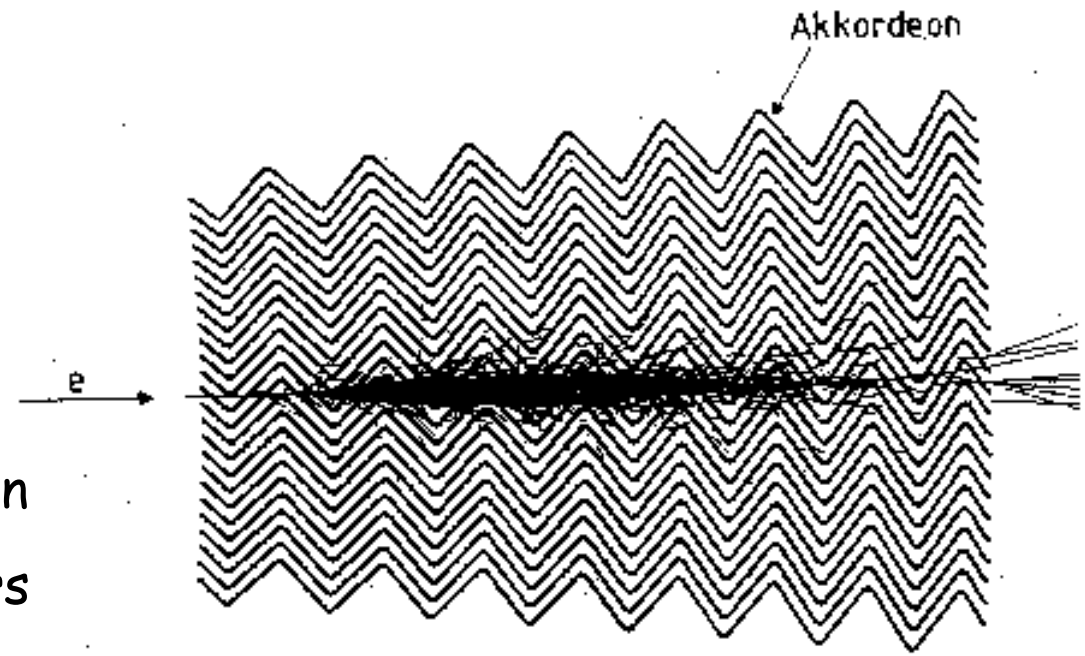
Icarus detector

+ hermiticty
+ resolution
- cryostat
- purity

Atlas, D0, SLC, NA31

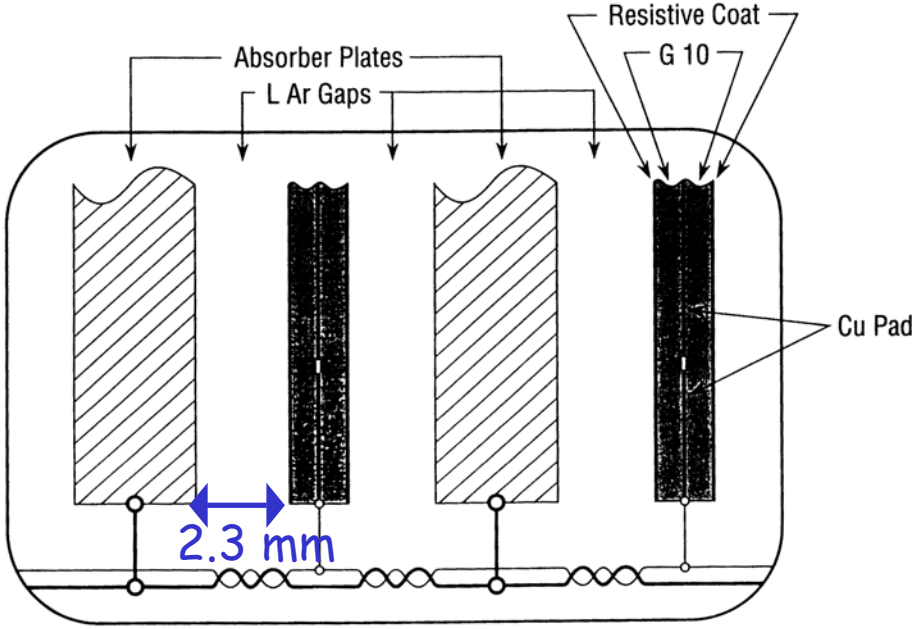
SLC

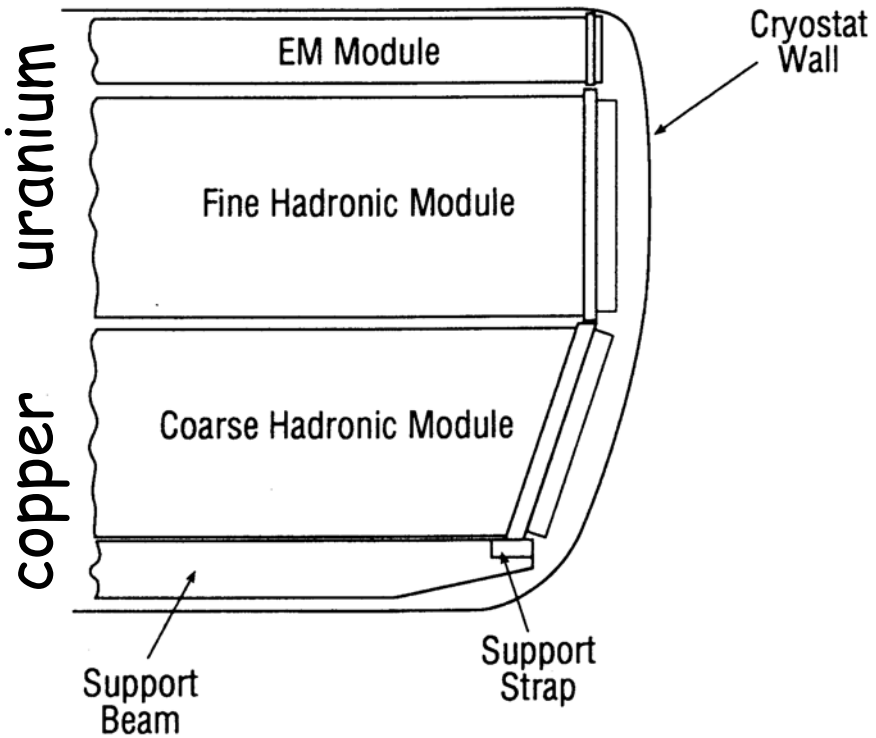
ionization chambers

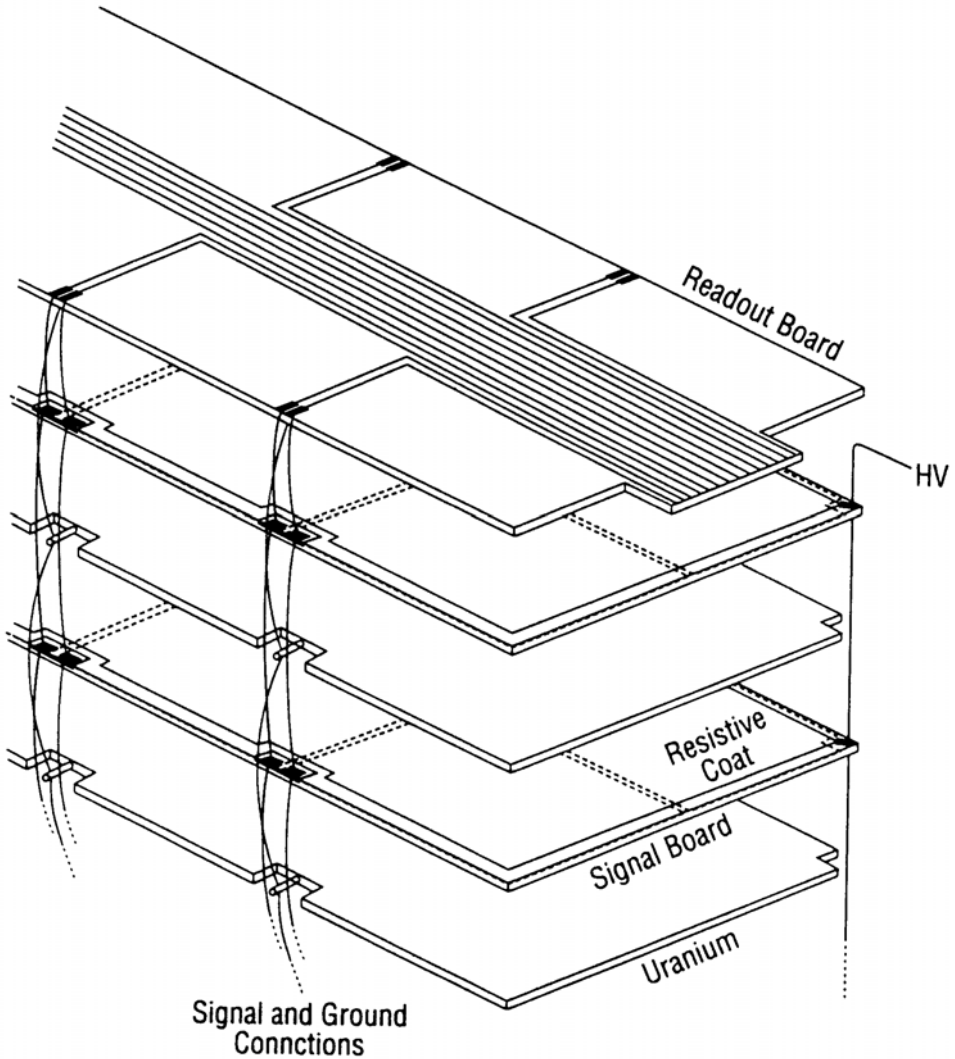


D0 calorimeter

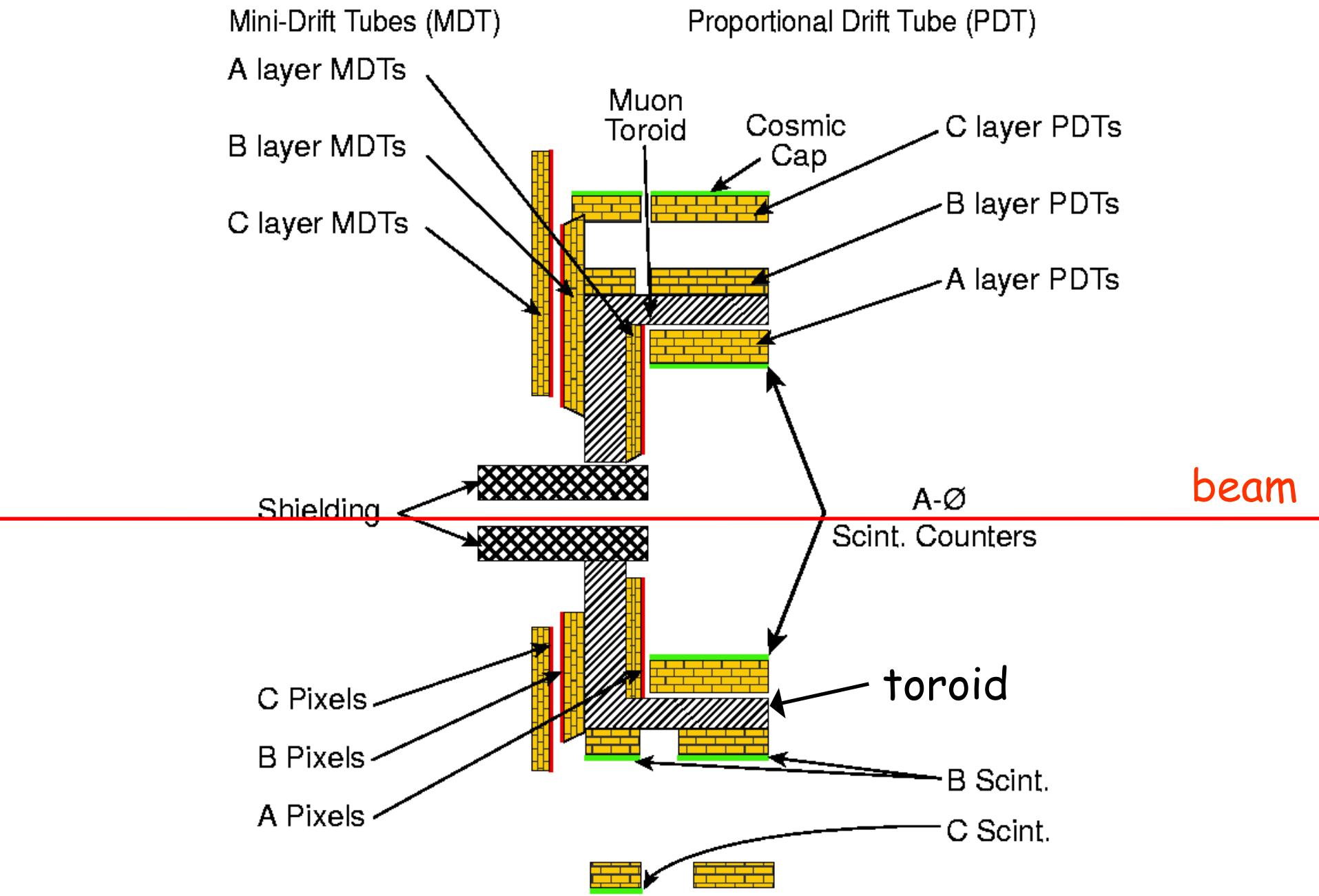
T.Hebbeker



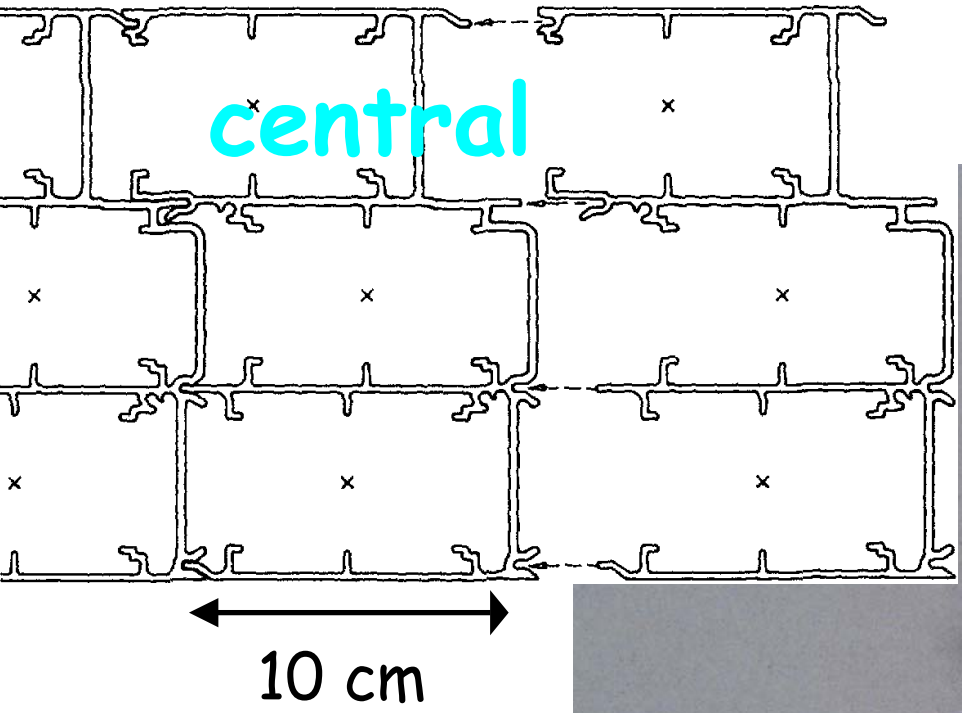




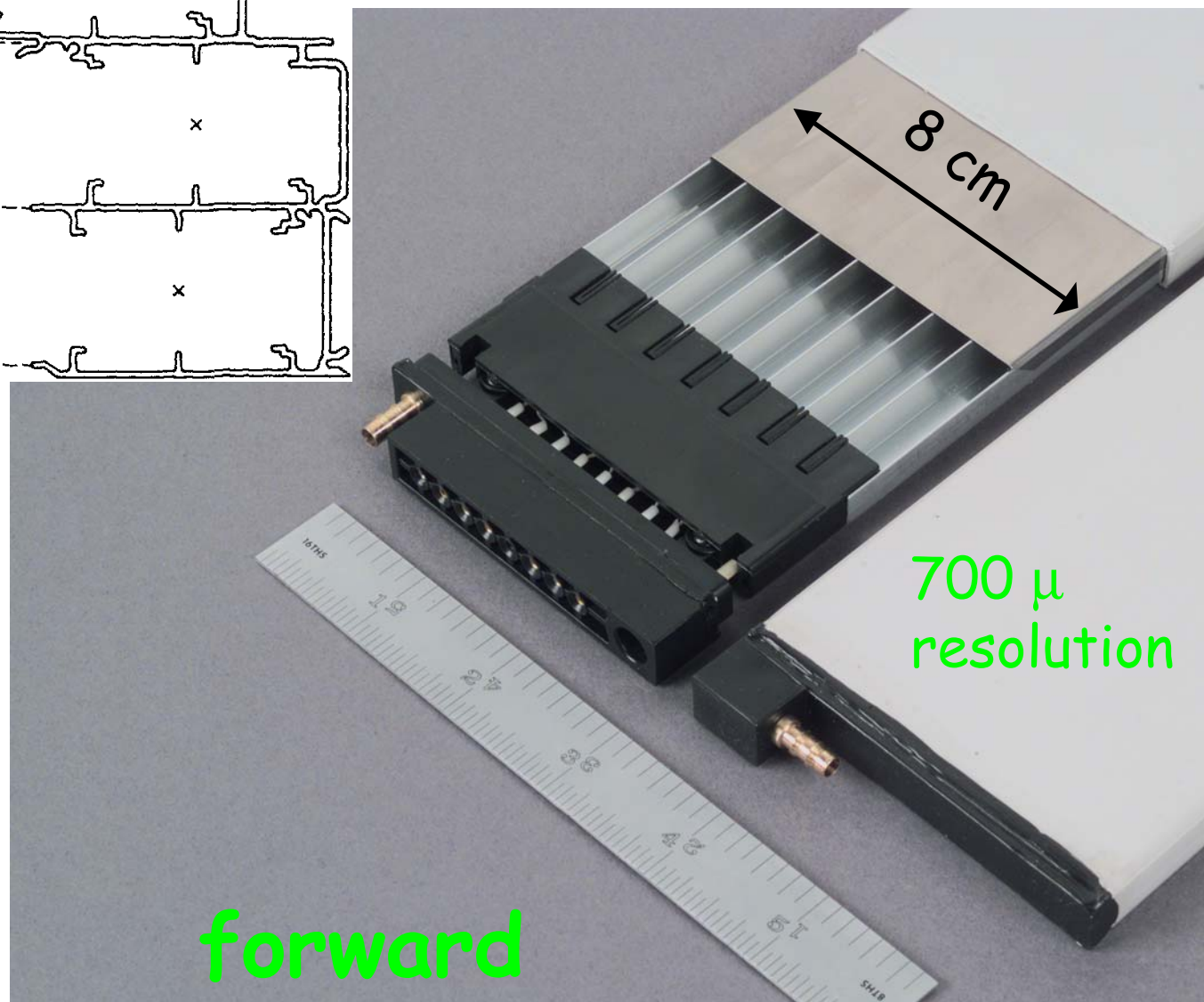
D0 muon system



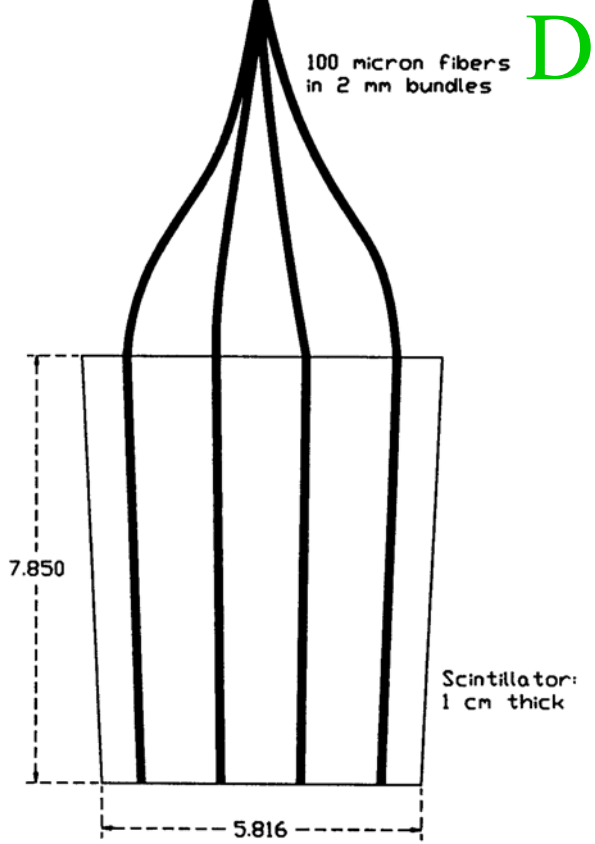
D0 Proportional- and Mini-Drift-Tubes

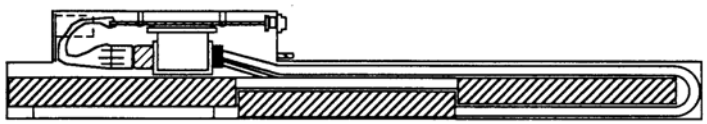


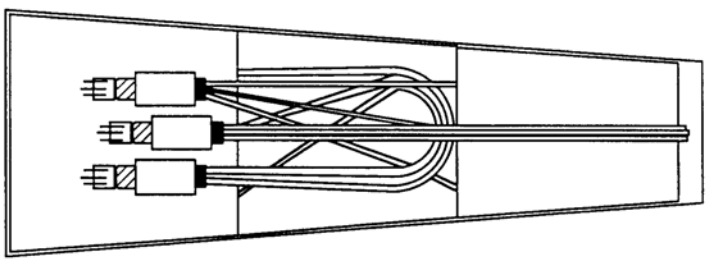
500 μ
resolution

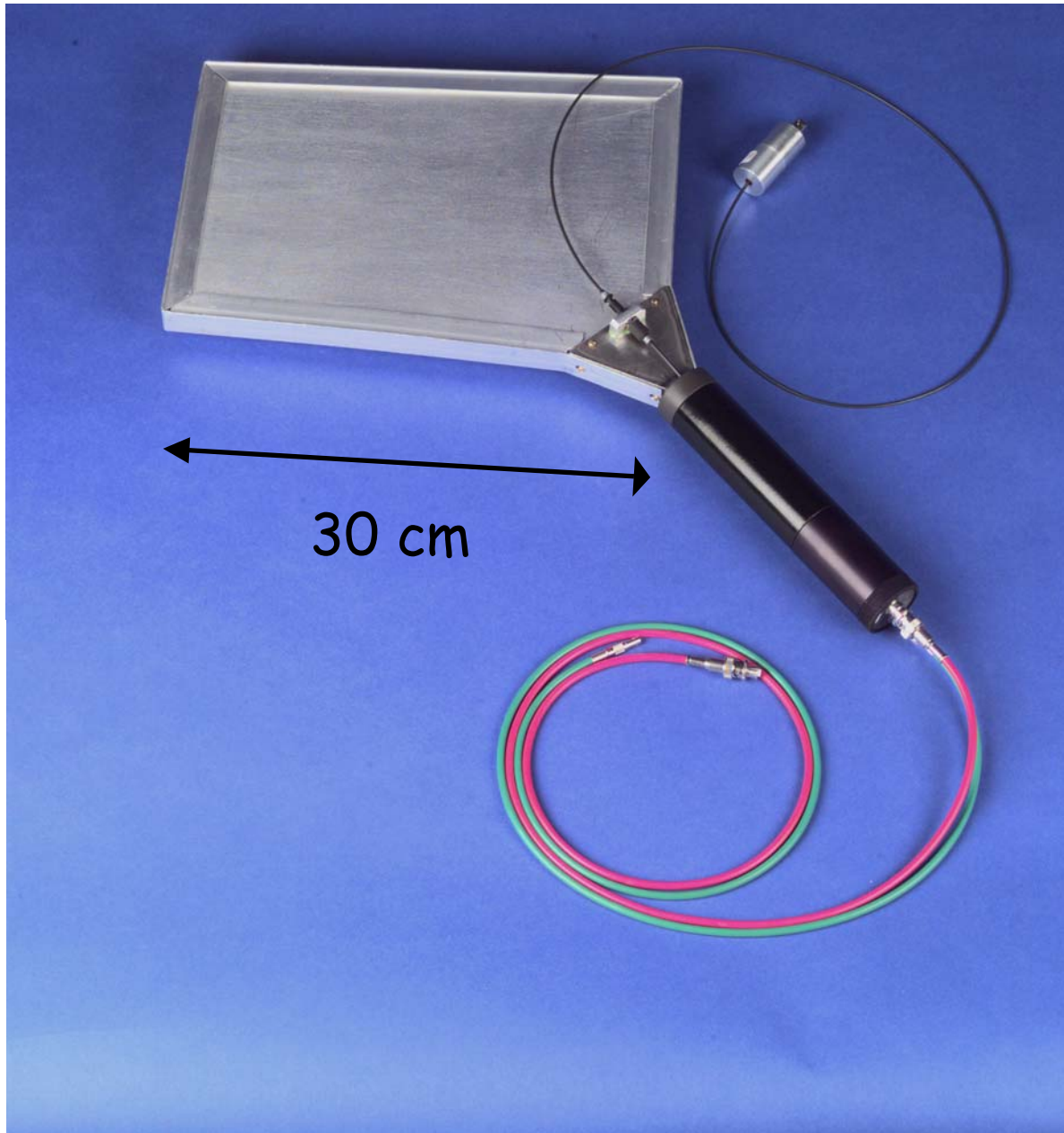


D0 (Pixel) Scintillators

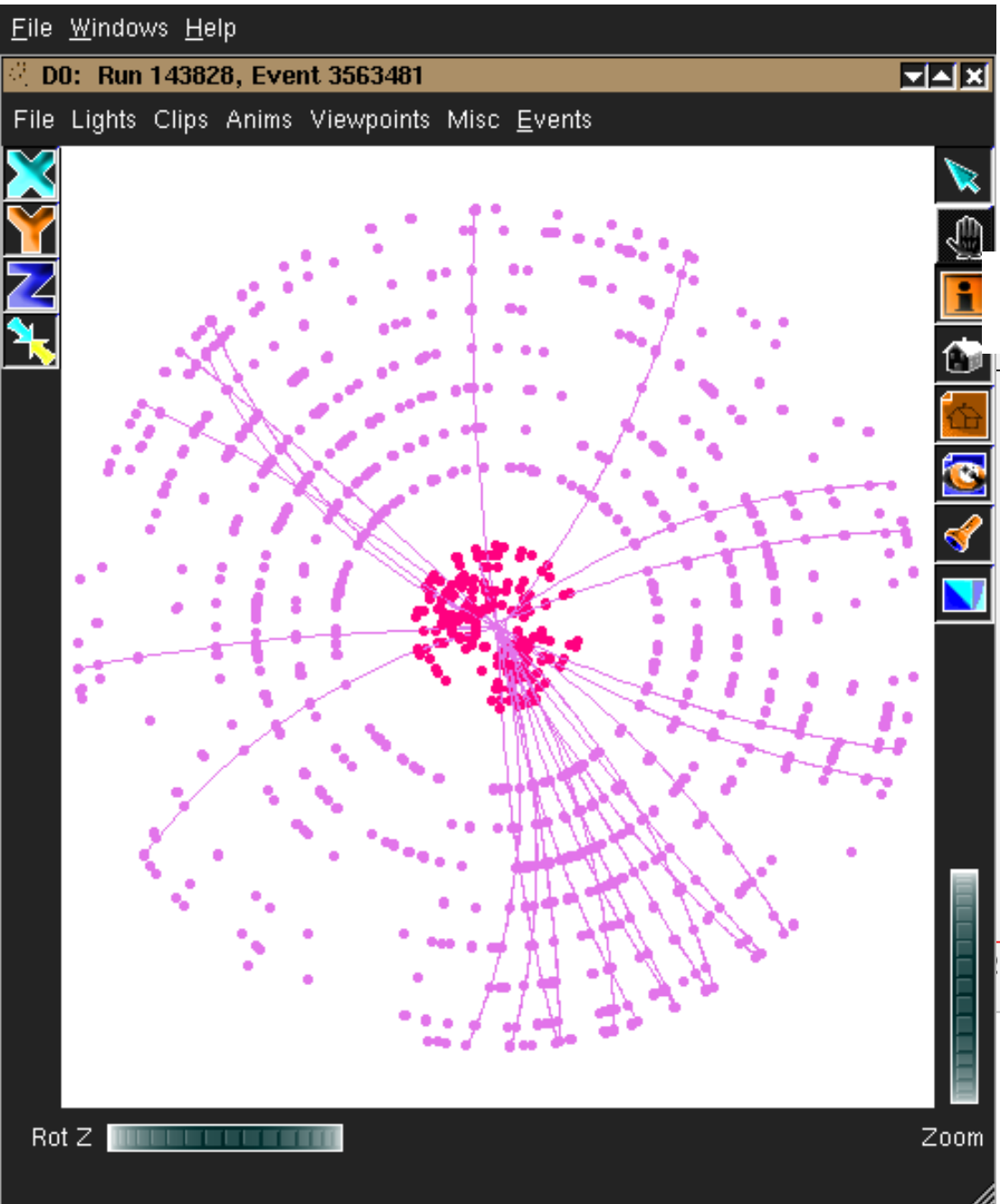






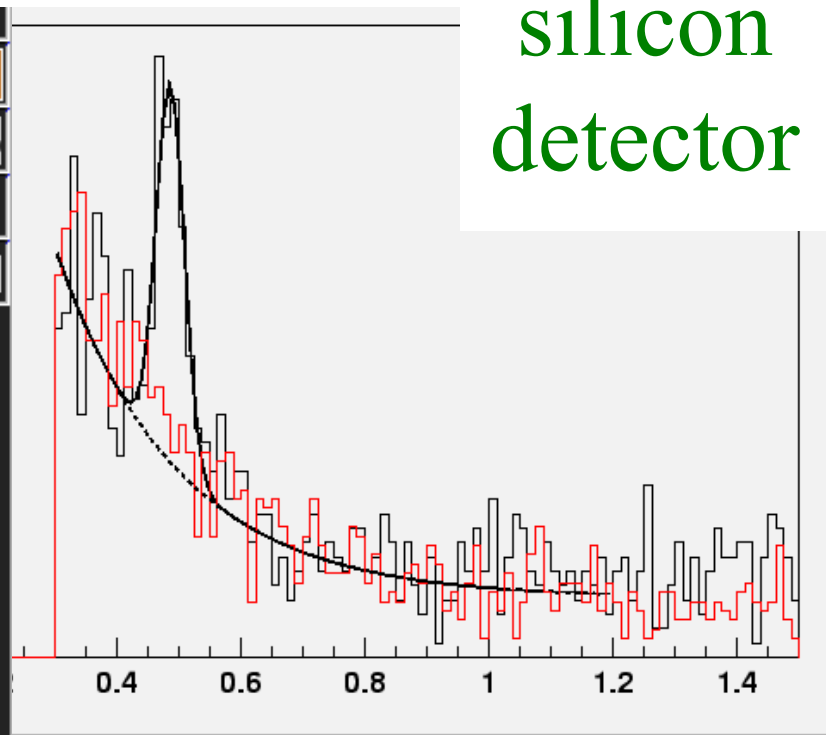


D0 event: inner tracker

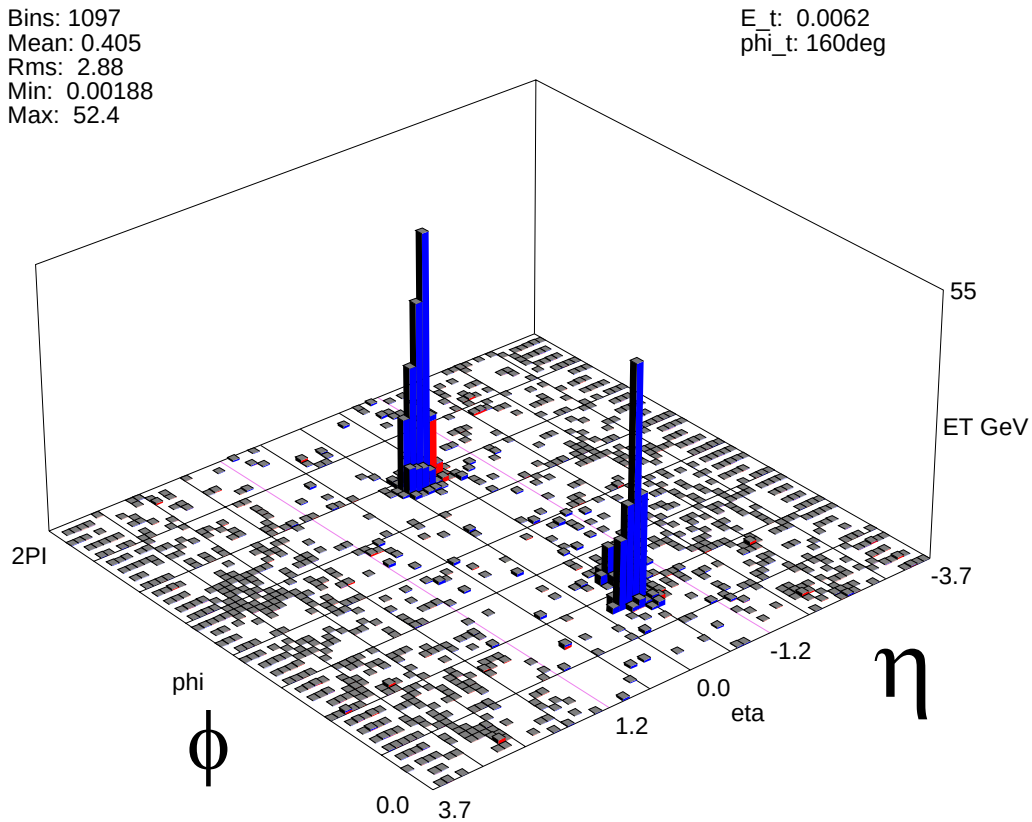


$K_s \rightarrow \pi^+\pi^-$:

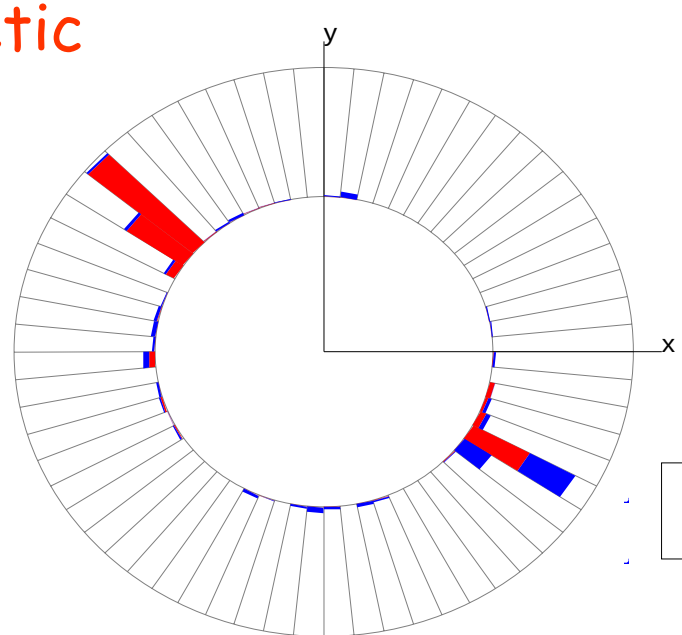
silicon detector



D0 event: calorimeter: jets

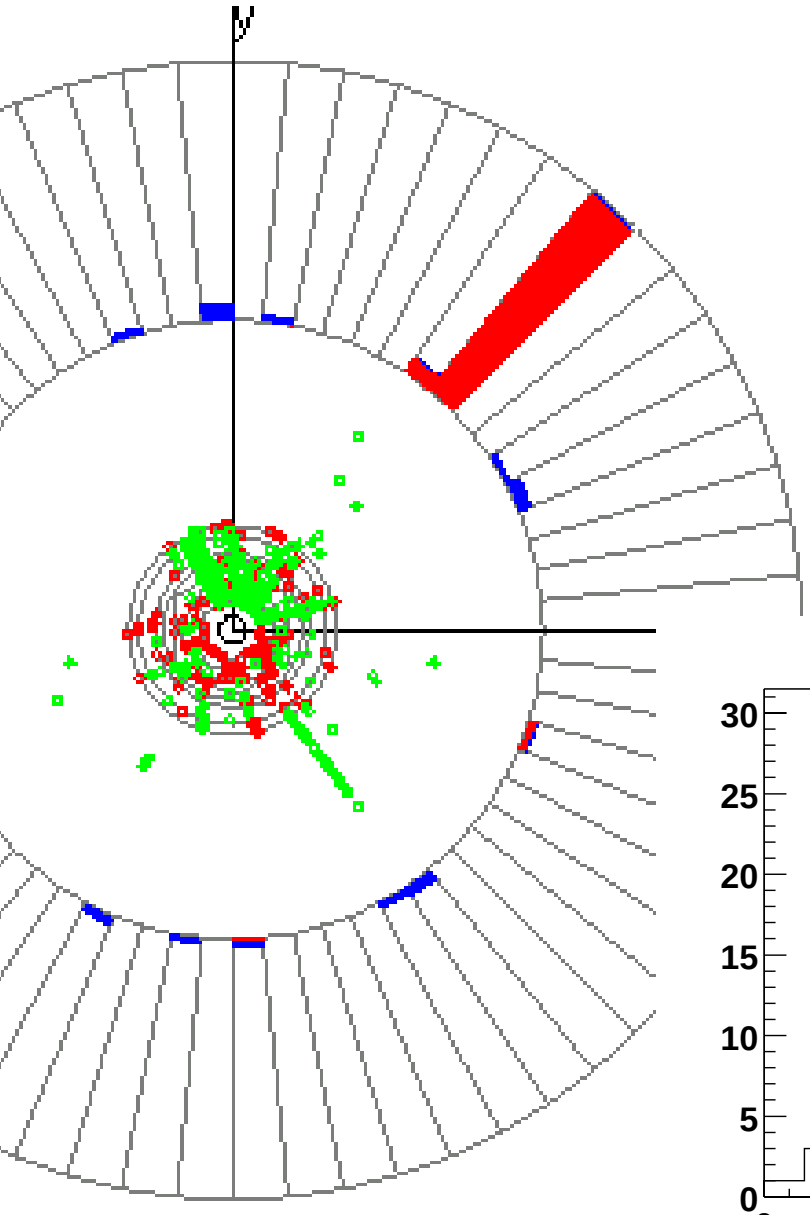


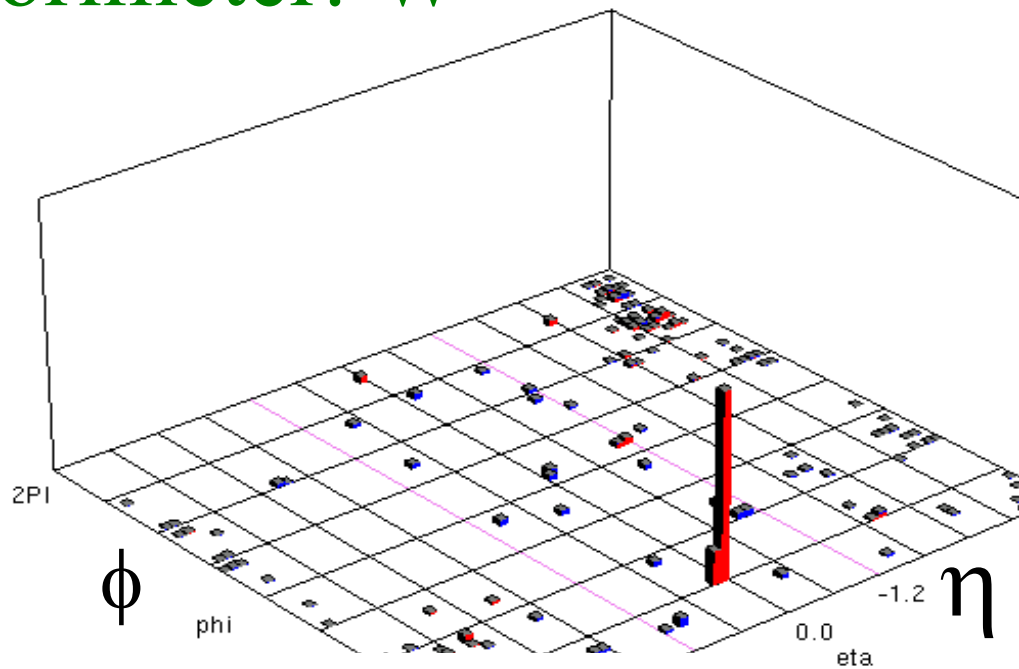
electro-magnetic

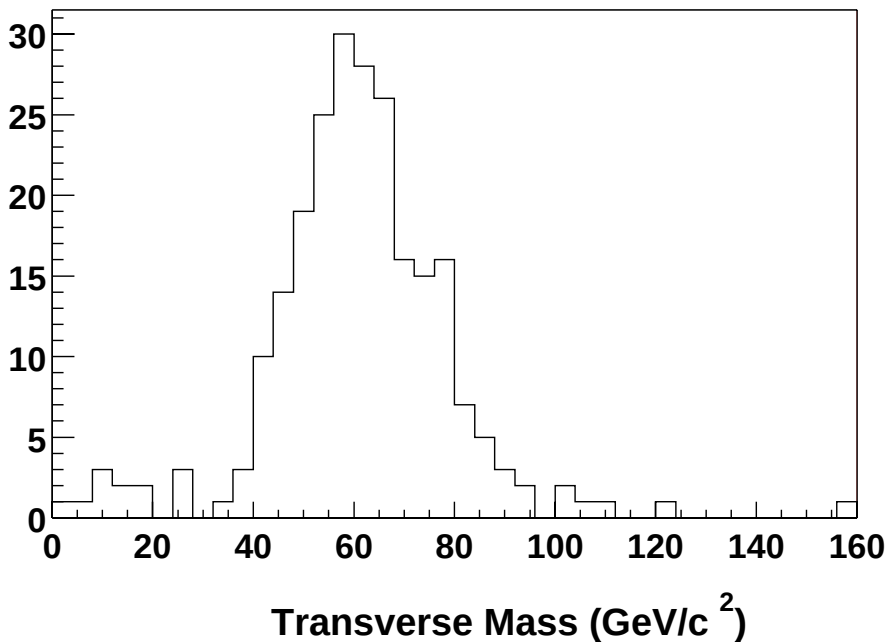


hadronic

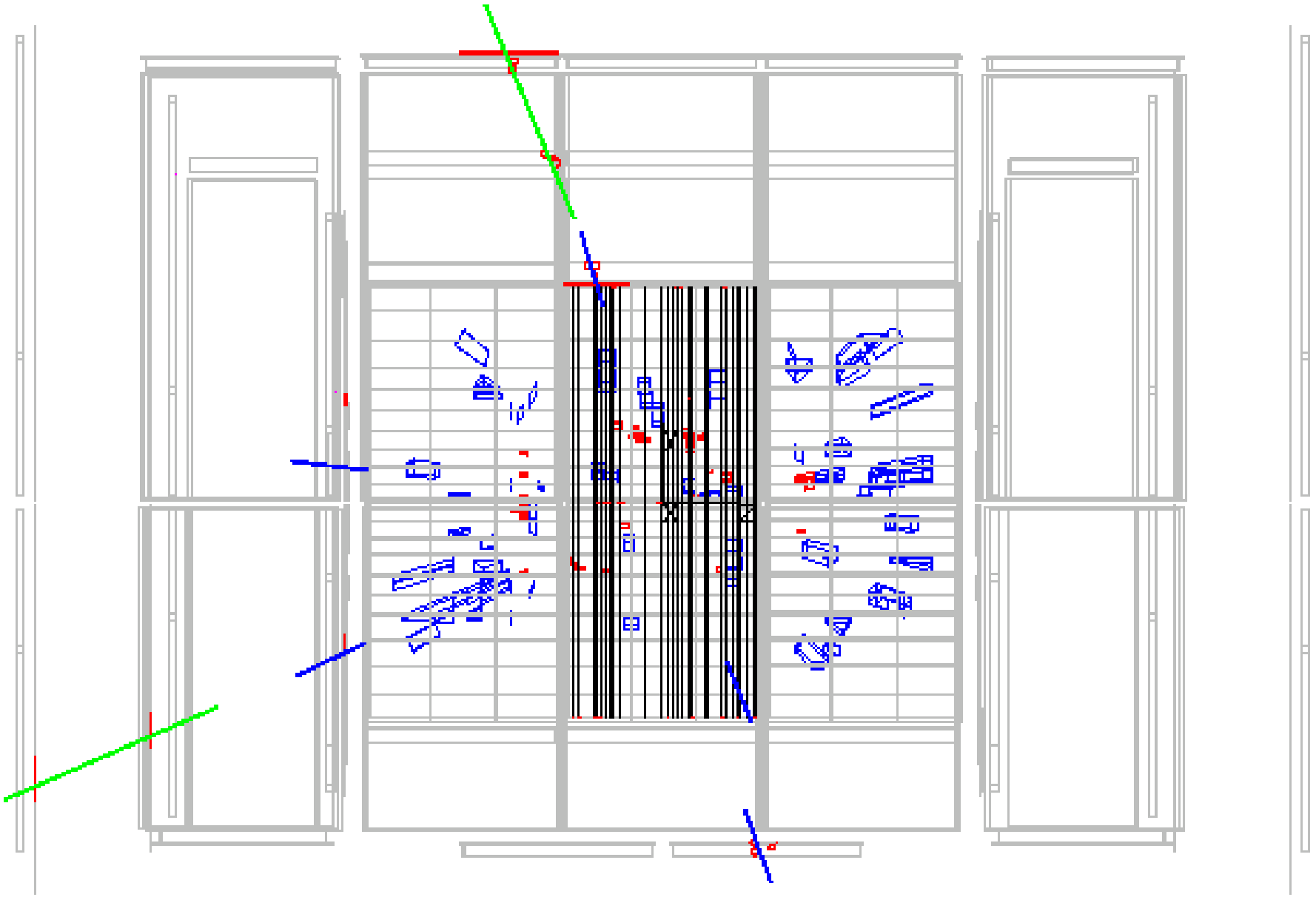
D0 event: calorimeter: W







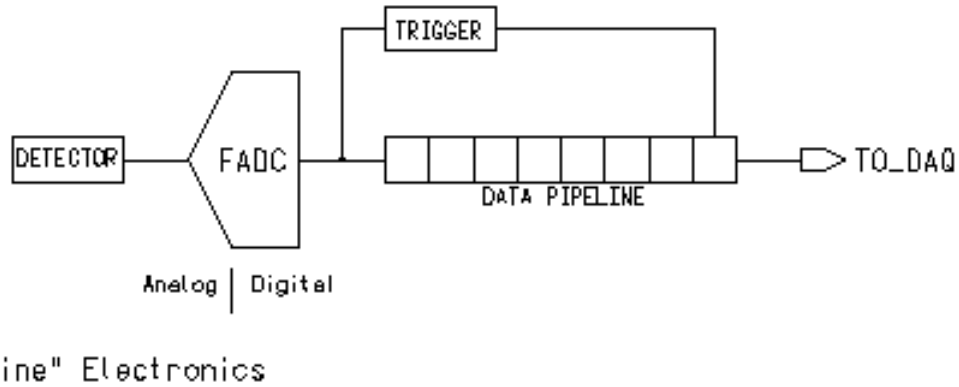
D0 event: muons: Z



D0 trigger and DAQ

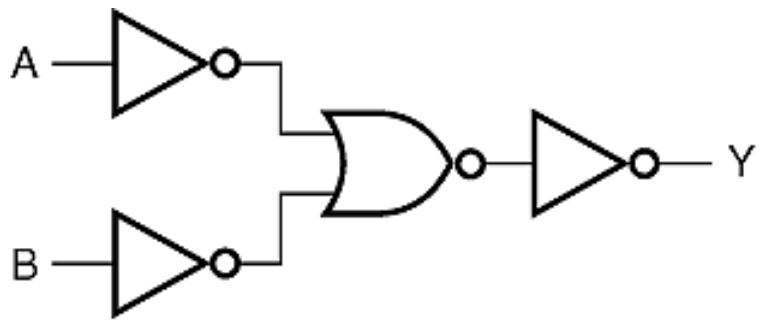
Trigger:

- level 1:
  pipelined, FPGAs
  3 MHz -> 10 kHz



"Pipeline" Electronics

- level 2:
  DEC alpha processors
  1 0 kHz -> 1 kHz

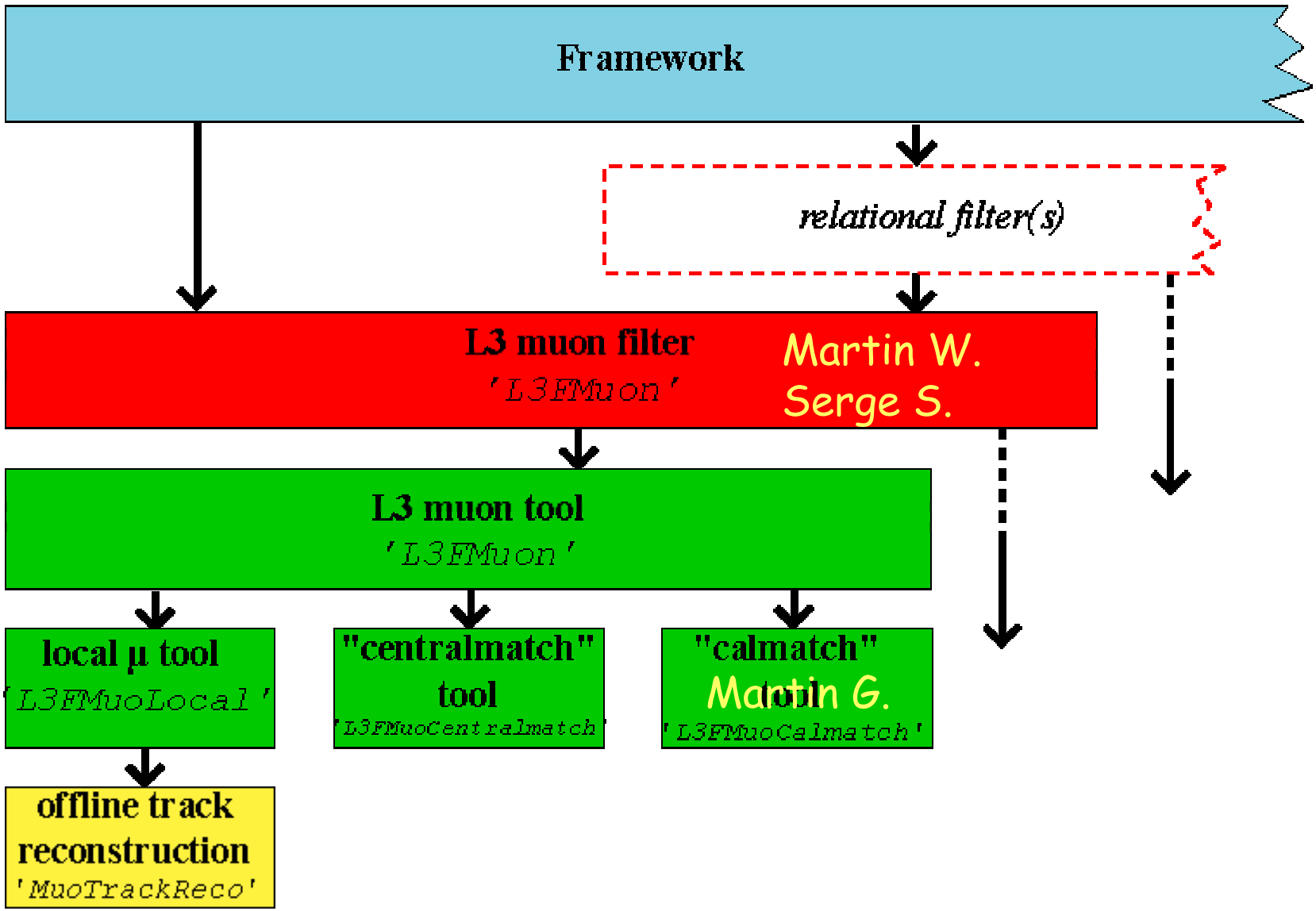


- level 3:
  Linux PC farm
  1 kHz -> 50 Hz

DAQ:

→ pentium processors in VME system

L3 trigger software



Martin Wegner 01/2002

Status Tevatron and D0

Tevatron:

peak lumi reached = 1/6 design value $(8.6 \cdot 10^{31} / cm^2 / s)$

efficiency = ½ design value (80%)

hope: 300/pb in 2002 (per detector)

D0:

recorded: ~10/pb

detector: most parts functional, biggest problem: tracks!

trigger/DAQ: design rate not yet achieved

hope: fully operational by summer 2002