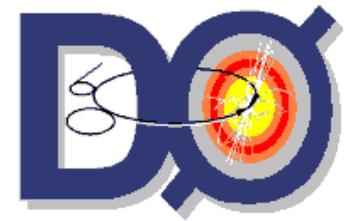
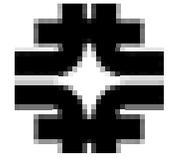


The D0 Experiment



Thomas Hebbeker
RWTH Aachen
March 2002

Fermilab



FNAL =
Fermilab
(Enrico Fermi)
1967



Tevatron = TEV machine 1983

The Tevatron



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

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

bunches: every 396 ns

8 → 150 GeV

main injector

new

collects antiprotons

recycler

150 → 1000 GeV

$p \bar{p}$

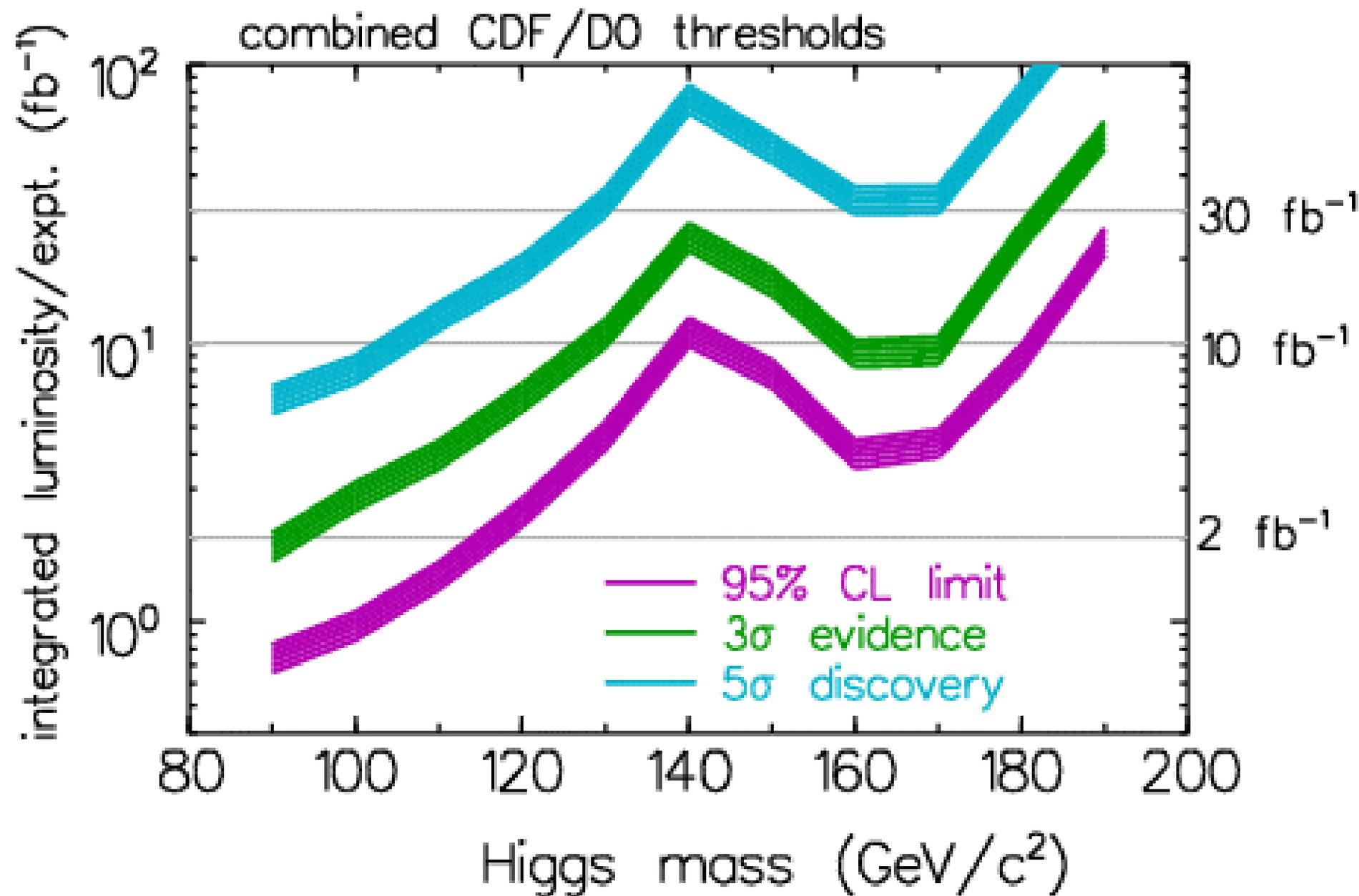


History/Future

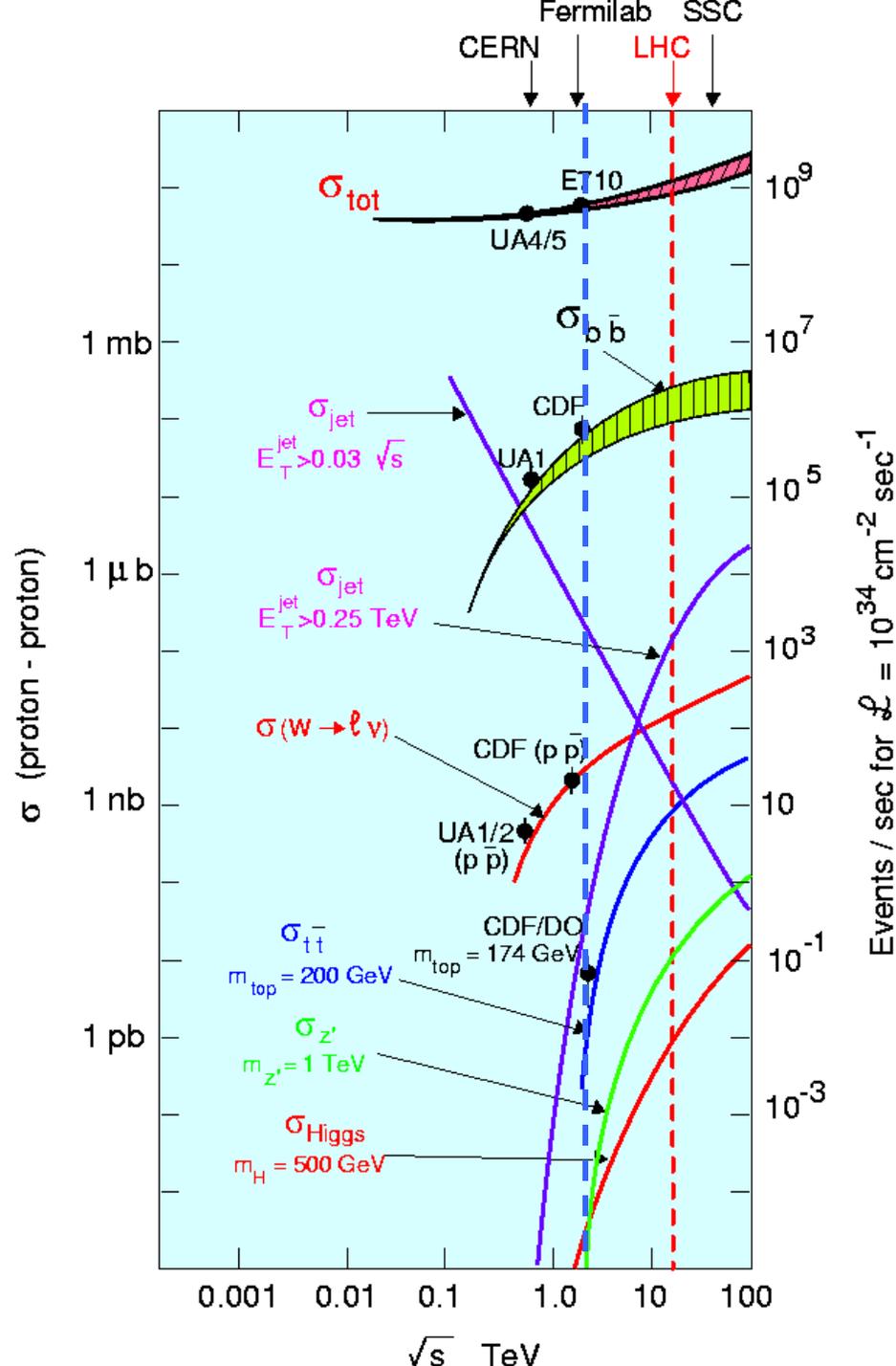
- 1987: CDF = Collider Detector at Fermilab
- 1987-1989: Run 0: 1.8 TeV $L \sim 10^{30} / \text{cm}^2 / \text{s}$
- 1992: D0 = Detector in shaft D0
- 1992-1996: Run I: $L \sim 10^{31} / \text{cm}^2 / \text{s}$
 - total $\sim 100/\text{pb}$ per detector
 - > 100 publications per experiment

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

Higgs-Suche



Cross Sections at Hadron Colliders



Run I results - highlights

- Top (1995) :

CDF + D0 combined: ~ 100 events

$$m = 174.3 \pm 5.1 \text{ GeV}$$

- W boson (1992-1996):

CDF + D0 combined: ~ 100000 events

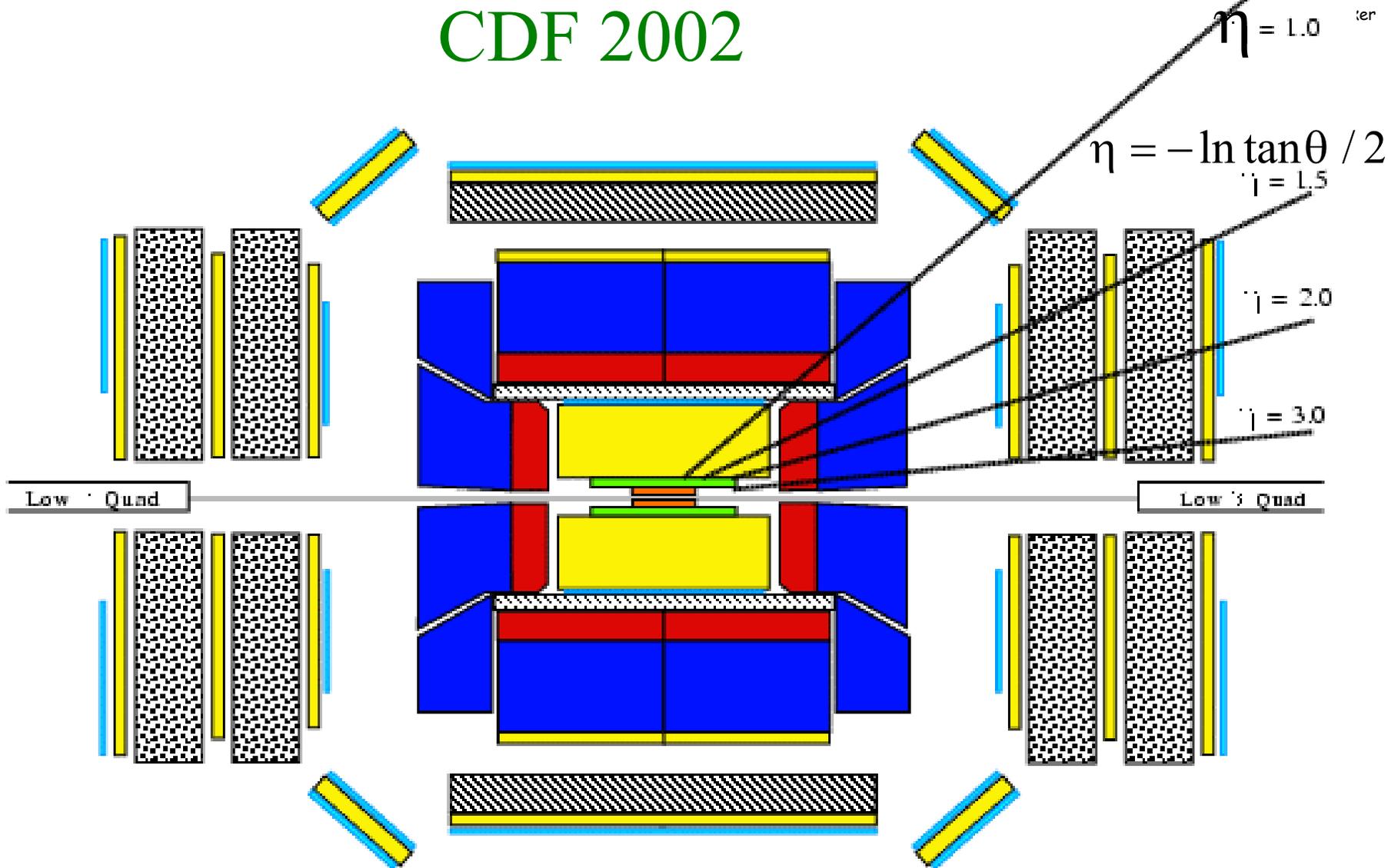
$$m = 80.454 \pm 0.060 \text{ GeV}$$

- Jet physics (QCD)

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

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

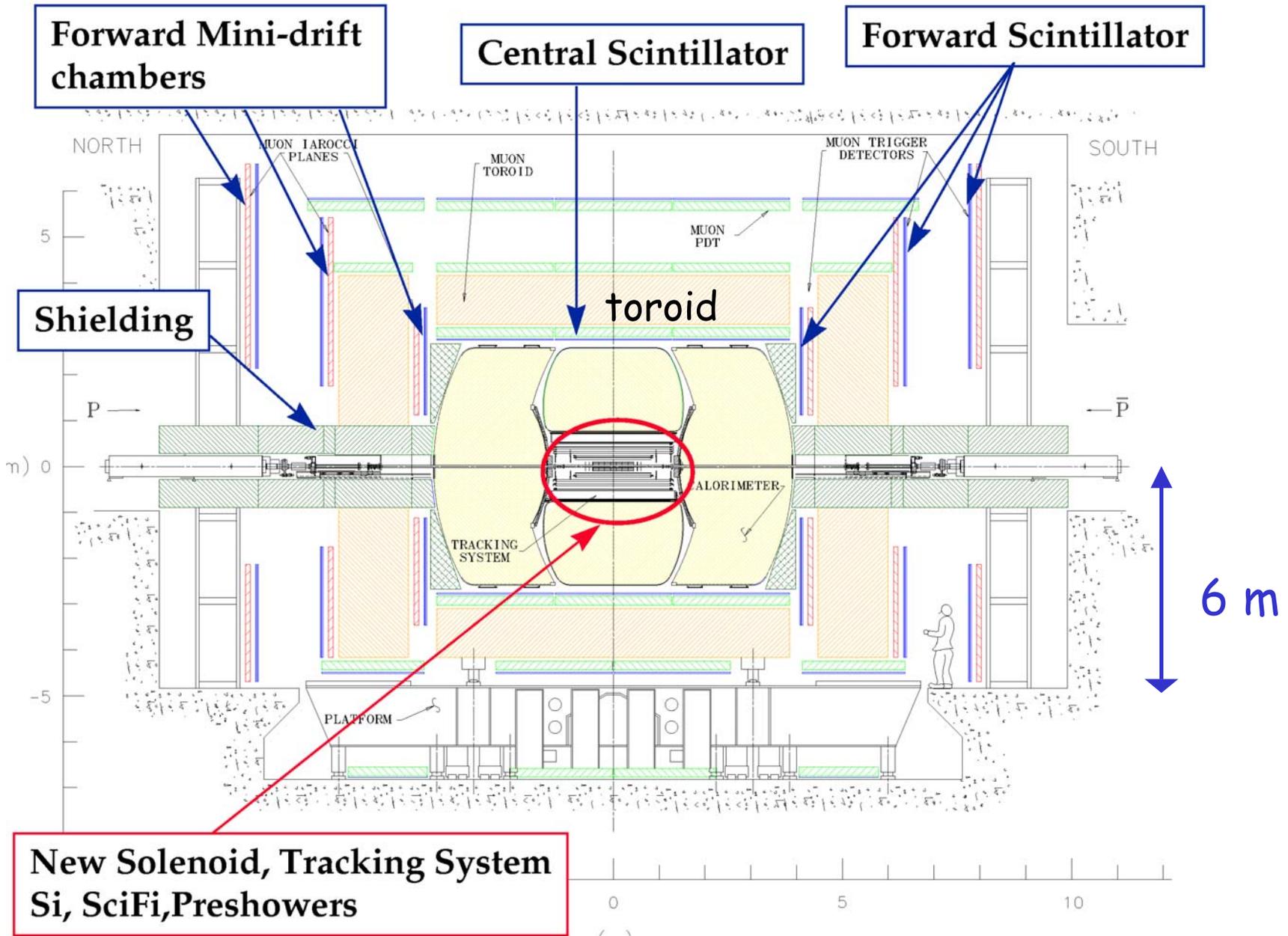
CDF 2002



Key:

- | | | |
|---|---|---|
|  Silicon Tracker |  Scintillator Counter |  Solenoid Coil |
|  Fiber Tracker |  Electromagnetic Calorimeter |  Toroid |
|  Drift Chamber |  Hadronic Calorimeter |  Steel Shielding |

D0 2002



**New Solenoid, Tracking System
Si, SciFi, Preshowers**

+ New Electronics, Trig, DAQ

D0 Collaboration



U. of Arizona
 U. of California, Berkeley
 U. of California, Irvine
 U. of California, Riverside
 Cal State U., Fresno
 Lawrence Berkeley Nat. Lab.
 Florida State U.
 Fermilab
 U. of Illinois, Chicago
 Northern Illinois U.
 Northwestern U.
 Indiana U.
 U. of Notre Dame
 Iowa State U.
 U. of Kansas
 Kansas State U.
 Louisiana Tech U.
 U. of Maryland
 Boston U.
 Northeastern U.
 U. of Michigan
 Michigan State U.
 U. of Nebraska
 Columbia U.
 U. of Rochester
 SUNY, Stony Brook
 Brookhaven Nat. Lab.
 Langston U.
 U. of Oklahoma
 Brown U.
 U. of Texas, Arlington
 Texas A&M U.
 Rice U.
 U. of Virginia
 U. of Washington



U. de Buenos Aires



LAFEX, CBPF, Rio de Janeiro
 State U. do Rio de Janeiro
 State U. Paulista, São Paulo



IHEP, Beijing



U. de los Andes, Bogotá



Charles U., Prague
 Czech Tech. U., Prague
 Academy of Sciences, Prague



U. San Francisco de Quito



ISN, IN2P3, Grenoble
 CPPM, IN2P3, Marseille
 LAL, IN2P3, Orsay
 LPNHE, IN2P3, Paris
 DAPNIA/SPP, CEA, Saclay
 IReS, Strasbourg
 IPN, IN2P3, Villeurbanne



U. of Aachen
 Bonn U.
 IOP, U Mainz
 Ludwig-Maximilians U, Munich
 U. of Wuppertal

The DØ Collaboration



Panjab U., Chandigarh
 Delhi U., Delhi
 Tata Institute, Mumbai



KDL, Korea U., Seoul



CINVESTAV, Mexico City



FOM-NIKHEF, Amsterdam
 U. of Amsterdam/NIKHEF
 U. of Nijmegen/NIKHEF



INP, Kraków



JINR, Dubna
 ITEP, Moscow
 Moscow State U.
 IHEP, Protvino
 PNPI, St Petersburg



Lund U.
 RIT, Stockholm
 Stockholm U
 Uppsala U.

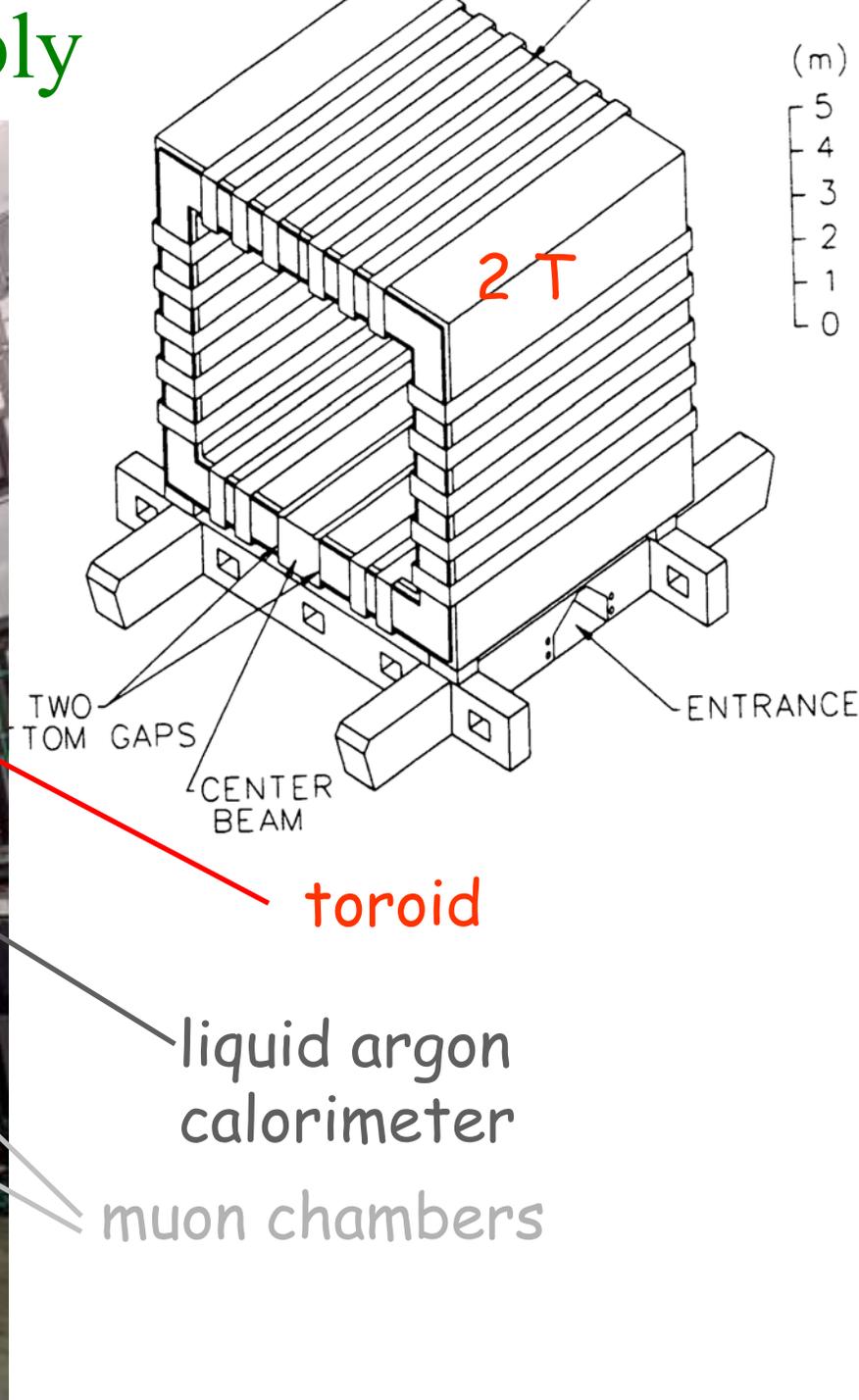


Lancaster U.
 Imperial College, London
 U. of Manchester

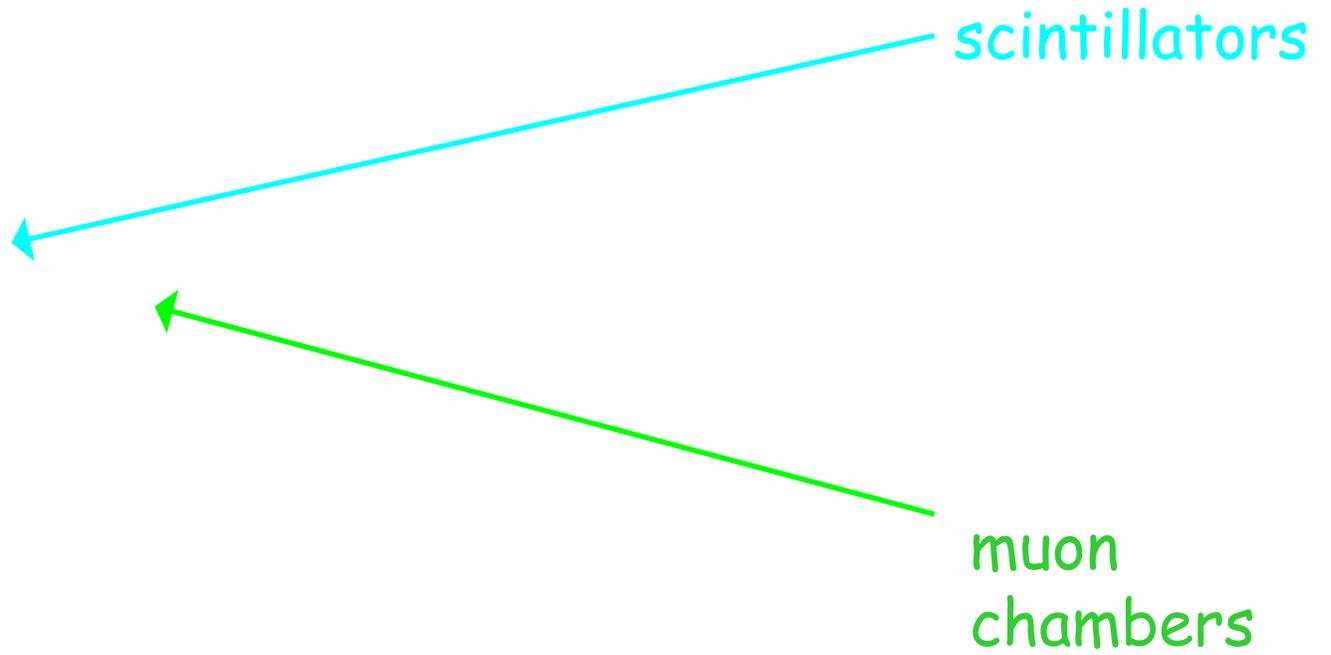


HCIP, Hochiminh City

D0 assembly



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-v-u)
- ◆ 74,000 830um fibers w/ VLPC readout

● Central Preshower

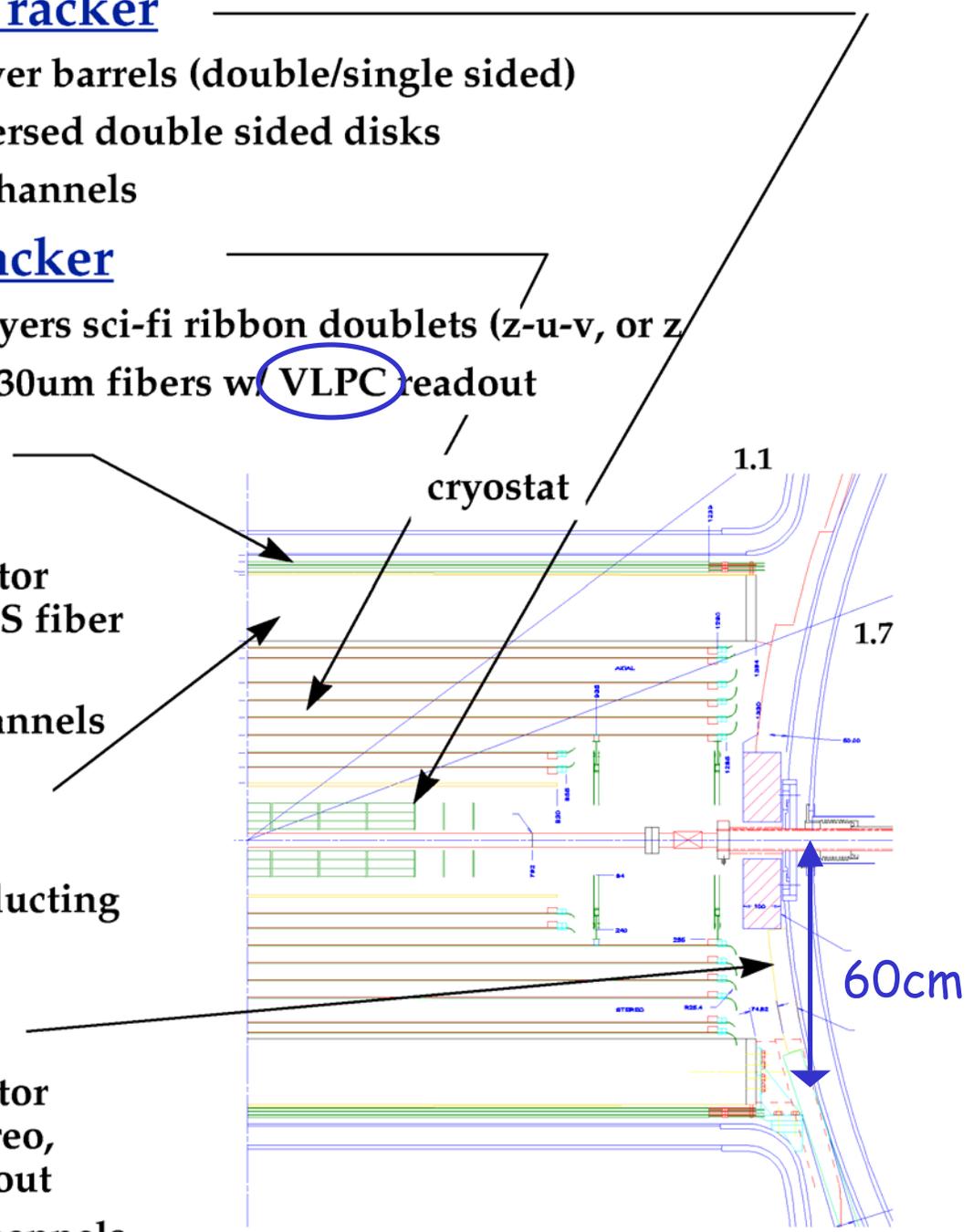
- ◆ Scintillator strips, WLS fiber readout
- ◆ 6,000 channels

● Solenoid

- ◆ 2T superconducting

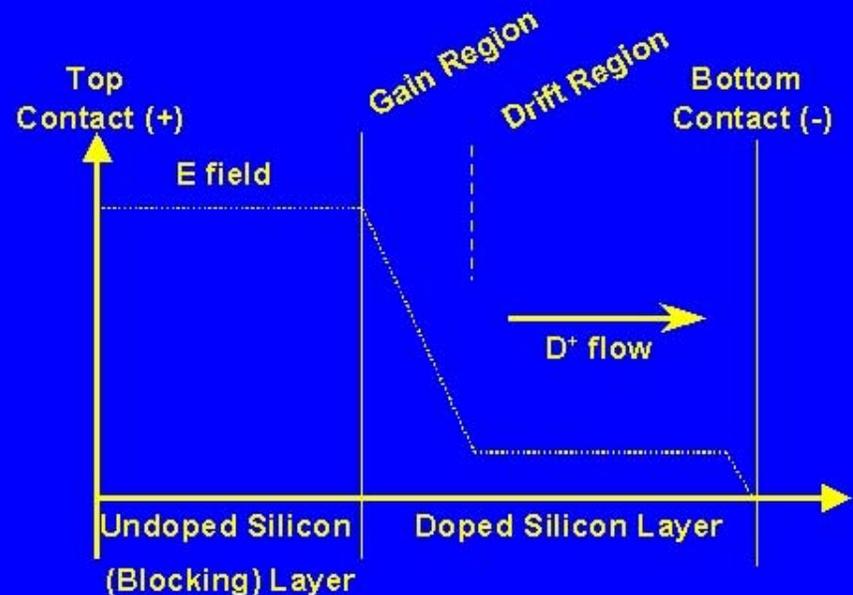
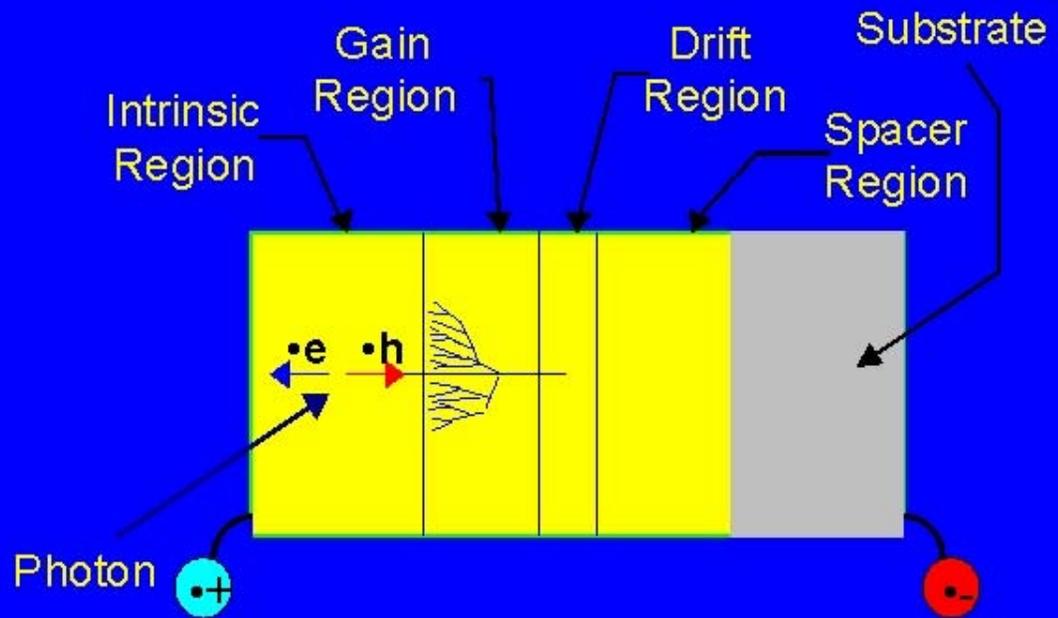
● Forward Preshower

- ◆ 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 $\times 20,000 - 60,000$ are achievable.



Liquid argon calorimeters

gas -> drift chamber

liquid -> calorimeter or drift chamber!

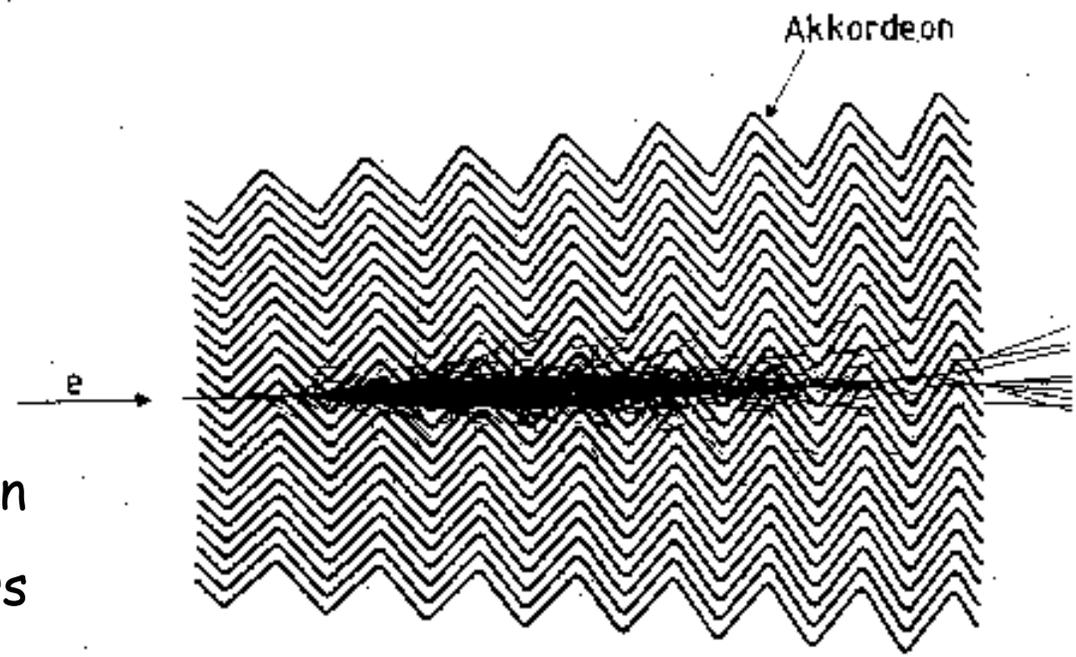
Icarus detector

- + hermiticity
- + resolution
- cryostat
- purity

Atlas, D0, SLC, NA31

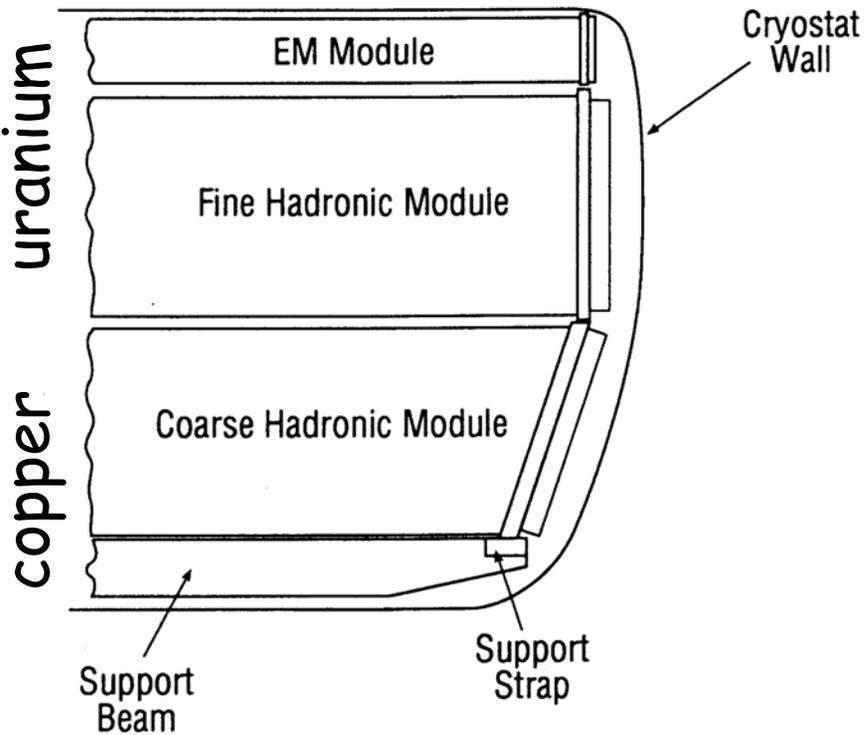
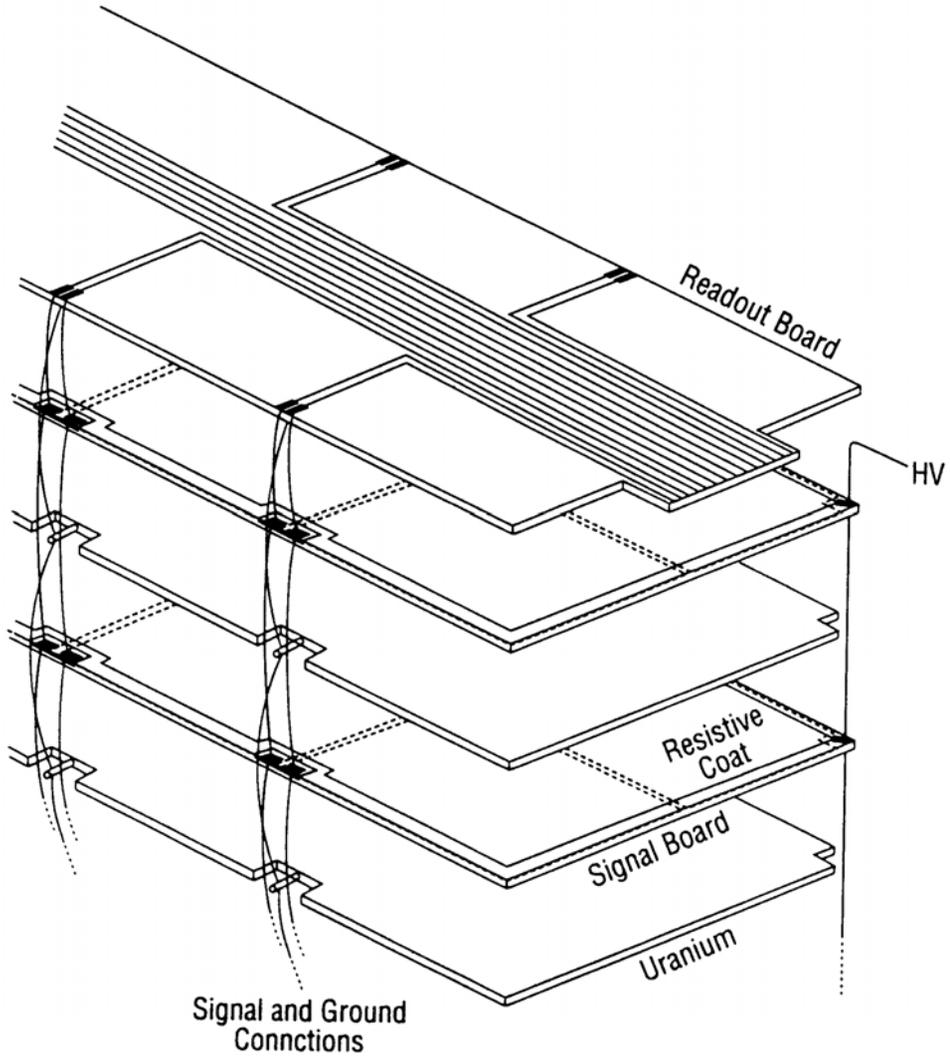
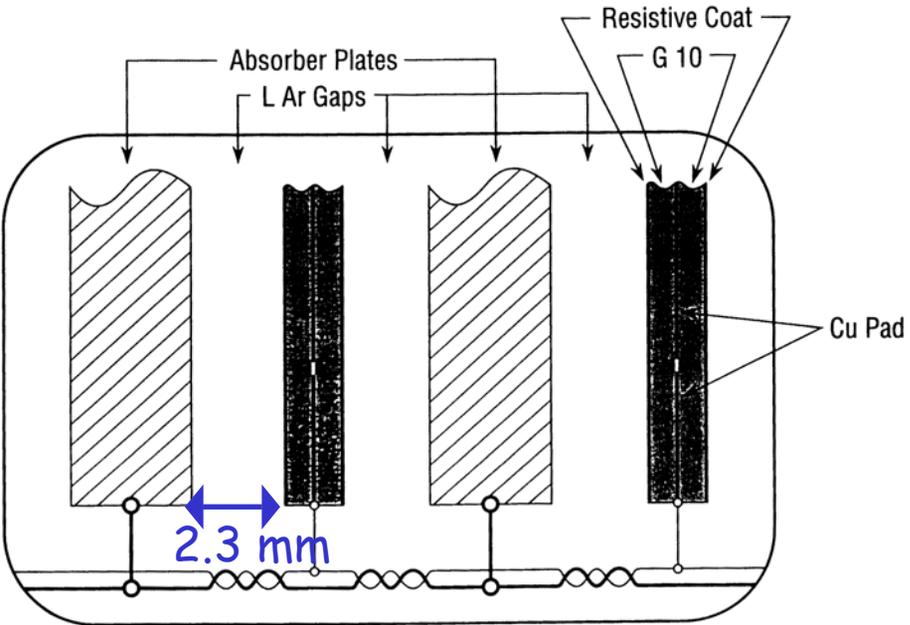


ionization chambers



SLC

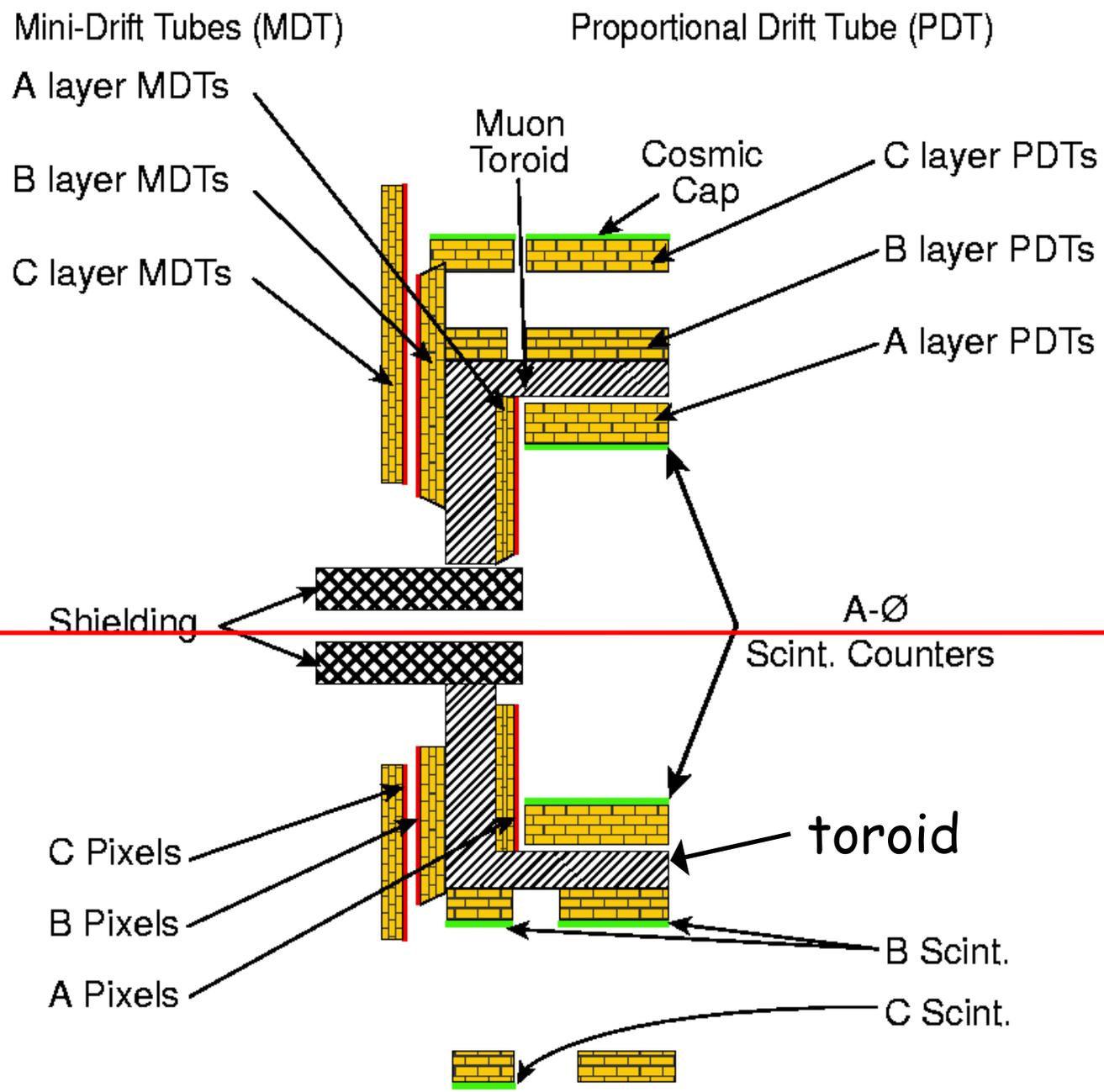
D0 calorimeter



uranium

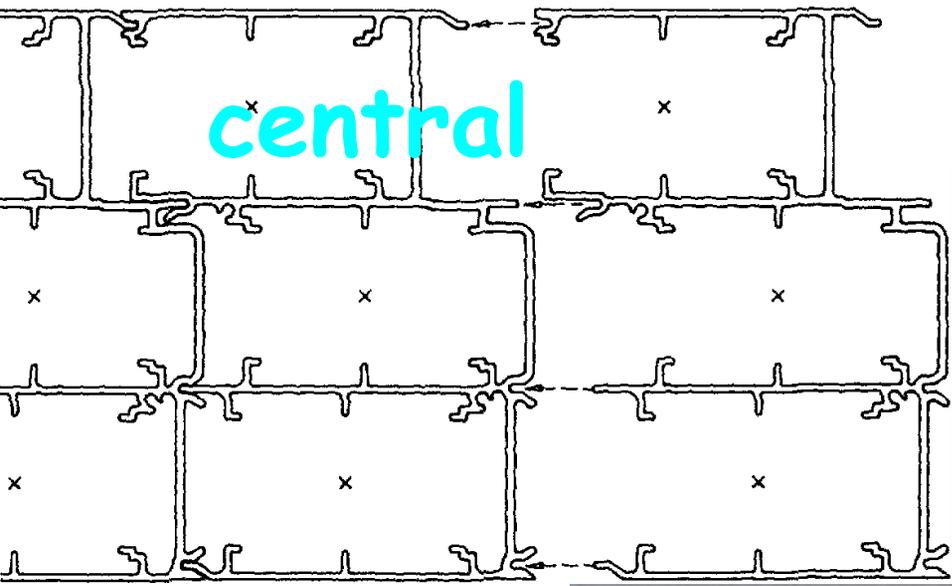
copper

D0 muon system



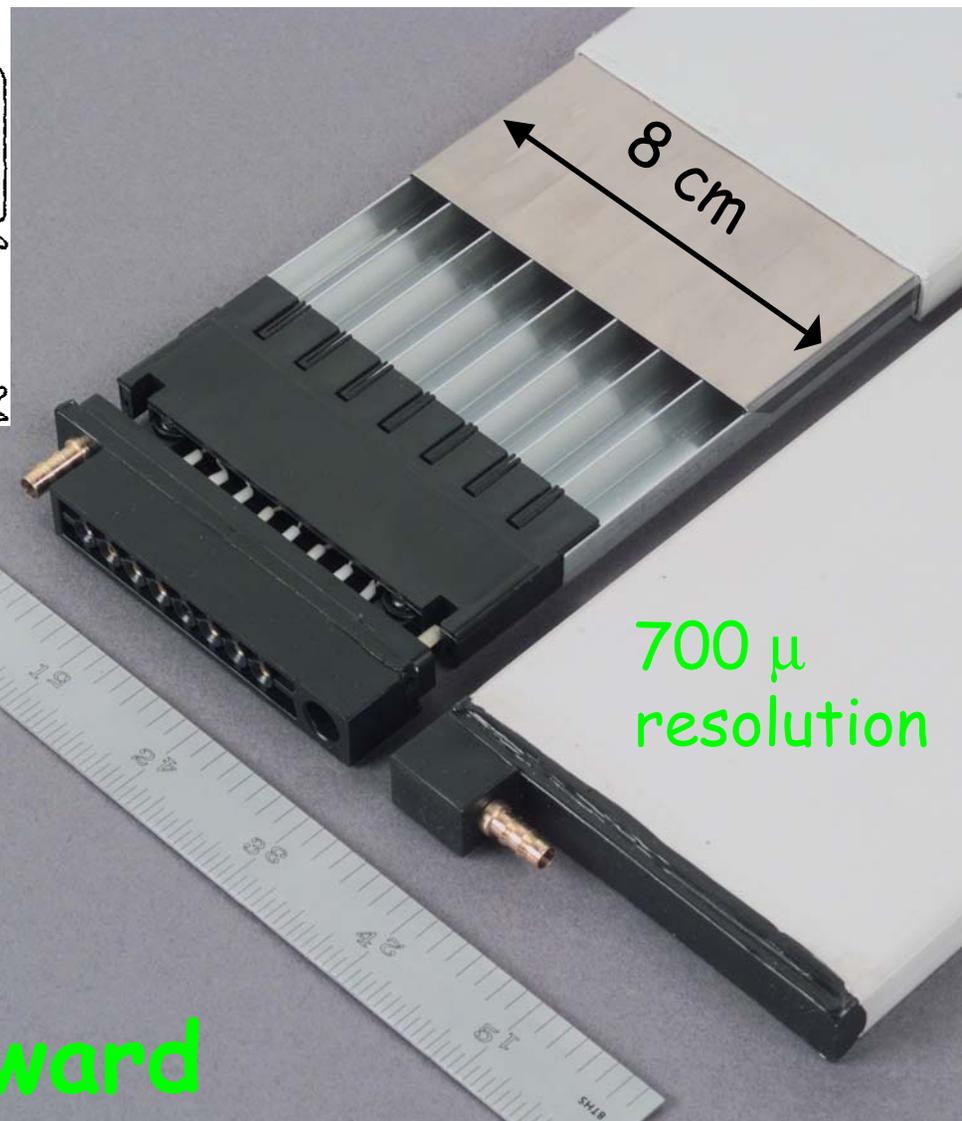
beam

D0 Proportional- and Mini-Drift-Tubes



10 cm

500 μ
resolution

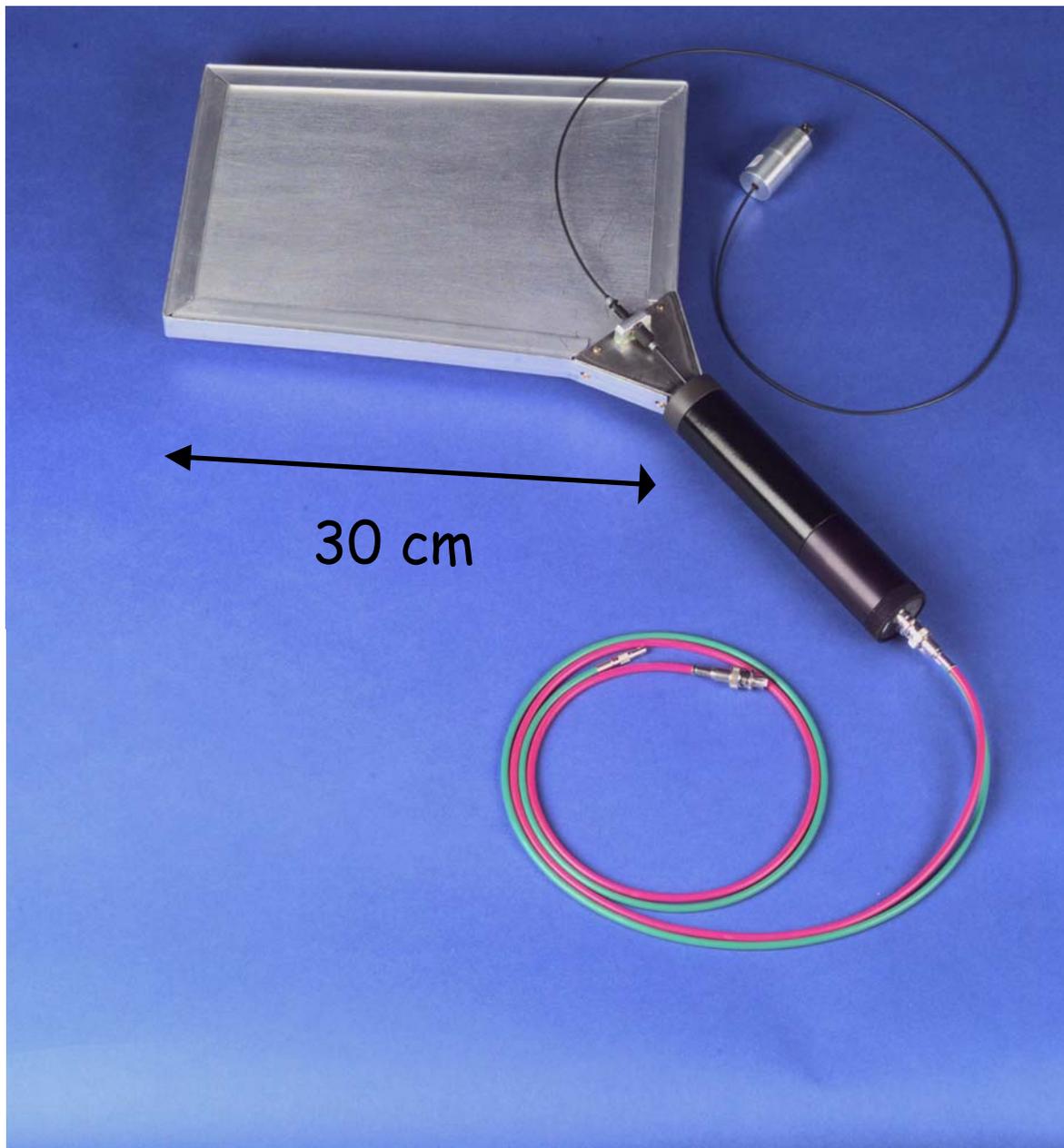
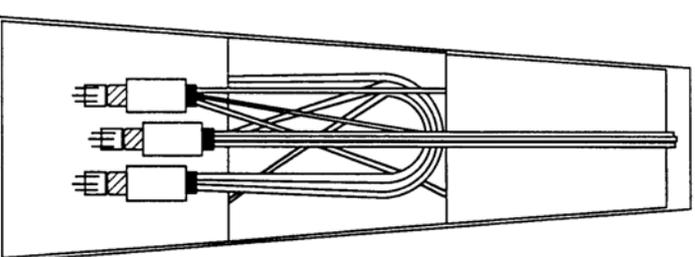
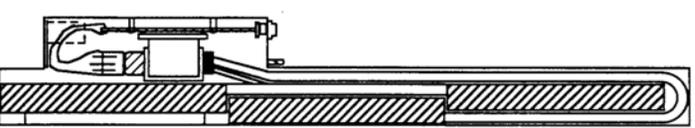
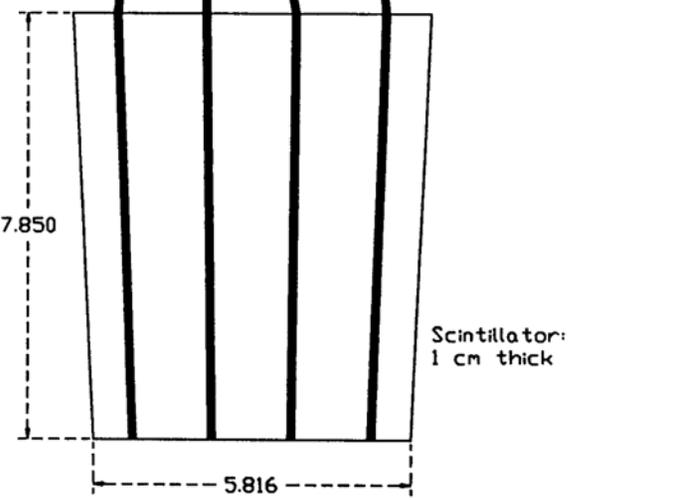


700 μ
resolution

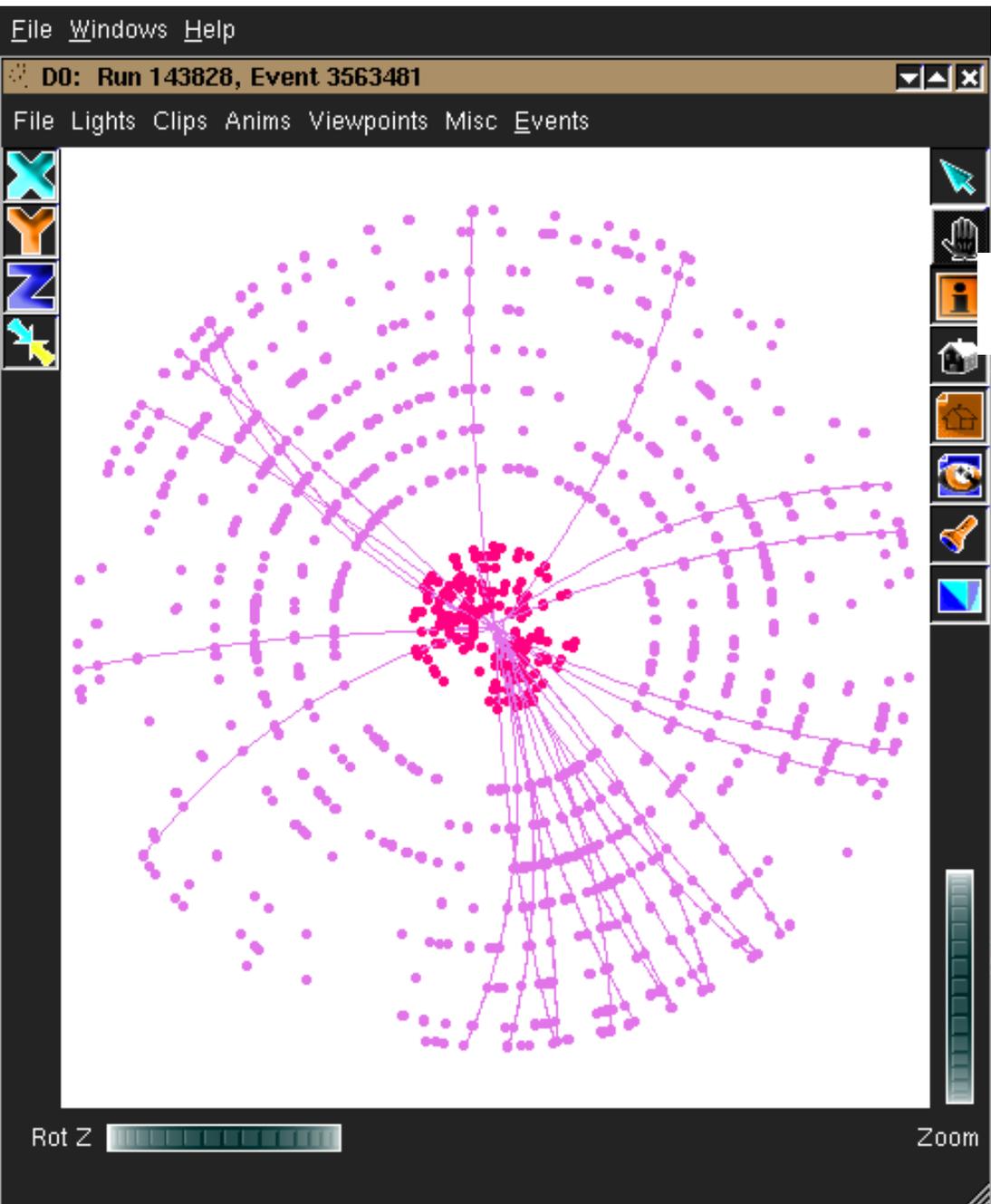
forward

D0 (Pixel) Scintillators

100 micron fibers
in 2 mm bundles

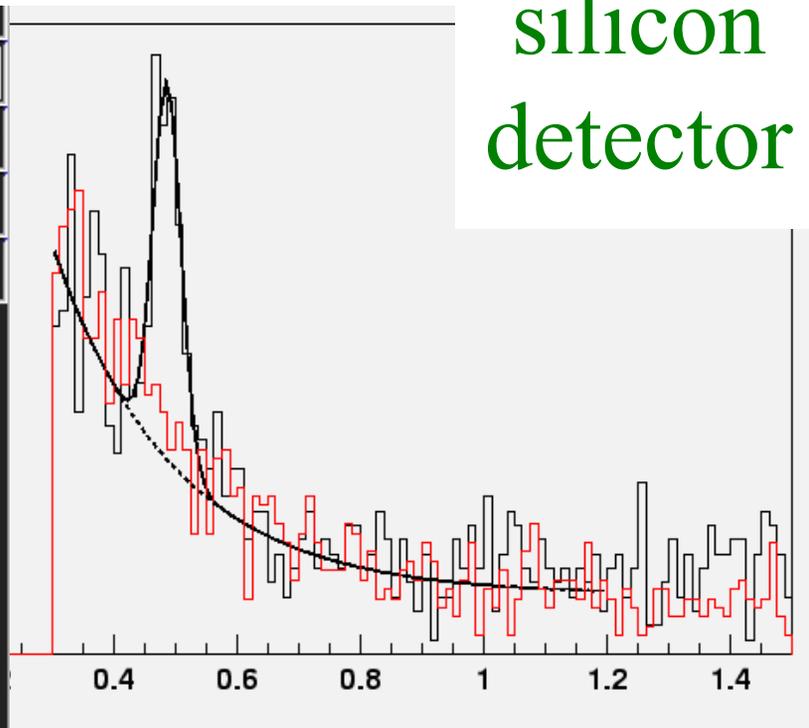


D0 event: inner tracker



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

silicon
detector

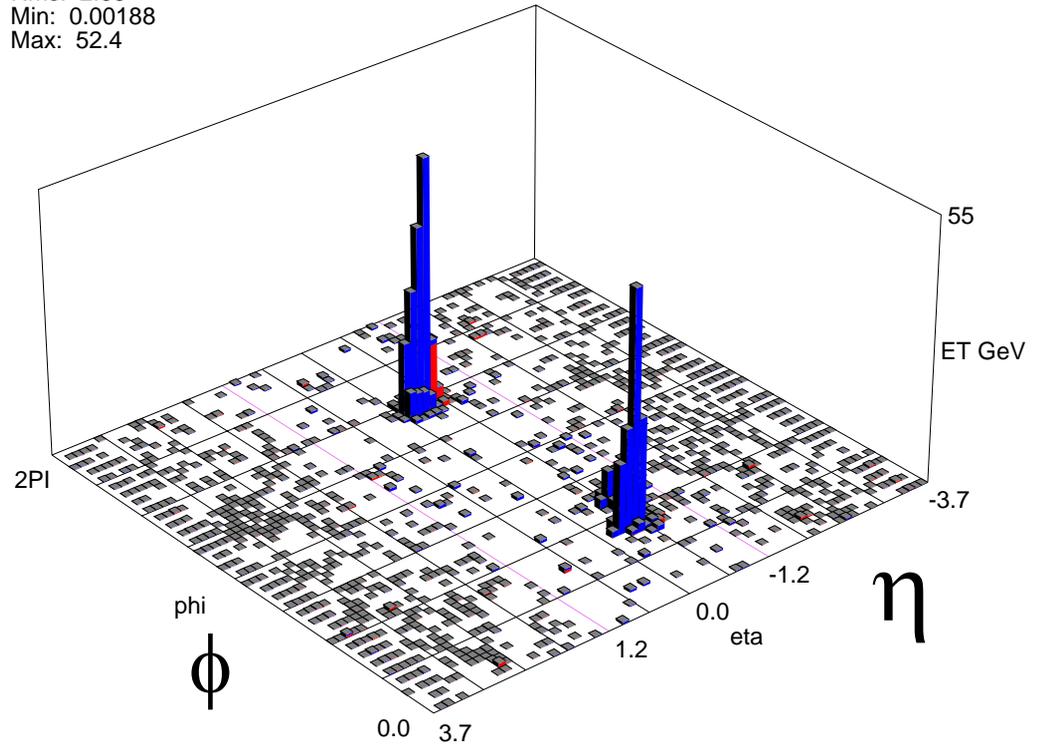


m/GeV

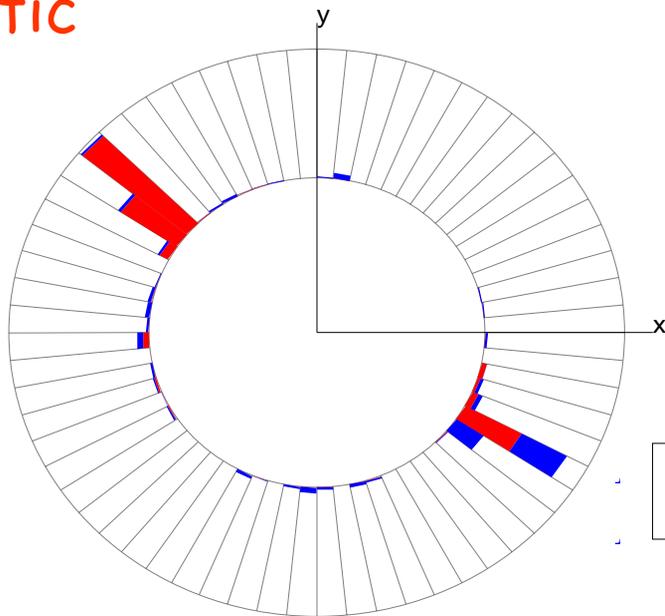
D0 event: calorimeter: jets

Bins: 1097
 Mean: 0.405
 Rms: 2.88
 Min: 0.00188
 Max: 52.4

E_t: 0.0062
 phi_t: 160deg

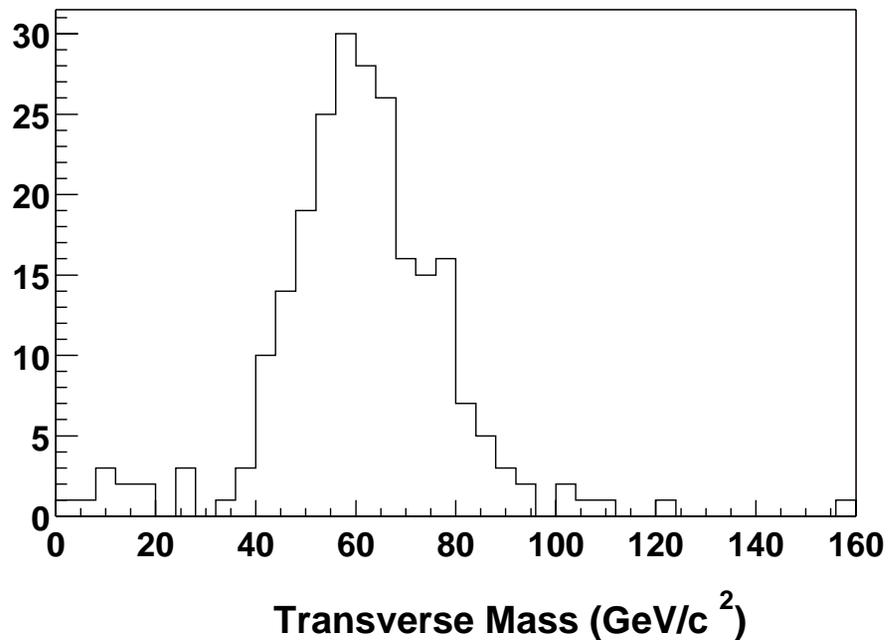
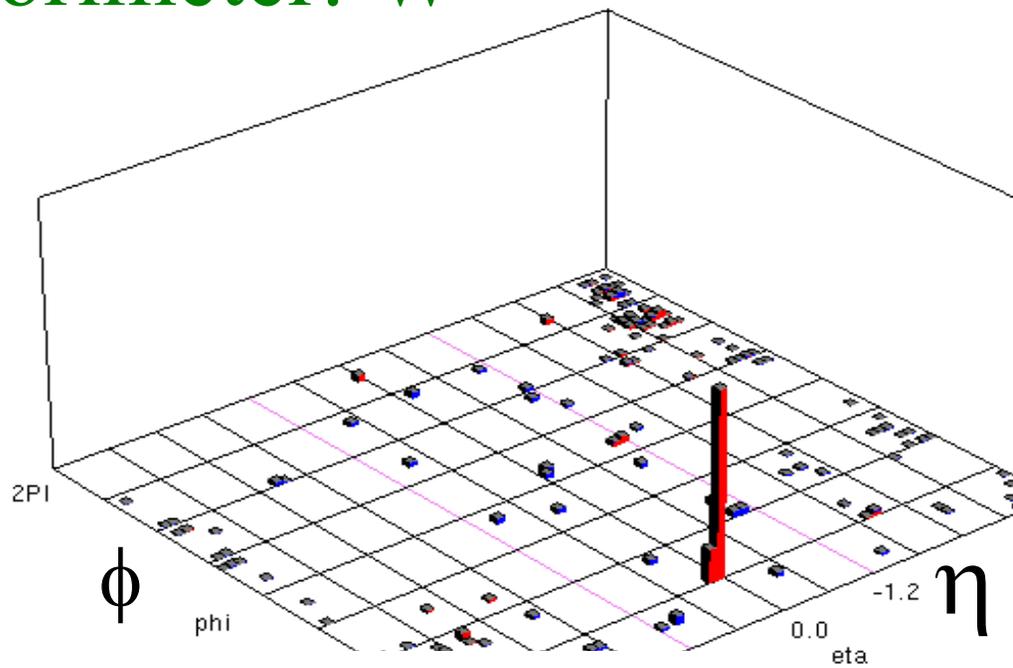
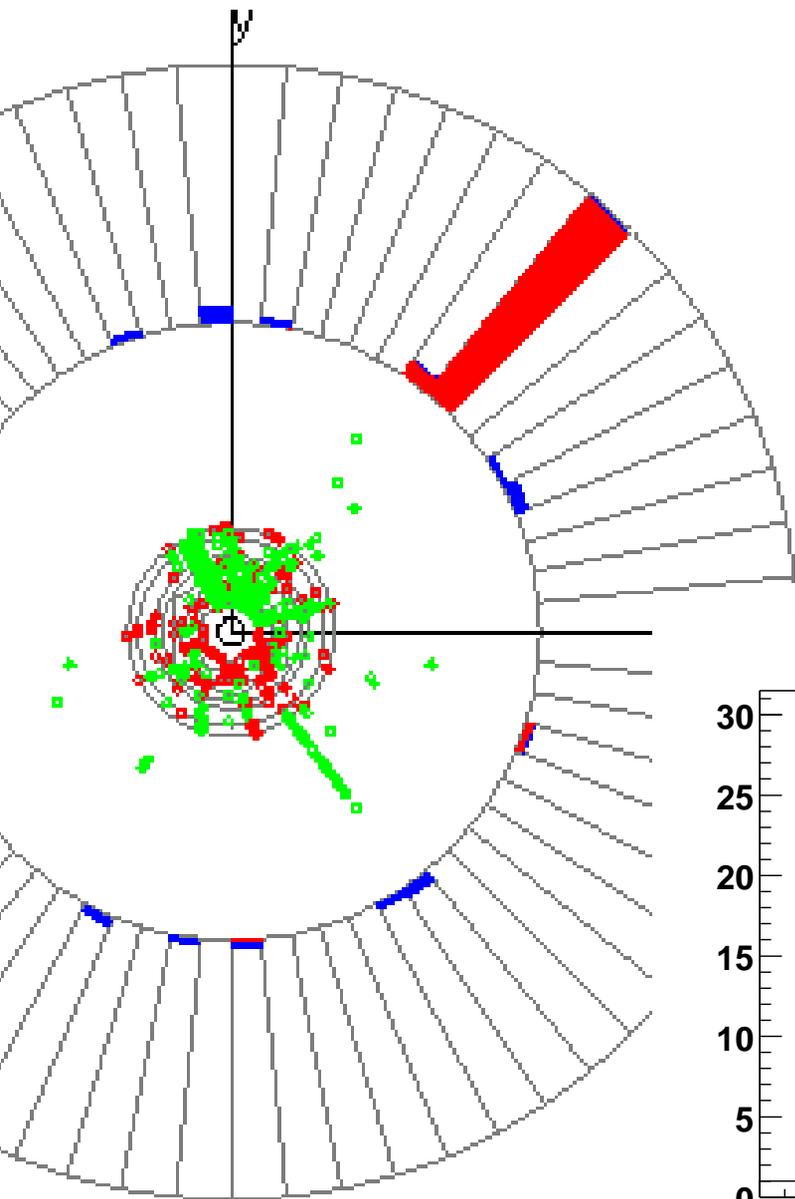


electro-
magnetic

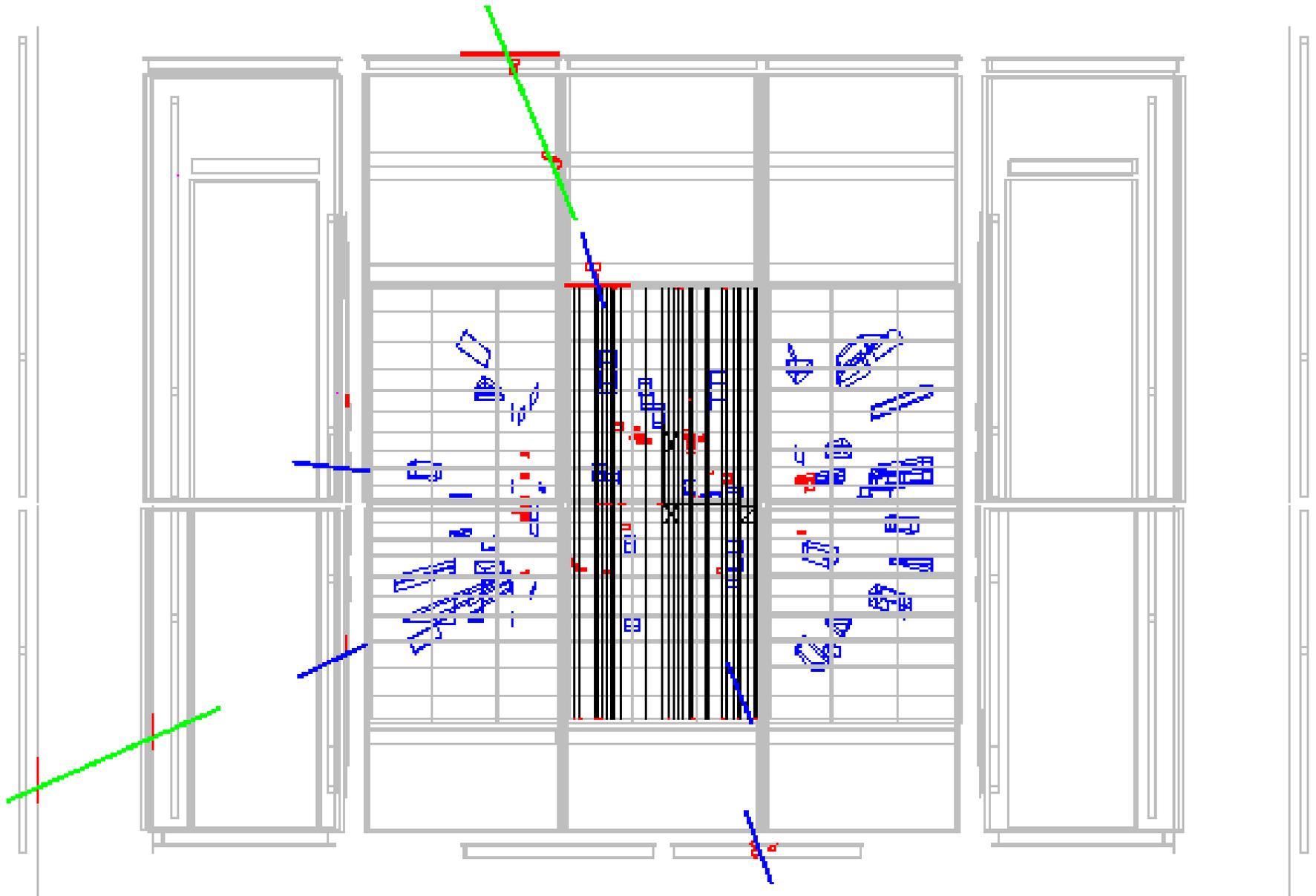


hadronic

D0 event: calorimeter: W



D0 event: muons: Z

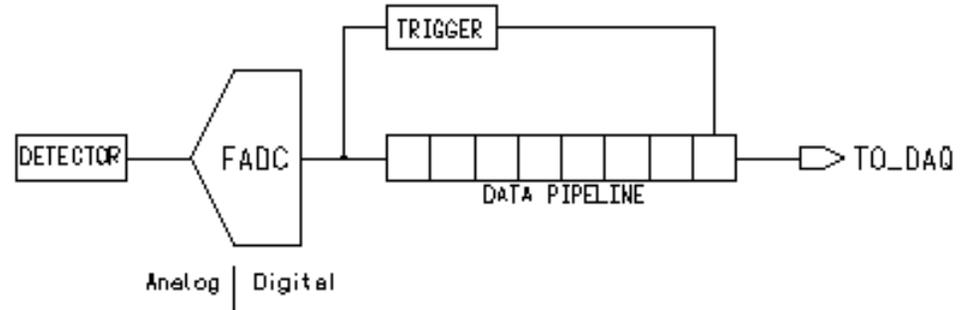


D0 trigger and DAQ

Trigger:

- level 1:

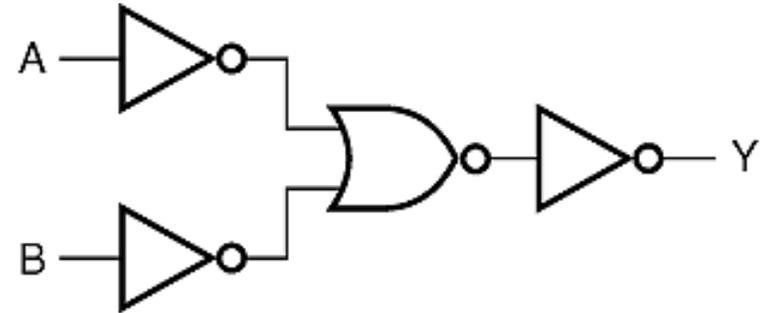
pipelined, FPGAs
3 MHz \rightarrow 10 kHz



"Pipeline" Electronics

- level 2:

DEC alpha processors
10 kHz \rightarrow 1 kHz



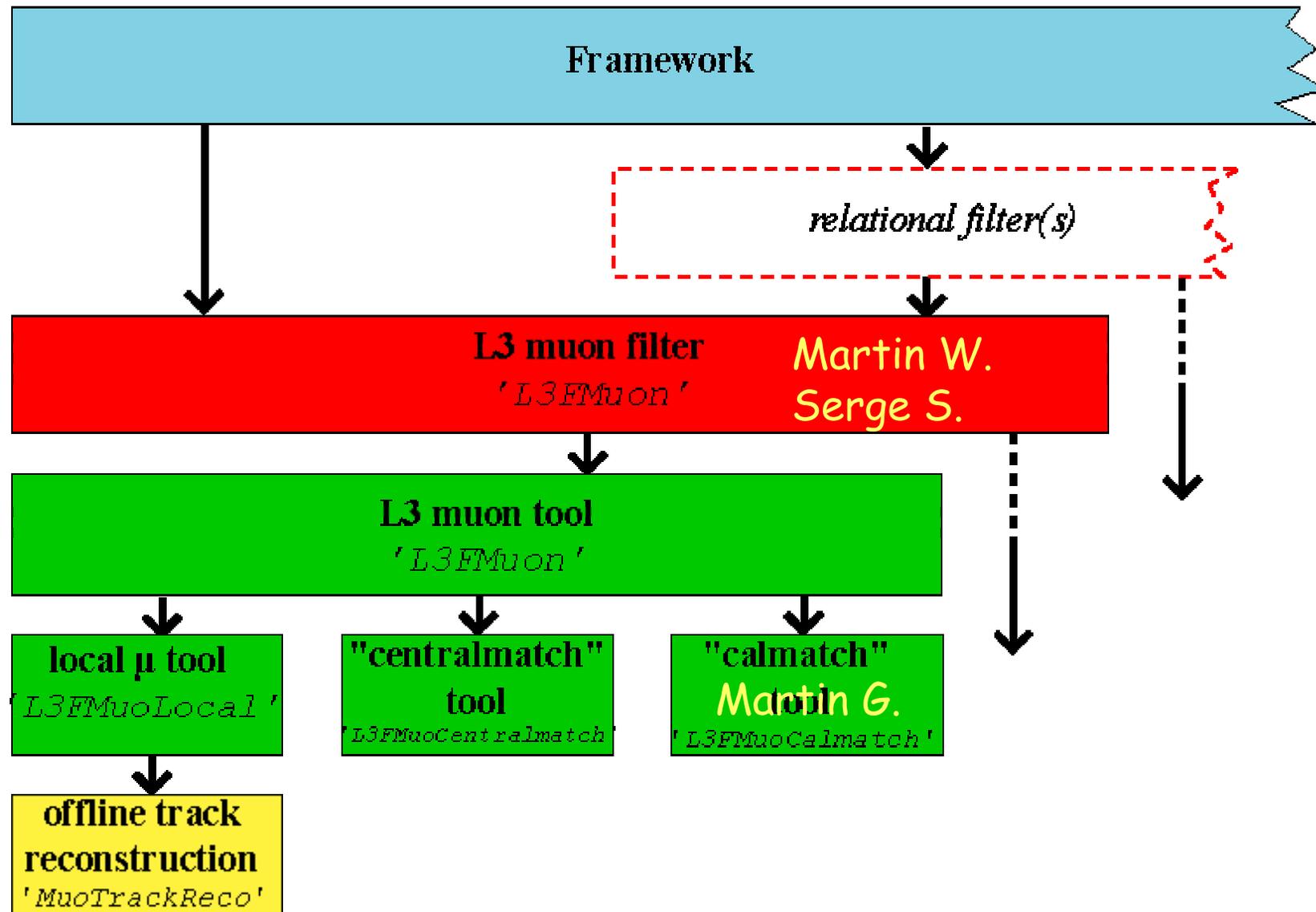
- level 3:

Linux PC farm
1 kHz \rightarrow 50 Hz

DAQ:

\rightarrow pentium processors in VME system

L3 trigger software



Status Tevatron and D0

Tevatron:



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

efficiency = $\frac{1}{2}$ design value (80%)

hope: 300/pb in 2002 (per detector)

D0:

recorded: $\sim 10/\text{pb}$

detector: most parts functional, biggest problem: tracks!

trigger/DAQ: design rate not yet achieved

hope: fully operational by summer 2002

