The D0 detector calorimeter

Oscar Larsson
KTH

Henri Seppänen
University of Helsinki

Björn Nordkvist, Maja Tylmad, Elin Bergeaas Kuutmann
Stockholm University

Purpose of D0

- General-purpose detector for high energy hadron collisions at the Tevatron proton-antiproton collider
  $\sqrt{s} = 1.8$ TeV (1.96 TeV in Run II)
- Designed for the study of high-mass and large E_T phenomena
- Top quark discovery required
  - good energy resolution (missing E_T)
  - good jet resolution
  - accurate jet energy scale

The D0 calorimeter system

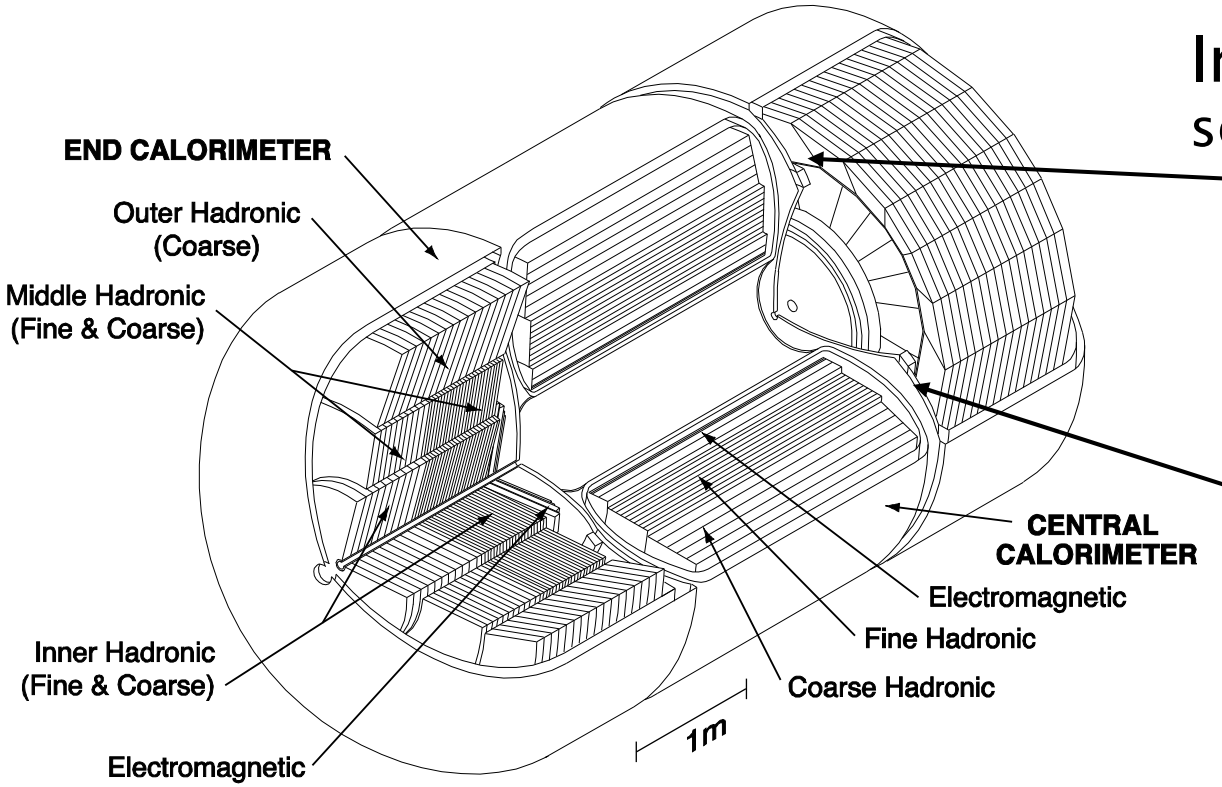
Pre-shower: scintillator (tracking/calo)

Central calorimeter (CC):

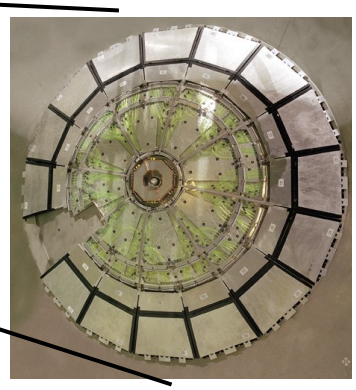
Electromagnetic, Fine hadronic, Coarse hadronic

End calorimeter (EC):

Electromagnetic, Inner hadronic, Middle hadronic, Outer hadronic



Inter-cryostat detector (ICD)
scintillators



D0 calos

Active material: LAr 15 000 litres

Passive material:

- EM: U
- Fine Hadron: U/Nb
- Coarse hadronic: copper or steel

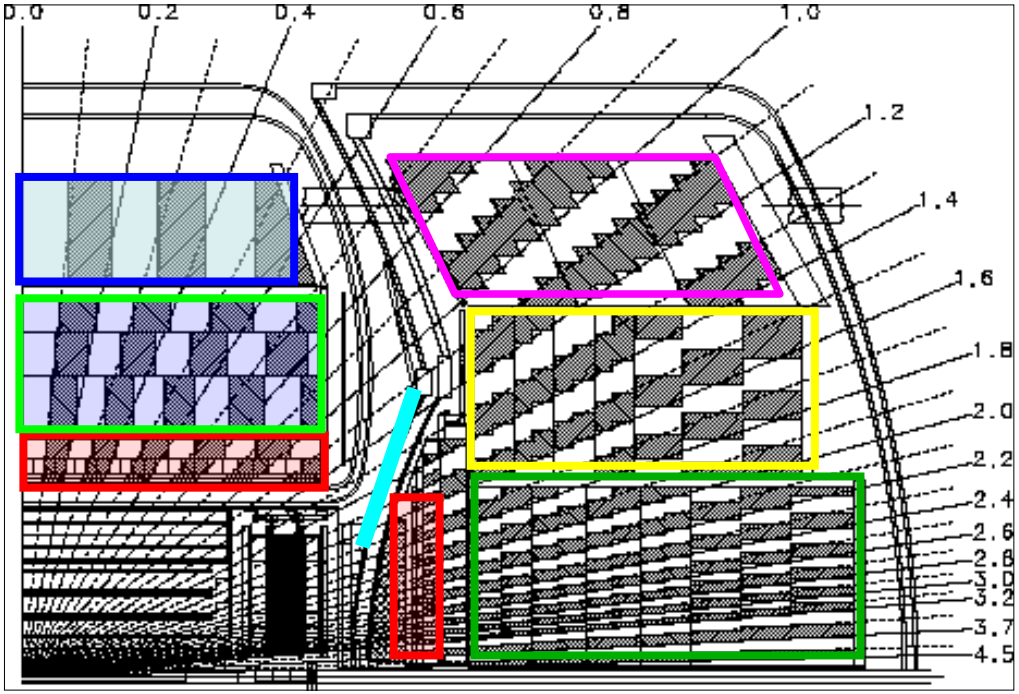
- Run I: compensating.
- Run II: increased collision frequency
=> shorter integration time
=> not compensating

Coarse Had

Fine Had

EM

ICD



Outer had (coarse)

Middle had (coarse & fine)

Inner had (coarse & fine))

Resolution

$$\frac{\sigma(E)}{E} = \sqrt{C^2 + \left(\frac{S}{\sqrt{E}}\right)^2 + \left(\frac{N}{E}\right)^2}.$$

Run I set-up test beam values:

Particle	C	S	N
e	$0.0115^{+0.0027}_{-0.0036}$	$(0.135 \pm 0.005)\ \sqrt{\text{GeV}}$	0.43 GeV
π	0.032 ± 0.004	$(0.45 \pm 0.04)\ \sqrt{\text{GeV}}$	0.975 GeV

The resolution worsened in Run II due to extra material before the calo, and new noisier electronics

Advantages

- LAr/U
  - ease of segmentation
  - compensating (suppresses response to EM part of had shower)
  - stability of calibration
  - homogenity of response
- U high density: compact calo at low cost
- LAr is radiation-hard, easy to handle, cheap

No changes were made to the calos in the Run I->Run II upgrade

Disadvantages

- Uranium is very **noisy** (radioctive)
- Not compensating in Run II
- Hard to handle (radioctive)

References

- J. Strandberg (doctoral thesis, 2006)
- S. Strandberg (doctoral thesis, 2007)
- Norm Buchanan: CALOR 2006 conference (June 5, 2006)
- F. Tarrade: Journal of Physics: Conference Series 110 (2008) 092030
- C. Santoni: Talk at TileCal Week, July 2, 2008