

Dual-Readout Calorimetry (Scintillation + Cerenkov)

Results of the DREAM beam test at CERN H4 beam, summer 2003

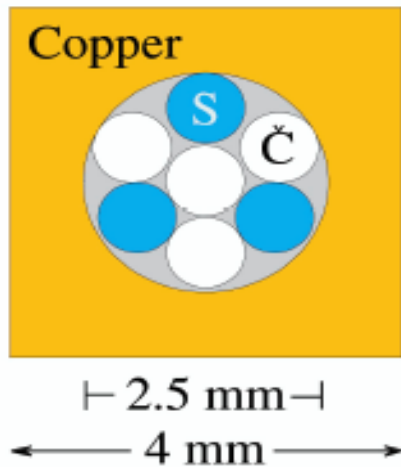
John Hauptman, Iowa State University

Richard Wigmans, Nural Akchurin, Heejong Kim, Ken Carrell, Ray
Thomas Texas Tech University

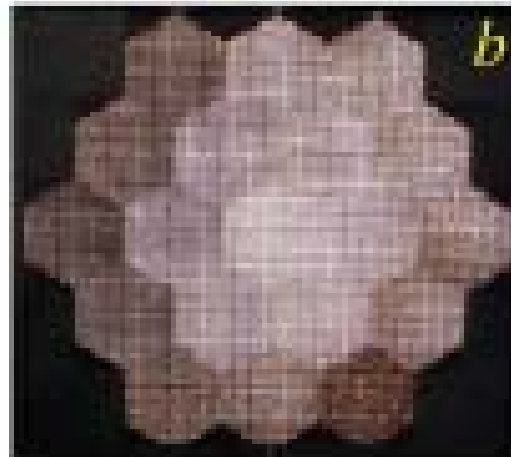
Aldo Penzo, INFN, Trieste; John Hauptman, Iowa State University;

Hans Paar, UC San Diego

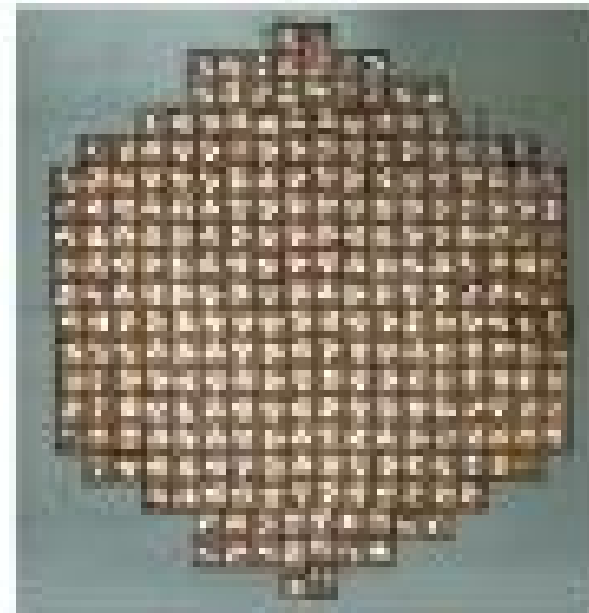
Dual-Readout Module (DREAM)



“Unit cell”



Fibers



Cu and fibers



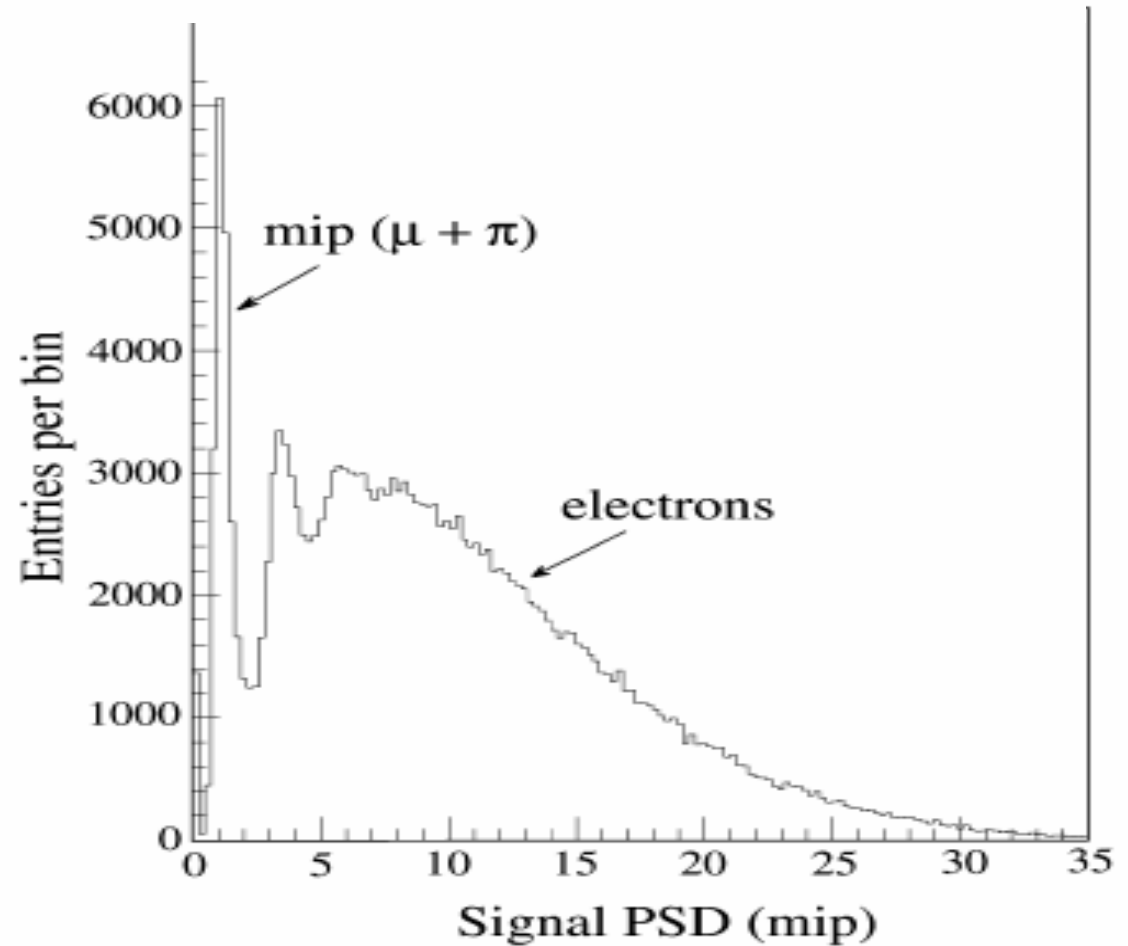
PMT readout box in H4 beam



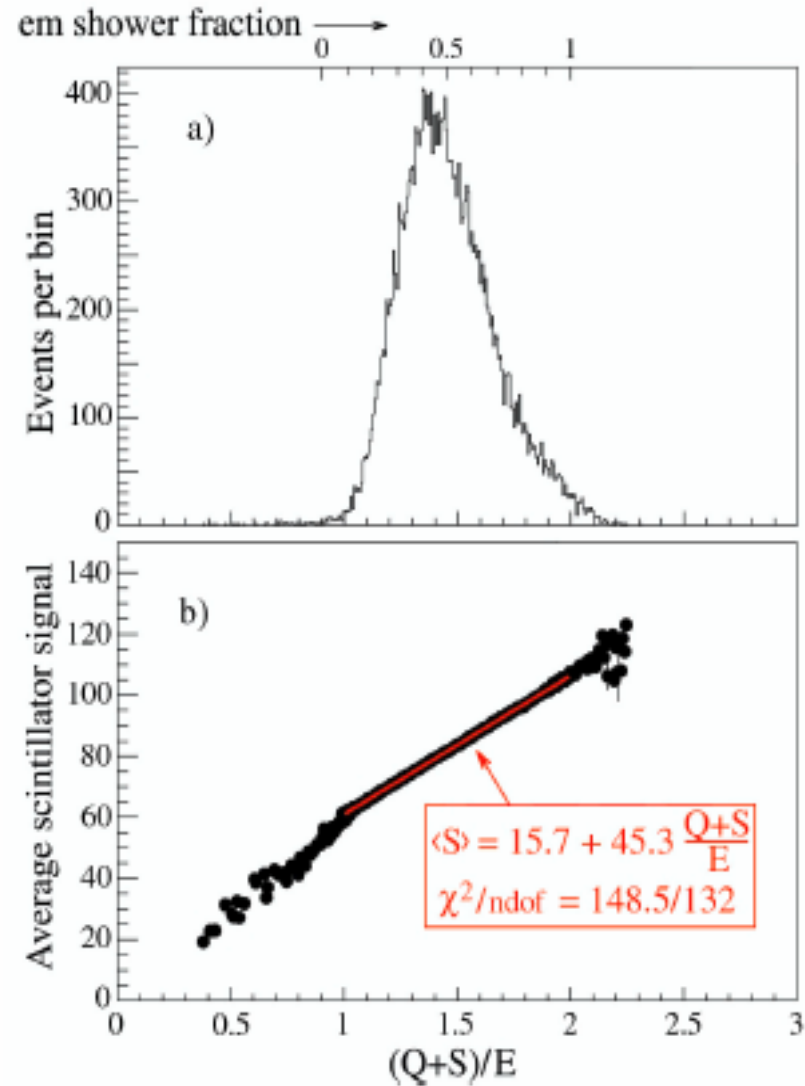
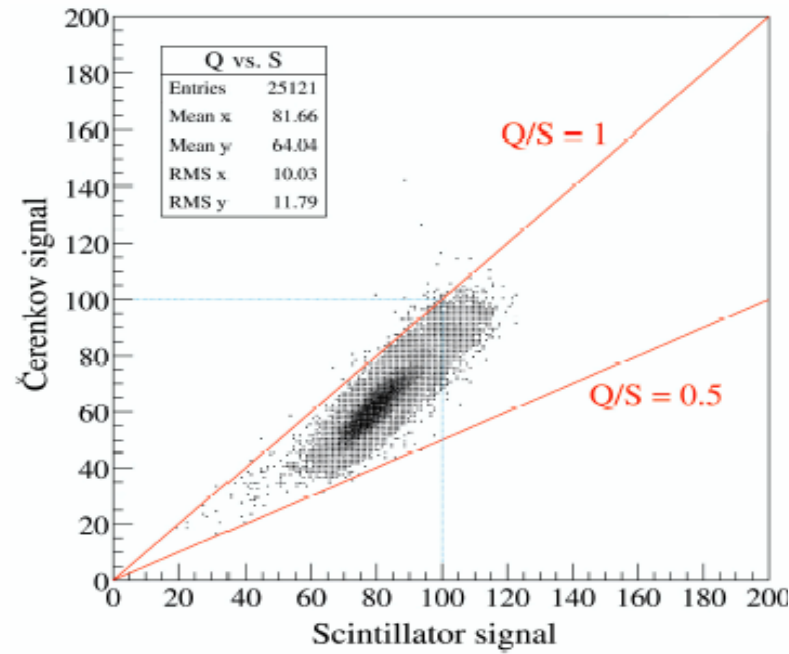
H4 beam – looking upstream



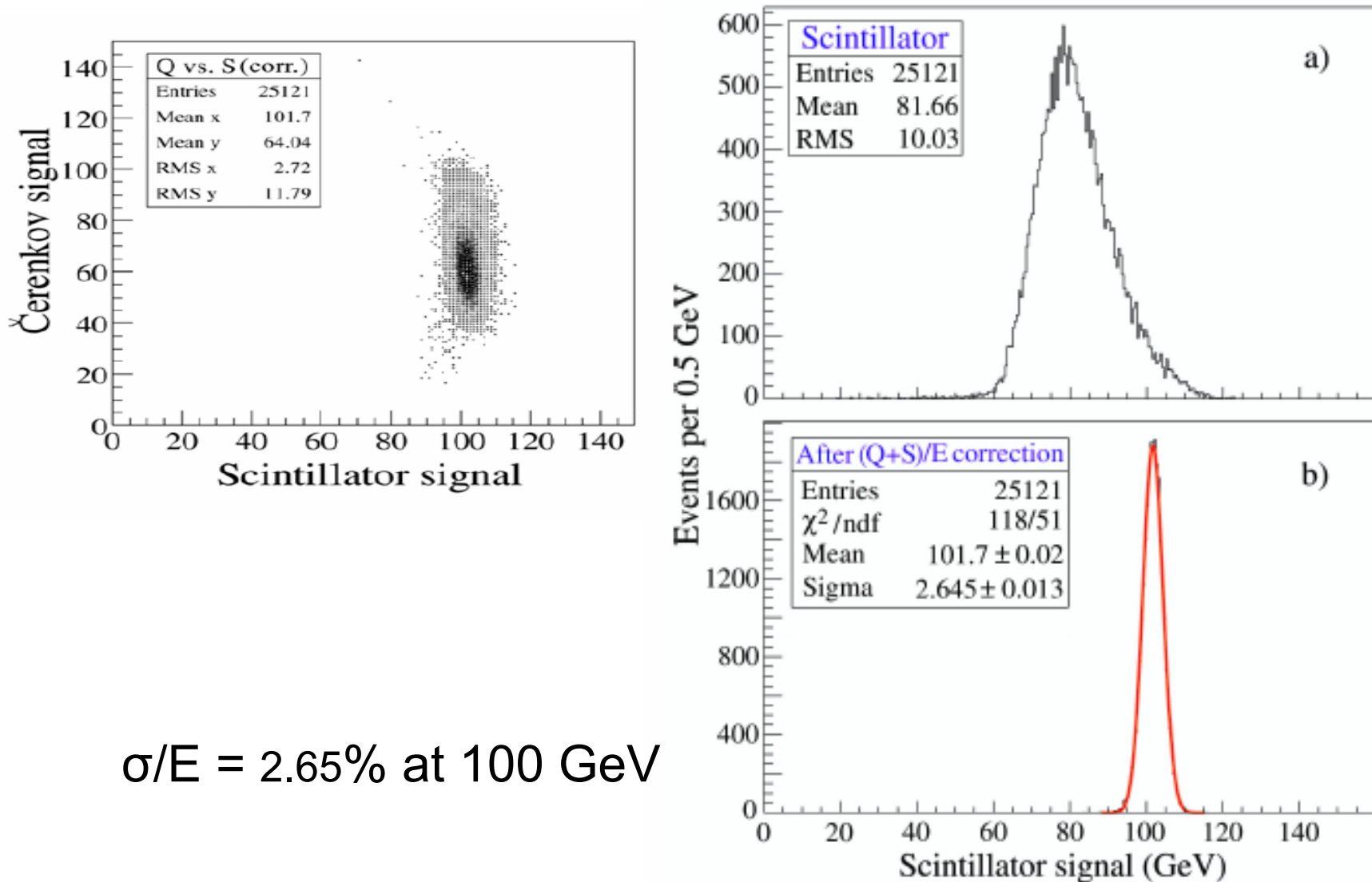
H4 beam



Cerenkov vs. Scintillation



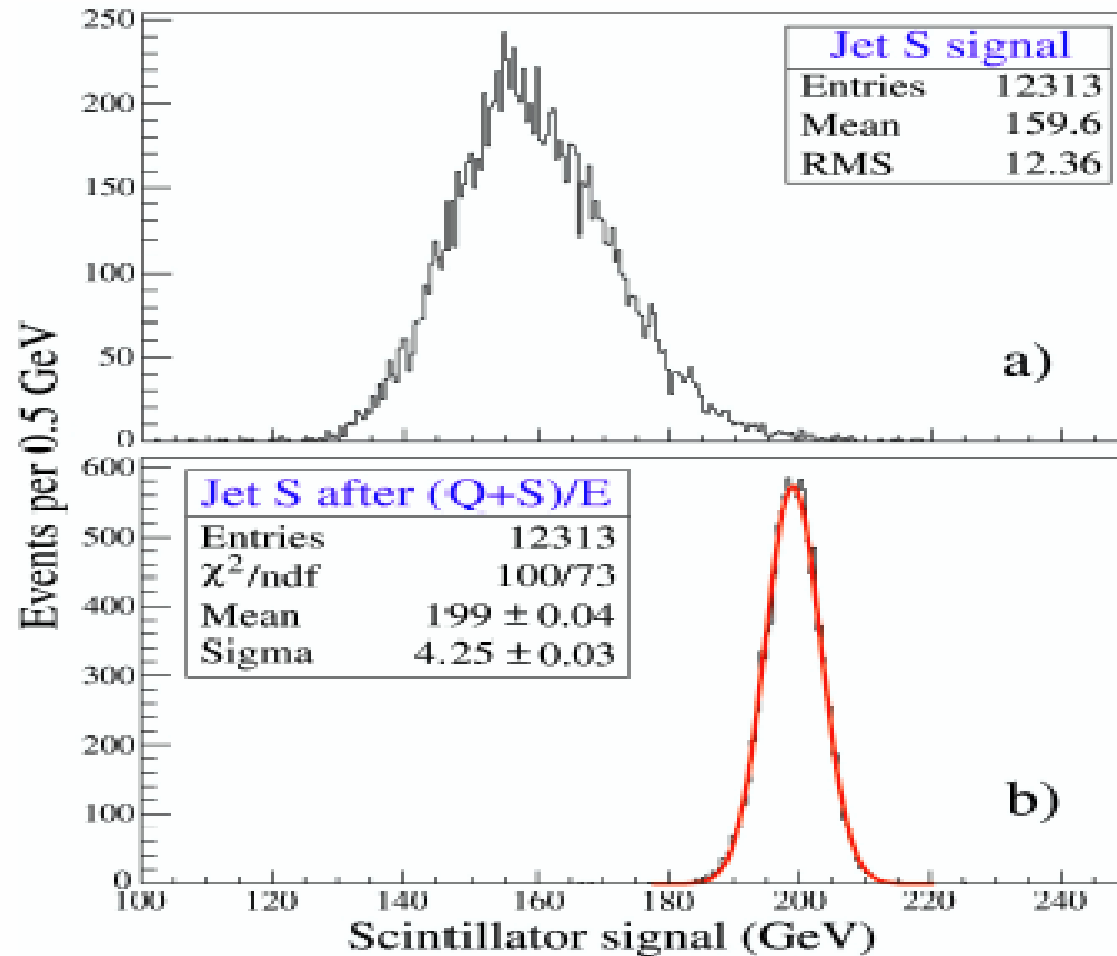
Correct event-by-event for EM fraction



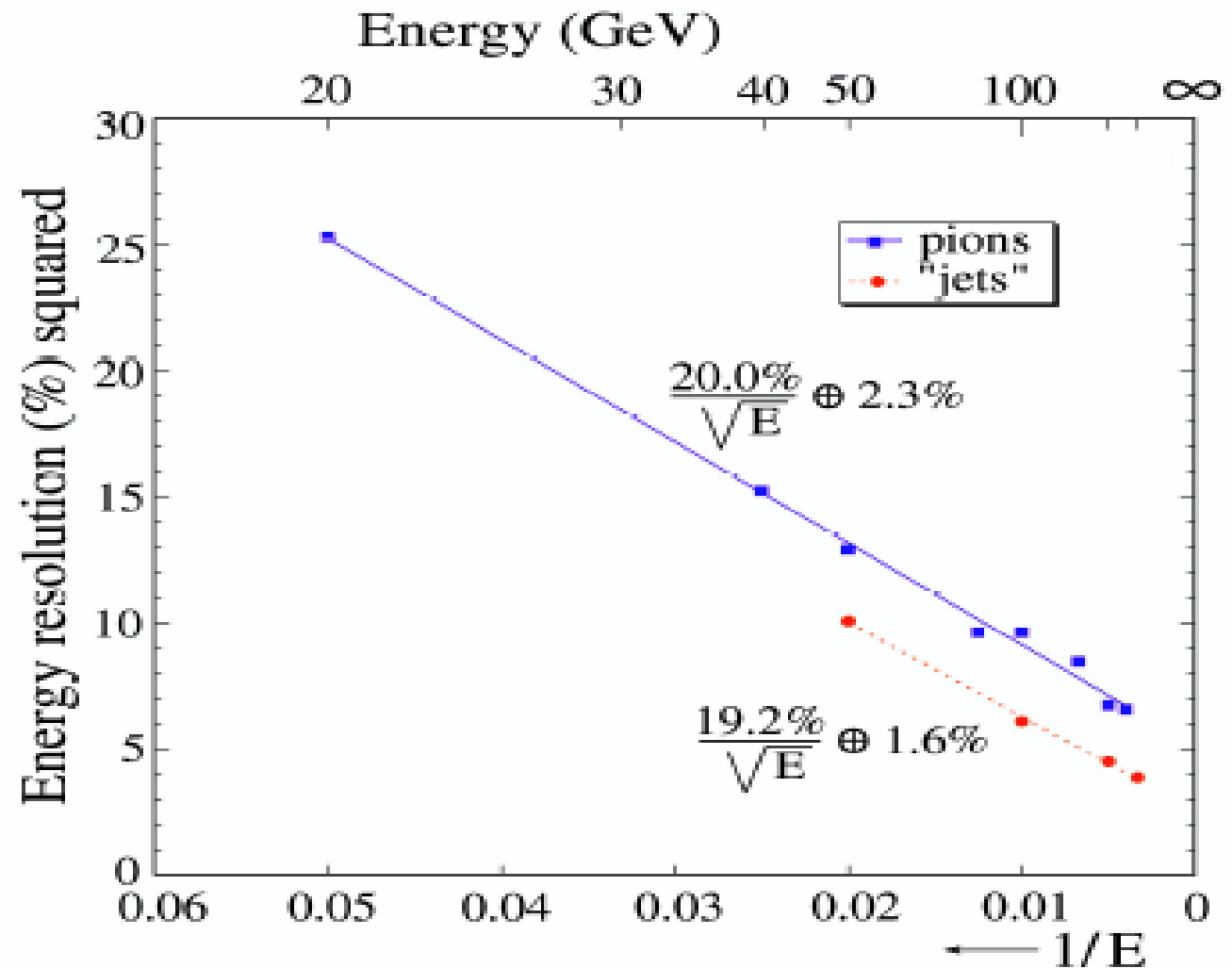
“interaction jets” – 0.1 λ Lucite

200 GeV
pions

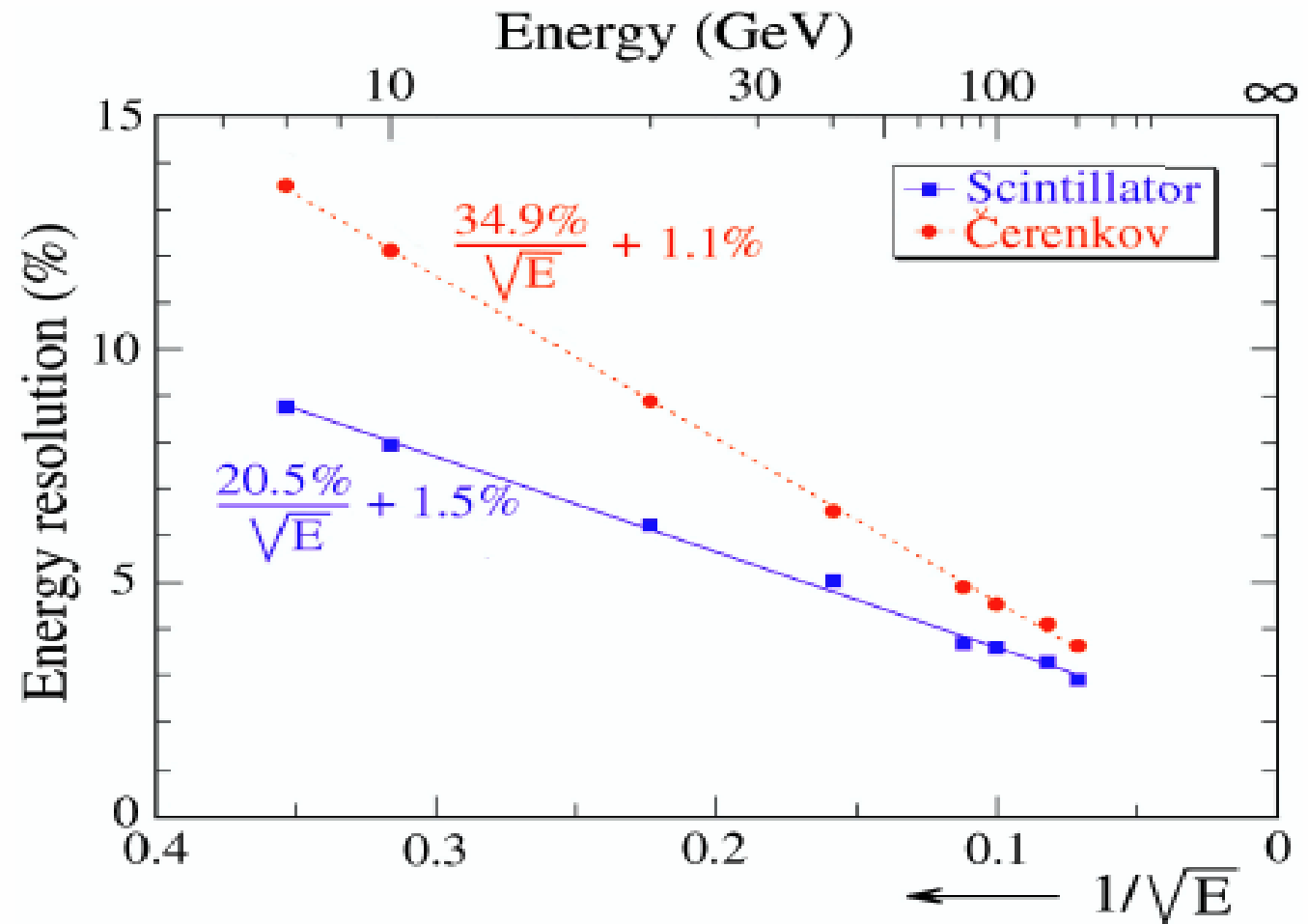
$$\sigma/E = 2.15\%$$



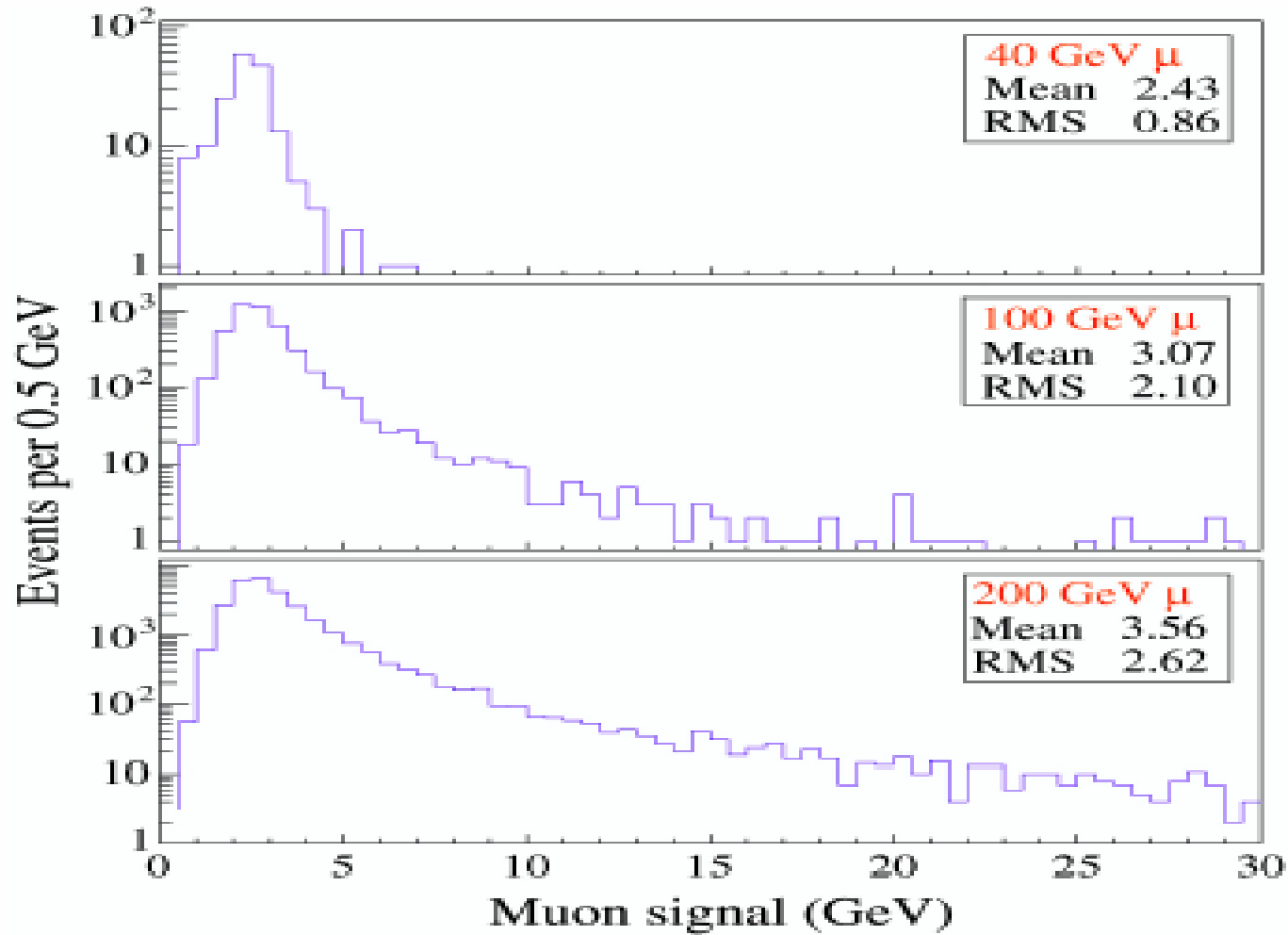
Resolution of π 's and "jets"



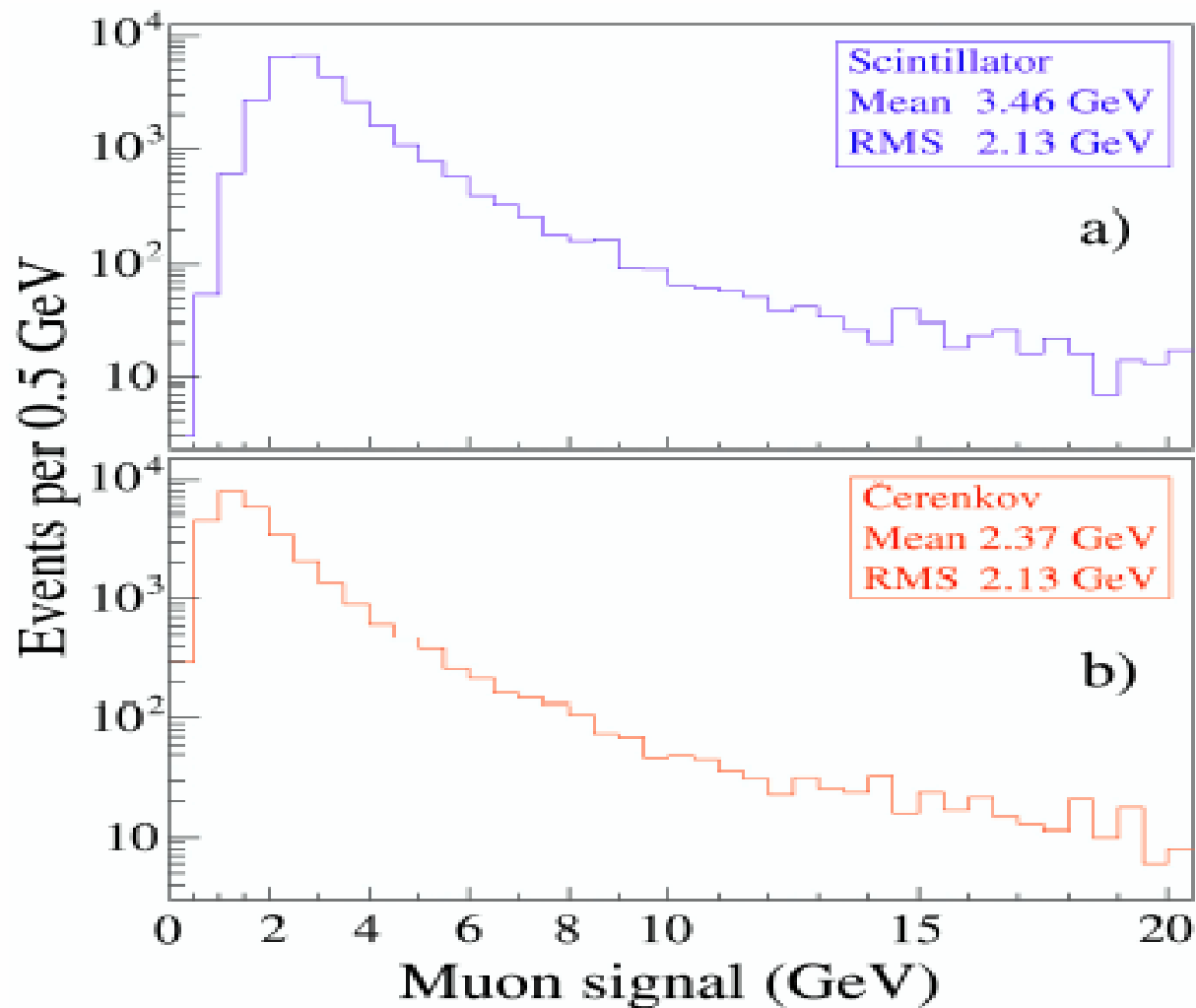
Electrons: energy resolution



Muons into DREAM

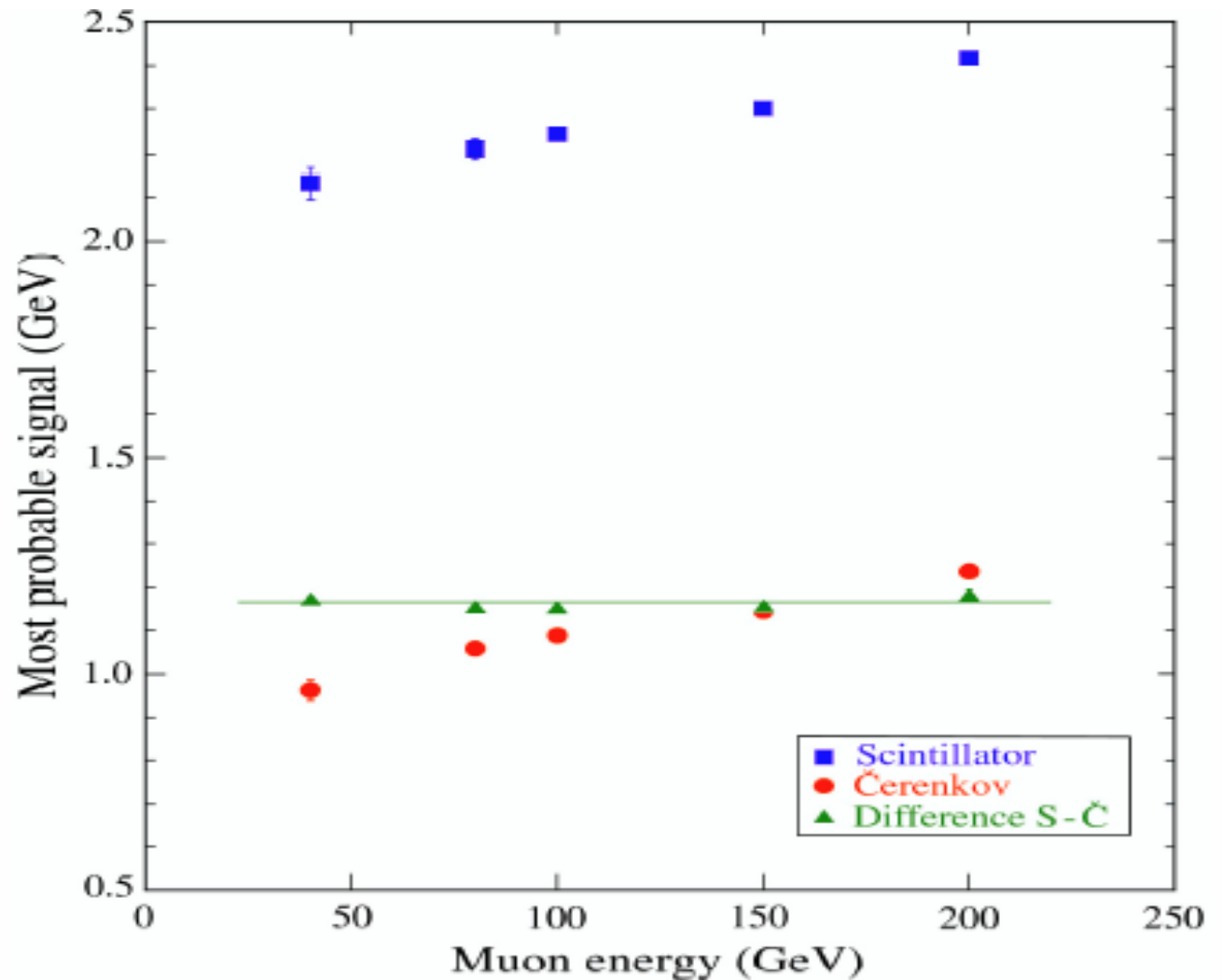


Scintillation & Cerenkov signals



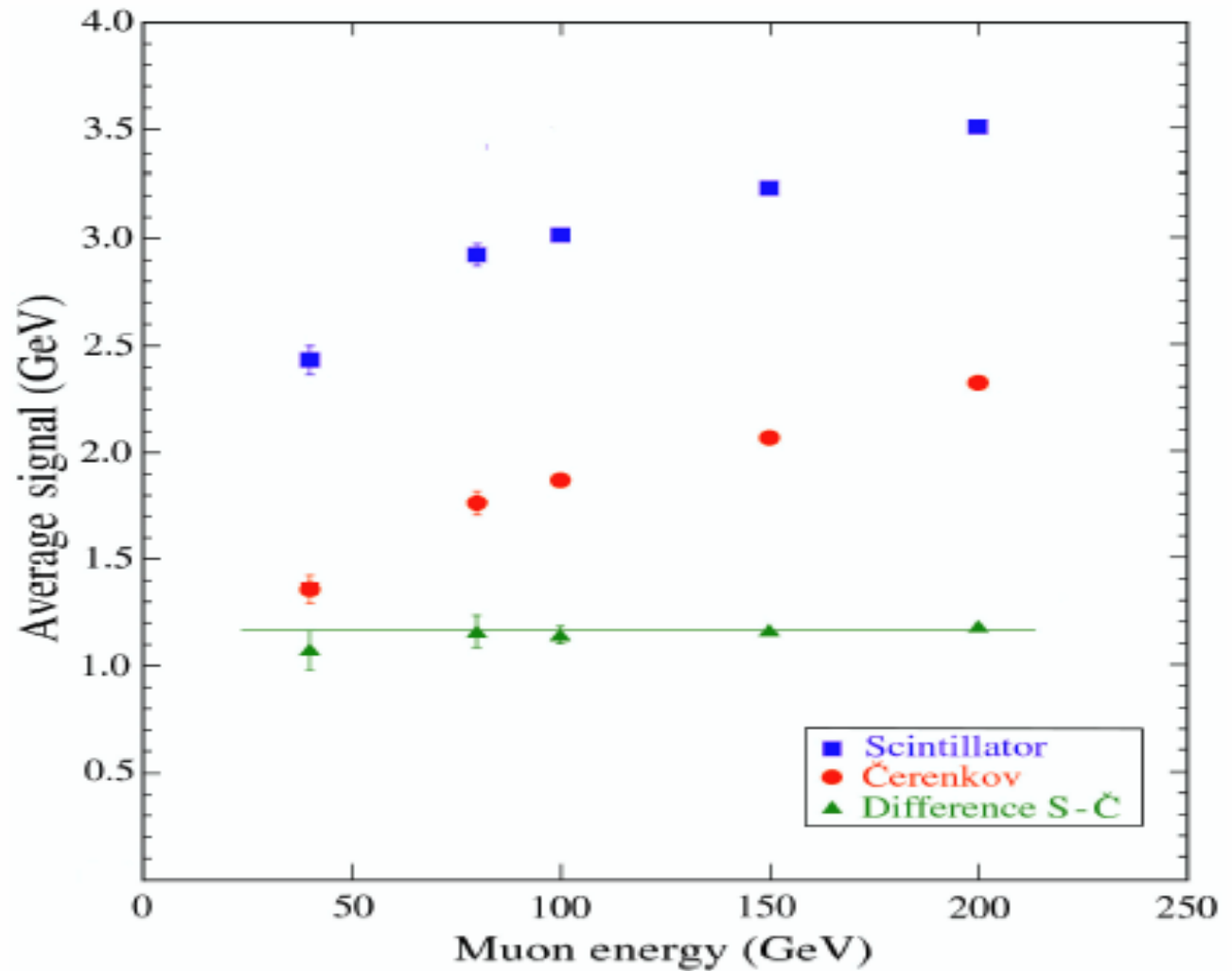
Separate contributions of ionization and radiative energy losses by muons

Most probable energy loss



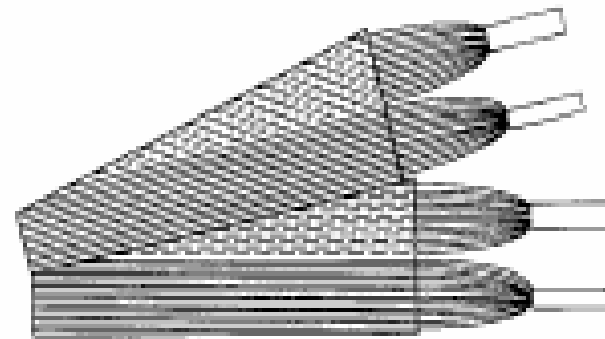
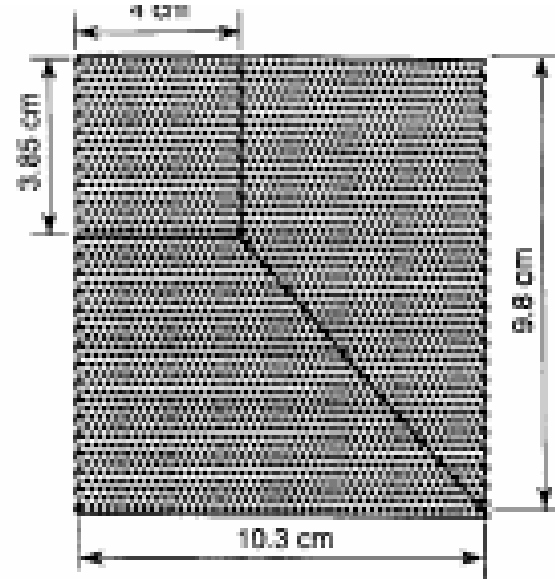
Ionization and radiative energy losses

Average energy loss



From a module to a 4 π detector

- Only important point - the fiber densities must be constant throughout the volume
- Several possible solutions...this is RD1

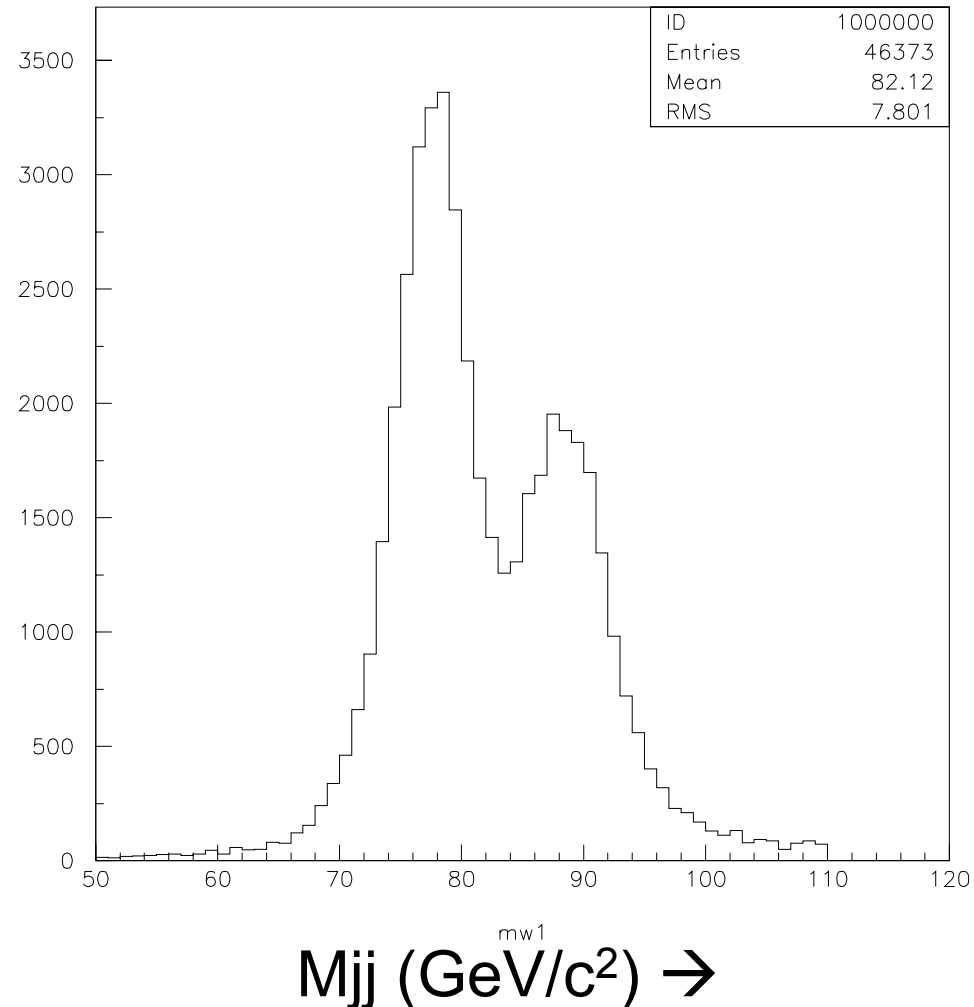


This dual-readout calorimeter can measure all the partons of the SM with comparable precision: e , μ , q , γ , and therefore all W and Z decays

Pythia processes 22 and 25,
DREAM resolutions, jet cone
reconstruction

$e^+e^- \rightarrow WW \quad \& \quad ZZ$

$W \rightarrow jj \quad \text{and} \quad Z \rightarrow jj$



Papers submitted to NIM: N. Akchurin, K. Carrell, J.

Hauptman, H. Kim, H.P. Paar, A. Penzo, R. Thomas, and R. Wigmans

- “Hadron and Jet Detection in a Dual-Readout Calorimeter”, Akchurin, *et al.* (40 pages)
- “Electron Detection in a Dual-Readout Calorimeter”, *ibid.*, (35 pages)
- “Muon Detection in a Dual-Readout Calorimeter”, *ibid.*, (25 pages)
- “Comparison of High-Energy Electromagnetic Shower Profiles Measured with Scintillation and Cerenkov Light”, *ibid.*, (24 pages)

Summary

There are many calorimeter technologies to be considered for the LC, and this is one.

We are a small group and would be happy to work with a large group to solve the several remaining problems (tracking system, magnetic field, muon system) for the development of a dual-readout calorimeter for the LC.

And, can this calorimeter be further *improved*?