A Fourth Detector Concept (no name, yet)

- Silicon Vertex: 3-4 layers, conventional
- Tracking TPC: 1 atm, moderate B field
- Calorimeter: measure all main fluctuations, obtain excellent energy resolution. Spatial (fine fibers), EM fraction (Cerenkov and scintillation), binding energy losses/neutrons (time readout, third fiber)
- Muon system: RPCs, CMS-like

People, Contacts and Website

- John Hauptman, contact and MDI, ISU, hauptman@iastate.edu
- Richard Wigmans, R&D contact, TTU, wigmans@ttu.edu

- Aldo Penzo, INFN, Trieste
- Hans Paar, UC San Diego
- Nural Akchurin, Ken Carroll, Heejong Kim, TTU
- Oleksiy Atramentov, Jerry Lamsa, Sehwook Lee, ISU

- Website: www.phys.ttu.edu/dream

- Contains proposals, papers, talks, all data figures, and pictures.

- Clearly, we welcome collaborators

Present Status: ± 2 years wrt others

- Calorimeter completely orthogonal to GLD, LDC, and SiD. Only similarity is use of word "calorimeter".
- 10 million triggers in test beam; present test module DREAM is very well understood, measures hadrons and "jets" to nearly $20\%/\sqrt{E}$
- Measures e to $20\%/\sqrt{E}$, and tags μ.
- Robust, easy. Calibration, cost OK.

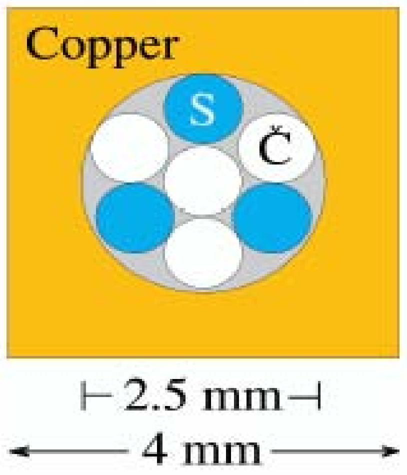
R&D: present year

- “Dual-Readout Calorimetry for the ILC” – objective is to optimize an electromagnetic section, and to devise a more robust readout.
- “Ultimate Hadron Calorimetry” – attempt to measure fluctuations in BE (binding energy losses, mostly MeV neutrons) with a third fiber, a time readout, etc.

R&D: next year(s)

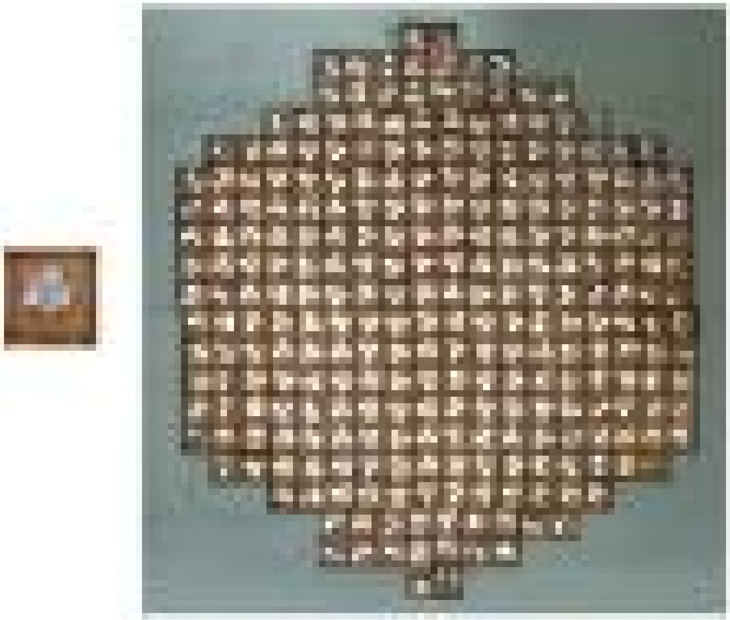
- Build a second beam test module, wider and not as deep: 0.5m x 0.5m x 1.2m (brass, W) with triple readout, time history readout, and test dual-readout EM section in front.
- Time history readout with ATWD (S. Kleinfelder)

Dual-Readout Module (DREAM)



"Unit cell"

Fibers

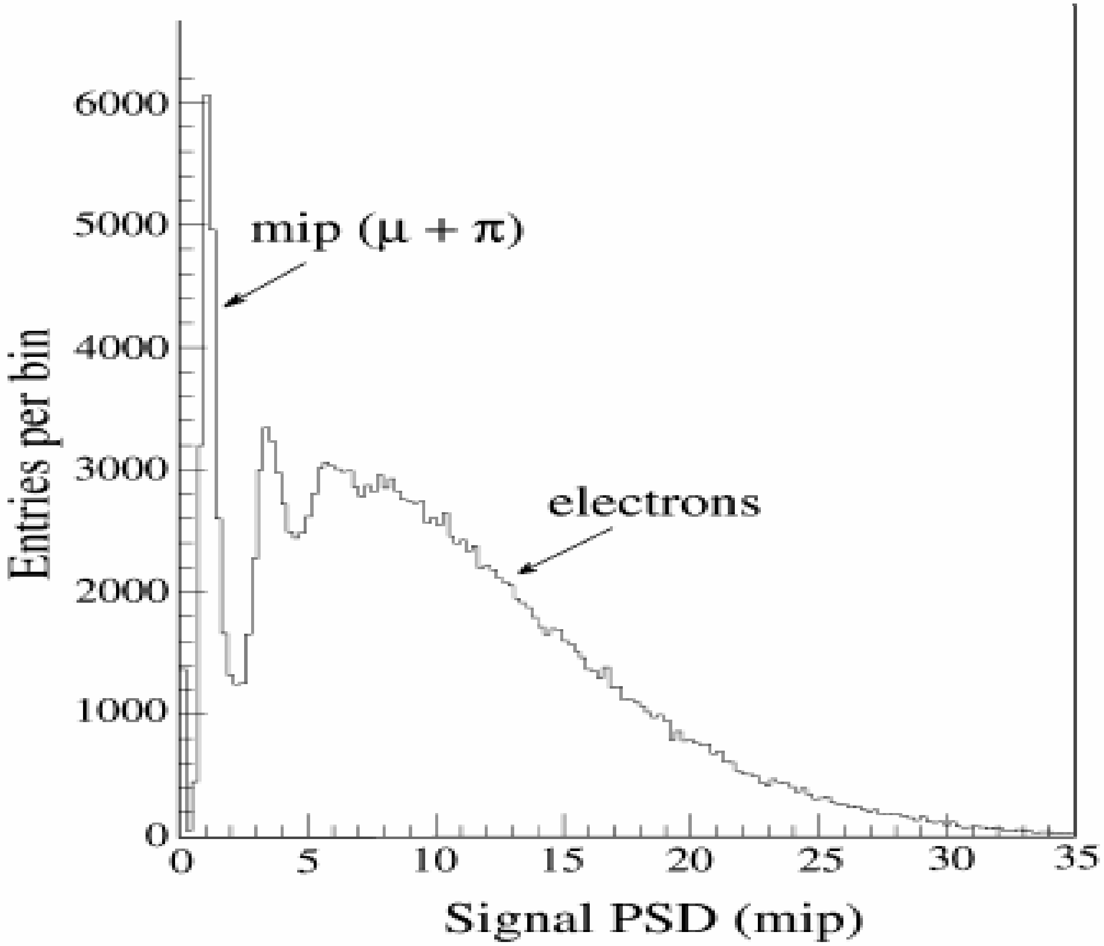


PMT readout box in H4 beam

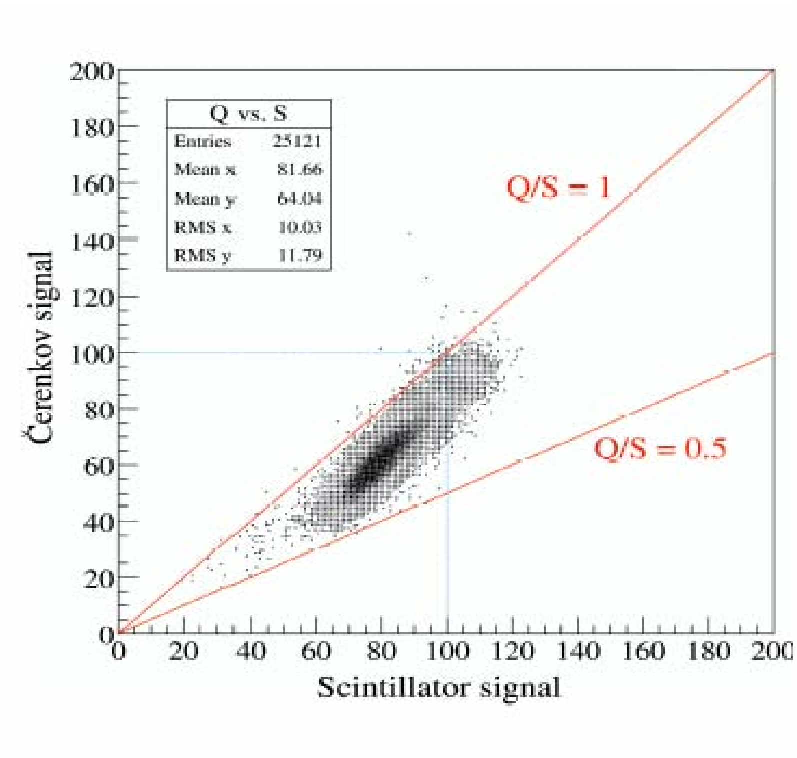
H4 beam – looking upstream

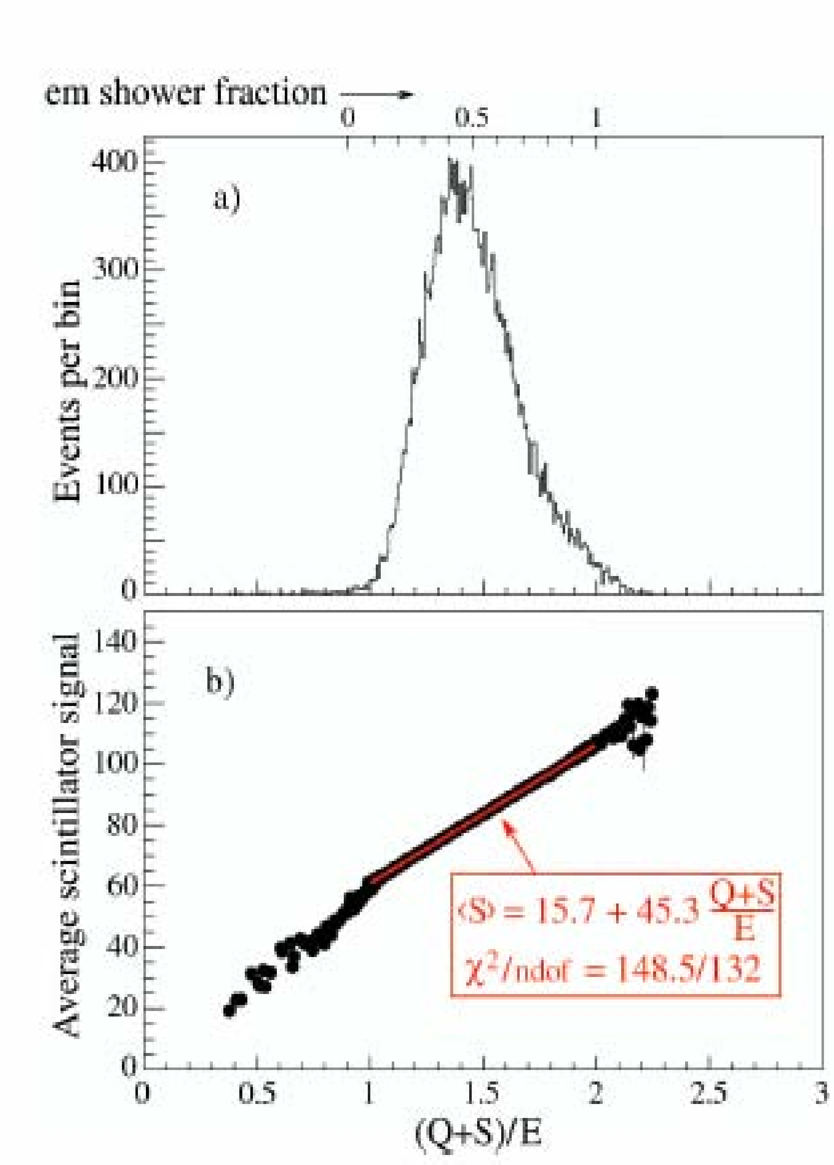
H4 beam


beam
TC
HOD
PSD
ITC
DREAM
ABSORBER
MU

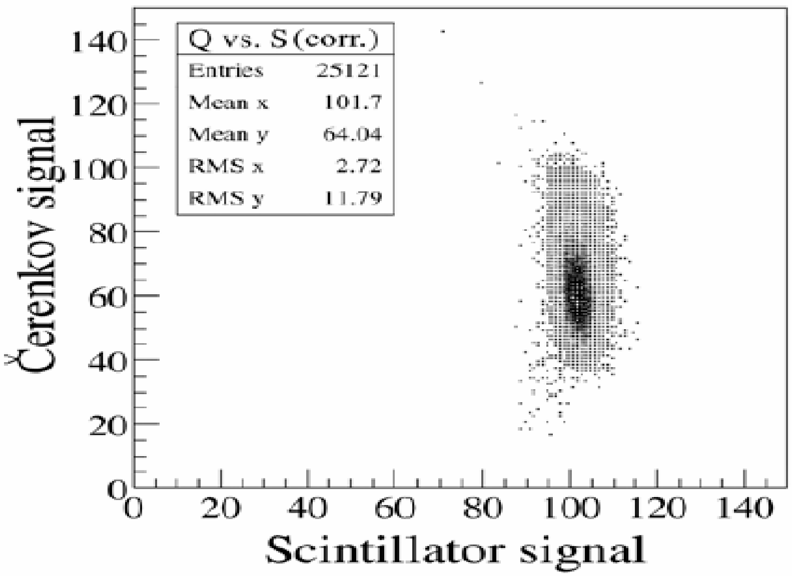

mip (μ + π)
electrons
Entries per bin
Signal PSD (mip)
0
1000
2000
3000
4000
5000
6000
0
5
10
15
20
25
30
35

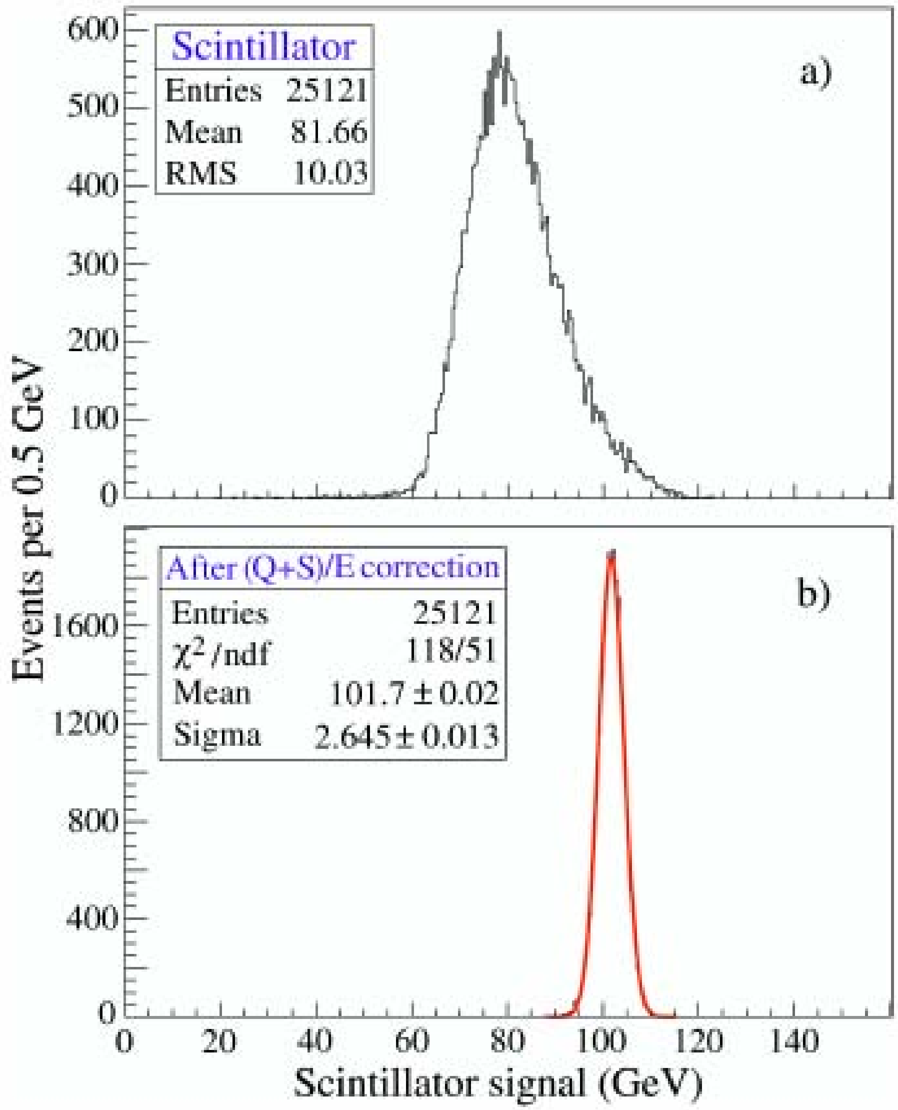
Cerenkov vs. Scintillation





Correct event-by-event for EM fraction

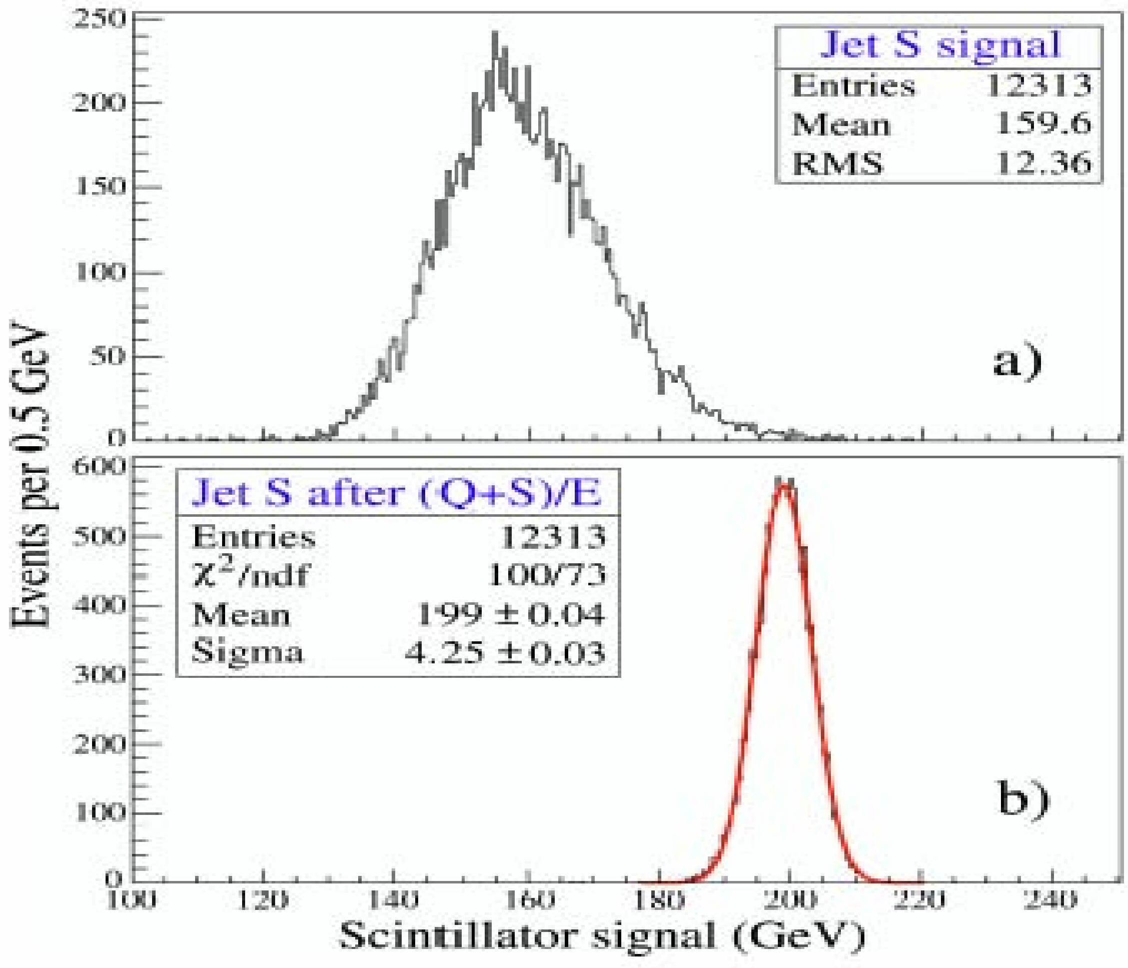




σ/E = 2.65% at 100 GeV

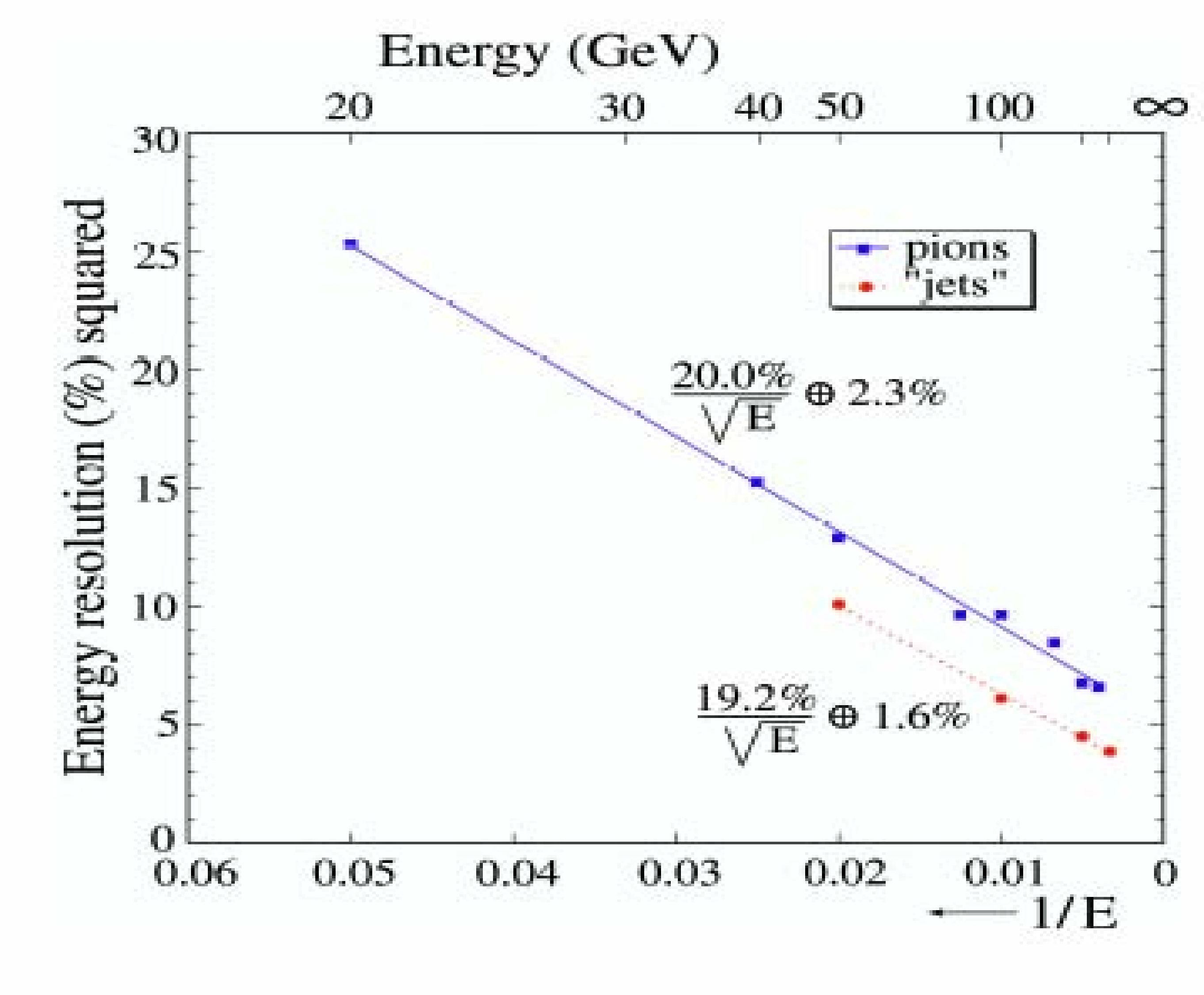
“interaction jets” – 0.1 λ lucite

200 GeV
pions

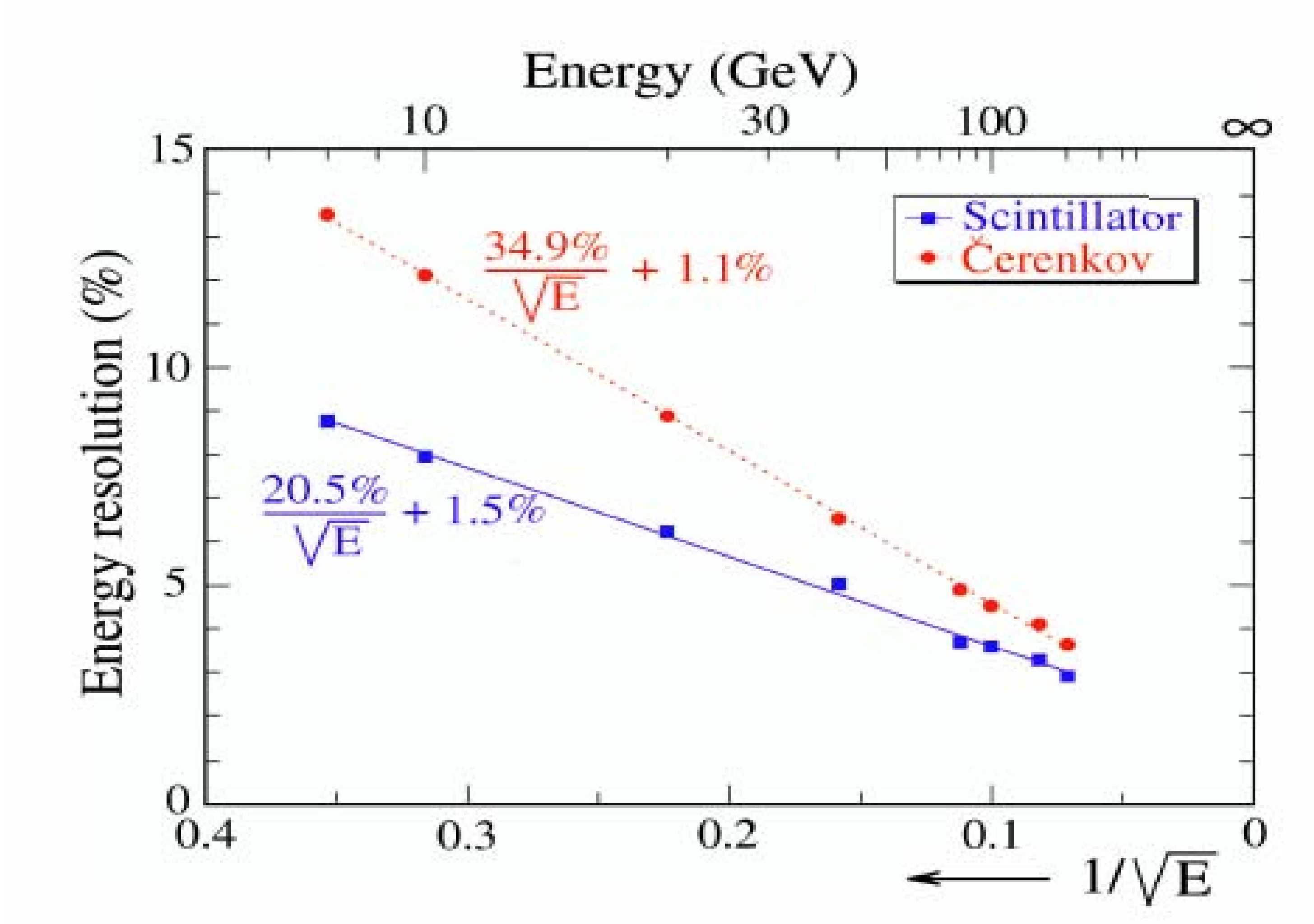


σ/E = 2.15%

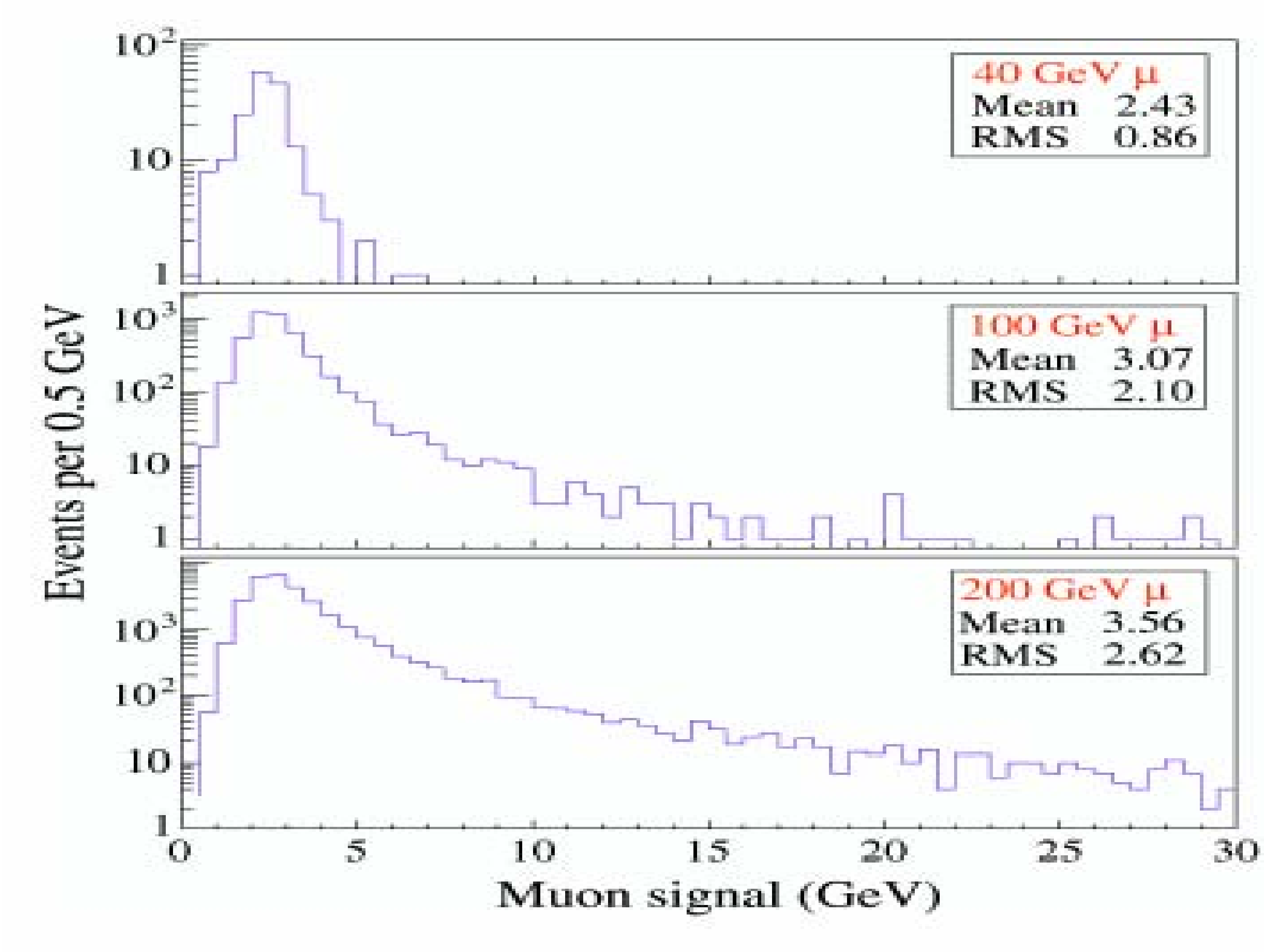
Energy resolution of π’s and “jets”



Energy resolution of electrons

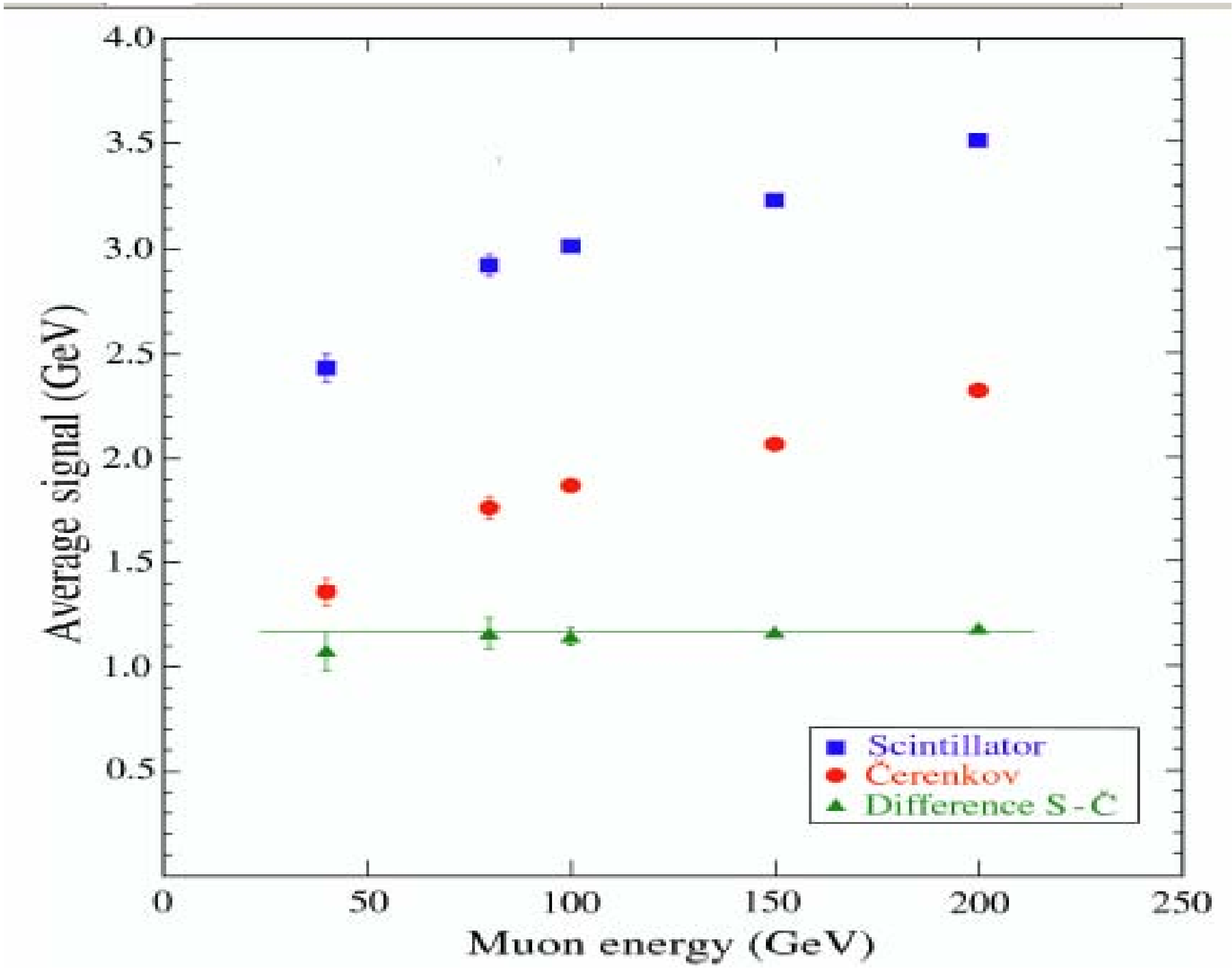


Muons into DREAM



μ ionization and radiative energy losses

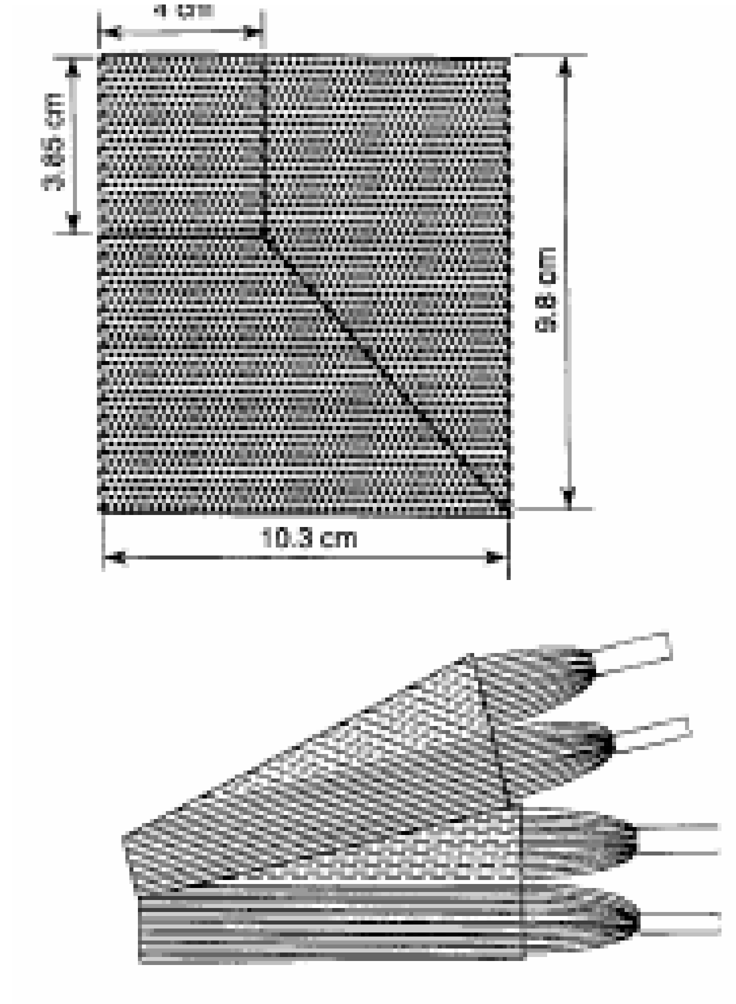
Average energy loss



From a module to a 4π detector

- Only important point - the fiber densities must be constant throughout the volume

- Several possible solutions…this is RD1

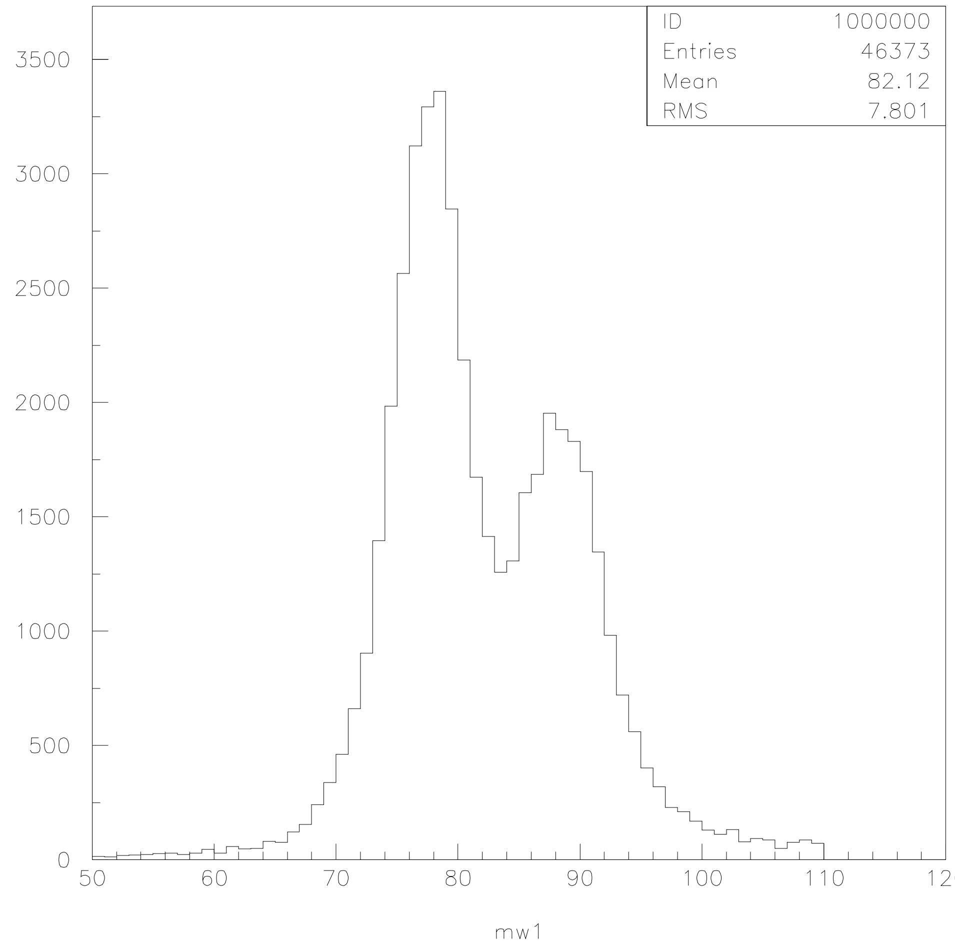


This dual-readout calorimeter can measure all the partons of the SM with comparable precision: e, μ, q, γ, and therefore all W and Z decays

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

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

$W \rightarrow jj$ and $Z \rightarrow jj$



Mjj (GeV/c²) →

Summary

These are new, and working, ideas in calorimetry: to make multiple measurements of each shower, and thereby reduce the fluctuations (spatial, EM fraction, BE losses) that dominate hadronic calorimetry.

We are a small group and would be most happy for a large group or groups to join.