Fermilab/ALC Muon Sys. R&D

- History
- Simulation Software Development
- Scintillator Detector Parameters
- Proposals for LCD Muon R&D
- Hardware Development
- Is R&D Really Needed?
- How can you help us?

History

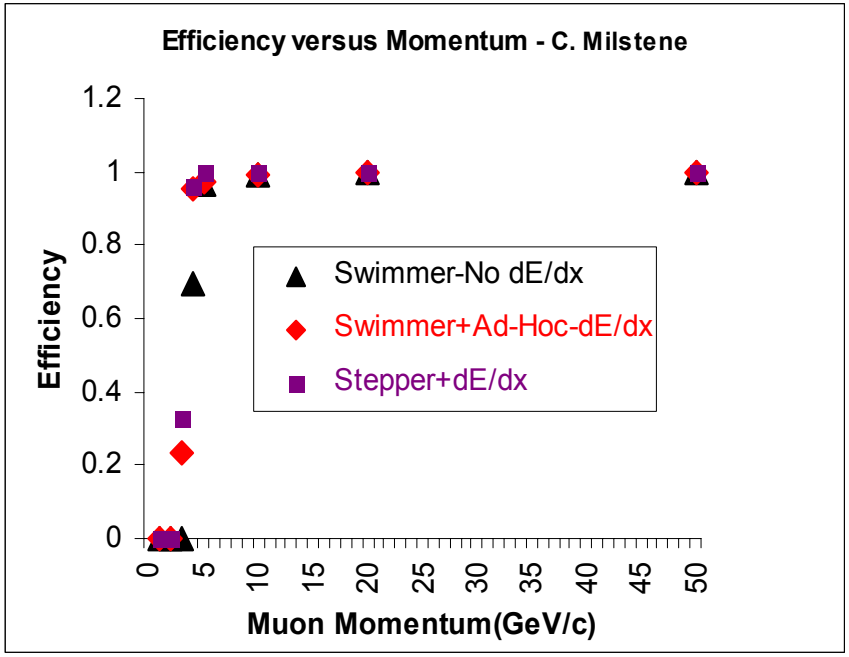
- Prior to 2000 LC proposals were for RPCs – Resistive Plate Chambers.
- March 2000 LBL ALC mtg – A. Para proposed strip scintillator system – like MINOS.
- October 2000 – LCWS presentation: Solid Scintillator-based Muon Detector for LC Experiments – in proc. p 865

More History

- Chicago ALC Mtg – Jan 2001 – Midwest focus
  Start of work on Fe layout; review of TESLA work by M. Piccolo
- 2002 Simulation work on efficiency vs. momentum for muons and hadronic punch-through presented.
- 4/05/2002 Fermilab meeting on:
  "R&D Opportunities for the LC"
- Formation of the ALC Muon Collaboration:
  Fermilab, UC Davis, NIU, Notre Dame, Wayne St

Simulation Software

- Java Analysis Studio
  R. Markeloff – NIU, '01
  C. Milstene

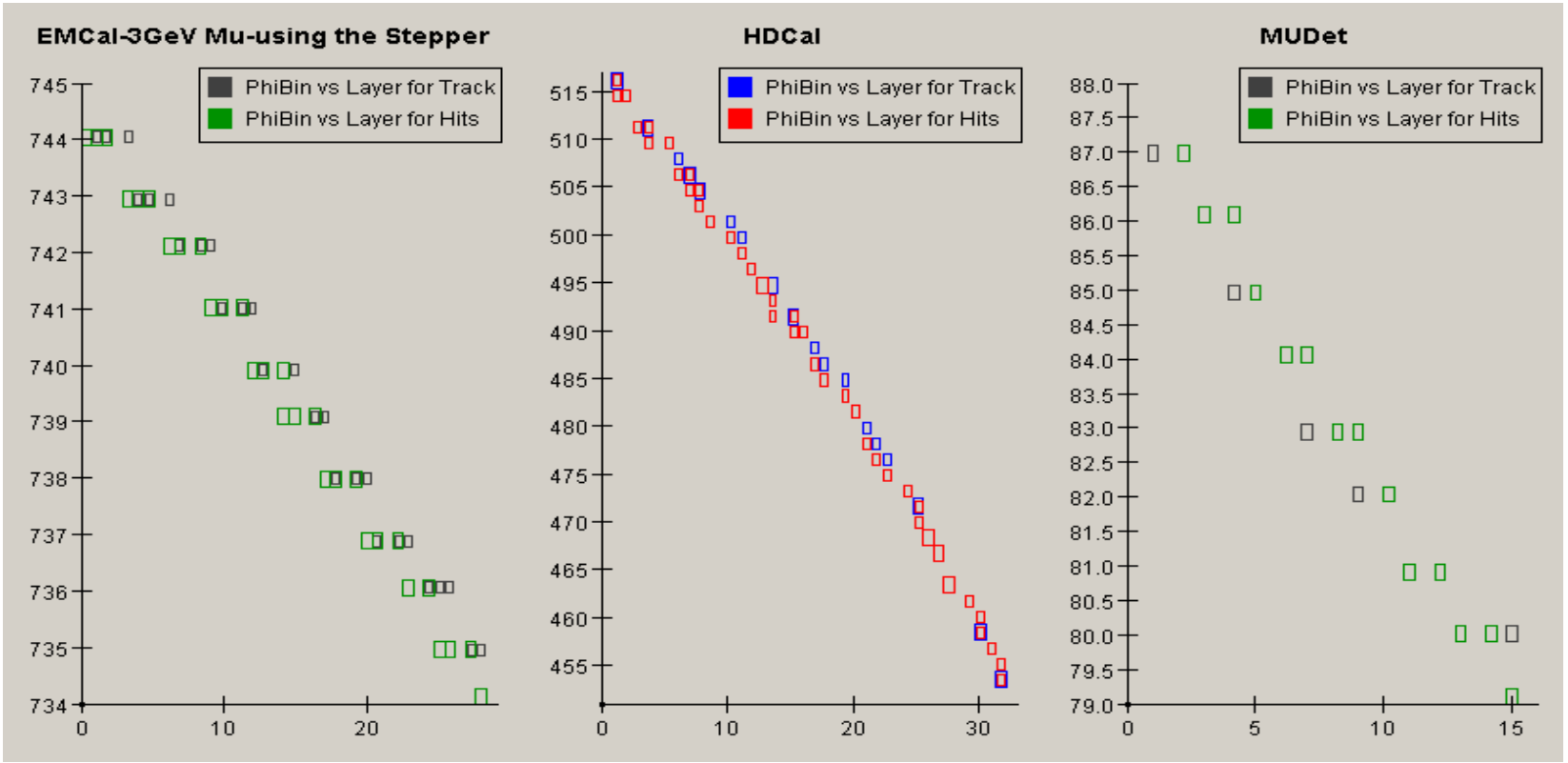


- dE/dx improvement
- Low pt tracking eff.
- B field trk following

E(Gev) /Tech	3	4	5	10
No dE/dx	0.06%	70%	97%	99%
Ad-Hoc dE/dx	23%	95%	97%	99%
V x B & dE/dx	33%	96%	99%	100%

Stepper in EM, H Cal and μ Det
Angle Bin versus Layer 3 GeV Muon
C. Milstene

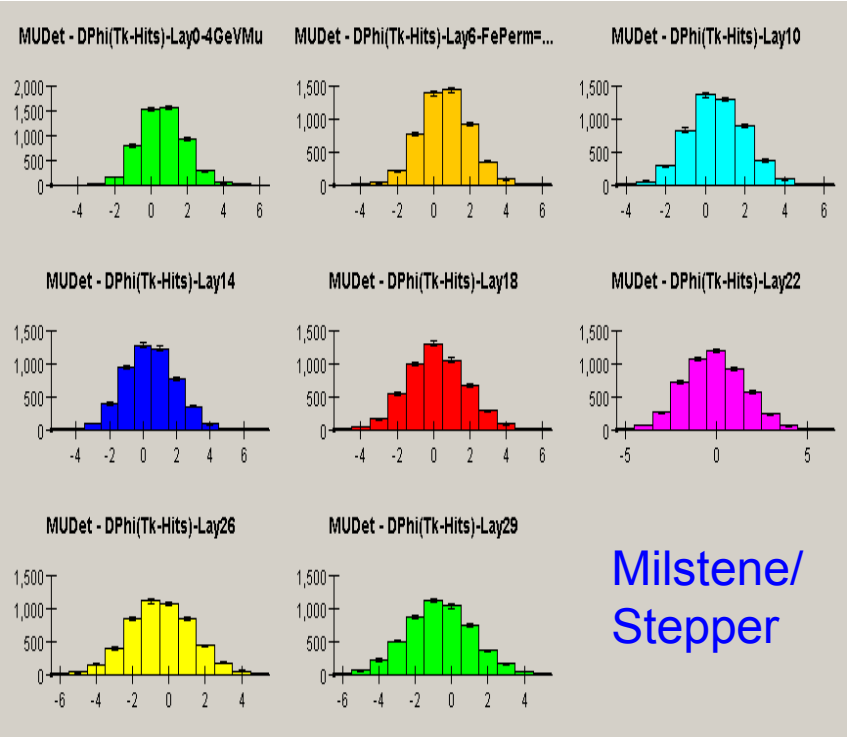
E Cal: 1680 φ bins/30Layers H Cal: 1200 φ bins/34Layers μ Det- 300 φ bins/32Layers

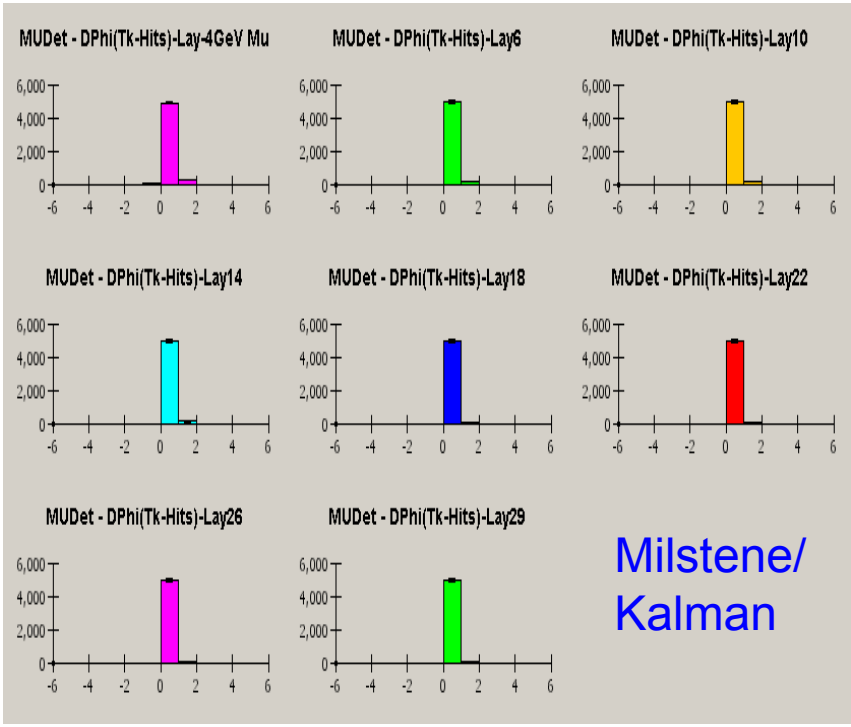


Kalman Filter – μDet. Angular Resolution

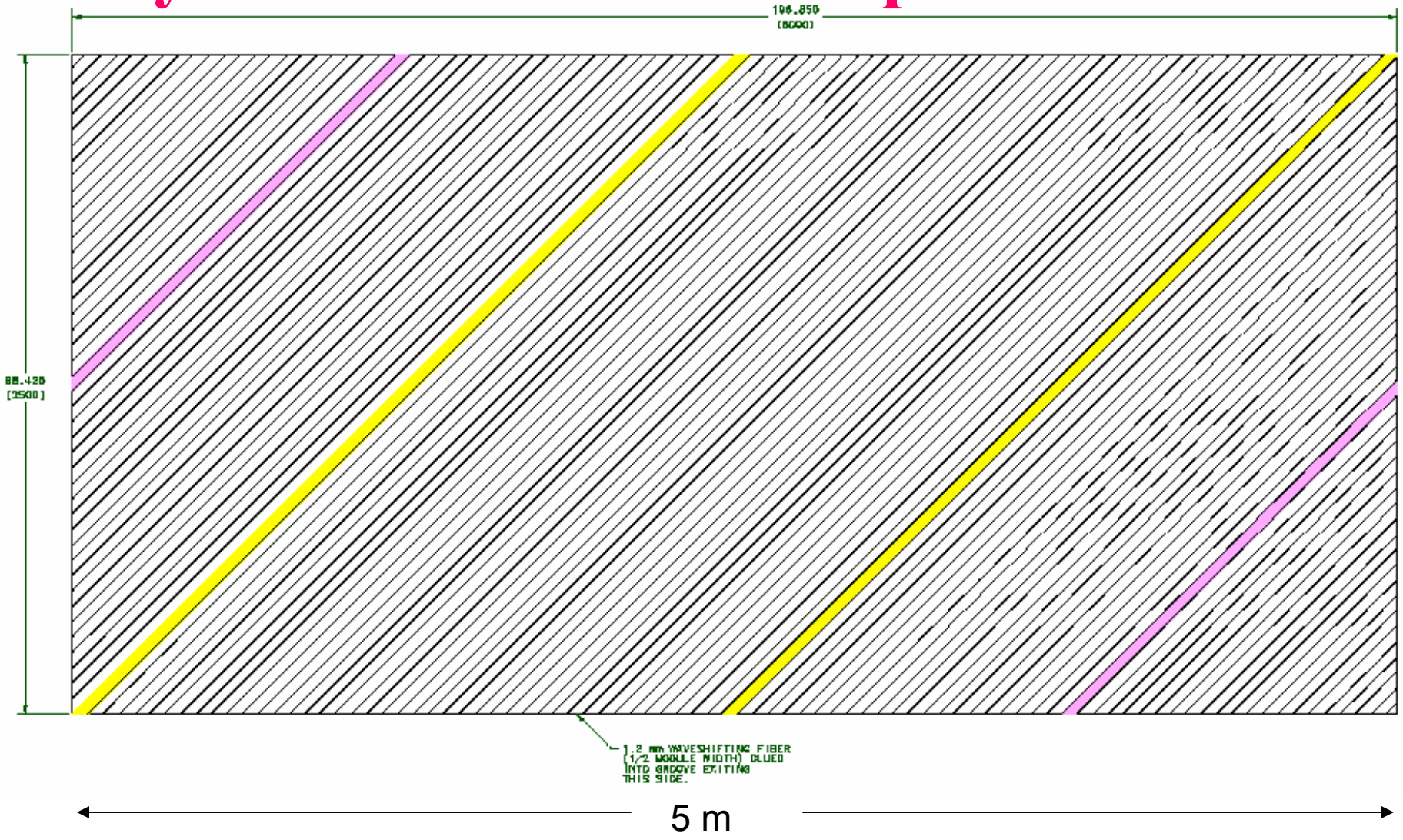
ΔΦ vs. Layer # for a - 4GeV μ

(Preliminary - Milstene)

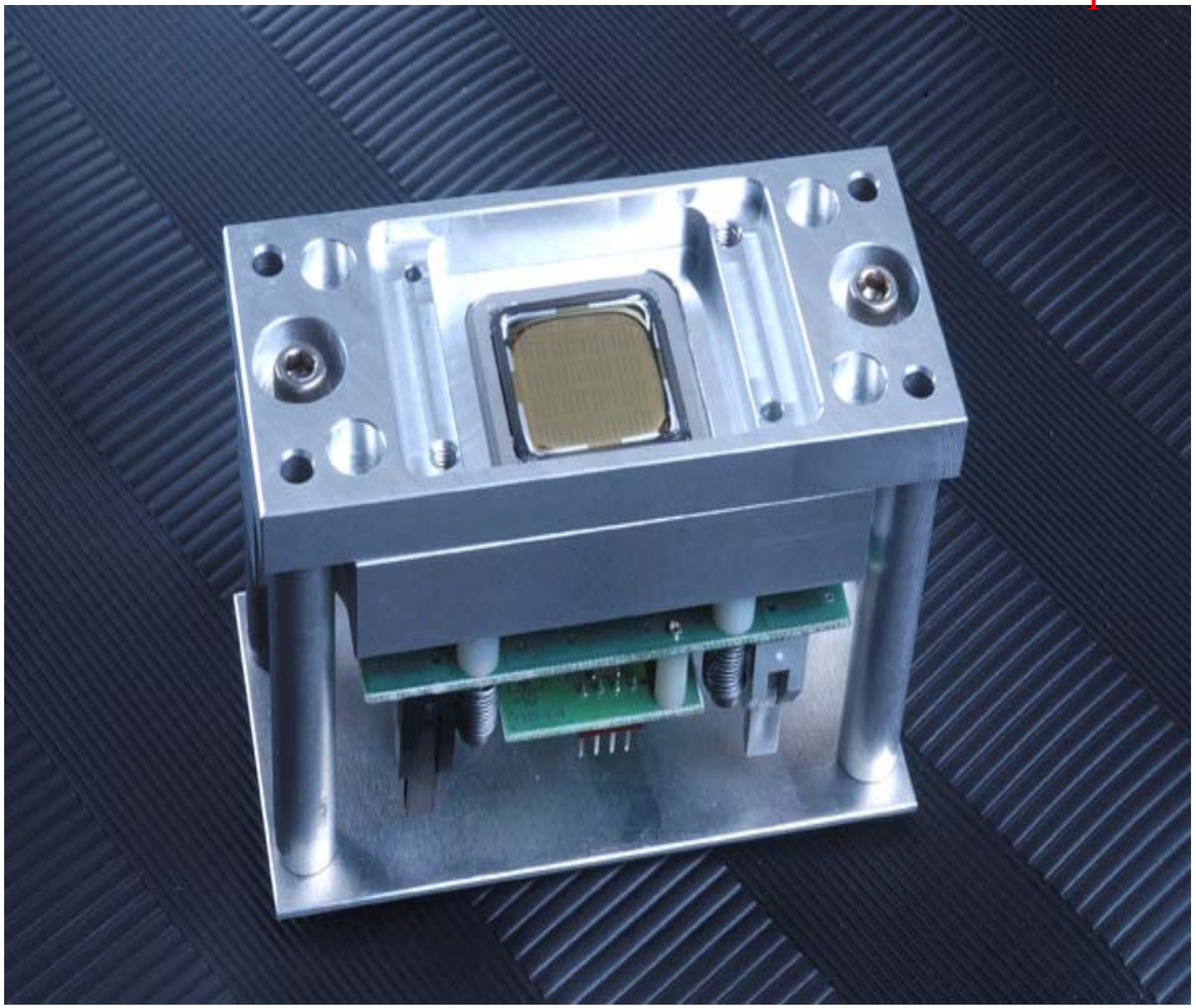




Layout of Scintillator Strips in one Plane



MINOS base - Hamamatsu 16 ch. MAPMT 4 X 4 mm^2 pix



Example Channel Count

- For TESLA barrel detector: (medium size)
  L = 9.4 m
  R_{in} = 4.2 m & R_{out} = 6.2 m

  15 planes => 110,409 strips /64 = 1725 MAPMTs

  25 planes => 188,016 strips /64 = 2938 "

Multiplexing schemes not yet investigated.

Collaboration + R&D Proposals

- Fall 2003 for FY03:
  Fermilab: Bross, Fisk, Krempetz, Milstene, Para, …
  UC Davis: Tripathi, Holbrook, Lizarazo, student, ..
  NIU: Maciel, Blazey, Dychkant,
  Notre Dame: Wayne, McKenna (Tech), student,
  Wayne State: Karchin, A. Gutierrez, student,
- FY04 – Rice: Padley,
  UTexas – Austin: K. Lang
- FY05 – Indiana: Van Kooten, R. Abrams

- High marks, but small amount of funding for the universities.

Responsibilities

- **Fermilab:** Muon tracking, proposals, Fe engr, plane design, fiber splicing, module test site, ..
- **NIU:** Initial muon tracking, scintillator tests, test beam plans,
- **Wayne State:** Proposals, MAPMT procurement & testing (gain vs. HV), LED pulser development, single p.e. threshold studies using QVT, noise meas., ..
- **Notre Dame:** fiber testing and QA, calib scheme w/WS, assembly of pre-prototype, assembly of $\frac{1}{4}$ size planes: 1.25 m X 2.5 m , ..
- **UC Davis:** Signal processing, digitization, readout, ..
- **Indiana:** Testing planes – Test PC development, etc.

Is LC Muon Sys R&D Really Needed?

- Is enough known to advance the case for a scintillator-based LC muon detector? NO!
- Our LC proposal R&D is in its infancy:

  No working prototype – first example ~ July 1.

  No tested in situ calib. scheme – 1 m strip Cs^{137} tests OK.

  No conclusion on the no. of pix: 2 X 2 or 4 X 4 mm^2 pix?

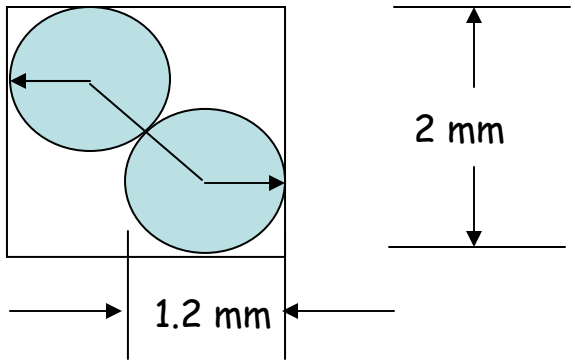
  No up & running DAQ; prototype to arrive 6/22. 64ch.

- ILC μ sys is not MINOS:

  1. Basic geometry is different;
  2. WLS – Clear fiber is spliced;
  3. MUX scheme undeveloped;
  4. New calibration scheme;
  5. Diff. electronics (Minerva);
  6. Open to diff. photodetectors

A trivial scintillator detector R&D Item

Can two 1.2mm diameter fibers be efficiently read-out with a 2 mm square pixel?



The circumscribed square is:

d/2 + d/2 + 0.707 d =

= 1.707 d

= 2.0484 mm

So, the 2 mm square pixel is 2 mils smaller than the circumscribed fibers. Seems close enough to squeeze. But, what is the efficiency of the anode over the 2 mm square? Measuring it is not trivial. First check with MINOS. Go to small dia. fiber? New die? Costly. Drilling two adjacent parallel 1.2 mm holes in the cookie?

The Good News:

1. A working collaboration, w/o adequate funding for the universities, is established. Notified 6/2 the universities will receive $13.5K.
2. Promising test results on:
   a. gluing of fibers. Cs 137 source) NIU/Fermilab
   b. WLS ⇔ Clear fiber splicing OK. ND/Fermilab
   c. LED pulser system established for measurement of Gain and p.e. yield. WS
   d. CAMAC based prototype DAQ & RO syst. UCD
3. The ¼ plane modules & electronics we are building will be useful at the Fermilab Test Beam. UCD/IU/ND/NIU/WS/FNAL
4. PPD has provided:
   One FTE physicist: C. Milstene on simulations + meas.
   M&S costs of ~ $50K. Moral support, travel, etc.

How can you help us?

- University collaborators need some ILC R&D funds to continue their involvement. This is a general problem not specifically directed at DOE labs.

  Keeping a collaboration together requires viable projects; physicists don't want to waste their abilities and time. They have just received some + feedback!

- PPD can continue helping with the setup of our testing area in Lab 6; We are in contact/getting help from Jason Ormes, Karen Kephart, Pat Richards, Eileen Hahn.

- CD can help with Minerva electronics (waiting for new TriP chip - PPD) and in the global development of simulation software.

1.25 m X 2.5 m ¼ Scale Prototype

Notre Dame
3/20/2005