Adam Para

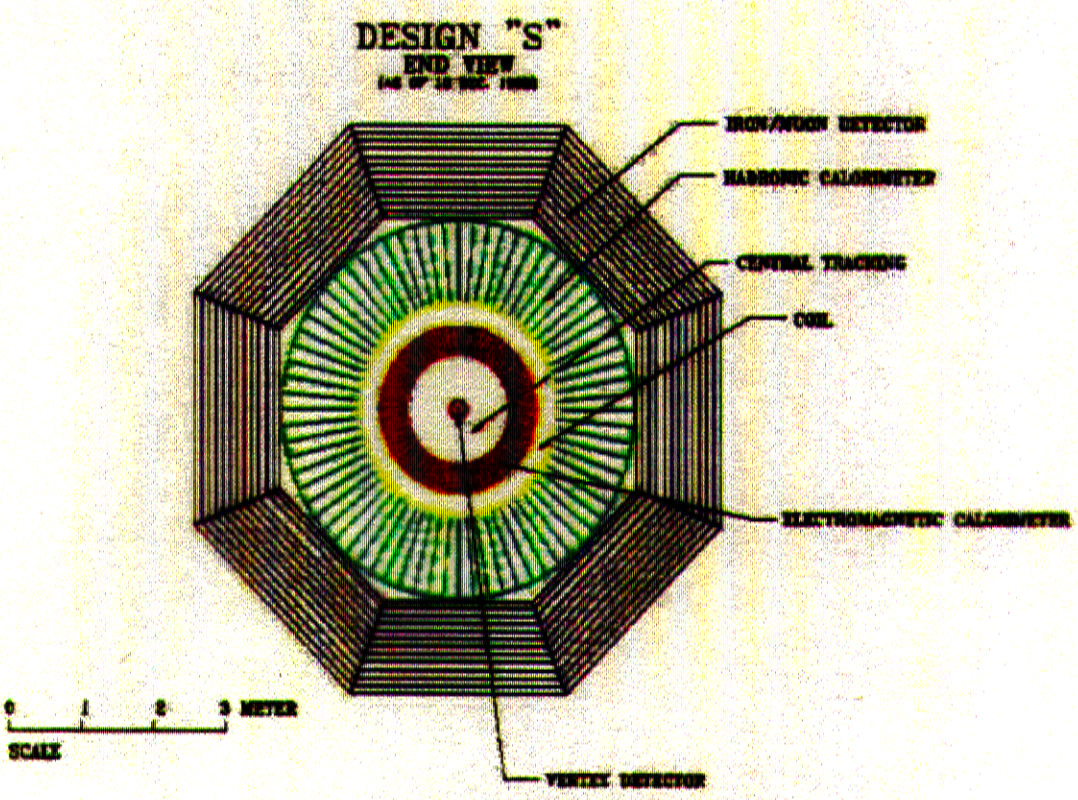
Thoughts on a possible muon system

Functions of the muon system:

- identification of isolated muons
- identification of soft muons within hadronic jets
- measurement of the tails of jet energy (improve resolution for W/Z spectroscopy)

Assumption: momentum measured by central tracker ⇒ no need for magnetic measurement

∴ Time? Background rejection for soft muons? Need studies



Design S - End View

For a postscript version, please click here.

Home

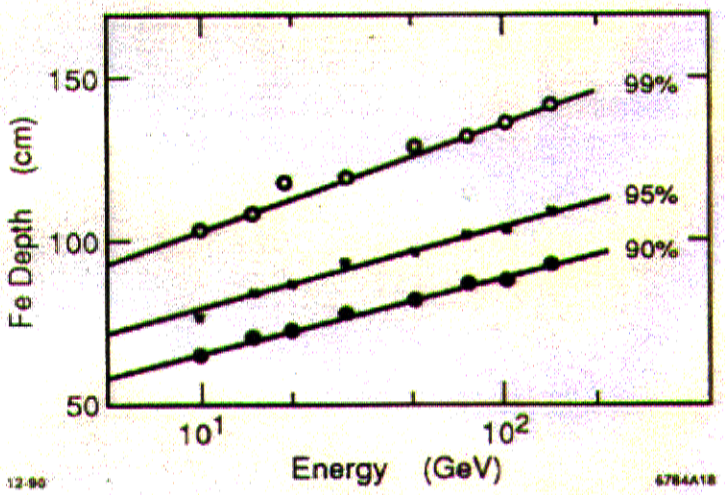
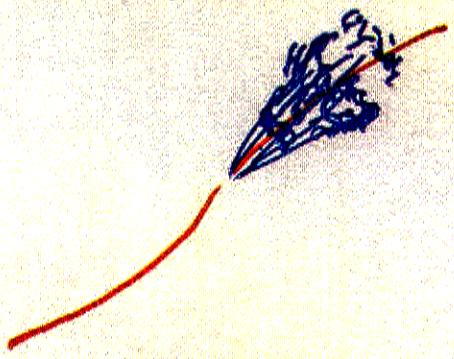


Fig. 11. Calorimeter size needed for given percentage of total shower energy containment as a function of pion beam energy.



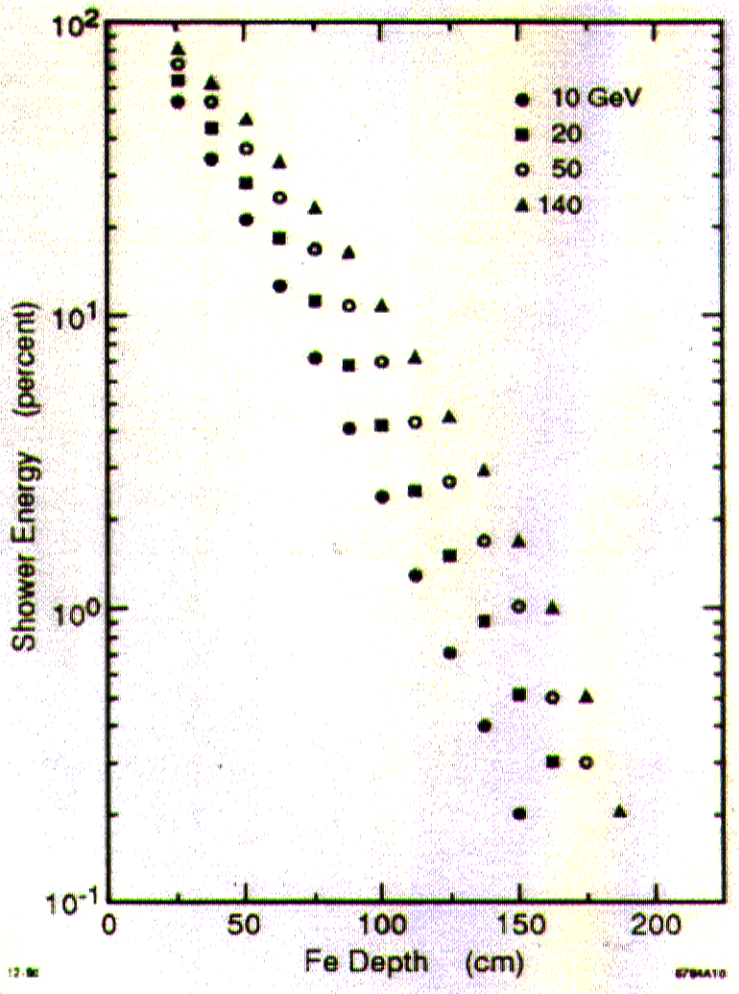


Fig. 10. Percentage of shower energy leakage as a function of calorimeter size for four different pion beam energies.

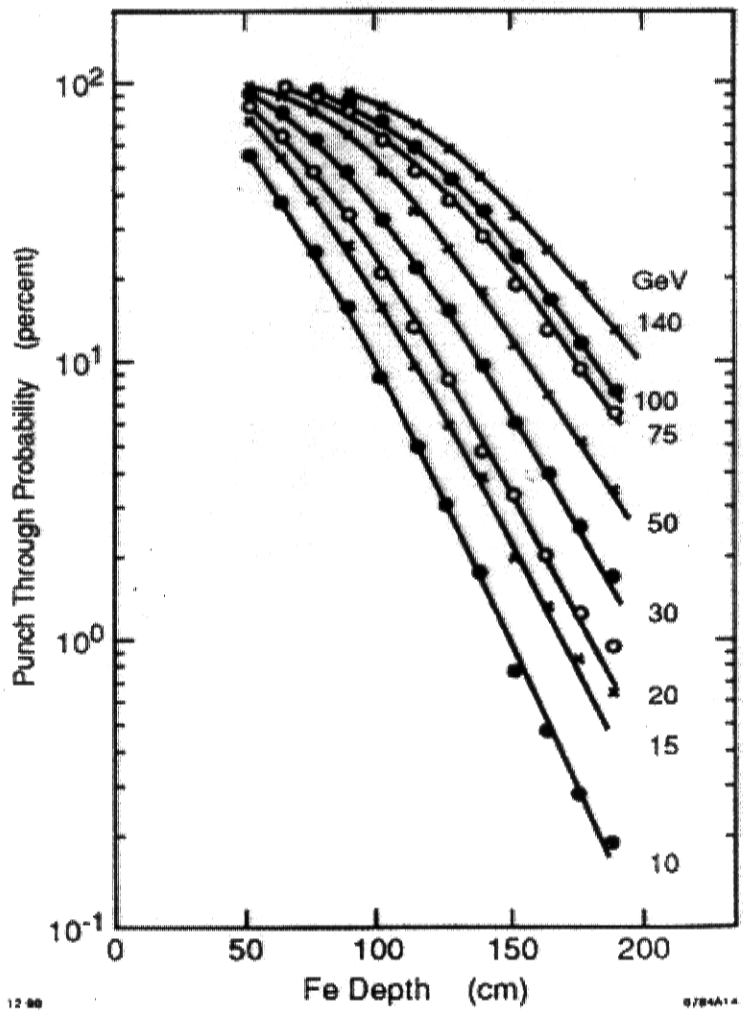


Fig. 15. **Probability of a scintillator hit as a function of the calorimeter depth for different pion beam energies.**

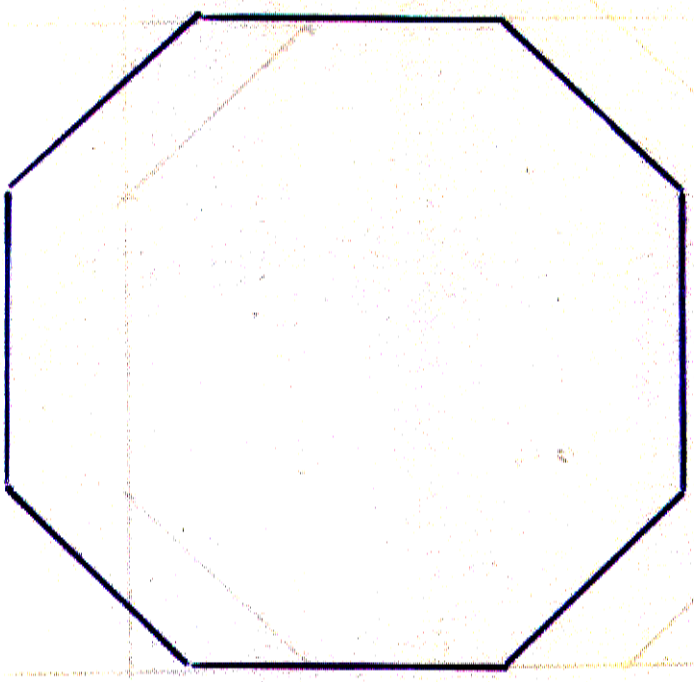
MINOS : an imaging calorimeter

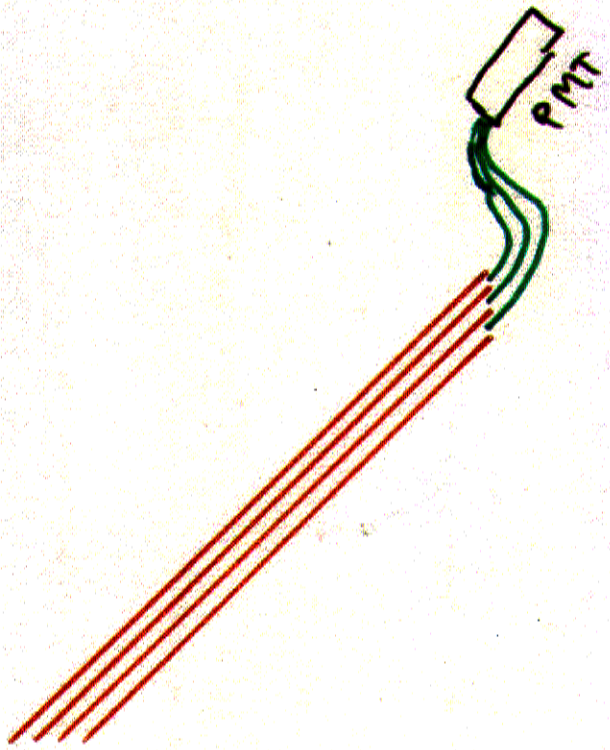
Alternating planes

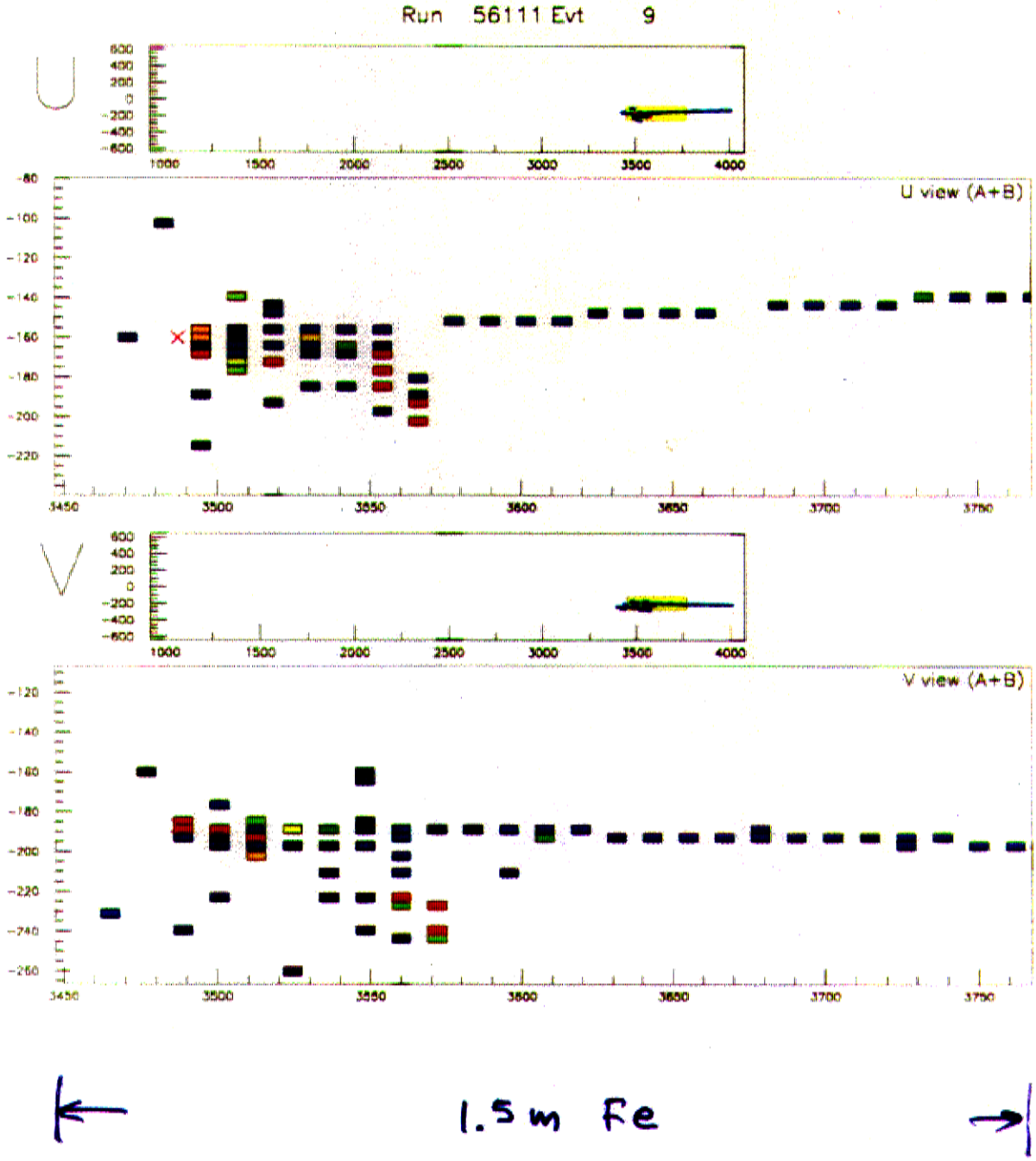
- 2.5 cm iron
- x - scintillator strips
- 2.5 cm iron
- y - scintillator strips
- ⋮

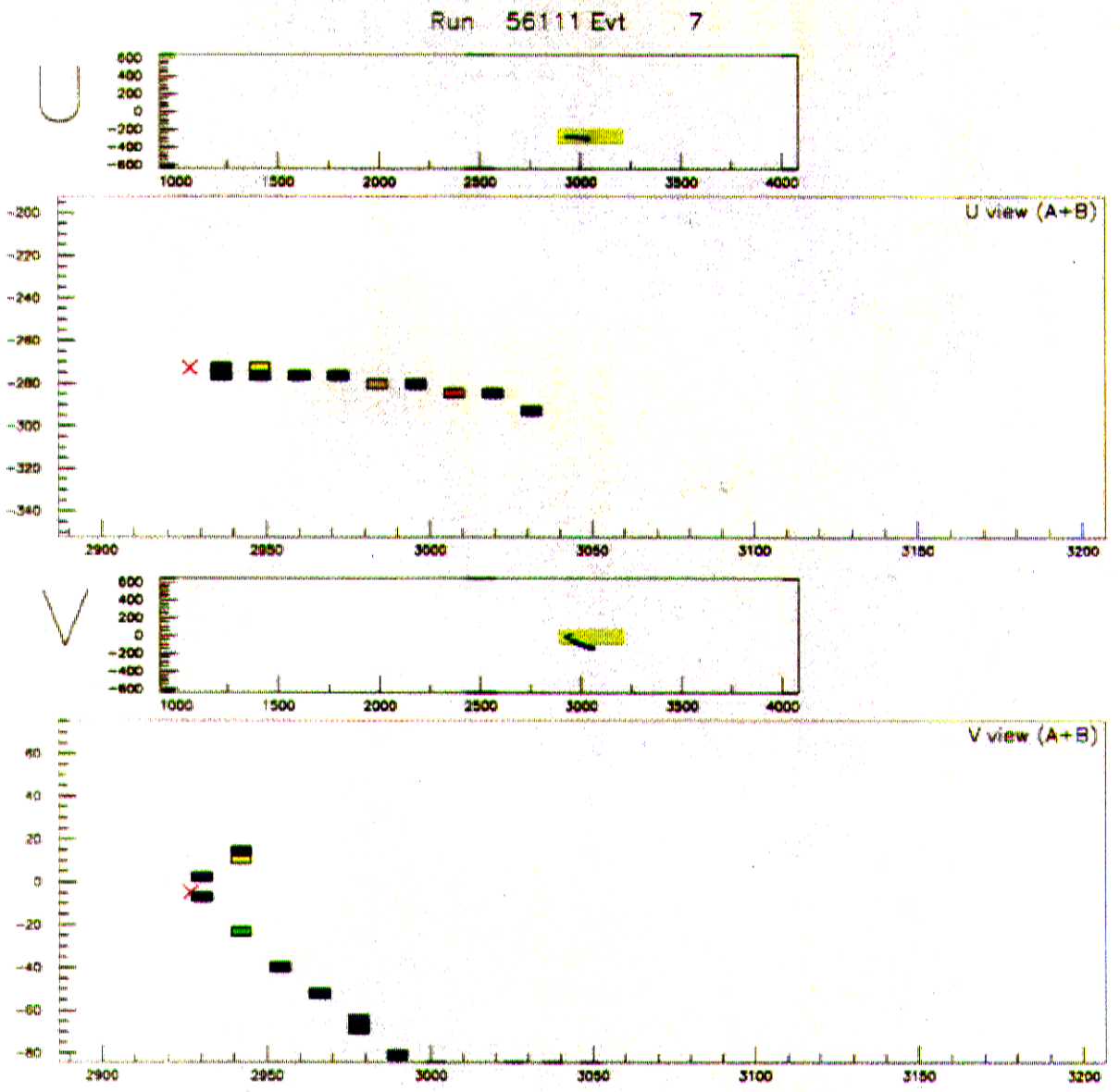
Magnetized iron : toroids (octagons)

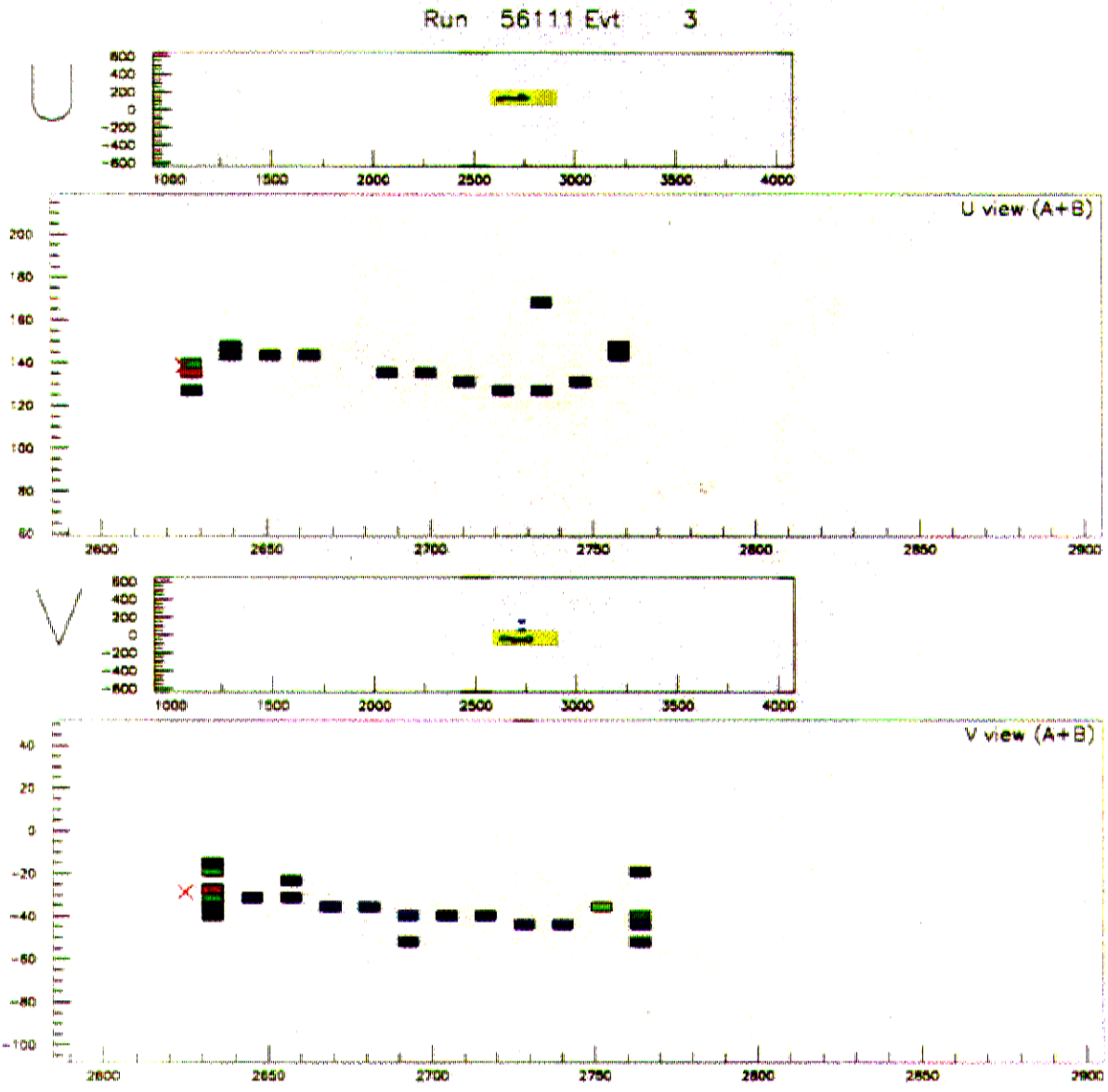
8 m across

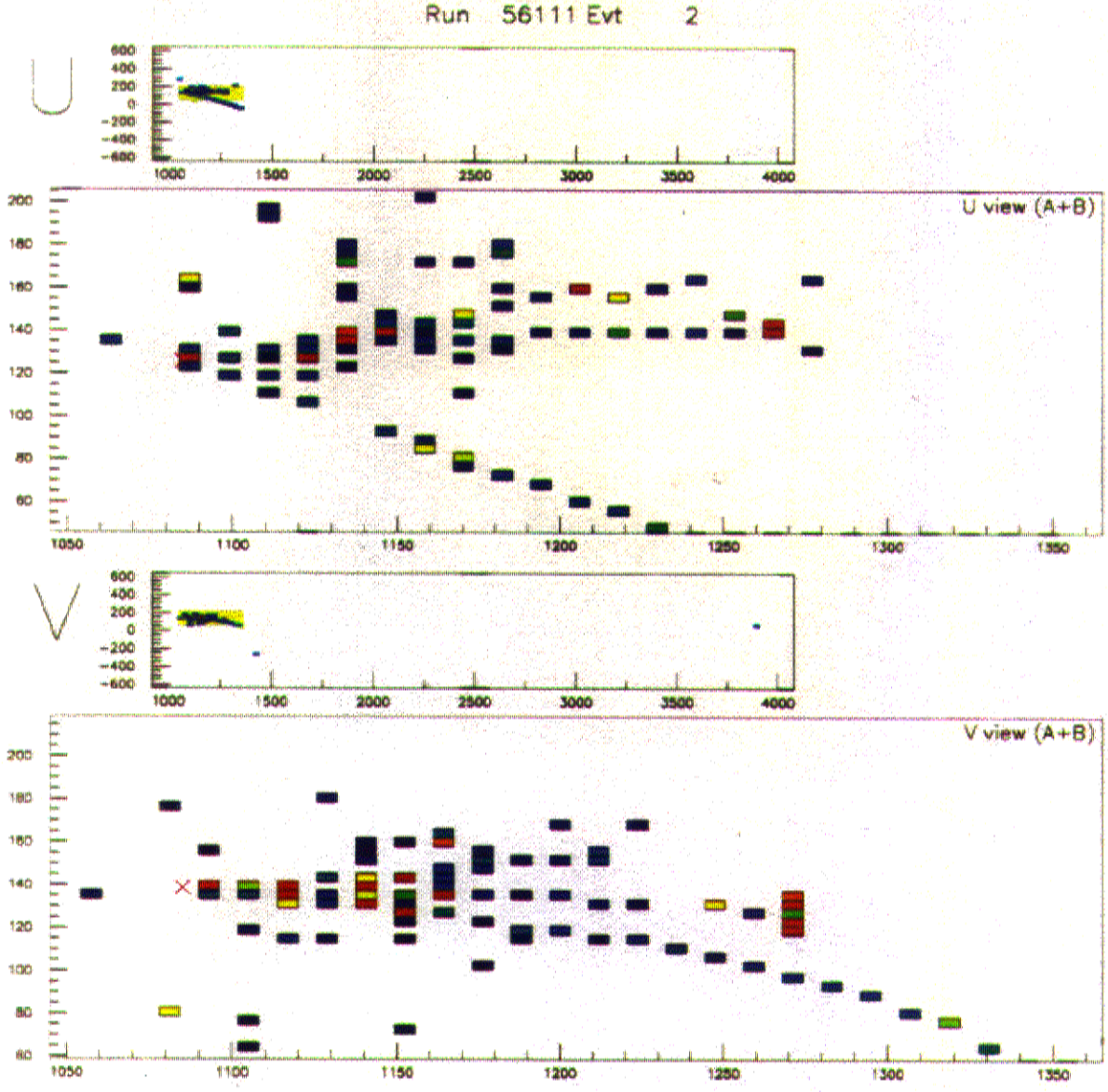


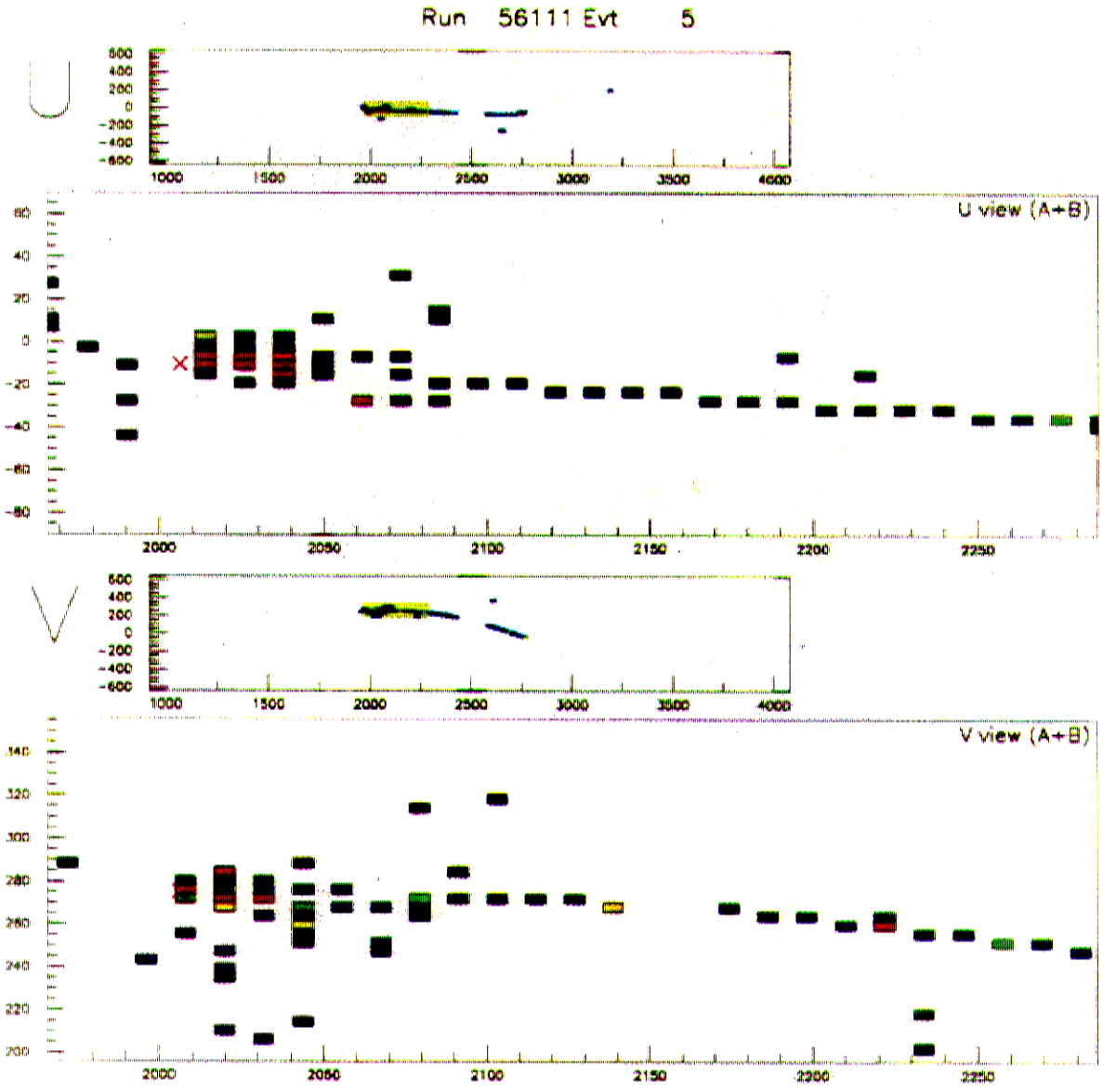

PMT

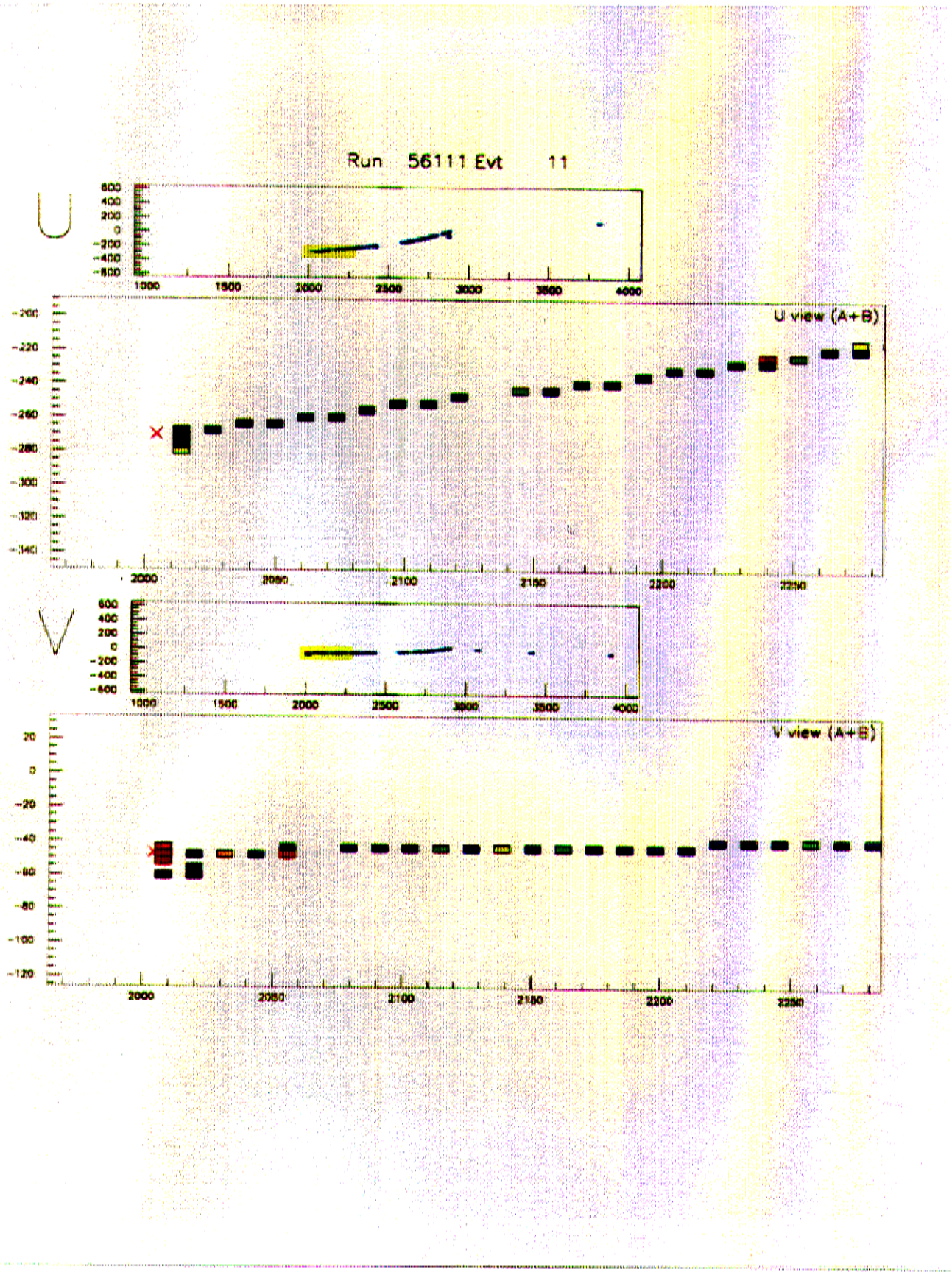

Run 56111 Evt 9
U view (A+B)
V view (A+B)
1.5 m Fe


Run 56111 Evt 7
U view (A+B)
V view (A+B)


Run 56111 Evt 3
U view (A+B)
V view (A+B)

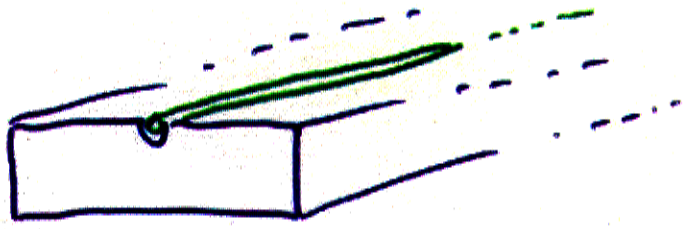

Run 56111 Evt 2
U view (A+B)
V view (A+B)


Run 56111 Evt 5
U view (A+B)
V view (A+B)

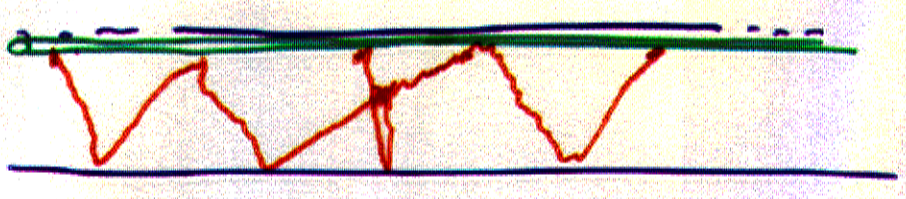

Run 56111 Evt 11
U view (A+B)
V view (A+B)

Scintillator strips

- up to 8 m long
- 4 x 1 cm cross section
- read out with wave shifting fiber (both ends)
- multianode PMT (Hamamatsu R5900, M16)
- 8 strips multiplexed on 1 pixel of the PMT



Fiber readout: principles

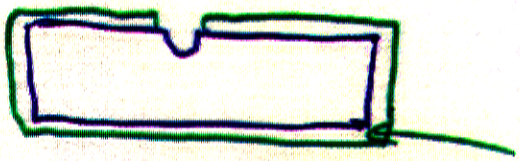


- Light collected into a fiber over relatively small distance (~ 5 cm)
- no need for excellent optical properties of the scintillator
- light transported by a fiber

Cheap scintillator: extruded

Polystyrene
PPO
POPOP
} ~ $2.50/lb of the final product

Extra bonus: co-extrusion



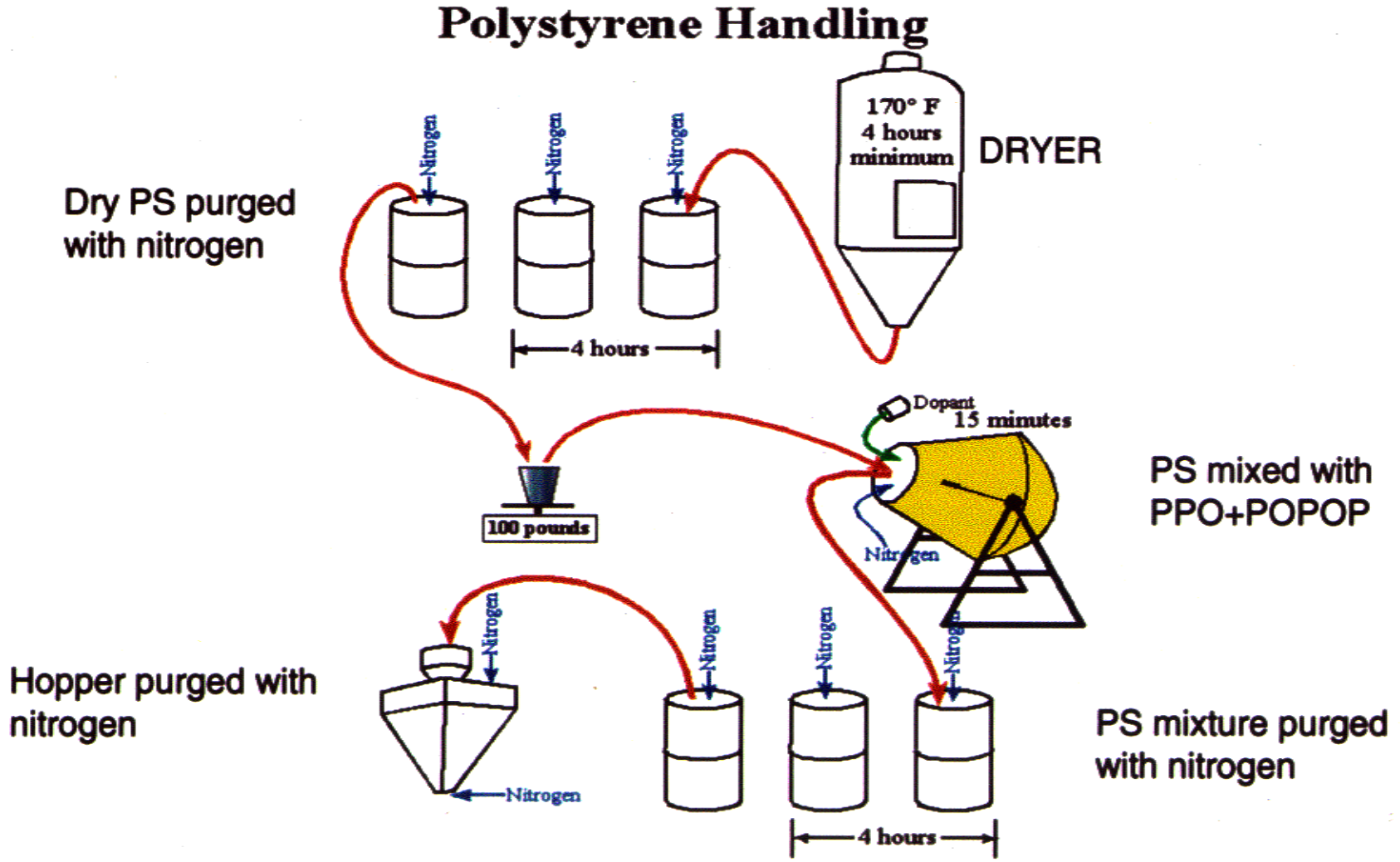
polystyrene doped with TiO_2

∴ increased light output

∴ robust (no need for great care in handling)

MANUFACTURING TECHNIQUE

MINOS

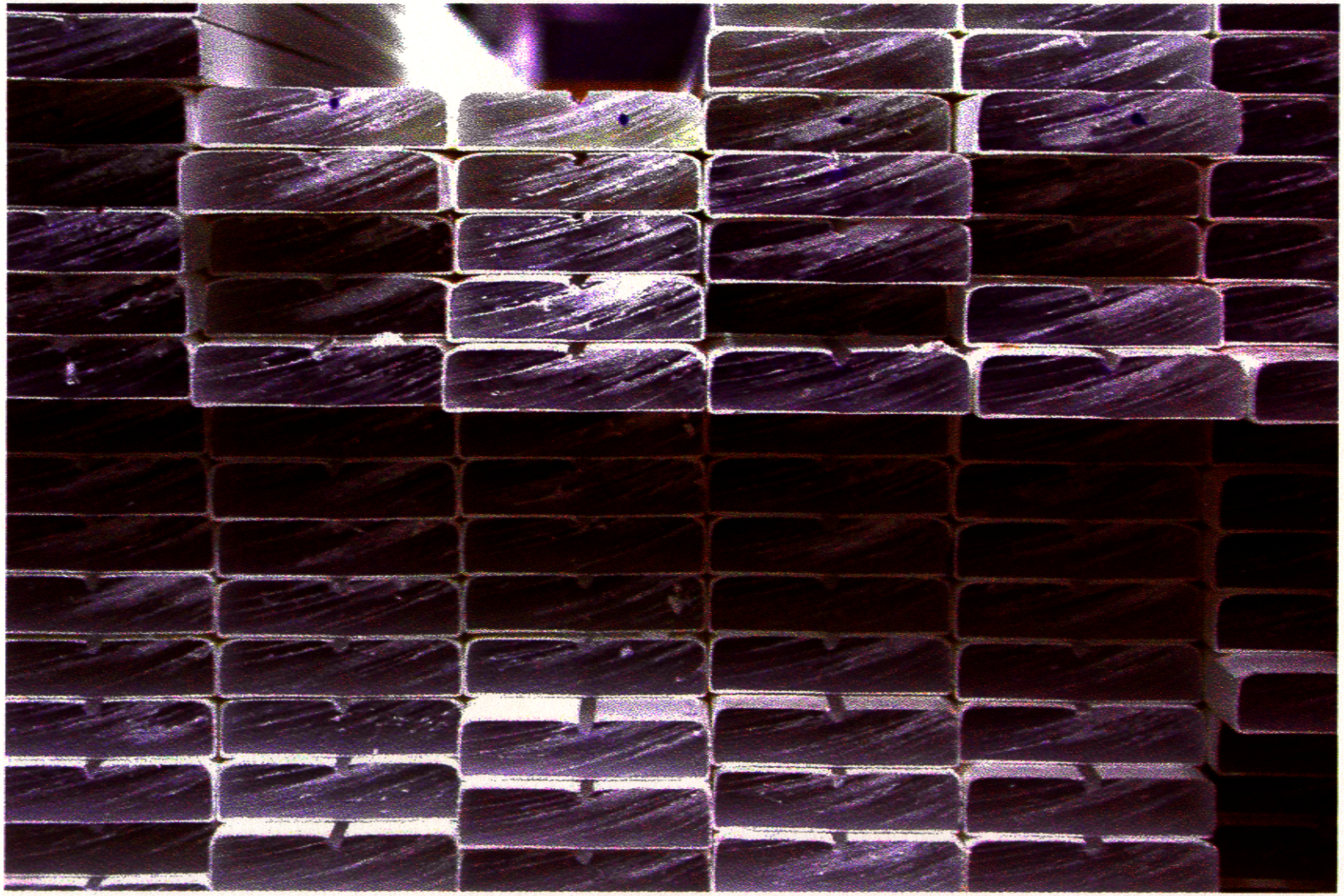


EXTRUSION AT ITASCA PLASTICS

MINOS

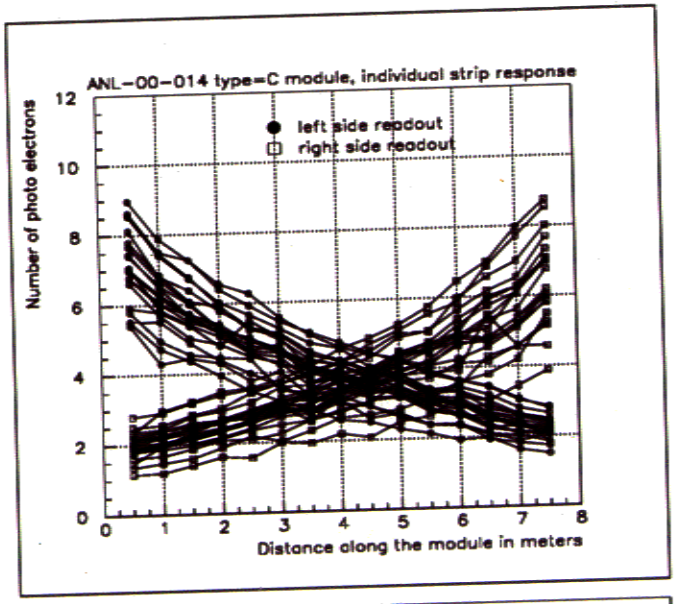
EXTRUDED SCINTILLATOR STRIPS

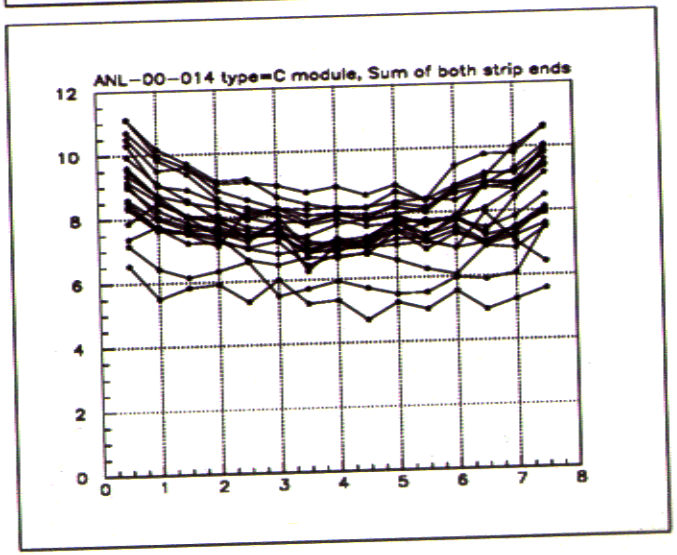
MINOS



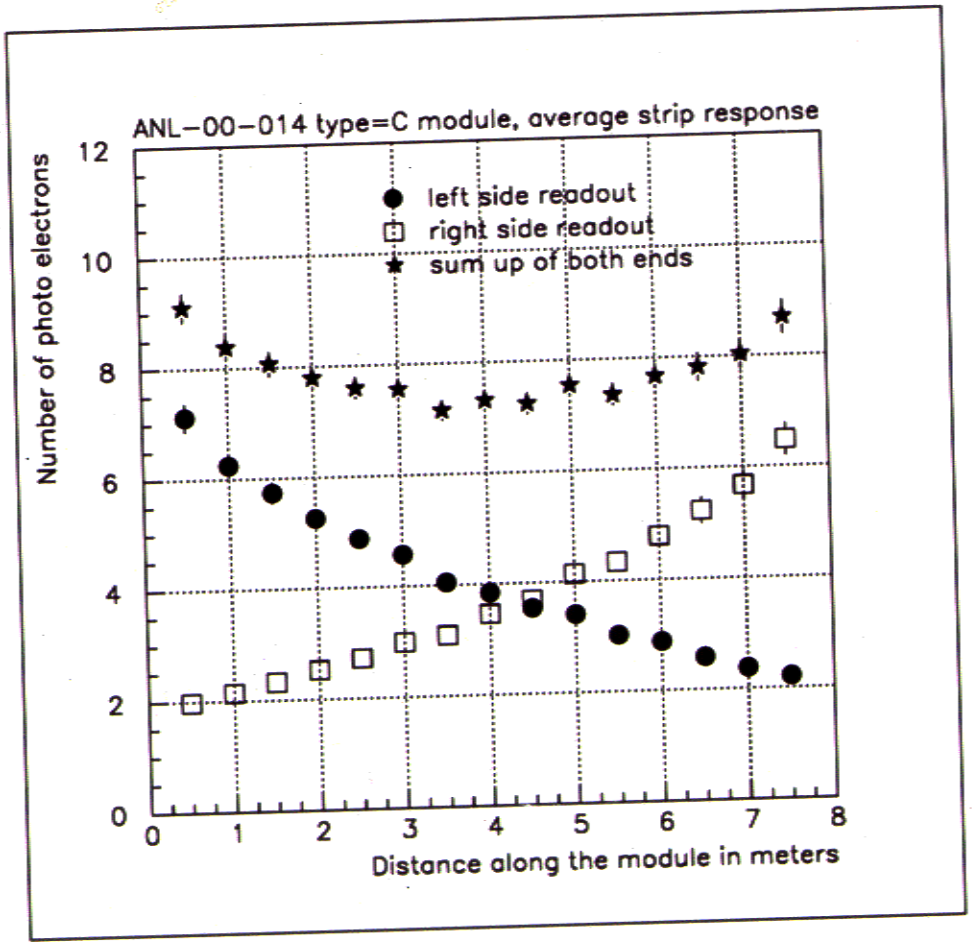
LIGHT OUTPUT
MAY 2000 MODULE PRODUCTION

MINOS





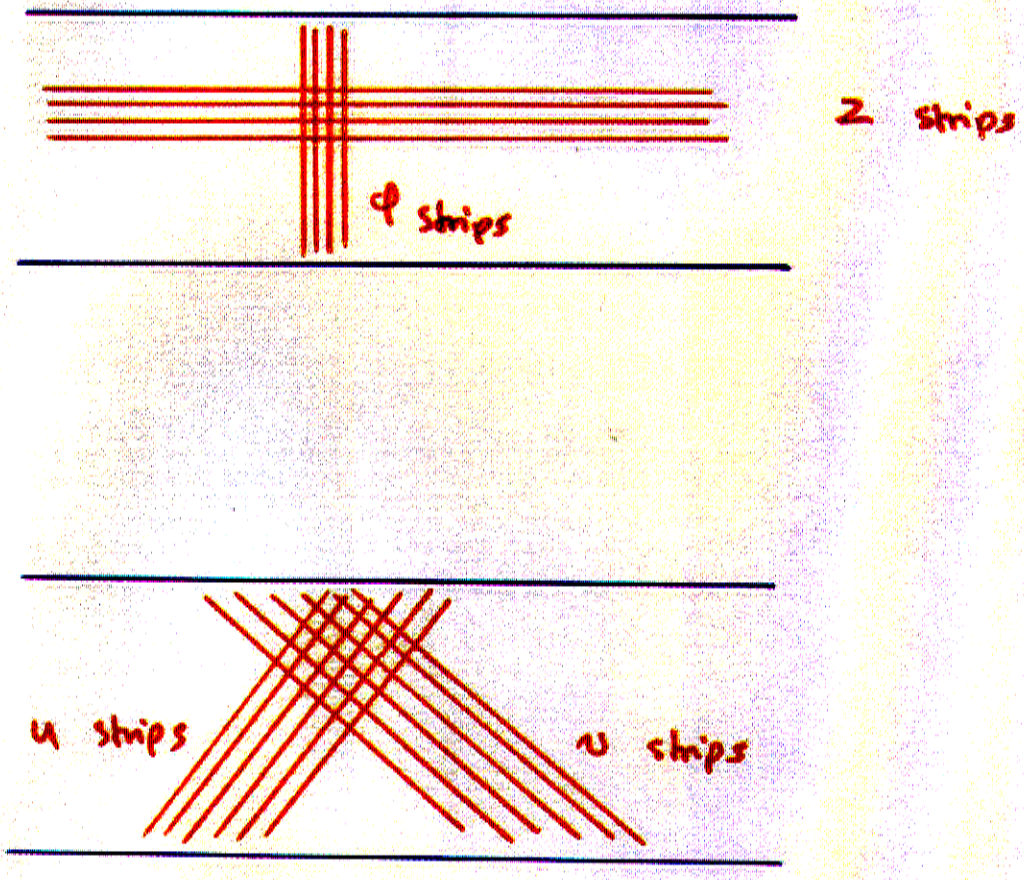
AVERAGE SUMMED LIGHT OUTPUT > 7.0 pe



Advantages of the solid scintillator-based system

- speed ($\lesssim$ 5 ns)
- good energy resolution (if needed)
- flexible geometry
- simple construction (low tech, suitable for distributed construction
- robust
- well understood, mature technology

Possible geometries of a muon wedge



R&D program / issues

Physics

- Understand specks / requirements
  - B or no B ?
  - tail catcher or not ?
  - occupancy / backgrounds
  - sampling frequency
    - 2.5 cm ? 5 cm ? 10 ? 25 ?
  - spatial resolution
  - optimal geometry
- Analog vs digital read out ?

Detector construction

- Geometry / construction / engineering, design
- optimization of scintillator/fiber
- full size (? ½? ¼?) prototype
- cosmic ray test stand

Readout

Very large number of fibers to read out

- MAPMT (Hamamatsu M64? Philips?)

- silicon-based ?
  ULPE

⇒
- APD
- MRS
- next generation APD's

goal : ≤$ 1-5 /pixel