INDIANA UNIVERSITY CYCLOTRON FACILITY

Circa 1998

OPERATING PARAMETERS

CYCLOTRON

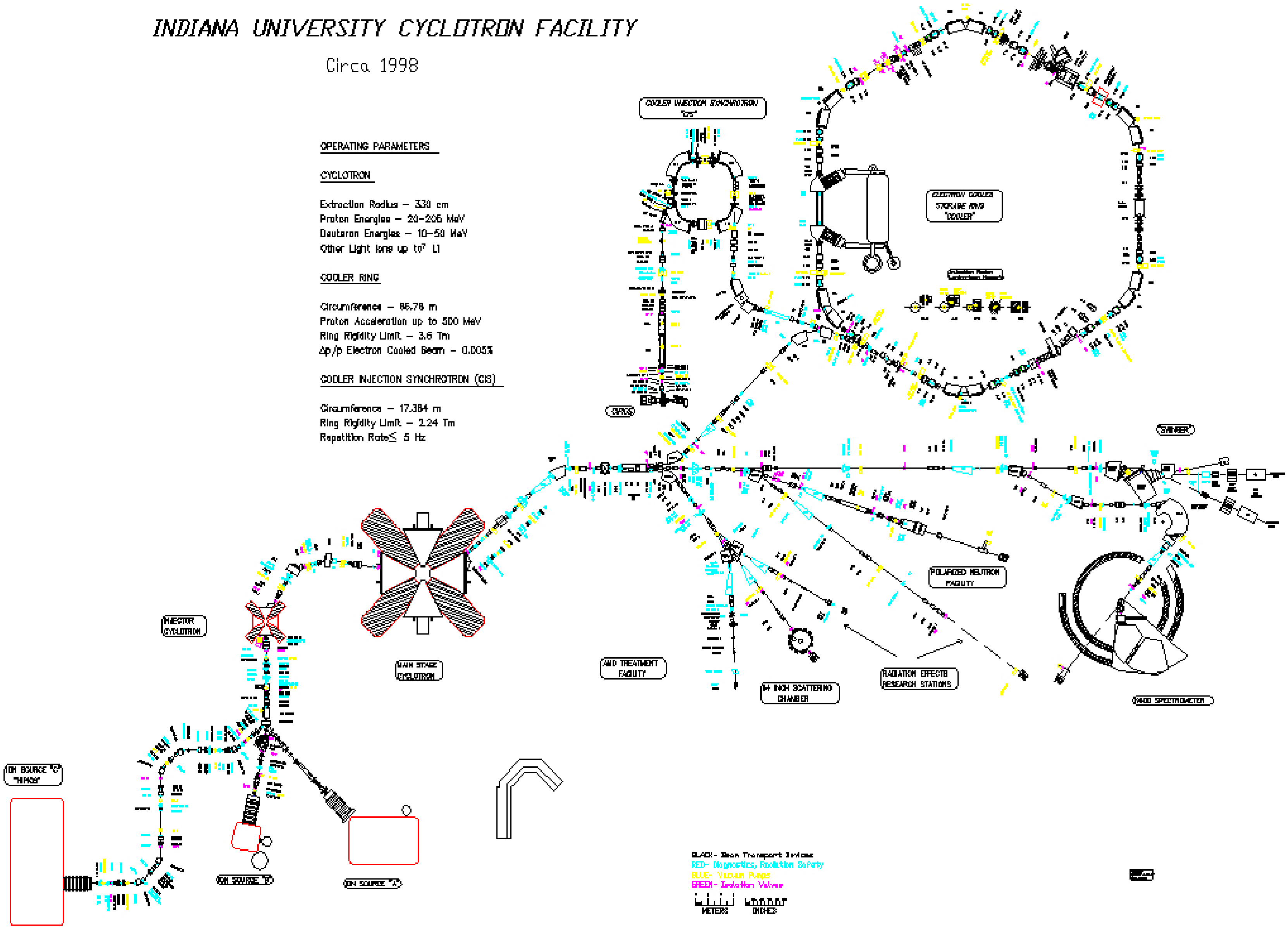
Extraction Radius – 330 cm
Proton Energies – 20–205 MeV
Deuteron Energies – 10–50 MeV
Other Light Ions up to ^{7} Li

COOLER RING

Circumference – 86.78 m
Proton Acceleration up to 500 MeV
Ring Rigidity Limit – 3.6 Tm
$\Delta p/p$ Electron Cooled Beam – 0.005%

COOLER INJECTION SYNCHROTRON (CIS)

Circumference – 17.364 m
Ring Rigidity Limit – 2.24 Tm
Repetition Rate ≤ 5 Hz



GASEOUS DETECTORS AT IUCF

HELICAL DETECTORS
- QDDM SPECTROMETER

MULTIWIRE PROPORTIONAL CHAMBERS
- DESIGNED FIRST WIRE CHAMBER WITH A HOLE IN IT FOR USE IN THE COOLER

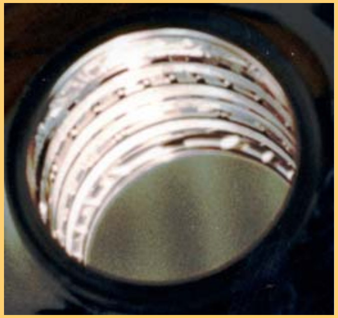
DRIFT CHAMBERS

VERTICAL DRIFT CHAMBERS
- PION SPECTROMETER
- K600 SPECTROMETER

BUILT WIRE WINDING MACHINE AND PERFECTED TECHNIQUES FOR DESIGNING AND CONSTRUCTING WIRE CHAMBERS AND ASSOCIATED GAS HANDLING EQUIPMENT

Fiber glass support ring. Wires are Soldered and glued to this ring

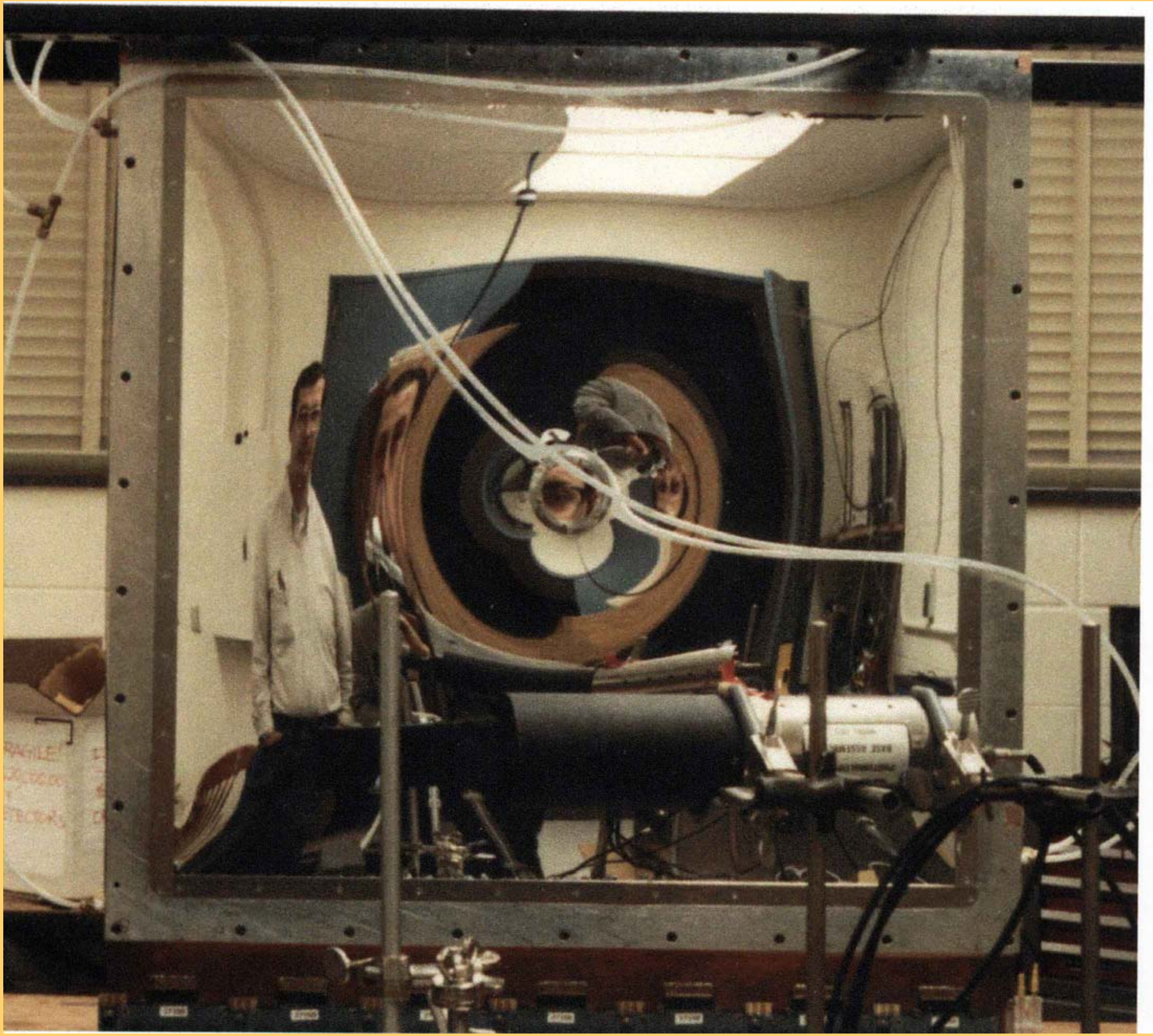
WIRES 20μm diam.
6.35 mm spacing

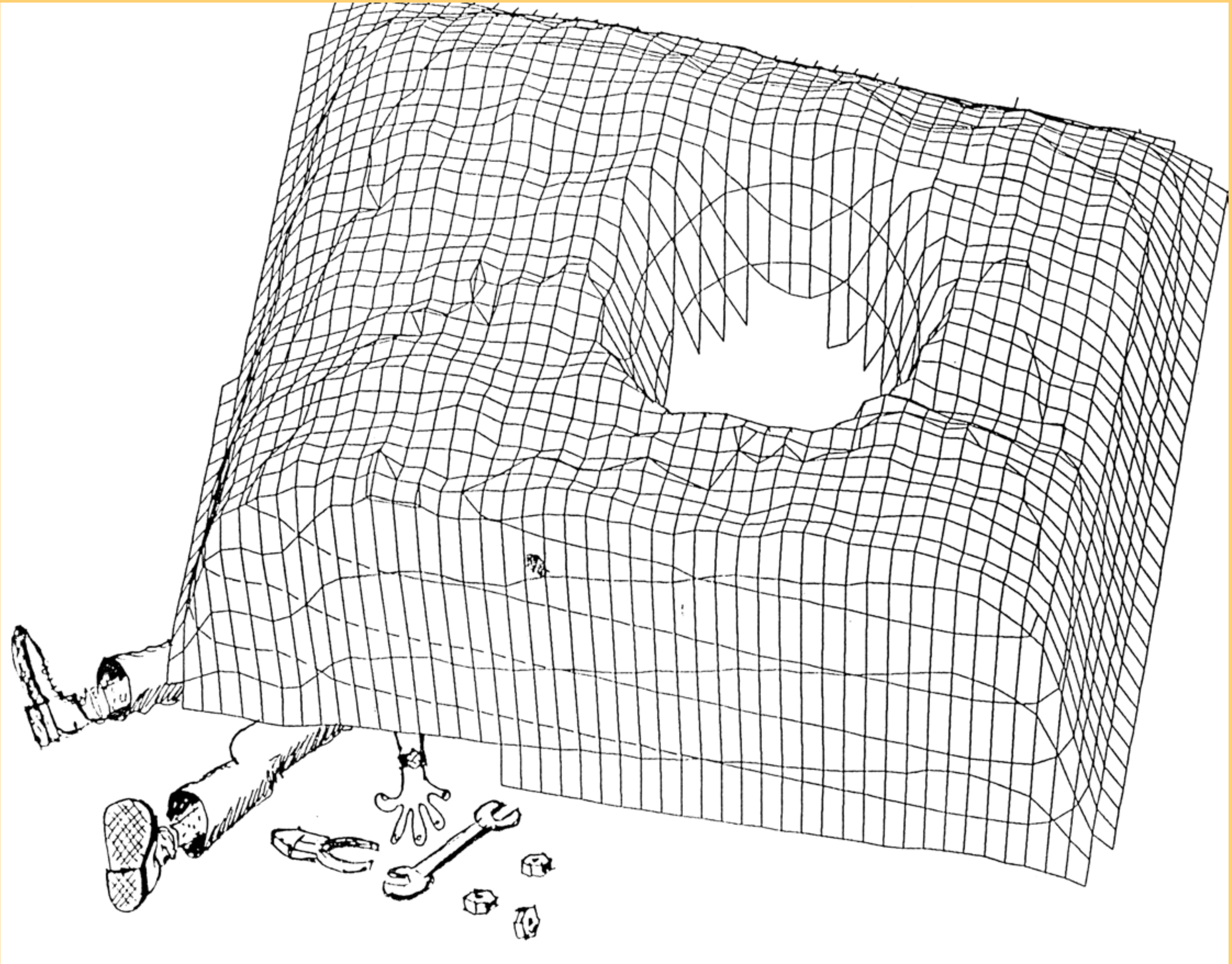


The picture on the left shows the inside of the stack of Rings attached to high voltage planes and windows as Well as the two wire planes of the detector

The hub, shown on the left, is inserted inside all of the rings. The hub seals the chamber inside rings and provides mechanical rigidity.

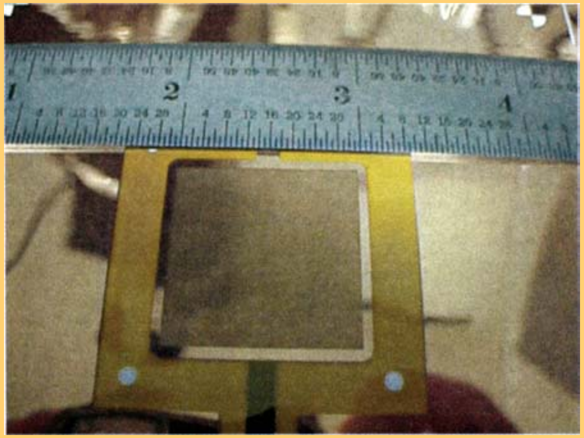
Assembled
Wire chamber
Filled with gas.



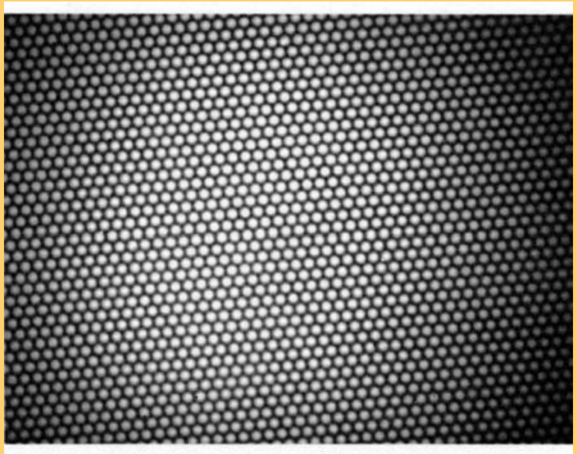


First data taken with chamber.

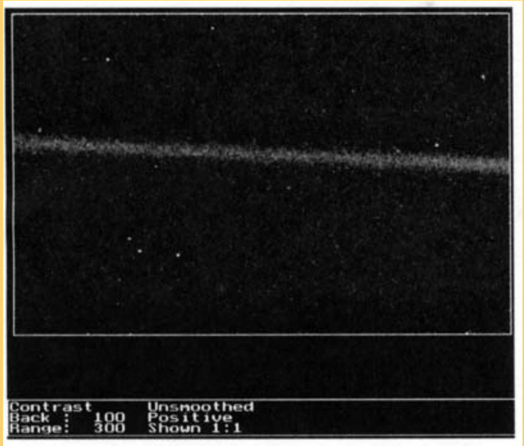
Around 1998 we formed a collaboration with Karl Pitts at the University of Louisville to study and develop gas detectors that use micro structures for electrodes. Karl developed techniques with lasers and etching to shape microstructures primarily in polyimide. IUCF Concentrated on electric field calculations, detector design, and studying applications.



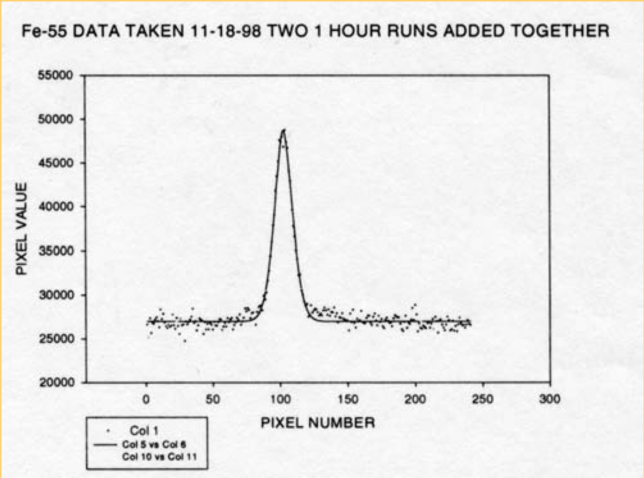
TYPICAL "GEM"



Scintillation light. Each disc is 50 μm in diameter

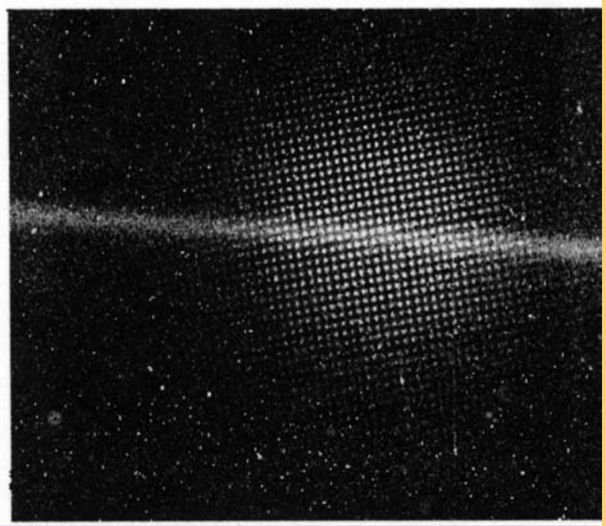


FE-55 SLIT SOURCE
2 HOUR EXPOSURE



Fe-55 source summed.

Alpha source added to Fe-55 source to show scale



THE HIGH ENERGY GROUP AT INDIANA UNIVERSITY IS A MEMBER OF ATLAS COLLABORATION AND IS PRODUCING HALF OF THE STRAW TUBES FOR THIS DETECTOR.

THEY HAVE MADE A VIDEO OF STRAW TUBE PRODUCTION

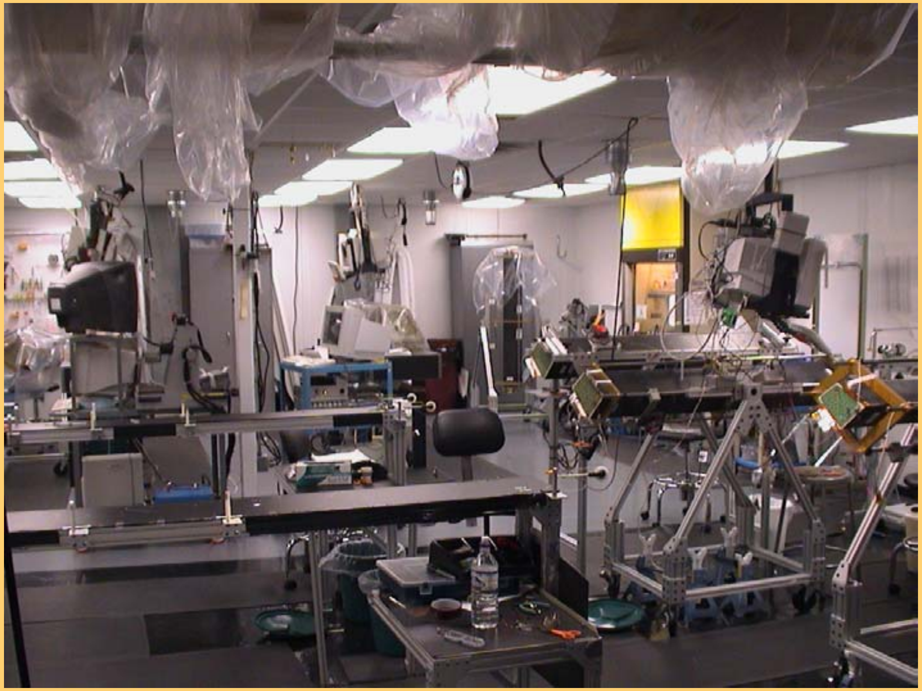
THEY WILL SHOW ANY INTERESTED PERSONS THEIR FACILITY

THEIR STRAW TUBES MUST HAVE LOW LEAK RATES AND HIGH COUNT RATE CAPABILITY.

THEY HAVE DEVELOPED

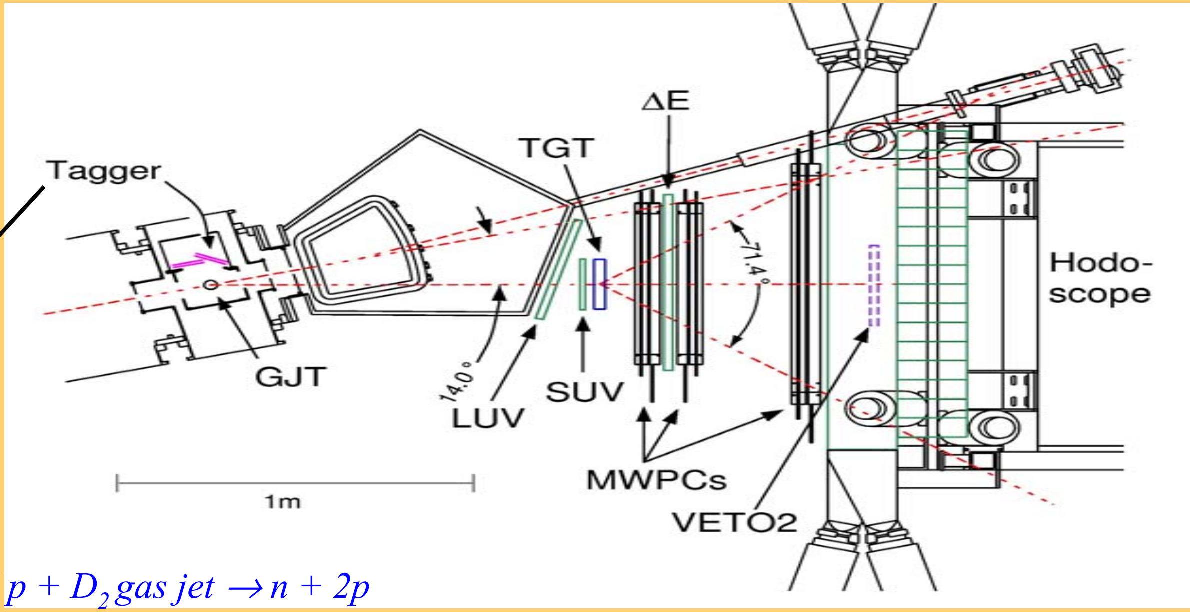
WIRE CENTERING TECHNIQUES FOR LONG TUBES

MODULAR UNIT DESIGNS

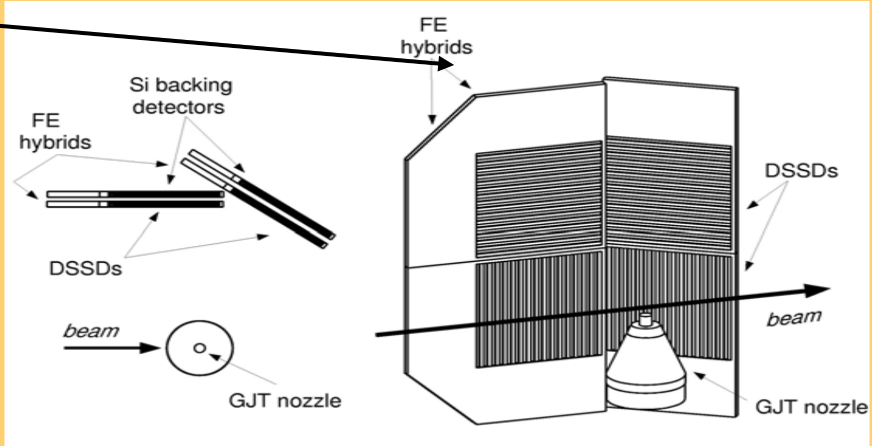


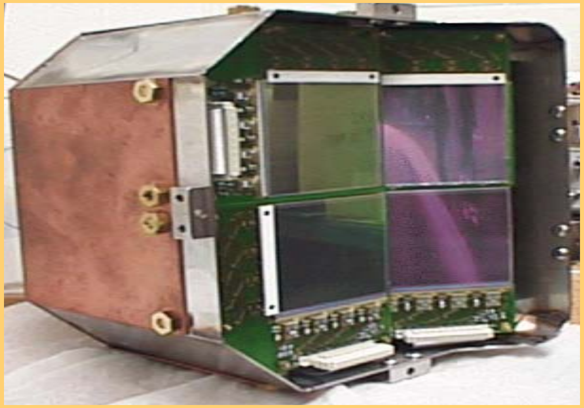
CLEAN ROOM WHERE STRAW TUBES ARE ASSEMBLED

IUCF Tagged Neutron Facility (commissioned May 2000) **permits precise measurement of absolute np scattering cross section**

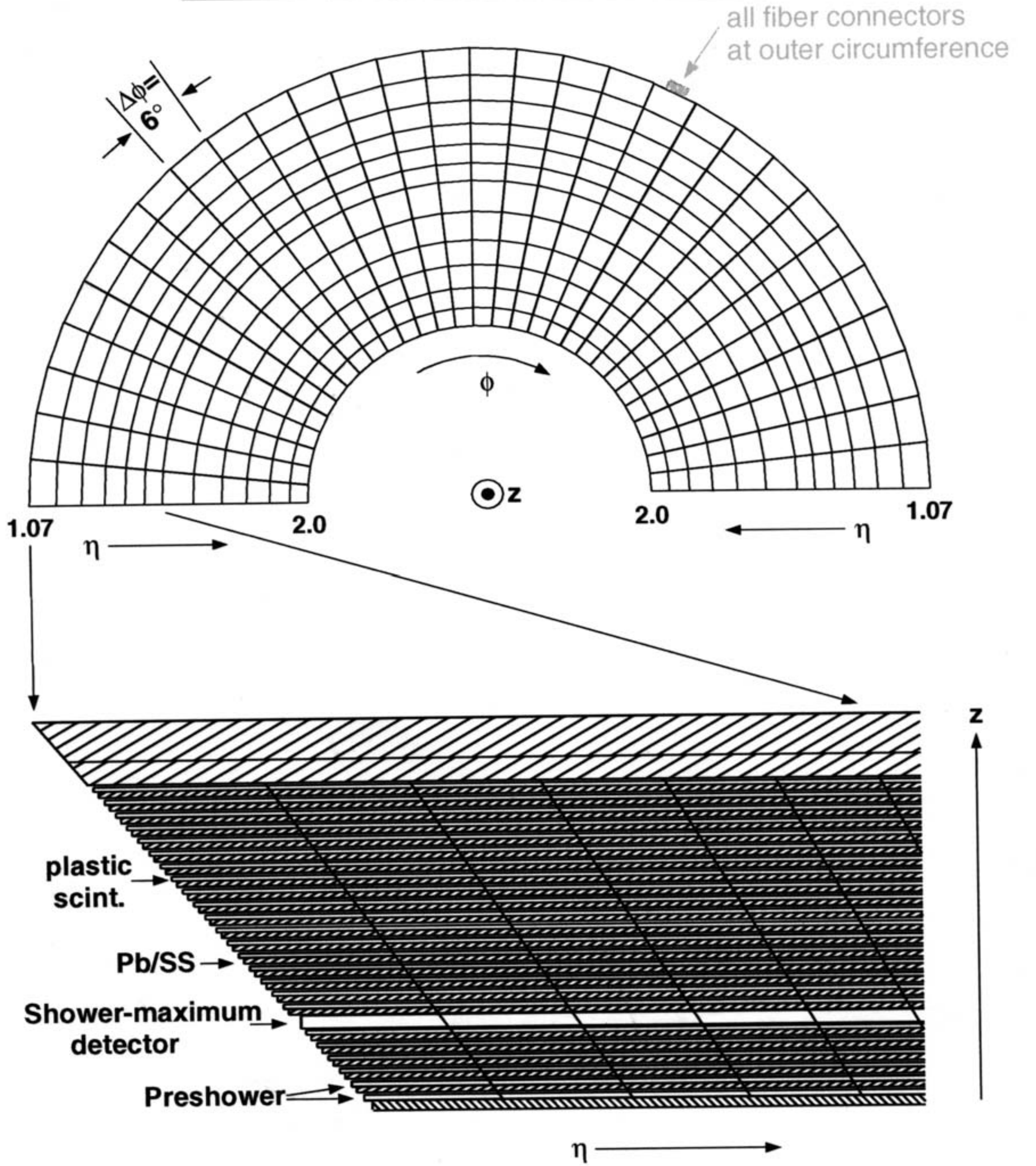


- *200 MeV cooled p + D_2 gas jet → n + 2p*
- *detect 2 low-E recoil p's in self-triggering tagger; measure E, t, x, y for each to tag and determine n 4-momentum event-by-event*
- *measure recoil p from np scat. in secondary target in large-acceptance forward array; measure pp scat. simultaneously*





Proposed Endcap EMC Layout



Thermwood router for machining
Scintillator and fiber routers

A portion of a six degree tile from the bottom side

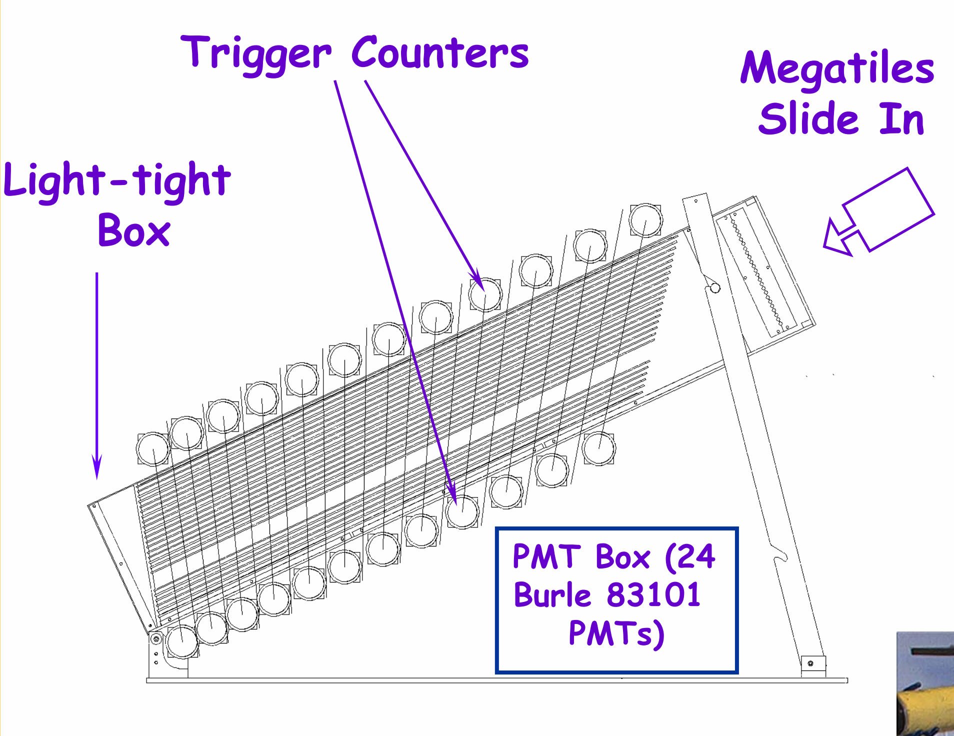
Assembled tile with fiber router and WSLF

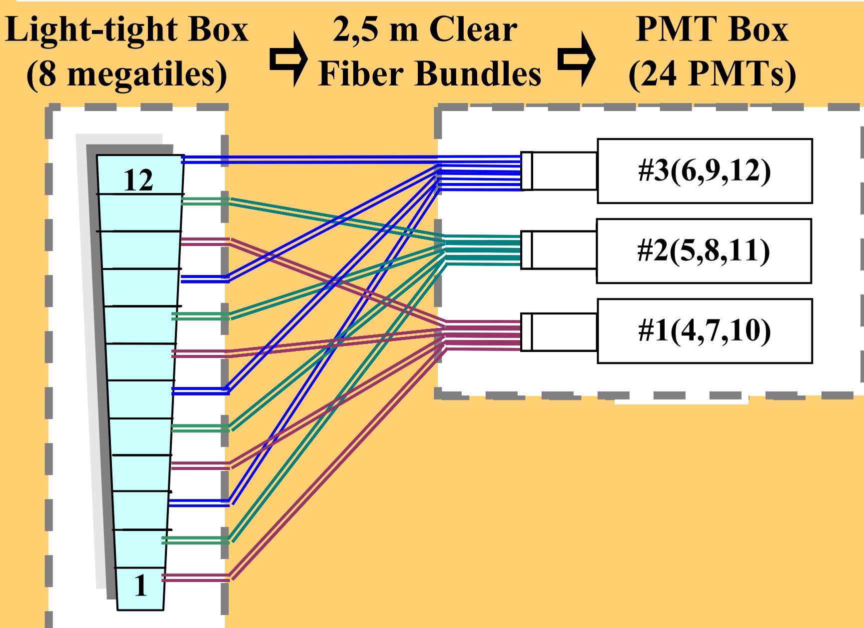
Cosmic Ray

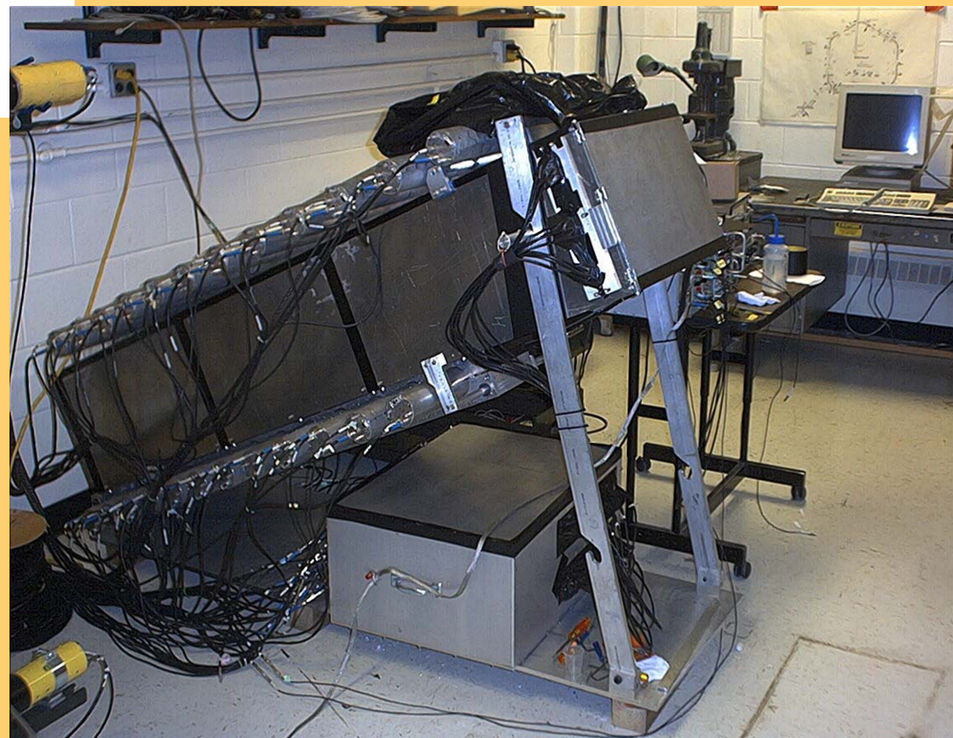
Test Stand

Test Stand

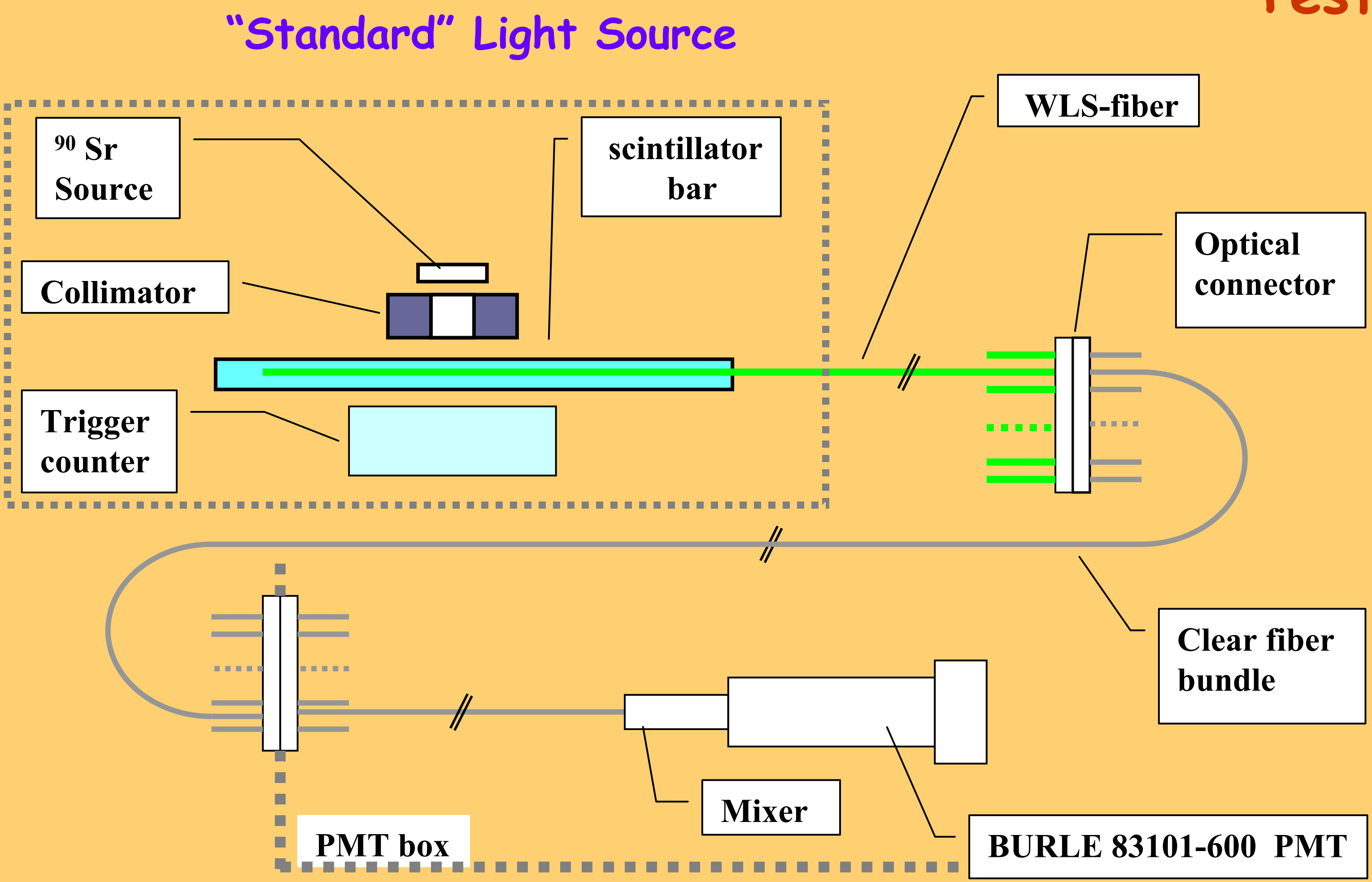
for Megatile QA/QC



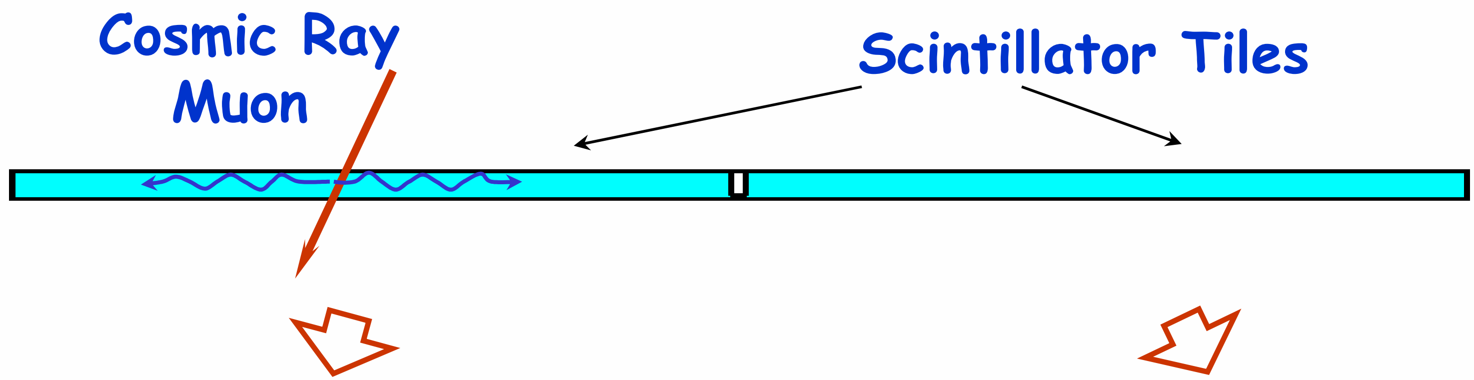




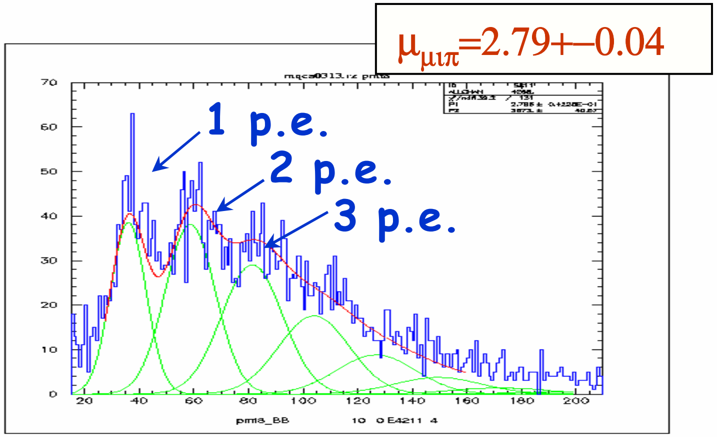
Optical Chain Calibration Test Stand



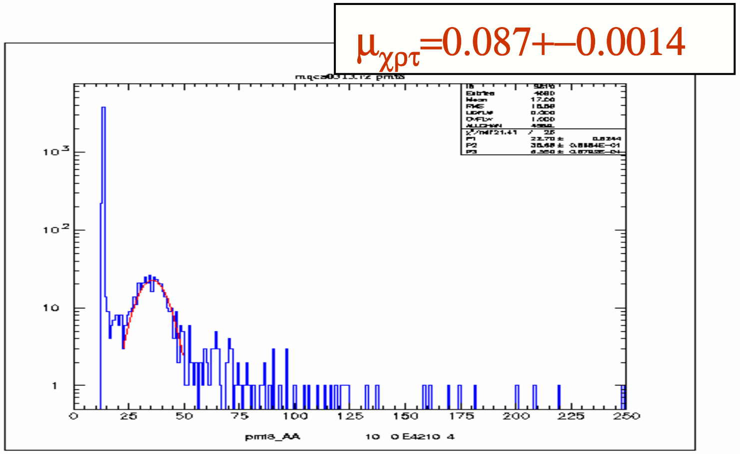
Megatile Light Yield Measurement



Tile Light Yield



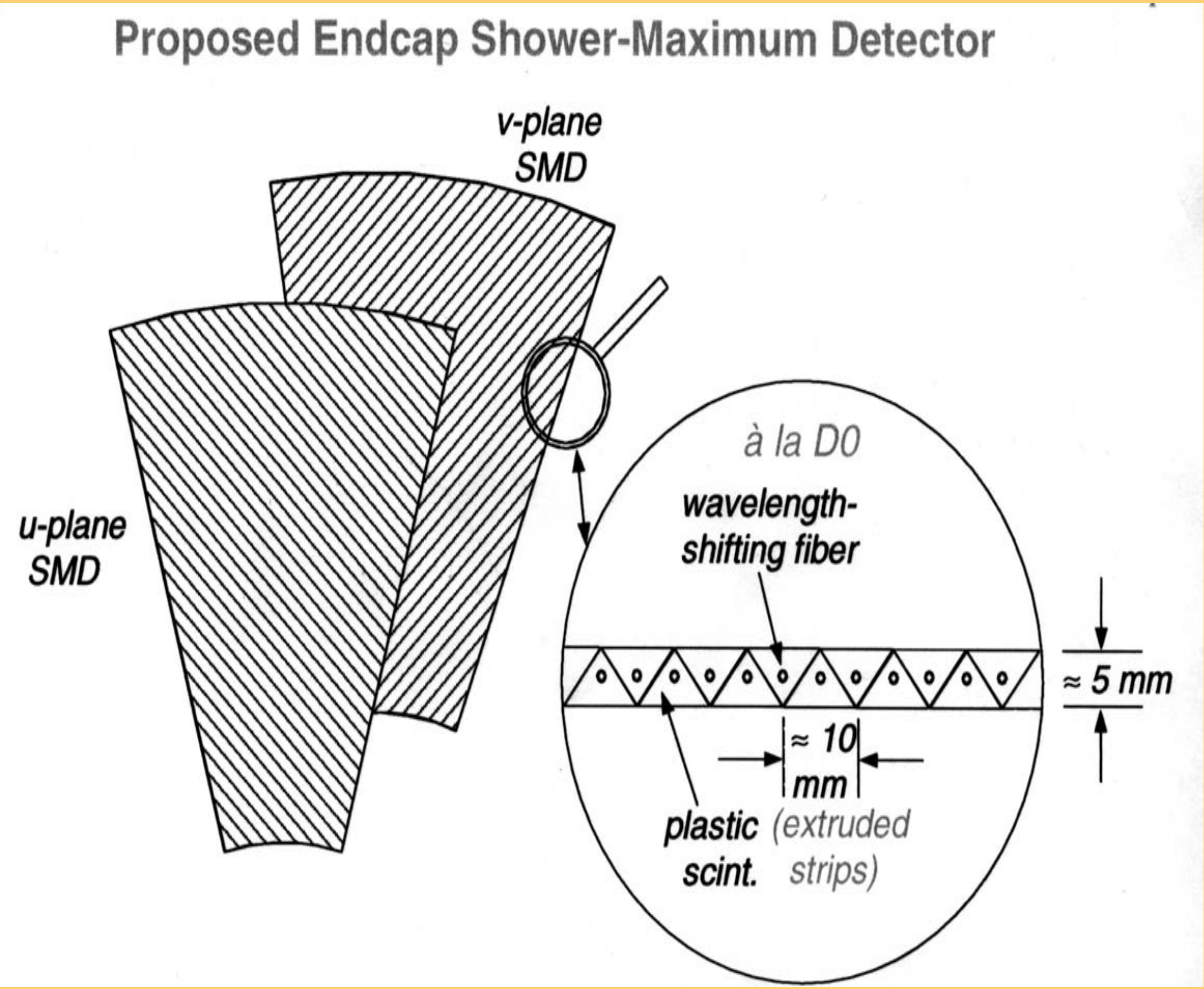
Crosstalk from Adjacent Tile

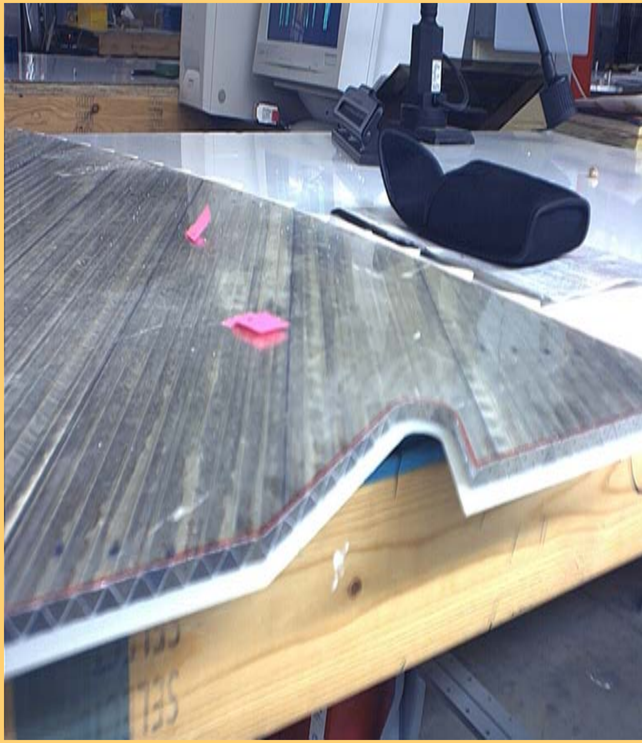


Analyze pulse height distribution as a convolution of:

1) a Poisson distribution of photoelectrons with mean m and

2) Gaussian distributions, representing PMT response to *n* photoelectrons, with $C_n = n\ C_1$ and $s_n = Sn\ s_1$, where C_1 and s_1 describe single photoelectron peak

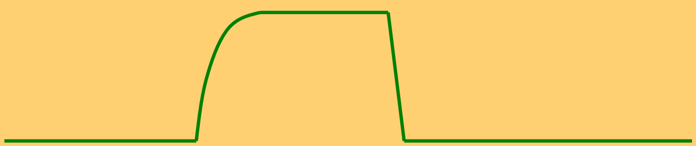




A portion of a machined Shower max detector

MAPMT Readout Electronics

G. Visser, IUCF



<u>for STAR EEMC</u>

• periodic 70 ns gated integration synchronized to external clock (~9.7 MHz)

• measure total charge on every cycle (no deadtime)

• max. signal 200 photoelectrons, 12 bit dynamic range

• locally store digital data in a pipeline buffer awaiting STAR trigger decision

• 9216 channels

• compact, highly integrated system (MAPMT, HV, FEE, DAQ interface, built-in test & calibration)

<u>for Sci-Fi Neutron Imaging</u>

• continuous-reset integration (RC integrator, $\tau \approx 100$ ns)

• periodic measurement with no deadtime

• 8 – 10 bit dynamic range

• locally compute event position and reject pile-up events

• order of 2000 – 8000 channels (for 1 m^2 active area)

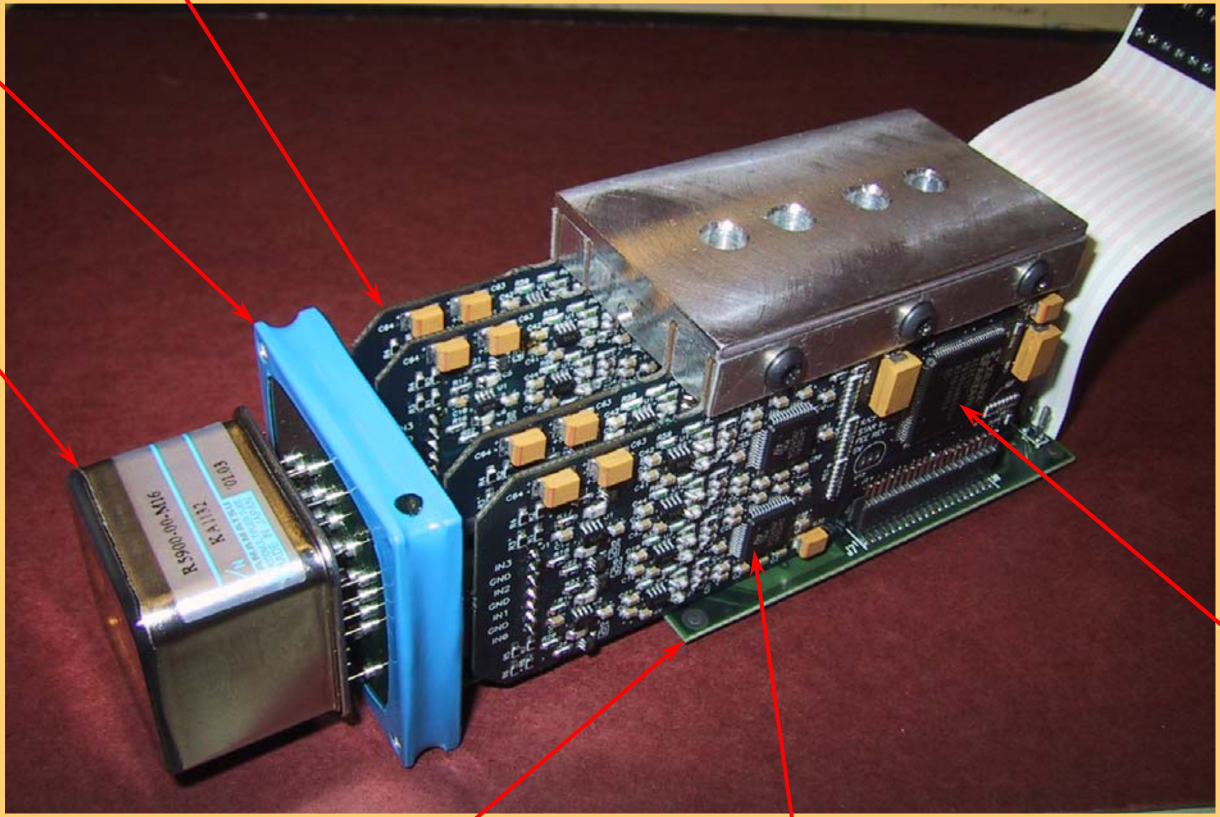
• compact, highly integrated system (MAPMT, HV, FEE, data processing, DAQ interface, built-in test & calibration)

STAR EEMC MAPMT FEE Assembly

Four FEE boards
(Identical except for input conn.)

CW base
assembly

16-anode
MAPMT



FPGA

Interface
board

Dual ADC

power: 220 mW/ch

STAR EEMC MAPMT Box

Fiber harness compartment

Fiber connector kiosk

192 channels

total power: 50 W

MAPMT

in steel shield

CW base assembly

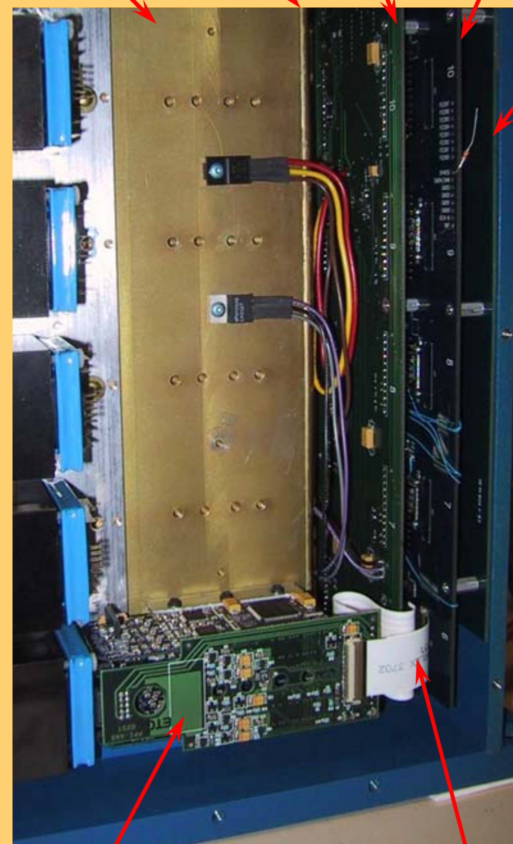
Cooling tube

Center plate

Power board

Readout board

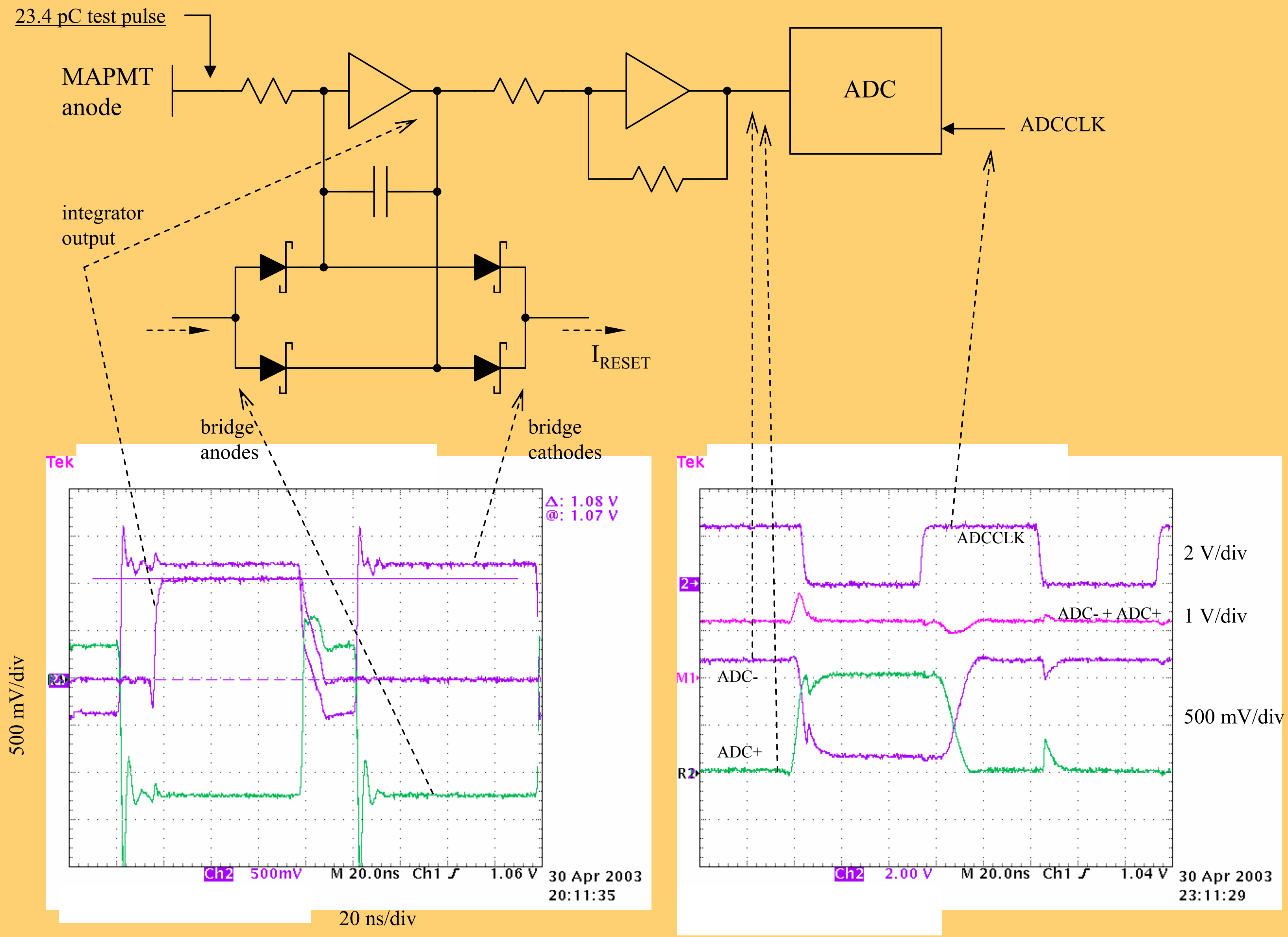
Connector board



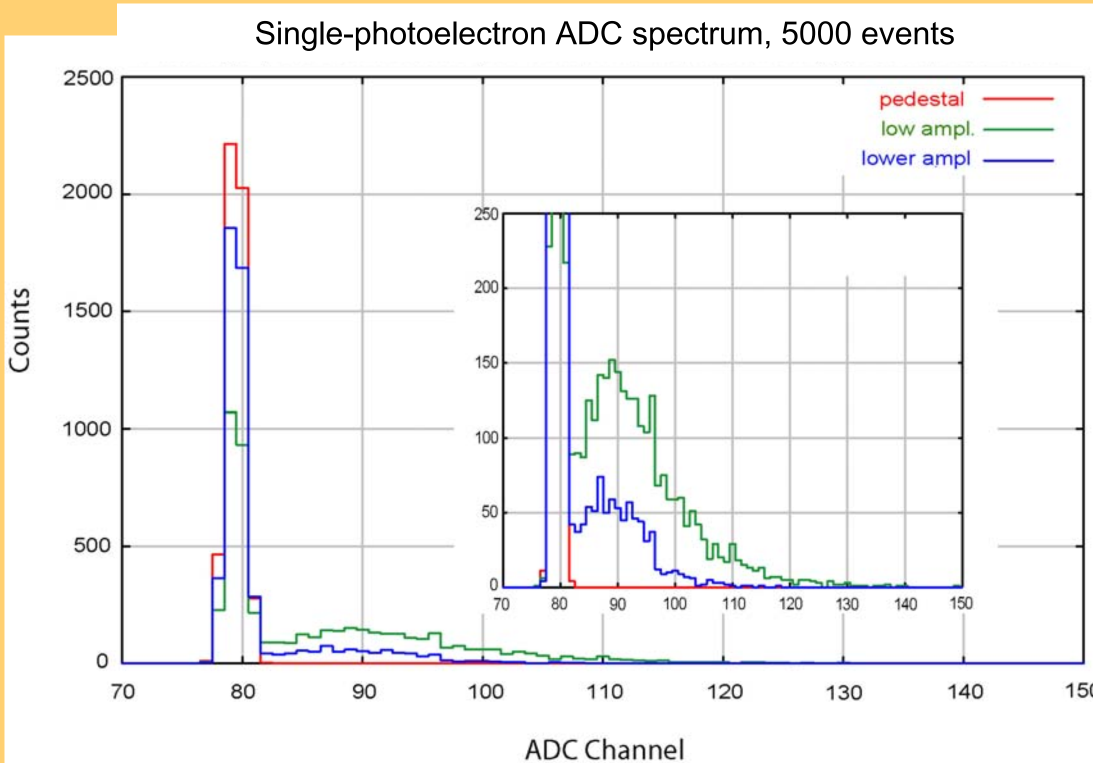
FEE assembly (12 per box)

Flex cables (data & power)

STAR EEMC MAPMT FEE – Waveforms



STAR EEMC MAPMT FEE – Response to LED pulser



IUCF HAS DEMONSTRATED ITS ABILITY TO UNDERSTAND, APPLY AND INNOVATE IN THE FOLLOWING AREAS

GASEOUS DETECTORS

SCINTILLATOR DETECTOR SYSTEMS

FRONT END ELECTRONICS

WE ARE LOOKING FORWARD TO THE NEW CHALLENGES IN NEUTRON DETECTOR DEVELOPMENT