ILC Prototype Muon Scintillation Counter Tests

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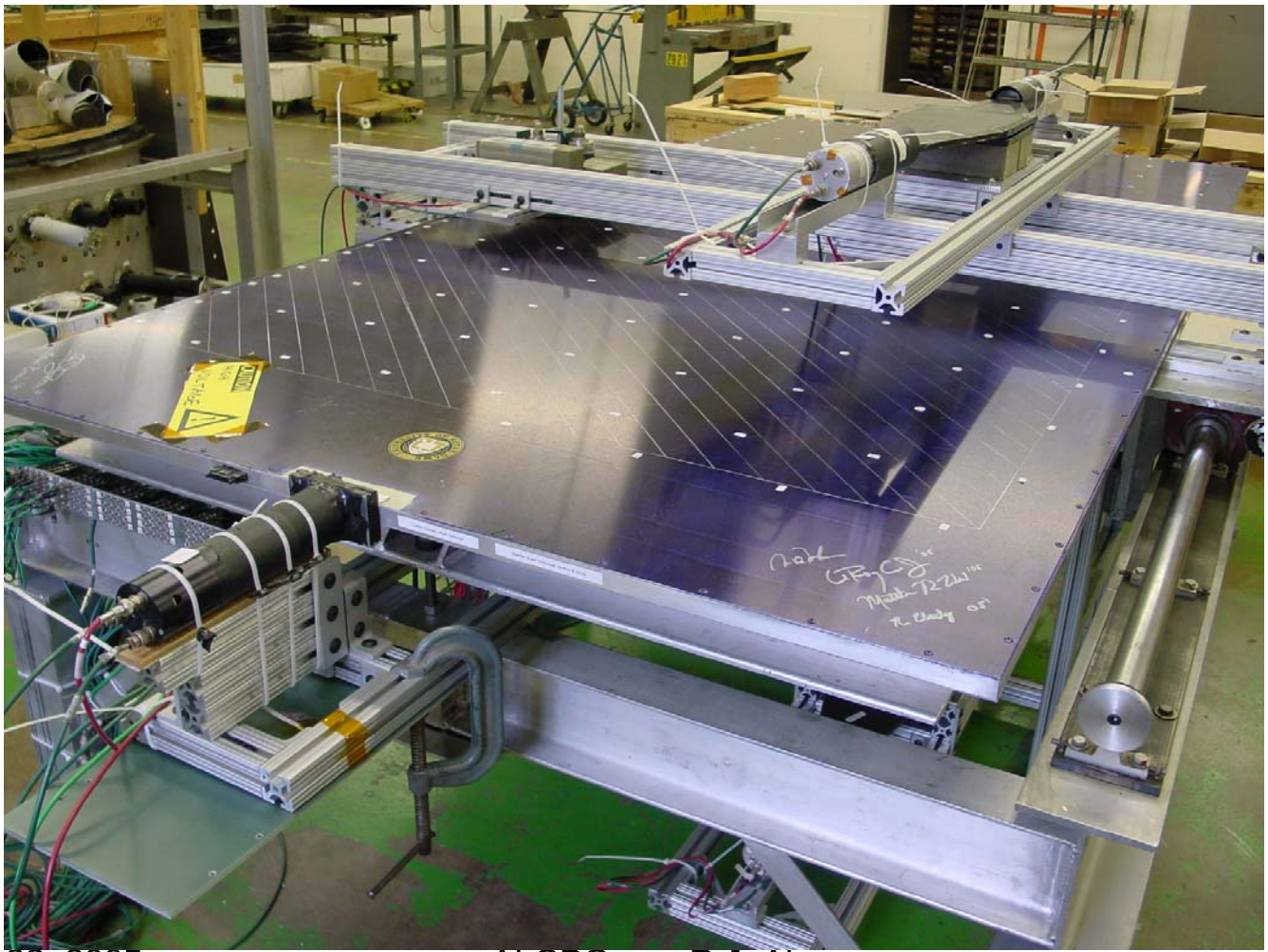
Update on Testing At FNAL

- New Test Setup in Lab 6 with Fermilab Support
- Testing Two New Prototype ILC Muon Counters from Notre Dame U. (S1 since 7/12/05, S2 since 8/10/05)
- Tests of Single Scintillator Strip From NIU
- MAMPT Installed, Testing has Begun, UC Davis Readout System w/CAMAC modules

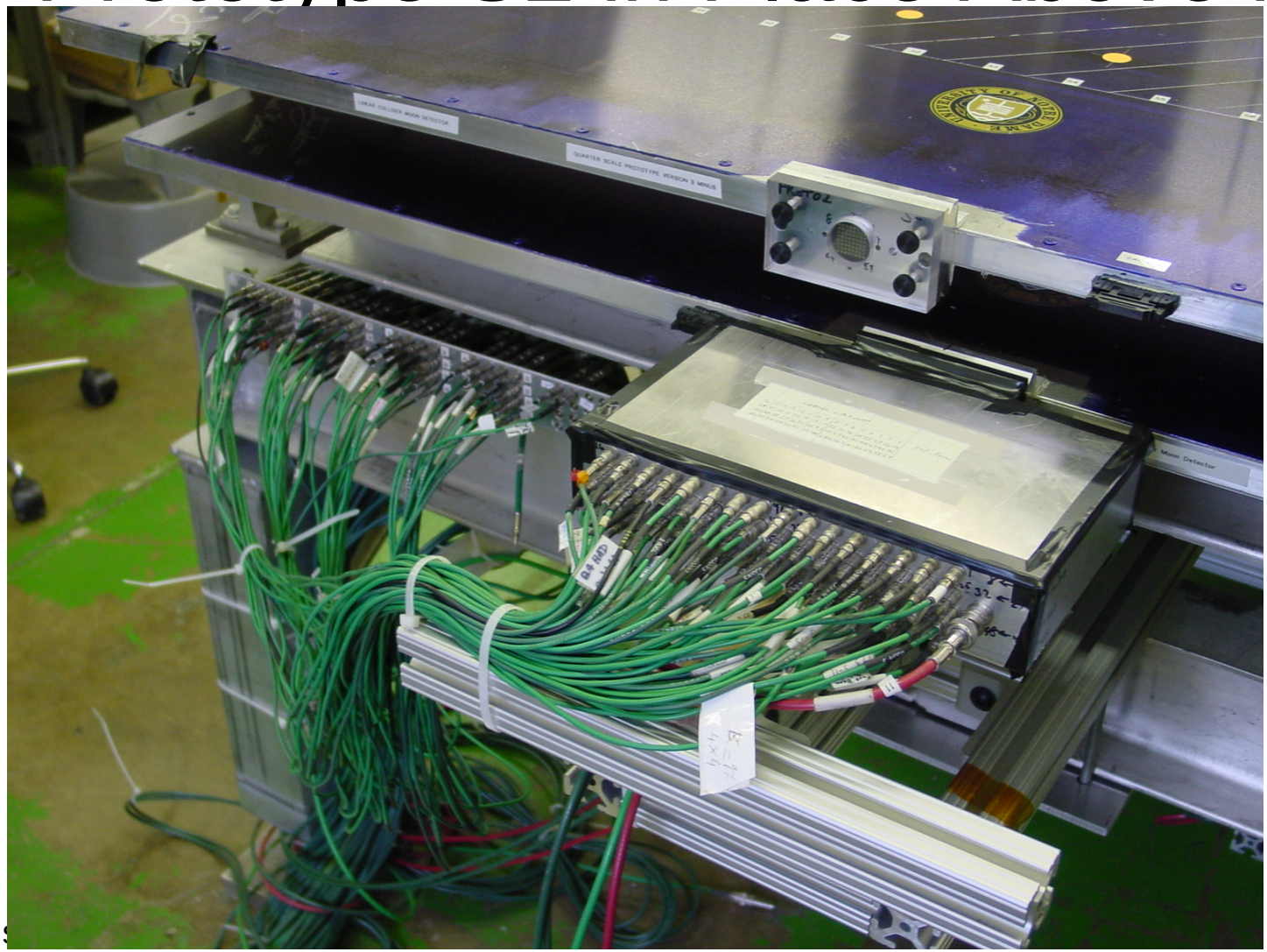
Test Setup

- Testing table holds 2 modules and 2 movable pairs of 20cm x 20 cm scintillation counters above and below prototype counter
- Source tests with 1mCi Cs137 gamma source mounted on transporter. Improved collimator (2” thick Pb).
- Single Anode PMT: Hamamatsu E934-01
- 64-element MAPMT: Hamamatsu H7546B

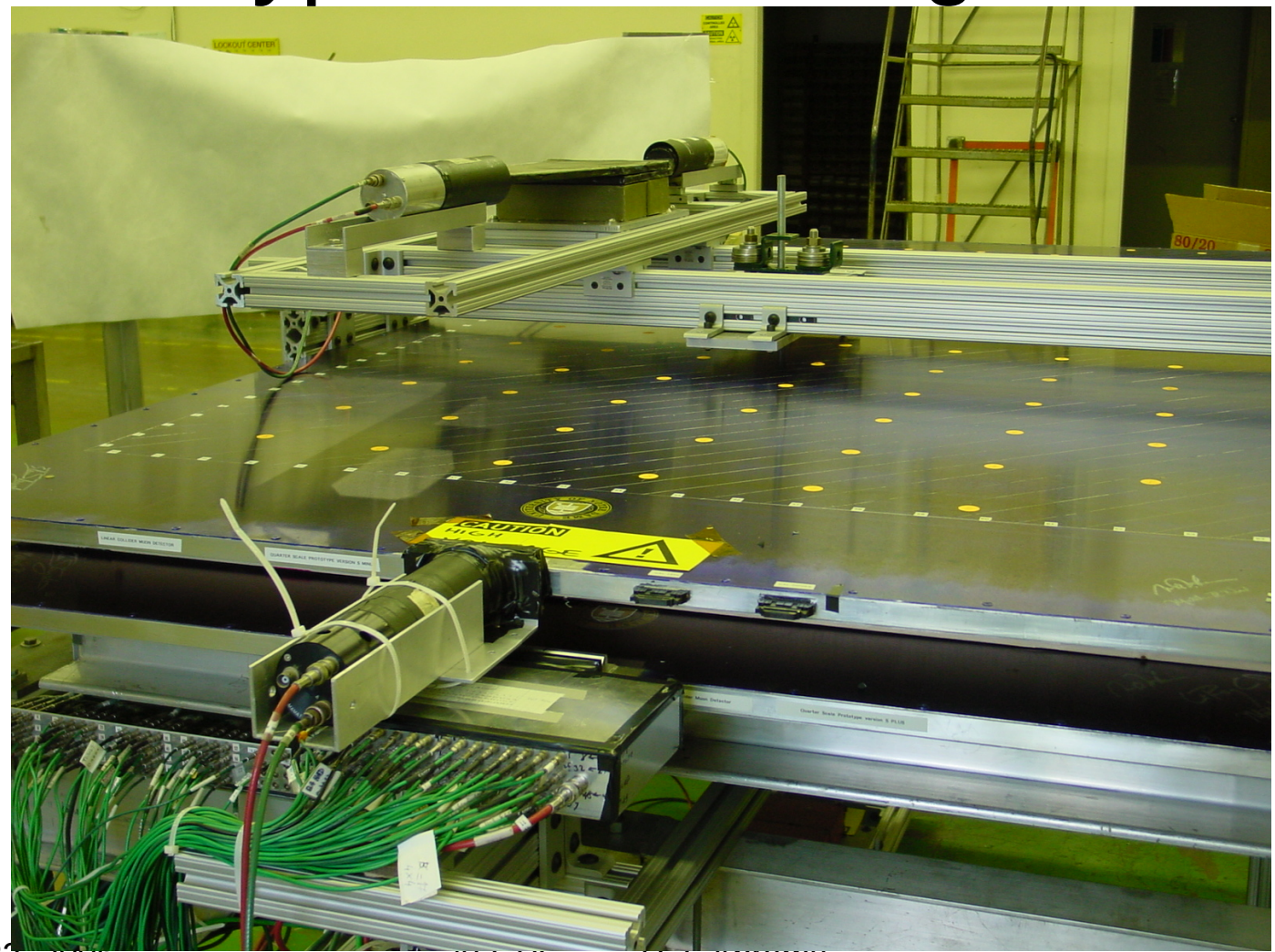
Prototype S1 with Single PMT



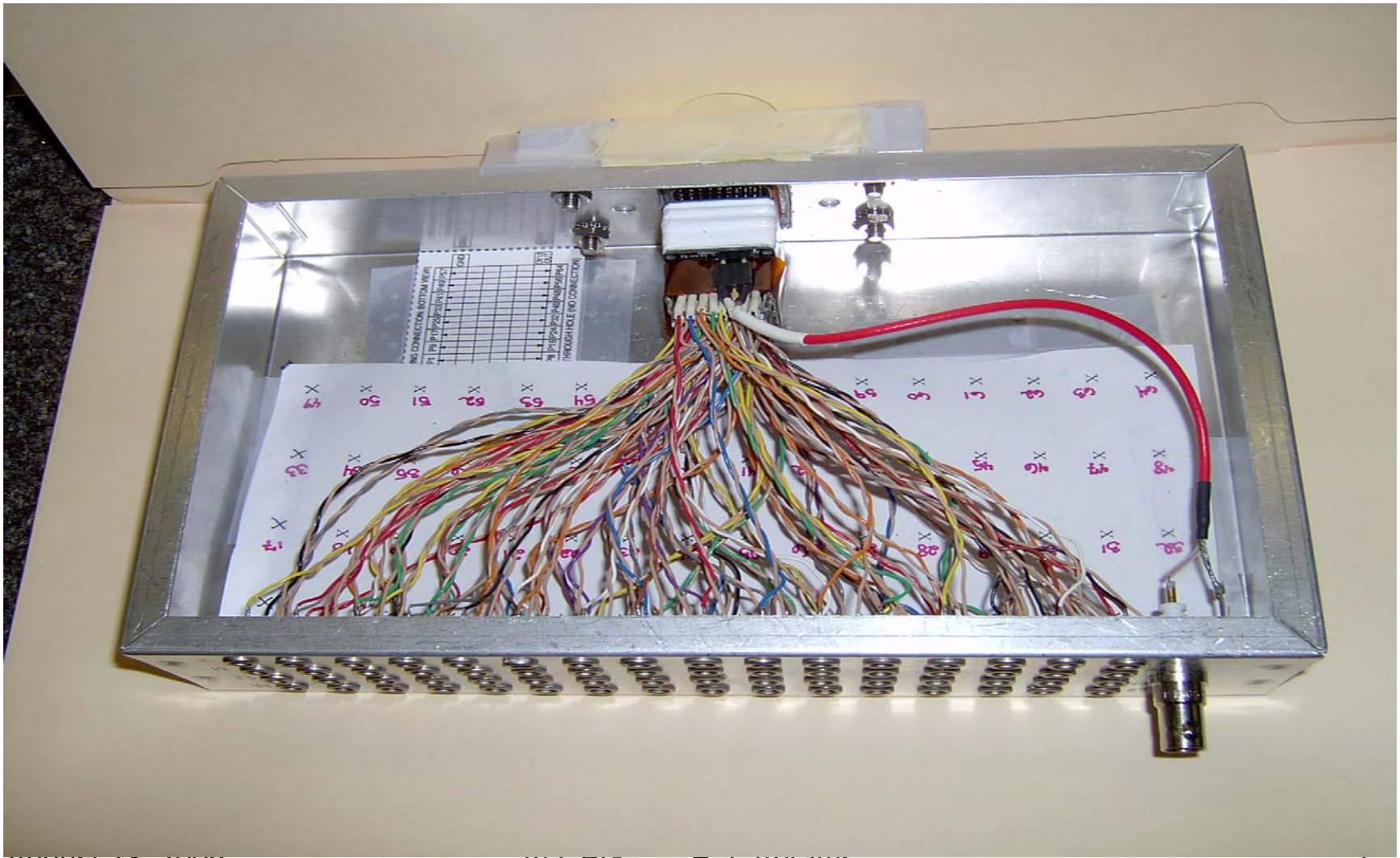
Prototype S1 with MAPMT, Prototype S2 in Place Above it



Prototype S1 with MAPMT, Prototype S2 with Single PMT



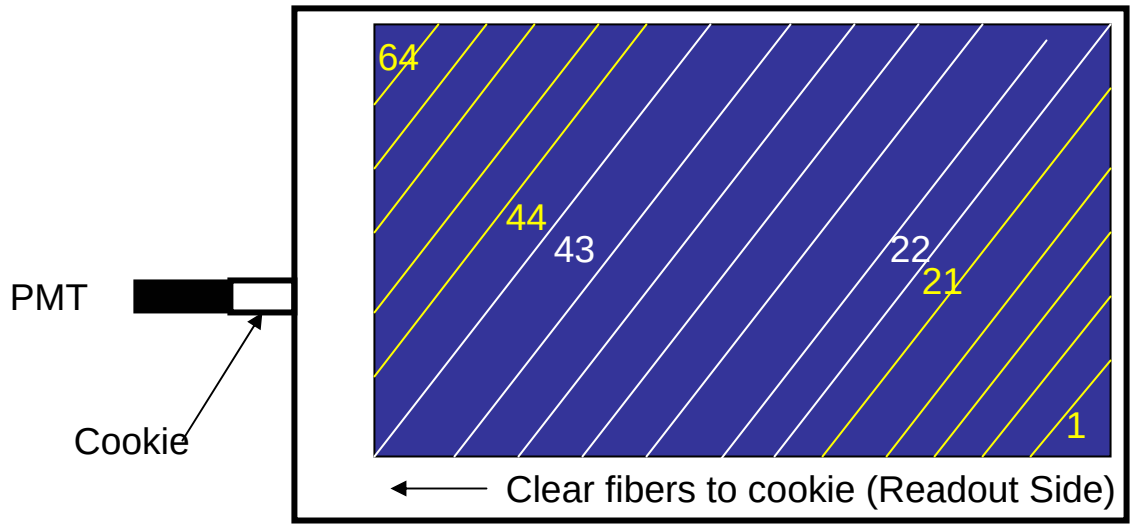
MAMPT Connector Box



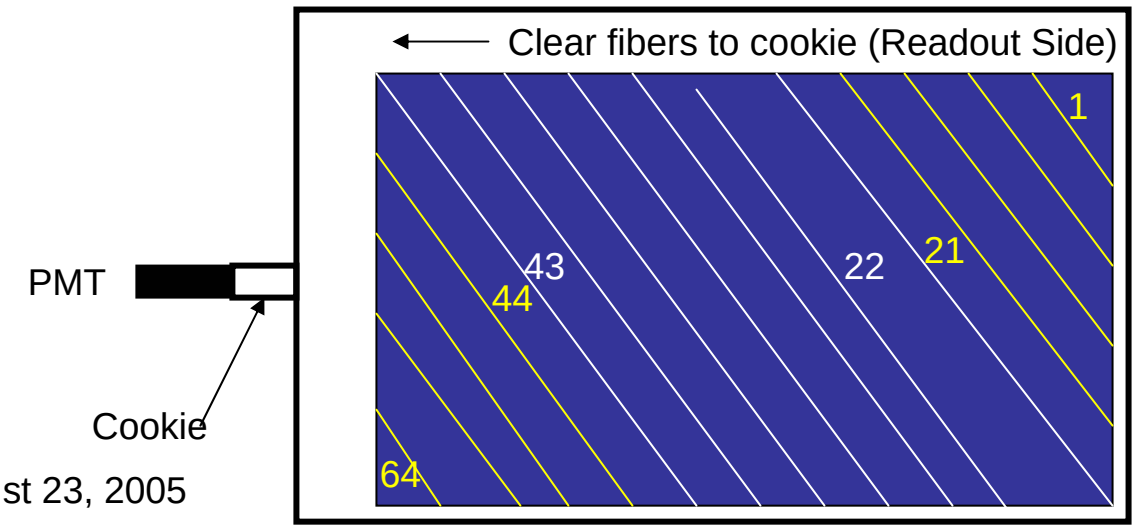
Prototype Muon Detectors

- Module dimensions 1.25m x 2.5m
- Constructed at Notre Dame University (See M. Wayne talk at this conference
- 64 scintillator strips at 45 degree angle to edges
- 2 modules built, at +/- 45 degrees
- Strips #22-43 same length across entire width
- Wavelength shifter fibers in grooves spliced to clear fibers that run from scintillator to cookie.
- 9 sets of LED-driven fiber bundles illuminate ends of all strips for monitoring
- Proto S2 has PIN photodiodes to monitor LEDs

Scintillator Strip Layout Simplified

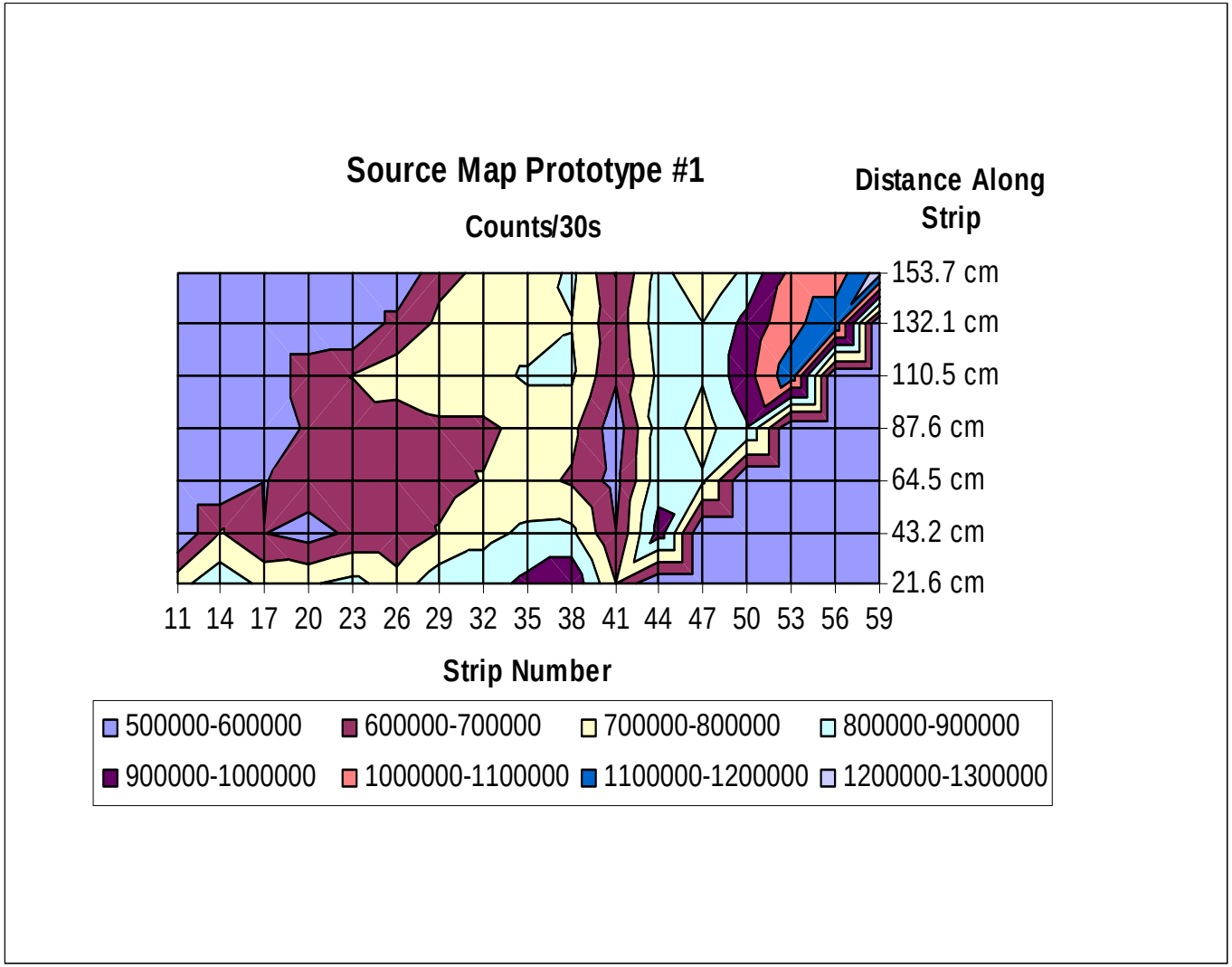


Prototype S1

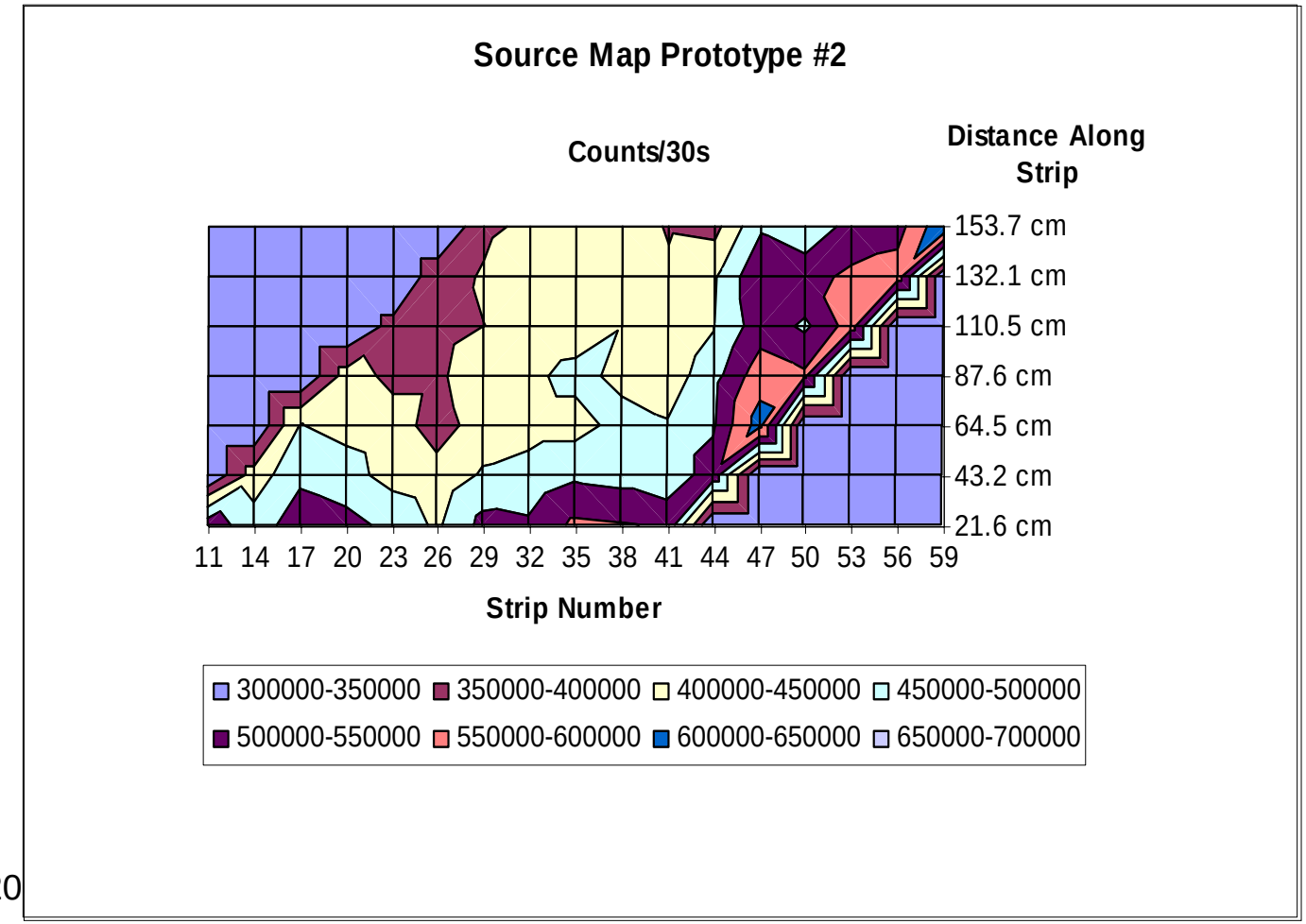


Prototype S2

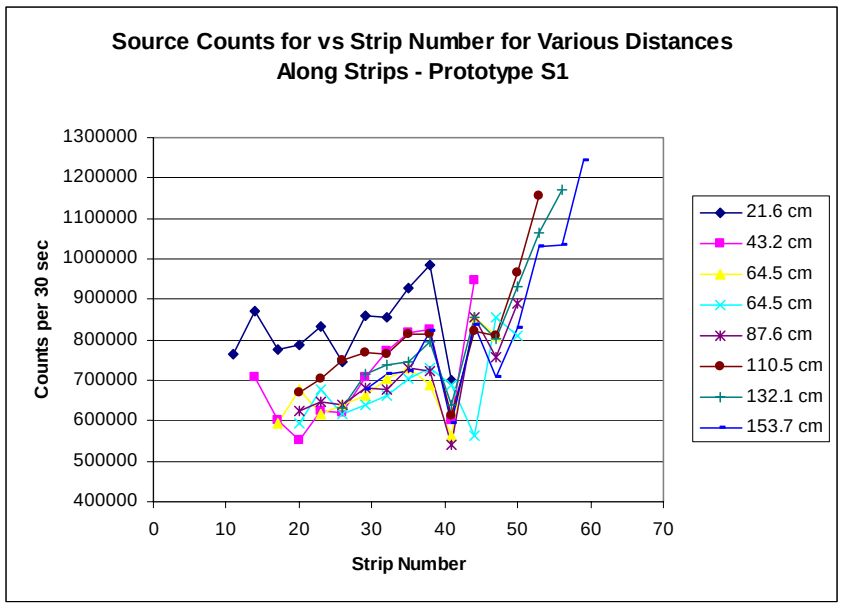
Prototype S1 Source Map

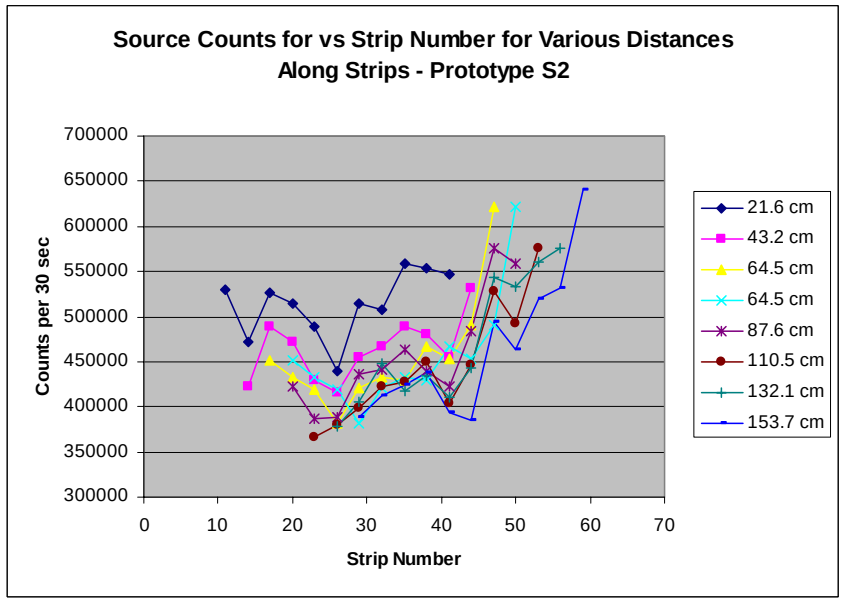


Prototype S2 Source Map

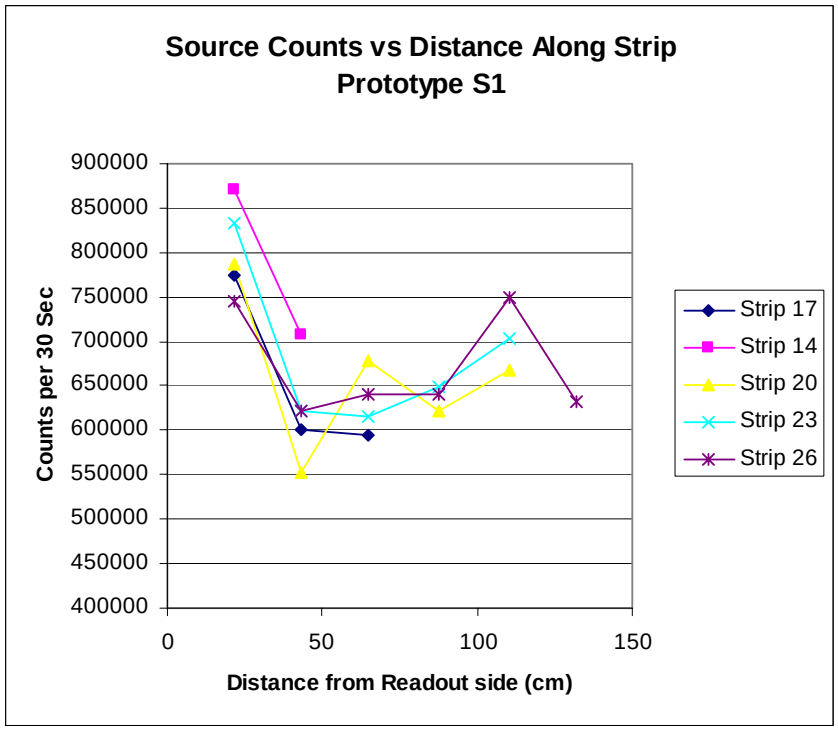


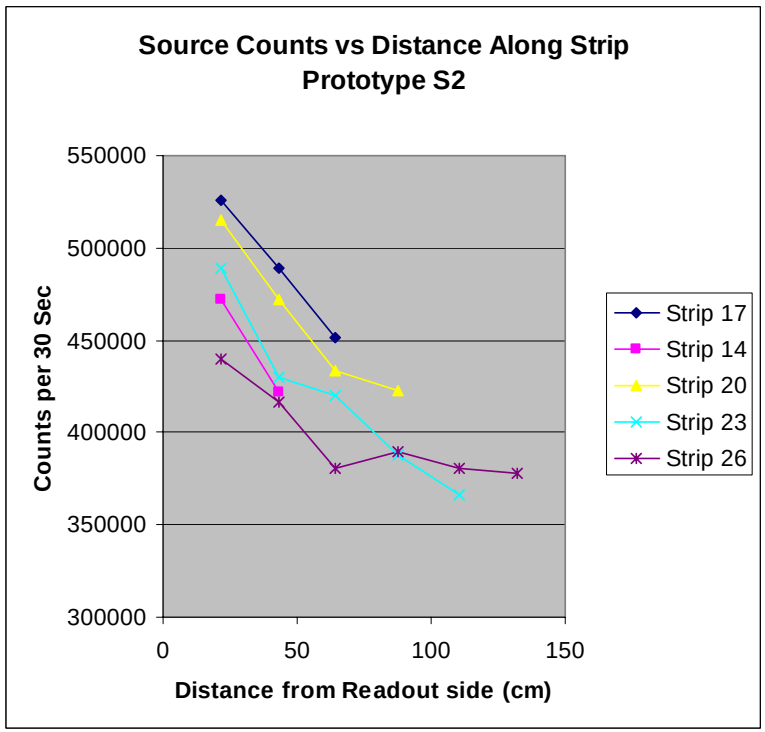
Response vs Strip Number



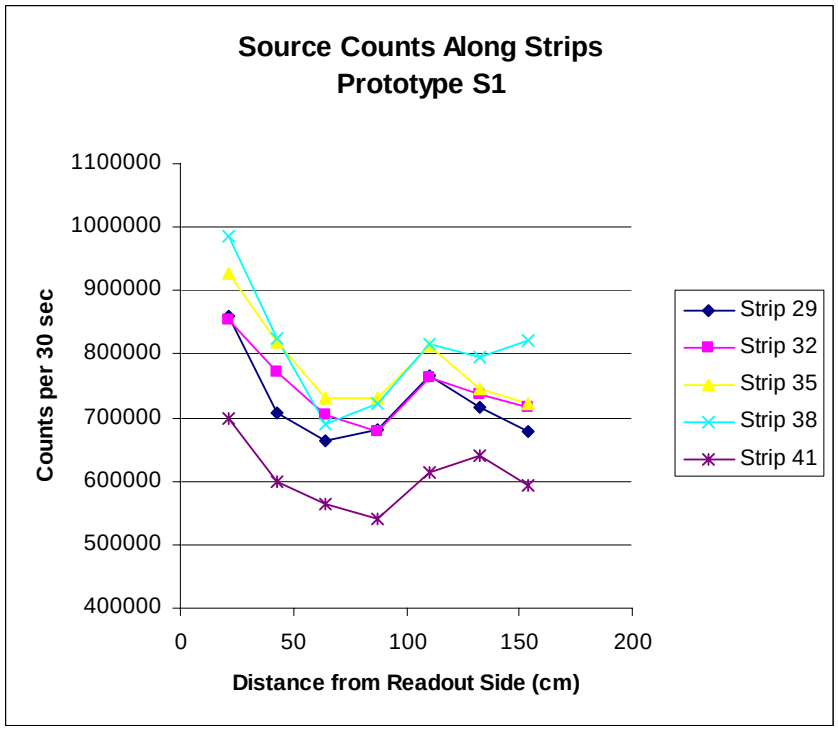


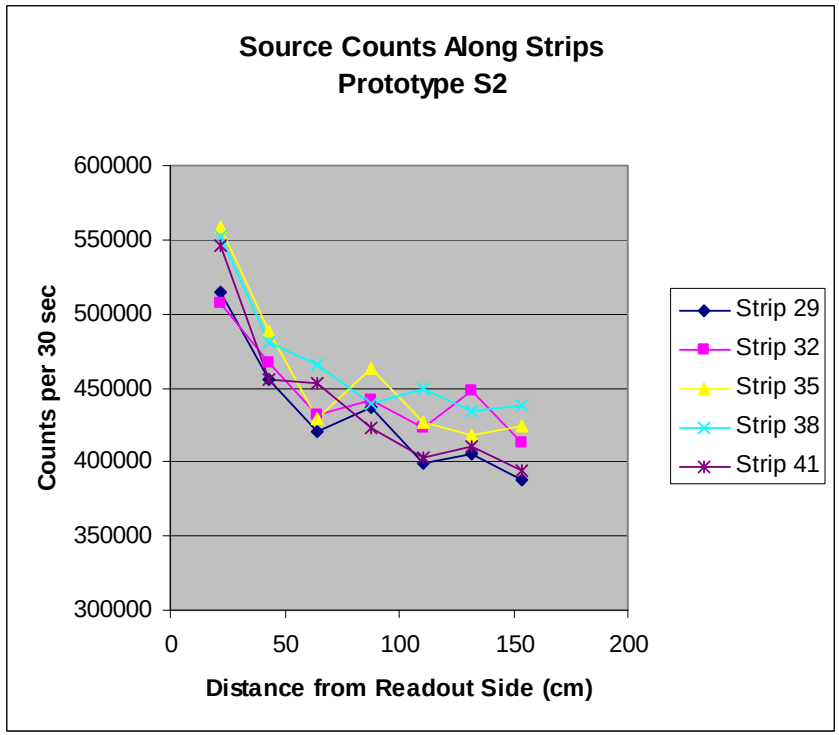
Source Count vs Distance From Readout Side (Strips 14-26)



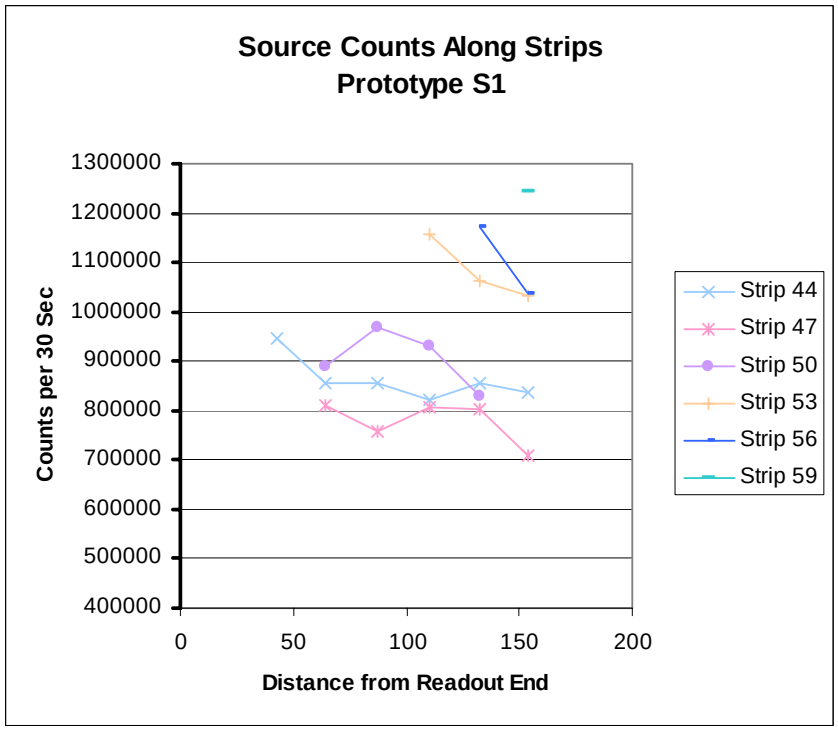


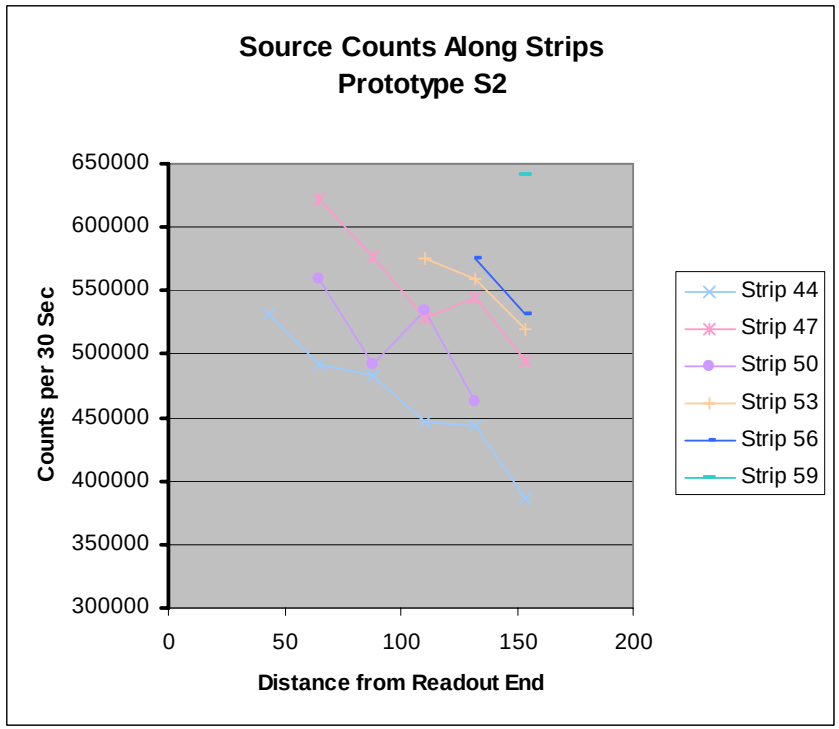
Source Counts vs Distance from Readout Side (Strips 29-41)





Source Counts vs Distance from Readout Side (Strips 44-59)





Summary of Source Tests – Central Region

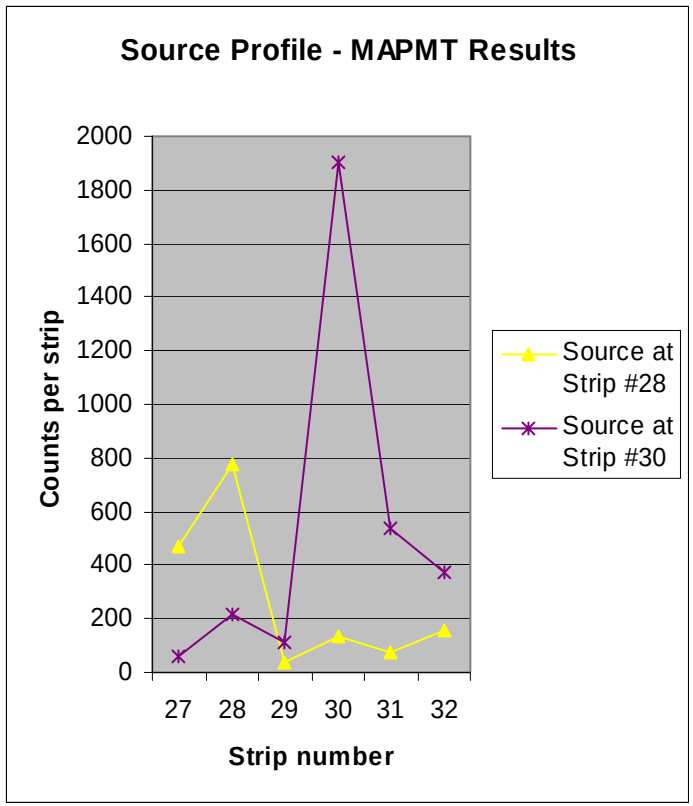
- Found low yield from Prototype S1, Strip 41, possibly fiber splice damaged in transit
- Rates decrease by 10-20% between strips 20 and 44 at constant distance along scintillator. Probably loss in clear fiber. 15% loss in 1.25m → 7.7m attn length
- Rates decrease by 20-25% along Strips. Corresponds to ~4-6m attn length in scintillator and wavelength shifter, as expected.

Cosmic Ray Test Results: Prototype S1 Mainly

- ADC Spectra yield Means of 110-160 channels above pedestal at .25 pC/channel
- Means correspond to ~6 to 8 P.E.s for M.I.P. – a 2X improvement over pre-prototype
- Typical ADC run has ~2% pedestals --> ~4 P.E.s
- Proto #1 efficiency ~90% at disc threshold of 50 mV. Small Plateau. Proto #2 efficiency ~98% at 30-35 mV.
- Mapping ADC spectra with cosmic triggers progressing.

MPMT Result: Source Spot Size

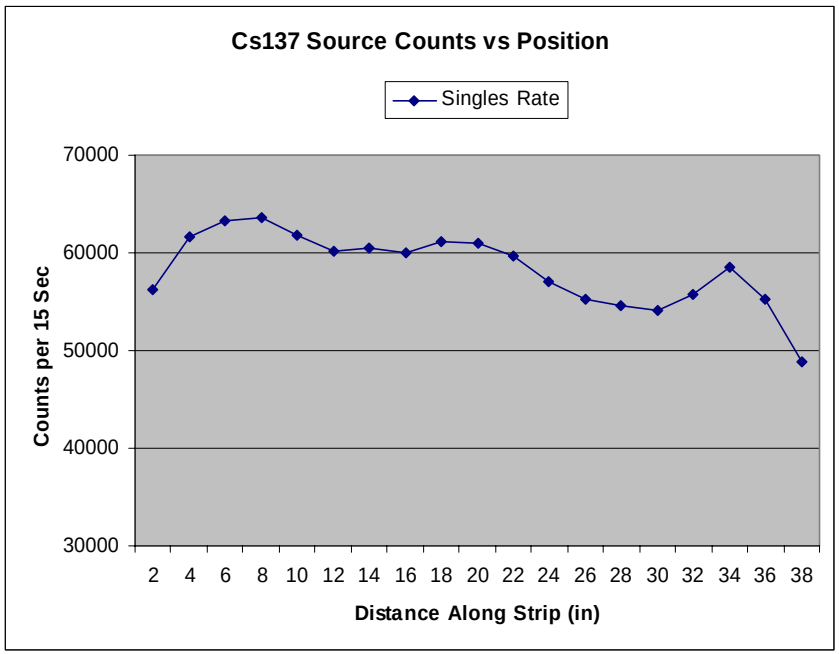
- Individual Strips read out from MAPMT
- Backgounds (no source) subtracted
- Shows typical spread of source counts is 1-2 strips wide
- From geometry, expect ~25% in adjacent strips

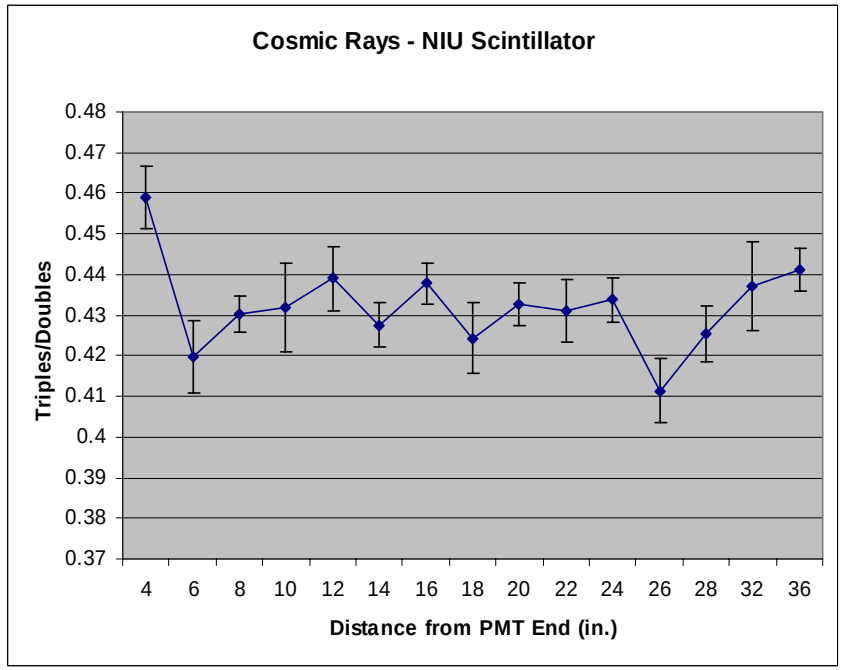


Tests of Single Scintillator Strip

- Single 1m long strip provided by NIU
- Wavelength shifter fiber extends 15 cm past end
- PMT near end of shifter fiber
- Tested with Cs137 source and cosmic rays
- Source tests show attenuation length of ~4.6m. Nominal scintillator attenuation length is 5m.
- Cosmic rays consistent with source tests
- Measured ~8 PEs output

Scintillator Strip Data





Next Steps

- Calibrate MAPMT
- Use MAMPT with UCD readout system, study time over threshold to pulse height relation and response of individual strips.
- Improve MAMPT connector box and add magnetic shielding
- Test LED /PIN calibration system
- Continue cosmic ray mapping
- Test next set of prototypes that collect light at both ends of scintillator strips.