

Start Counter

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Questions in May

What is the function of the START counter ?

- Start signal for what : TOF, beam pulse identification ?
- Vertex reconstruction: connect tracks to FDC's , resolution (0.5 mm) ?
- Part of the hardware trigger?
- Part of the “software” trigger?
- All of the above?
- Readout/front-end electronics ADC/TDC logic

Justification of requirements: physics driven

- minimal position resolution requirements as a function z and direction
- minimal timing resolution requirement
- efficiency, redundancy, uniqueness
- multiple scattering tolerance
- alignment requirements, fiber location
- phase space considerations, shadow regions (minimize impact of shadow regions)
- kinematic reconstruction, over determination of tracks, redundancy

MC studies

MC studies: need position resolution $\sigma \leq 100 \mu\text{m}$
for a significant improvement of momentum resolution.
Conference Call Minutes July 12.
(thanks to Curtis Meyer, Ed Brash and David Lawrence)



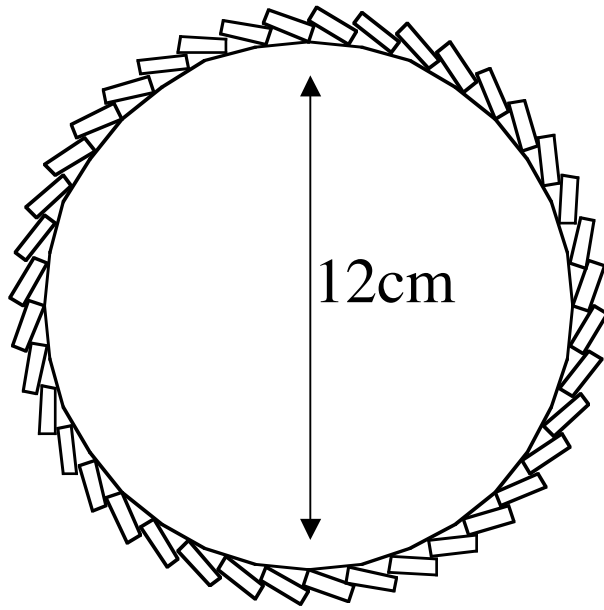
- focus first on start detector
- study options for good position resolution for later design
- upgrade detector if need arises later

Start Counter Design

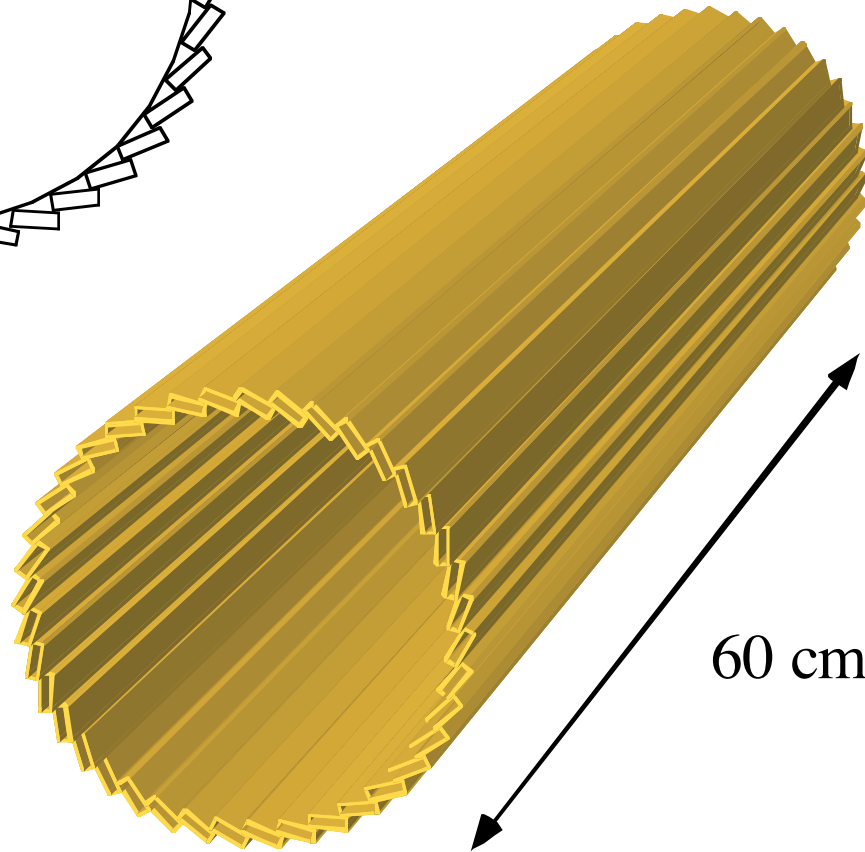
- array of scintillator bars (40)
- fiber light guides to low field region ($< 2\text{kG}$)
- read out by PMT: 5924-70 (Hamamatsu)

Segmentation:

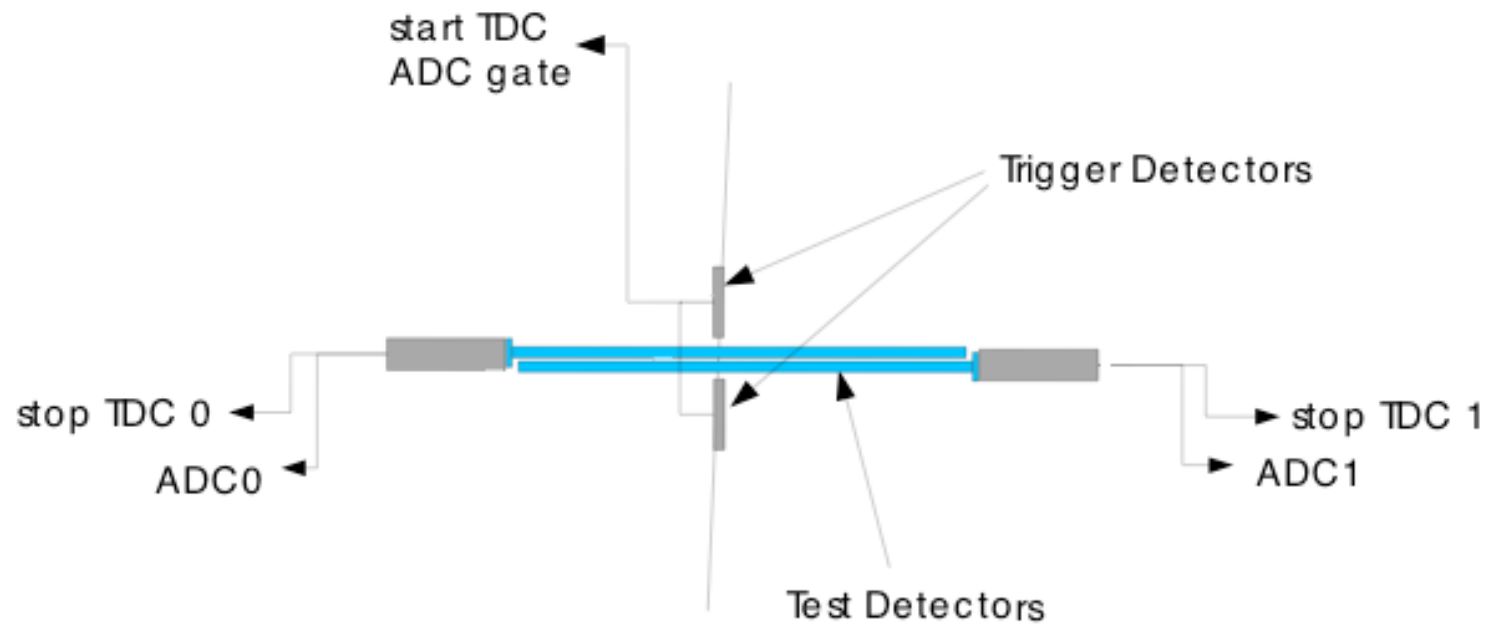
- 40 individual detectors
- driven by back ground rate :
 - 650 kHz for e^+/e^- with $p > 1\text{MeV}$
 - $\approx 100\text{kHz}$ from γ (latest GEANT)
- $\Rightarrow 20\text{ kHz}$ background rate per scintillator



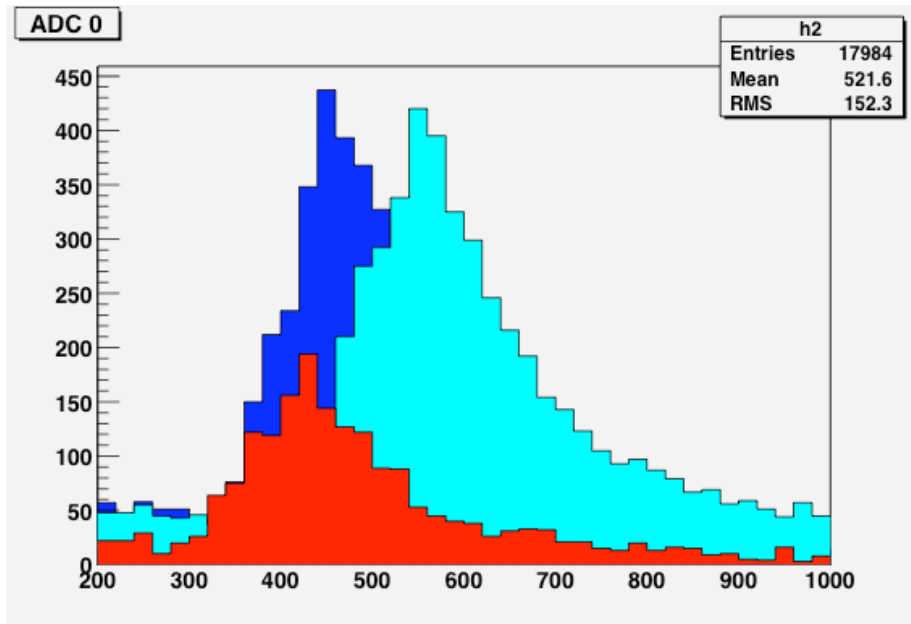
effective material thickness
for trajectories at 90° : 5 mm



R&D Studies with H6614 System

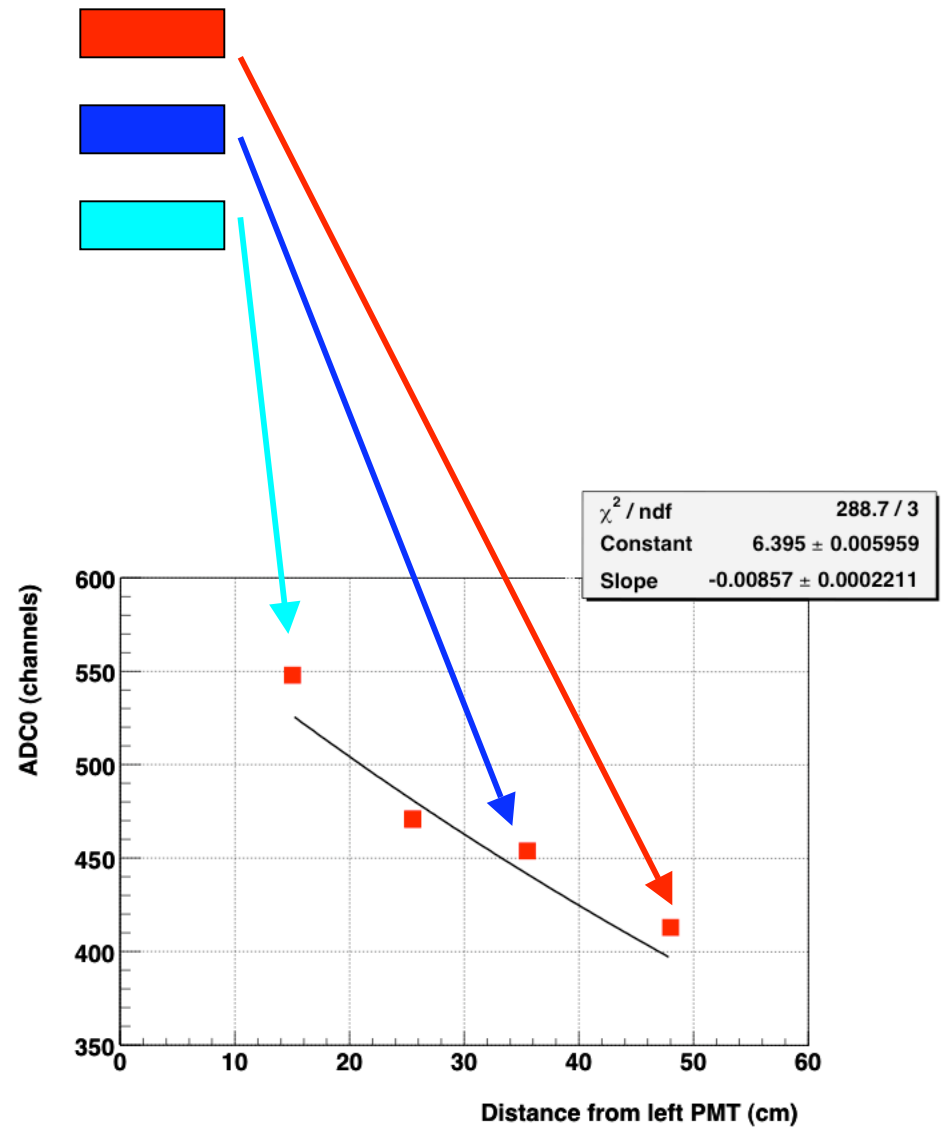


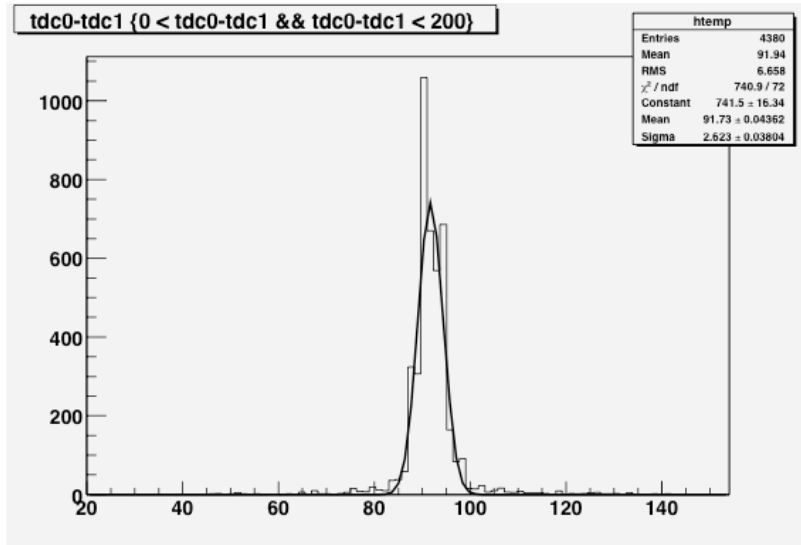
Eljen Technology EJ204 and EJ208 Scintillator bars: 70 x 3 x 0.5 cm



peak position as a function
of position in detector

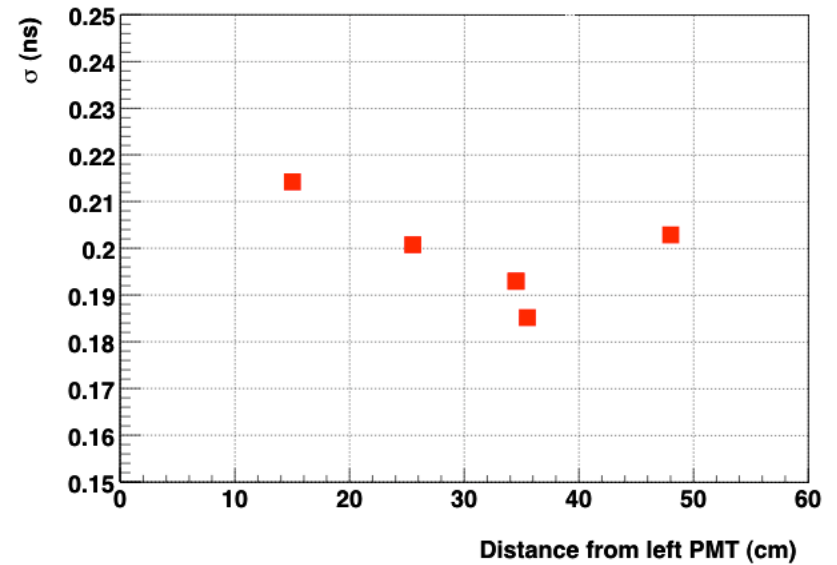
ADC spectra





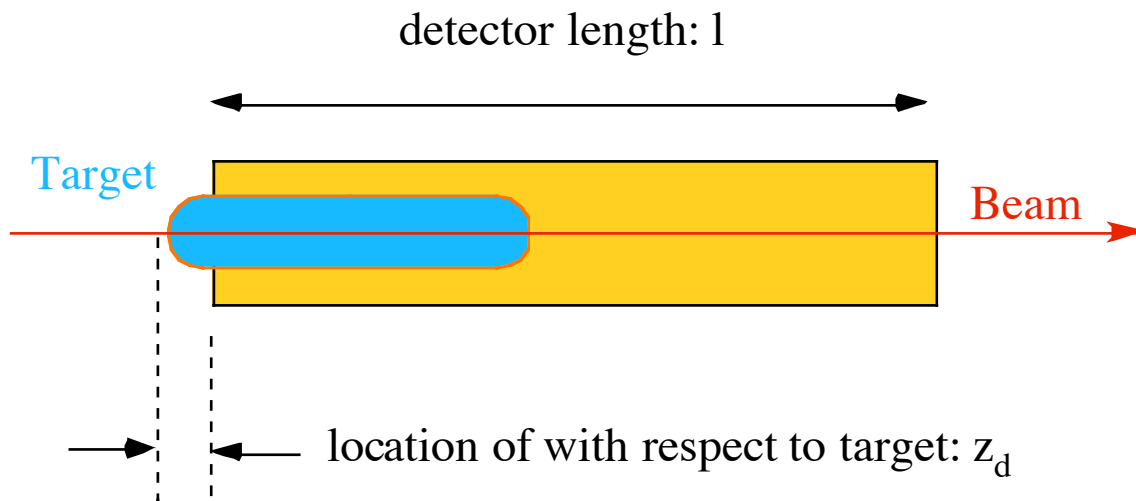
time difference between 2 detectors

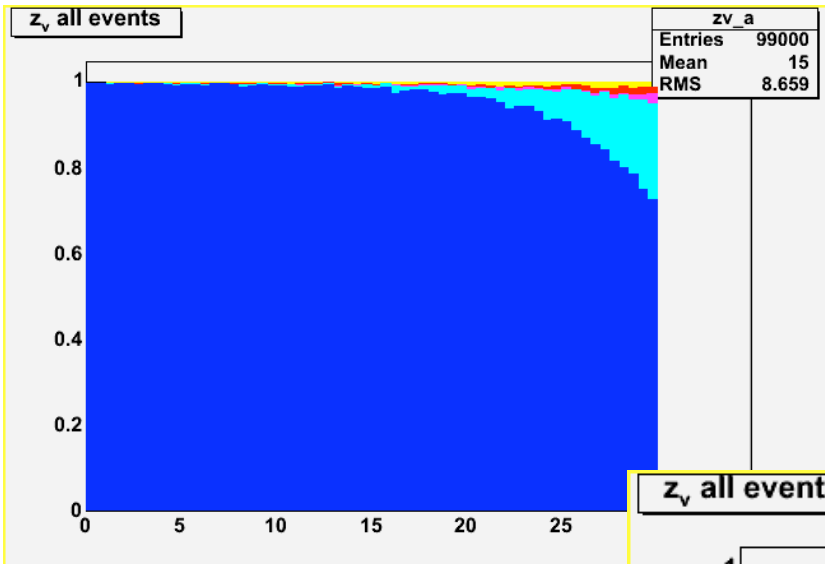
σ of time difference as a function of position



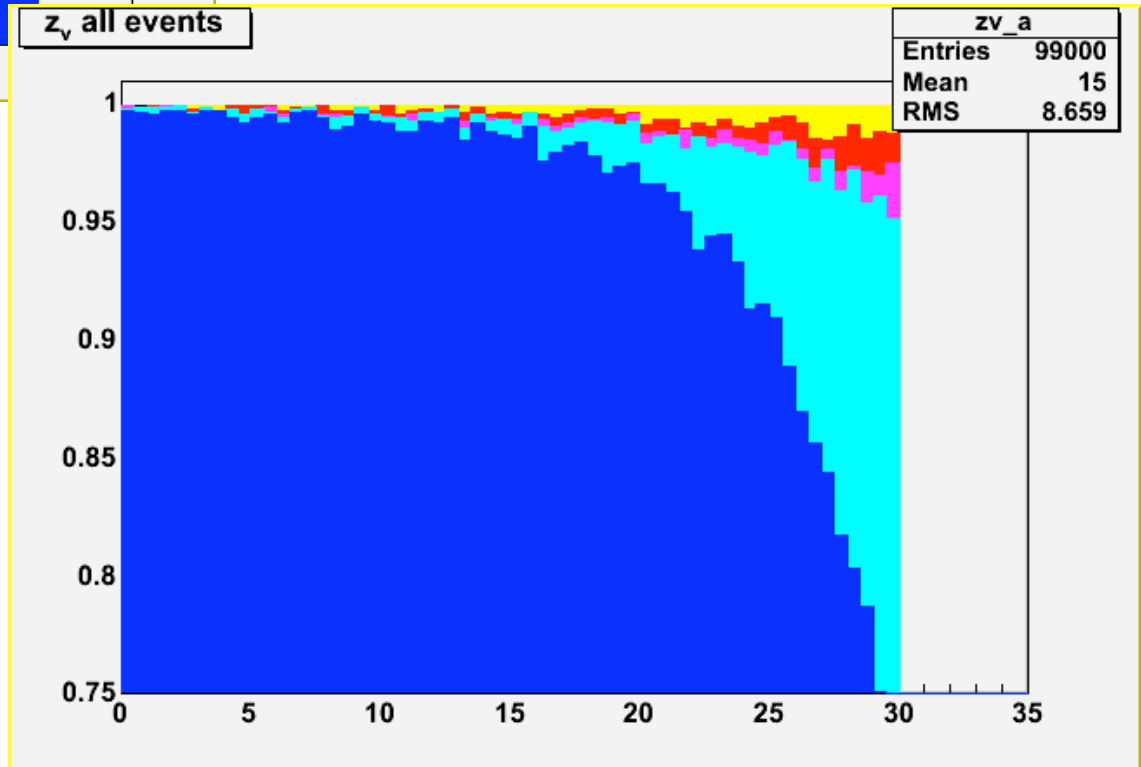
Geometry of Detector

- use 3π events
- require at least 1 hit in detector
- minimize length of detector

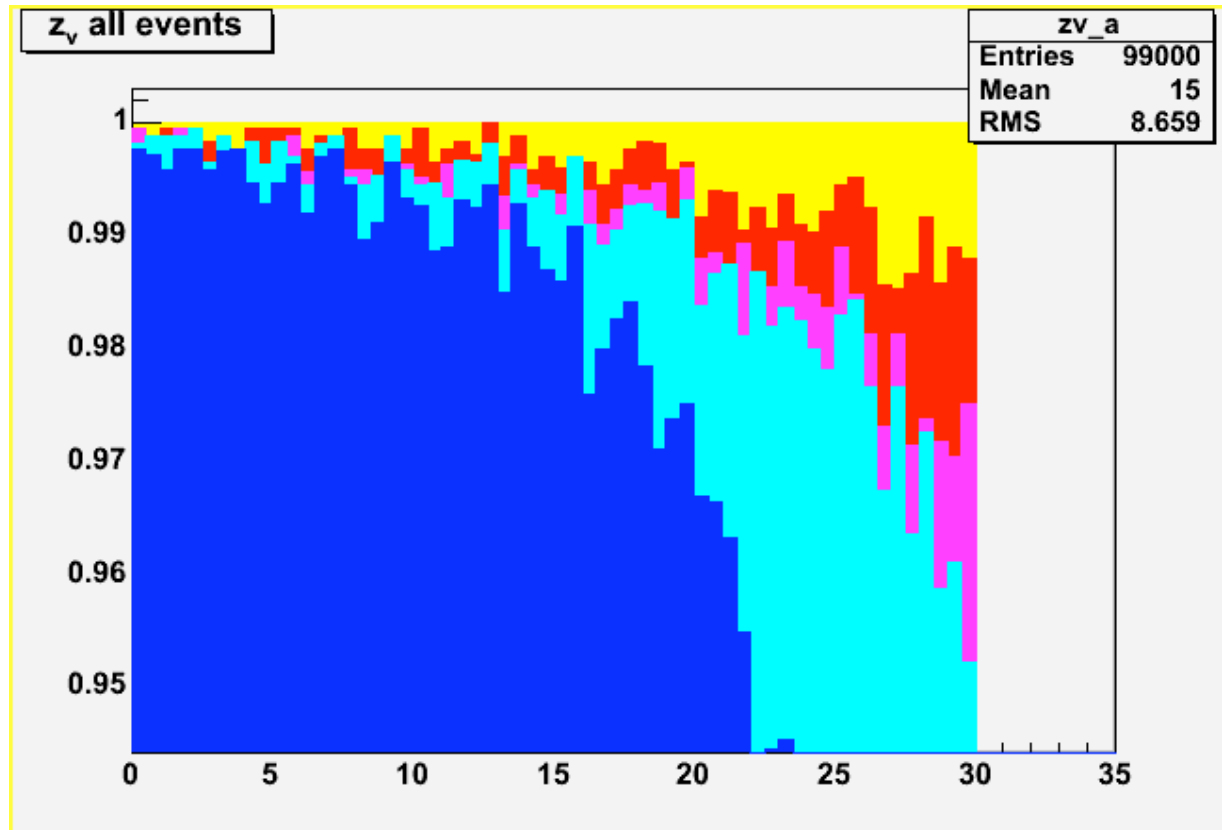




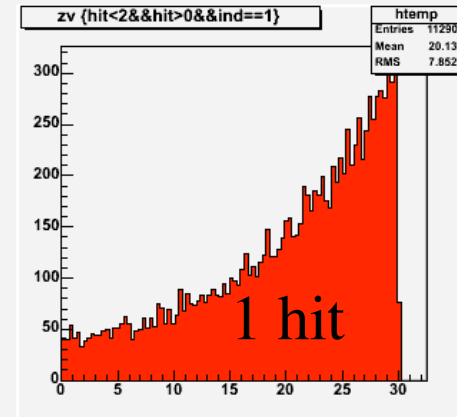
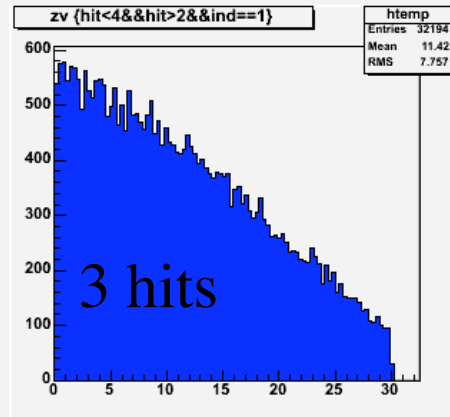
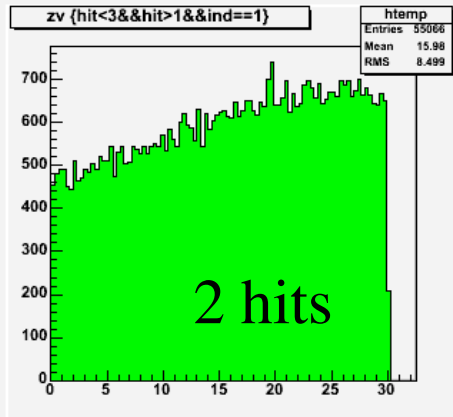
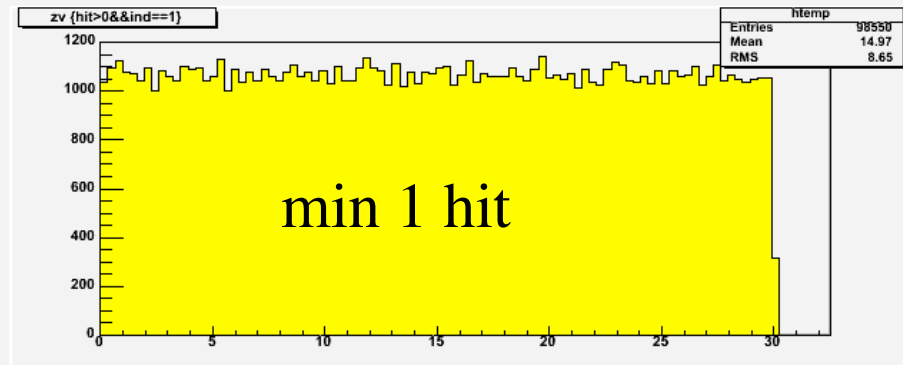
- $l = 50 \text{ cm}, z_d = -2.5$
- $l = 55 \text{ cm}, z_d = 0.$
- $l = 55 \text{ cm}, z_d = 1.5$
- $l = 60 \text{ cm}, z_d = 2.5$



- $l = 50 \text{ cm}, z_d = -2.5, \varepsilon_{\text{tot}} = .955$
- $l = 55 \text{ cm}, z_d = 0., \varepsilon_{\text{tot}} = .991$
- $l = 55 \text{ cm}, z_d = 1.5, \varepsilon_{\text{tot}} = .991$
- $l = 60 \text{ cm}, z_d = 2.5, \varepsilon_{\text{tot}} = .995$



z_v distributions, $l = 60$ cm, $z_d = 2.5$ cm



Readout

H6614-70 system (Hamamatsu):

- gain 10^7
- photo cathode well matched to EJ200, 208 scintillator
- according to data sheet, practically no gain loss up to 2kG
- expensive \approx \$2000-\$2500

Single ended readout: time variation due to light propagation 3 - 4ns

- \Rightarrow double ended readout with mean timer preferred
- \Rightarrow need transport light from front end of scintillator
- \Rightarrow possible with fibers (some material is added)

Cost Estimate (2 sided readout)

		Channels	Total Units	Unit Price	Total Price
Number of detectors	40				
scintillaor (EJ200)			40	600	24000
sides	2				
light gudes (2mm)	2	11	1760	1.5	2640
light guides (1mm)	2	42	3360	1.5	5040
PMT			80	2000	160000
HV					10000
Mean timers					10000
UV lamp					7000
Glue & Materials					10000
Mech construction (support & conncectors)					15000
Cables&Conncectors					5000
TOTAL					248680

Future work to be performed

- further optimize number of scintillators and geometry
- study performance of PMT in magnetic field
- design and proto type light guides & connectors
- is front end readout possible ?
- mean timers
- design support structure for scintillators