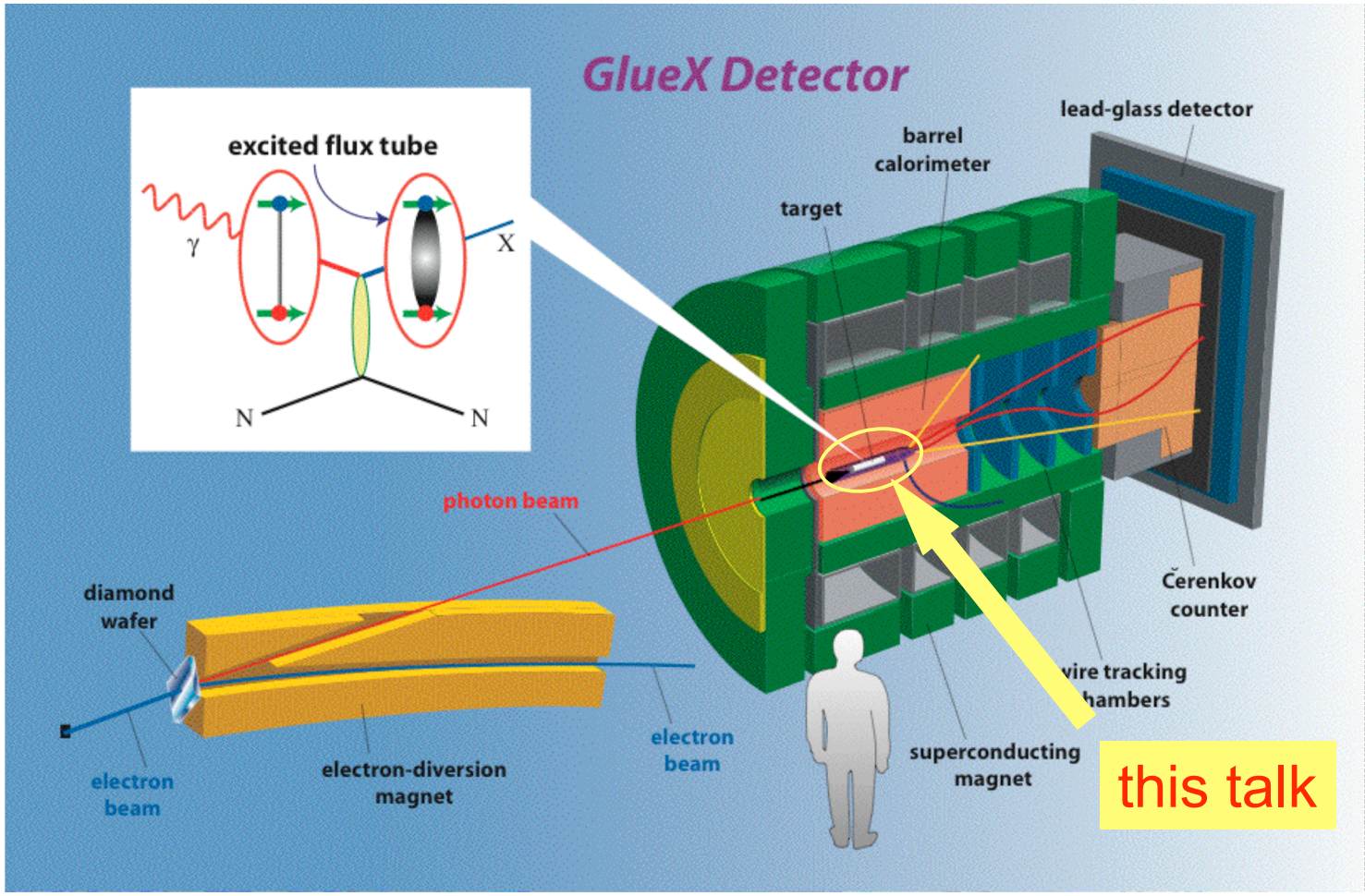
Start Counter

W. U. Boeglin



Functionality

- element of LEVEL 1 Trigger
- start signal for tracking detectors
- identify beam pulse (using tracking information)

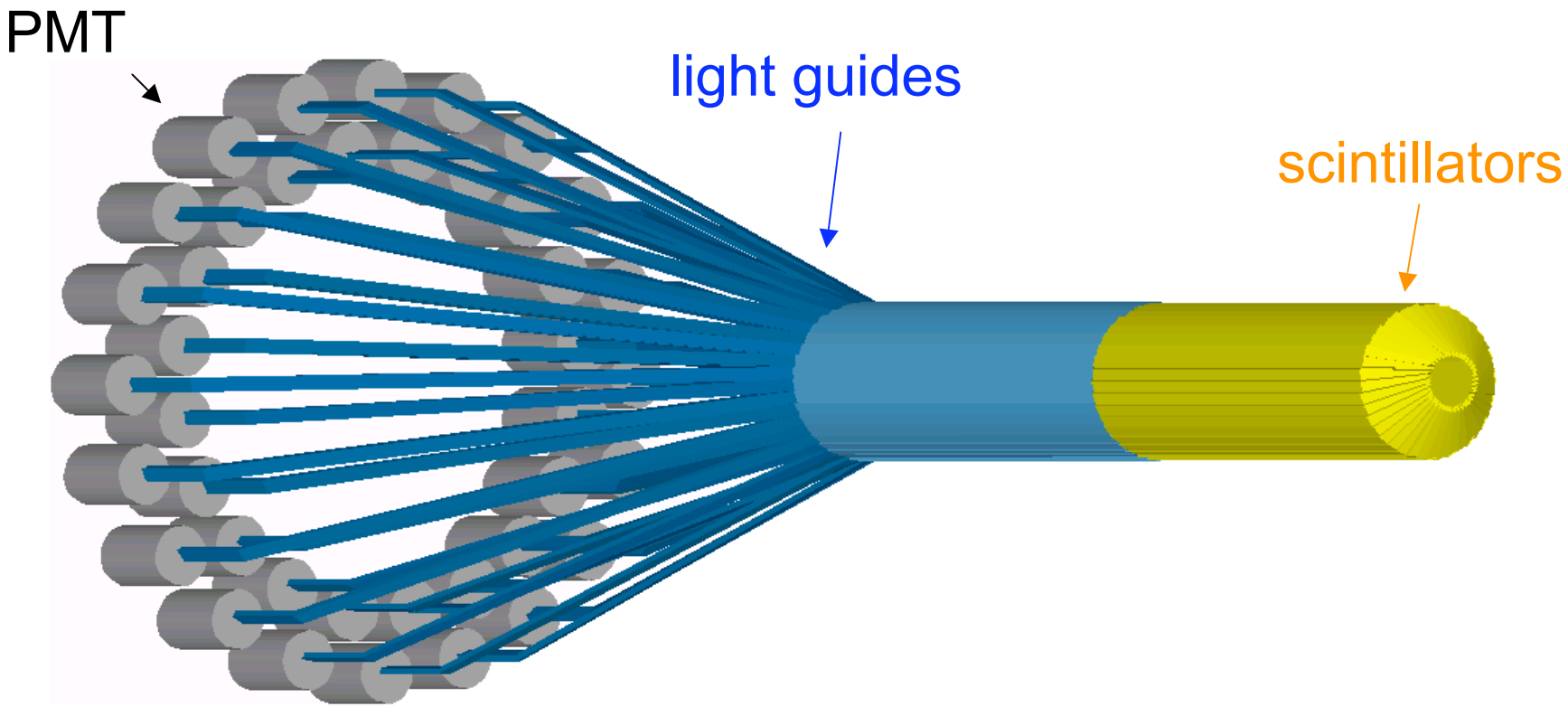
Performance Requirements

- time jitter < ±3 ns
- time resolution with tracking information: $\sigma \leq 0.5$ ns
- maximal solid angle coverage
- large segmentation (background reduction)

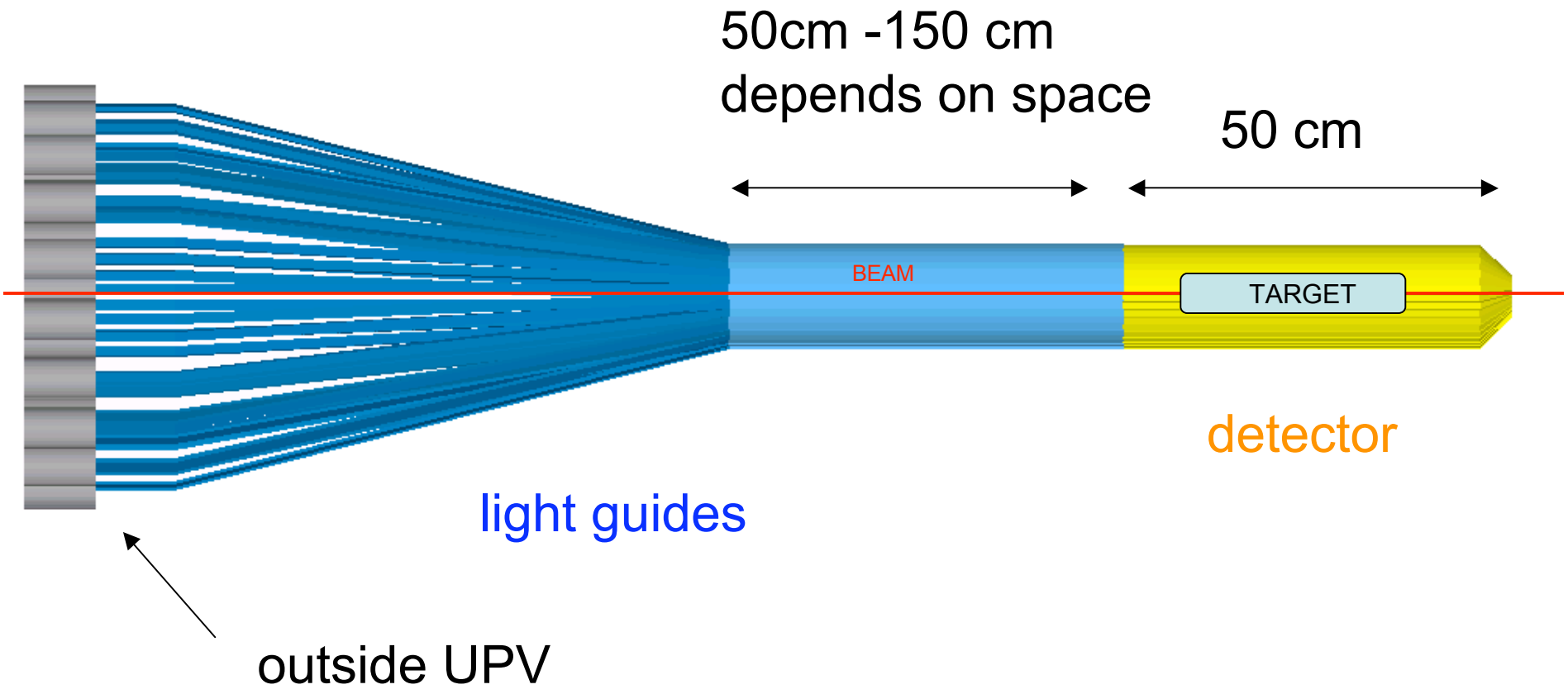
Start Counter Design

- array of 40 scintillators with bent ends
- light guides to low field region (< 2kG)
- read out by high field PMT
- similar to existing CLAS start counter

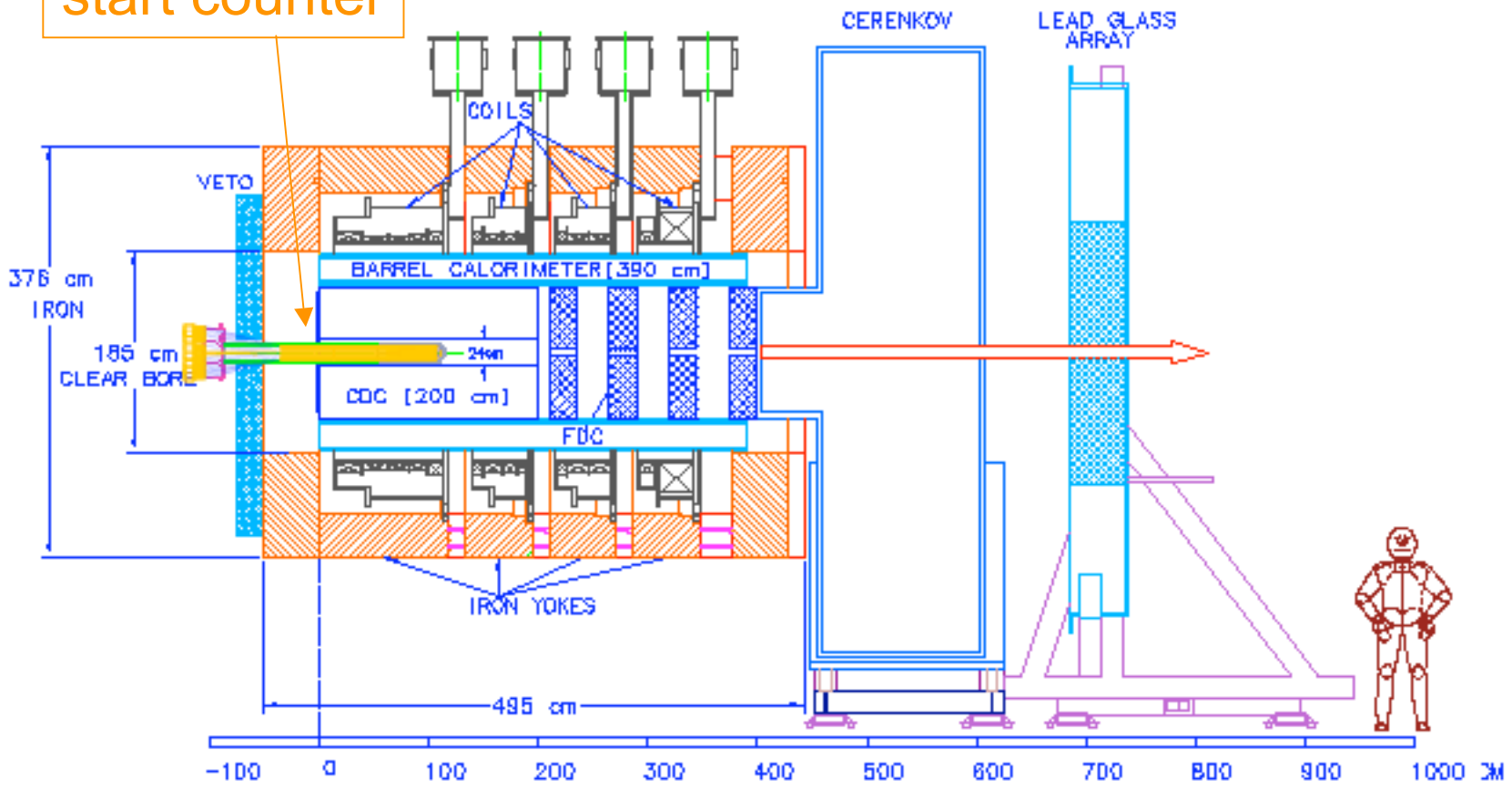
Start Counter 3d View



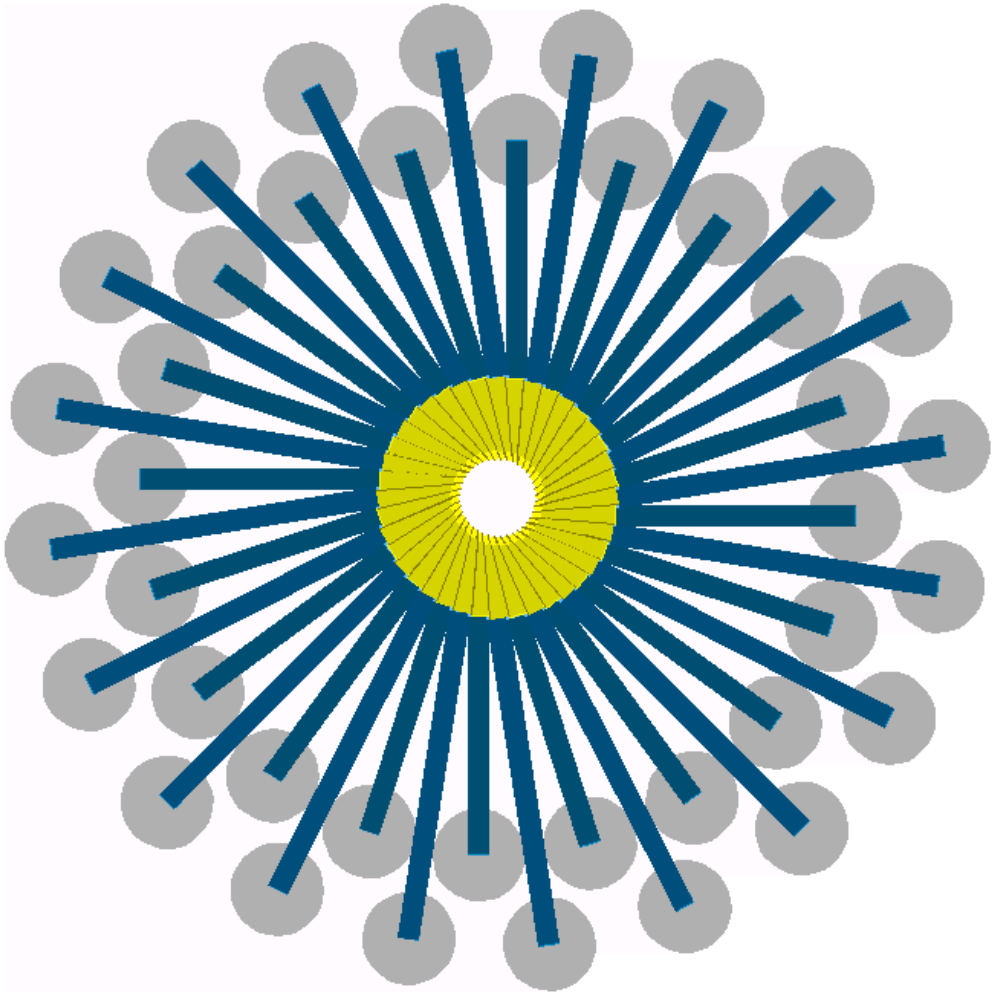
Start Counter Side View



start counter

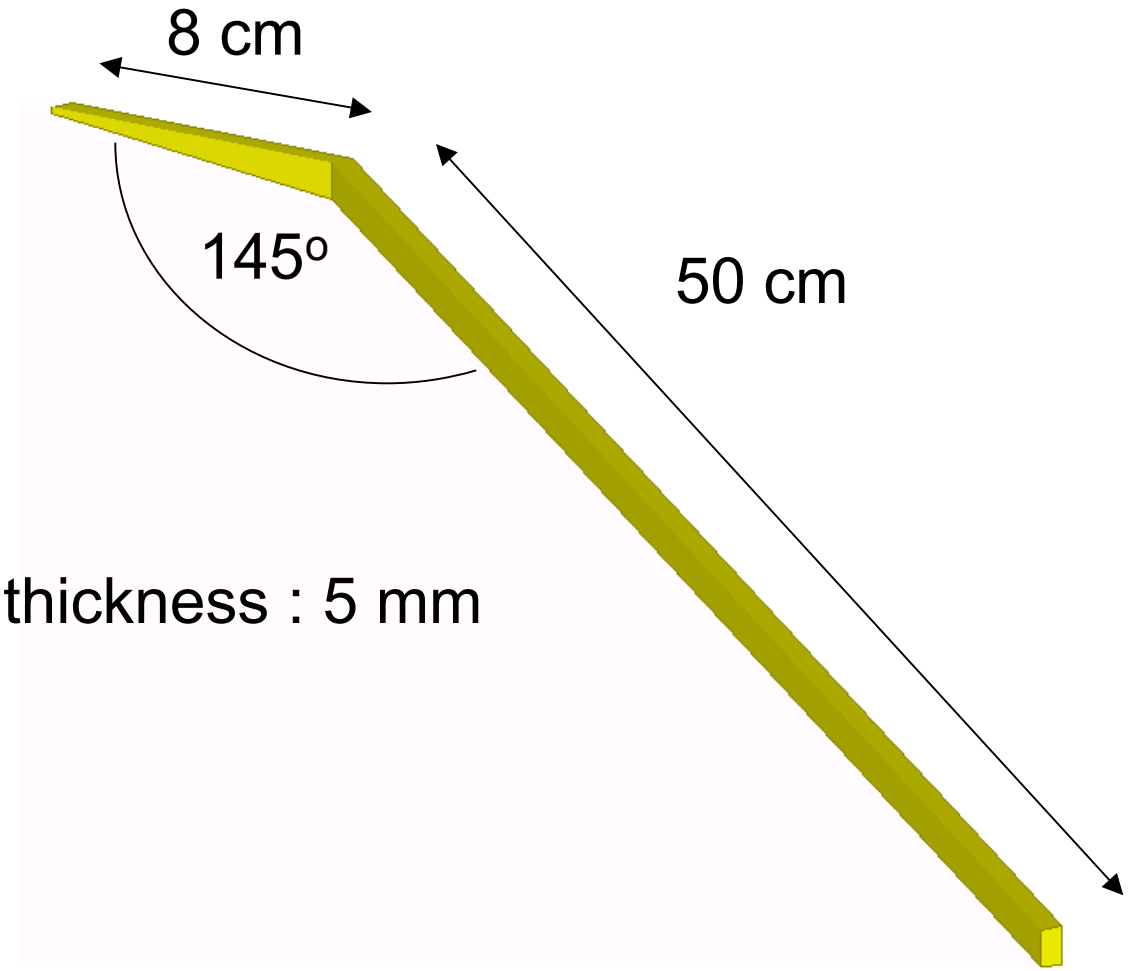


Start Counter Front View



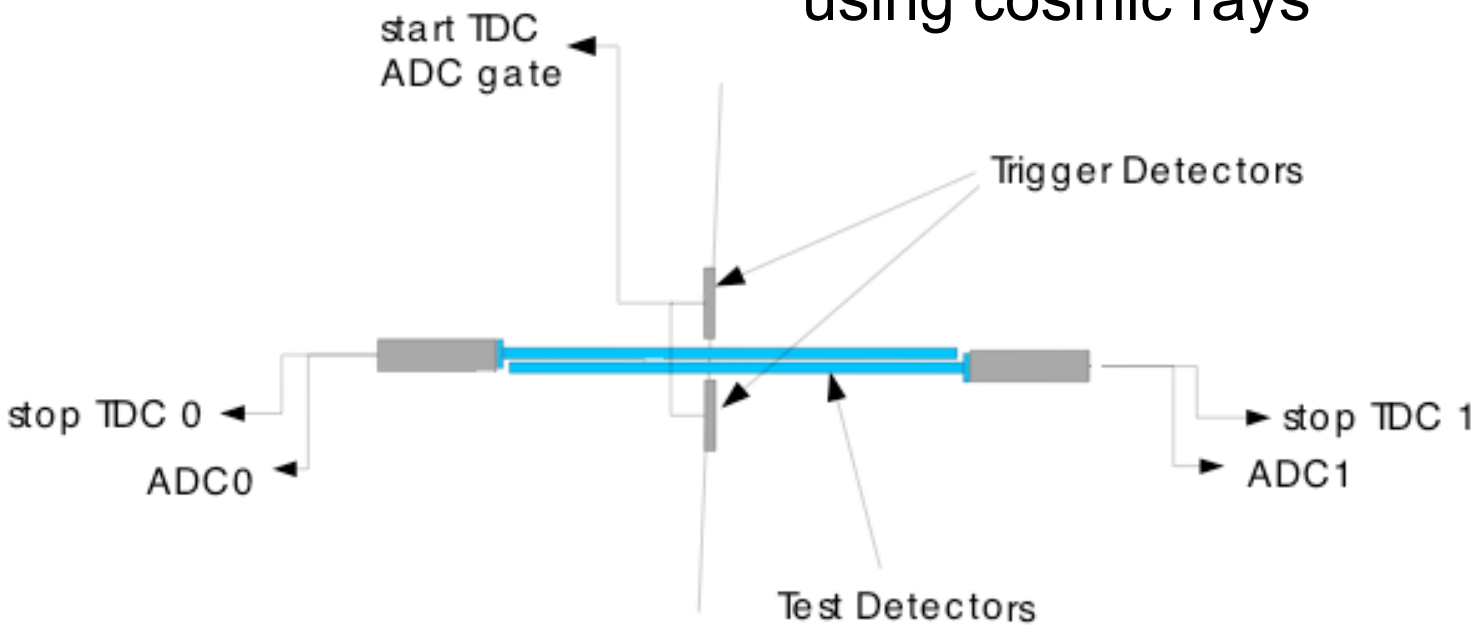
Start Counter

Individual Scintillator :

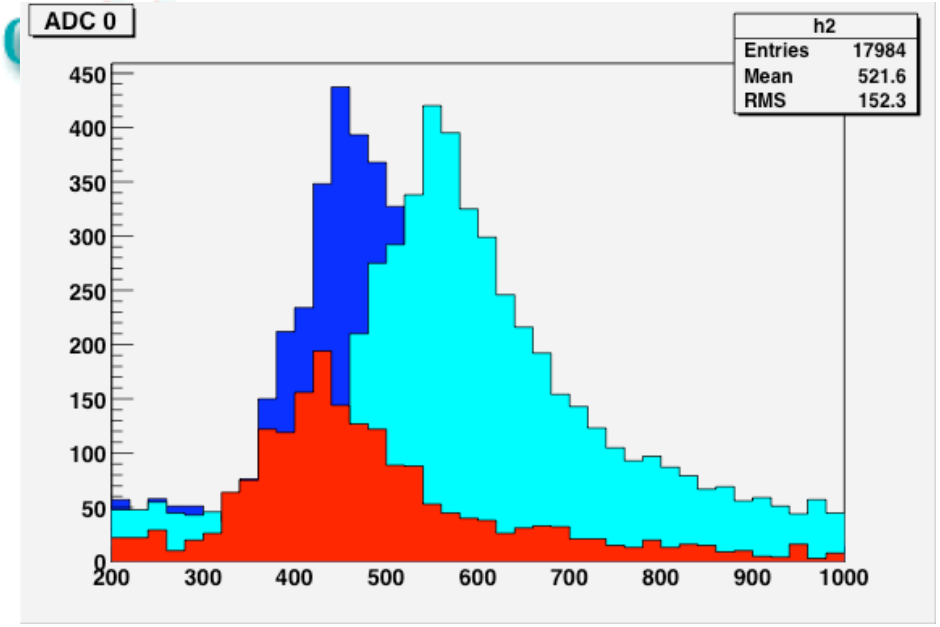


R&D Studies with H6614

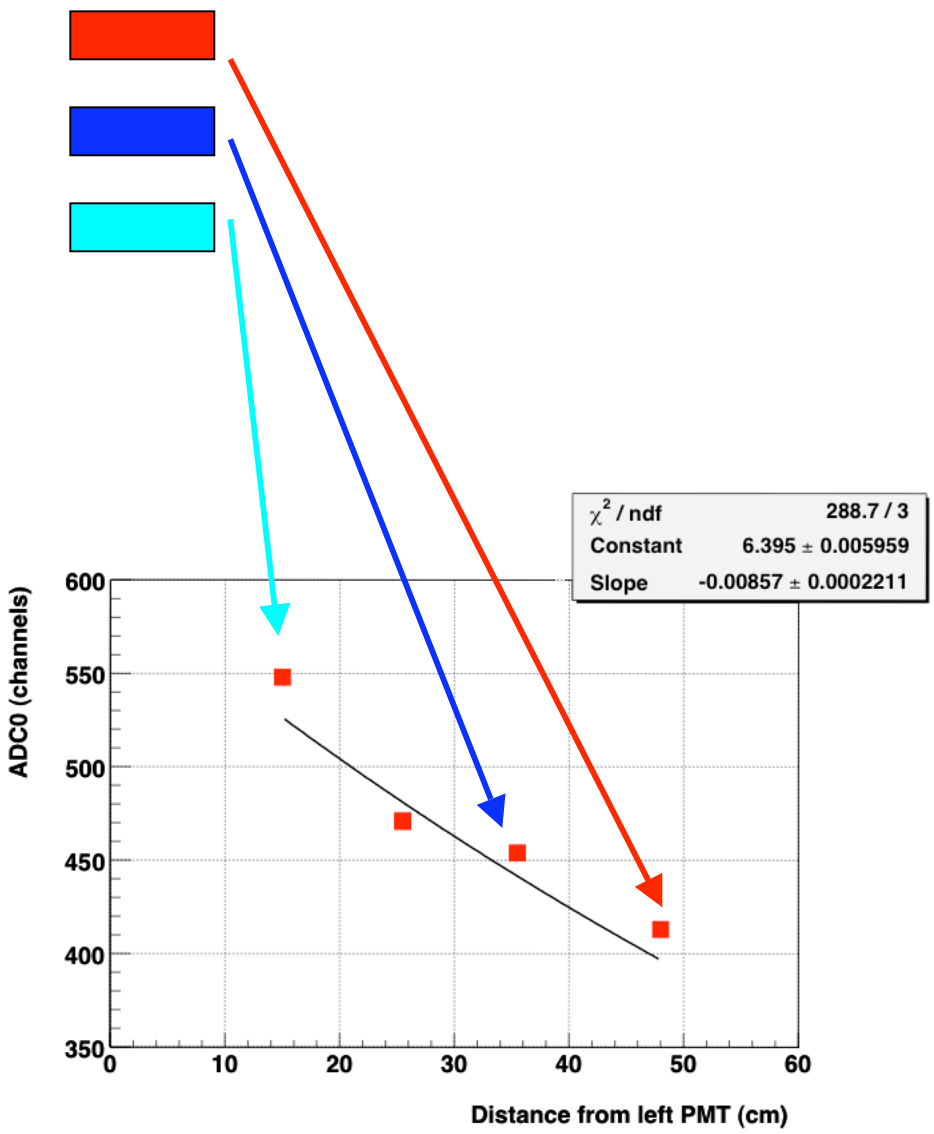
using cosmic rays



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

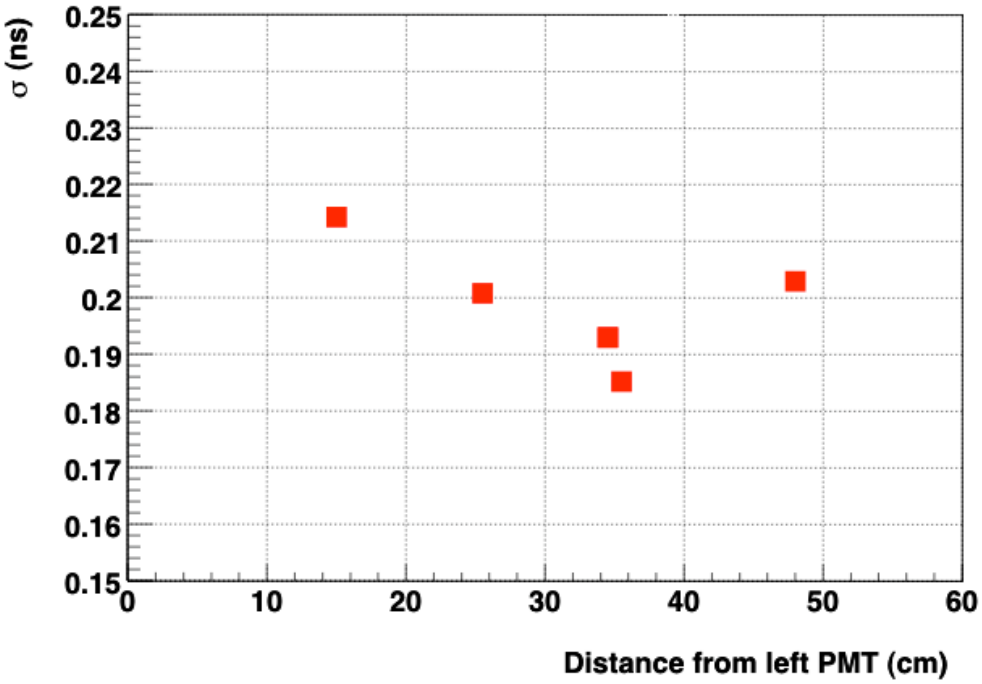


ADC spectra



peak position as a function of position in detector

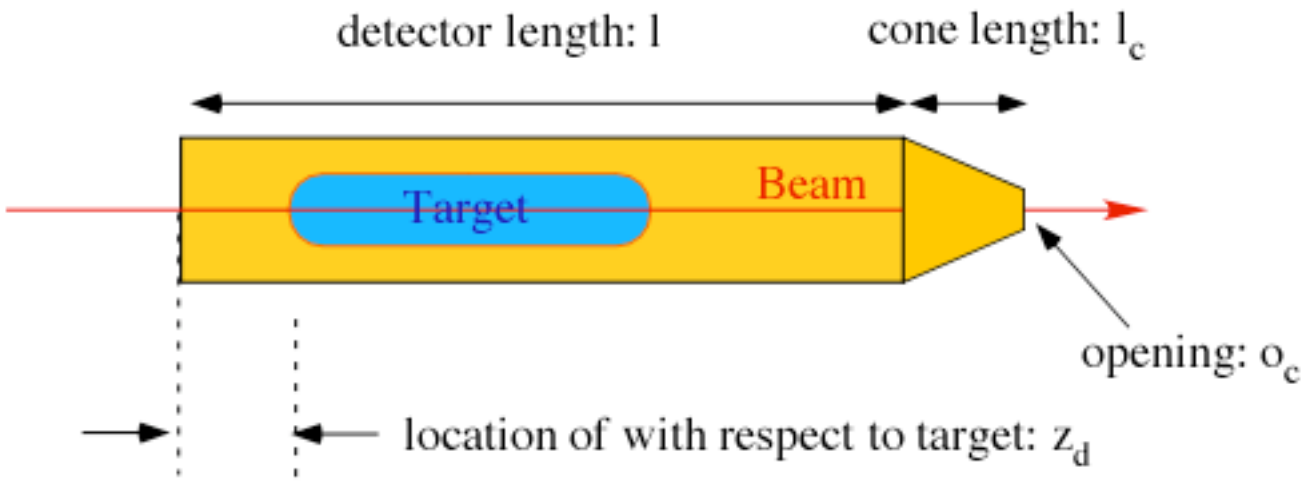
σ of time difference as a function of position



⇒ σ ≤ 0.5 ns can be achieved

Geometry of Detector

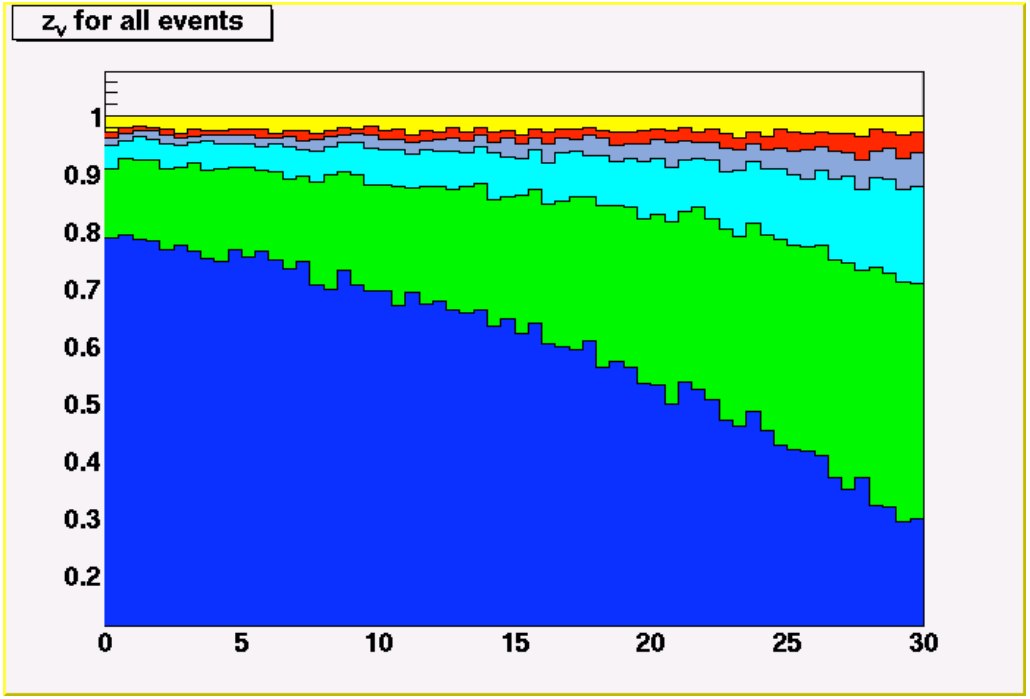
- use events with only 1 charged particle as as benchmark
- require at least 1 hit in detector
- minimize length of detector



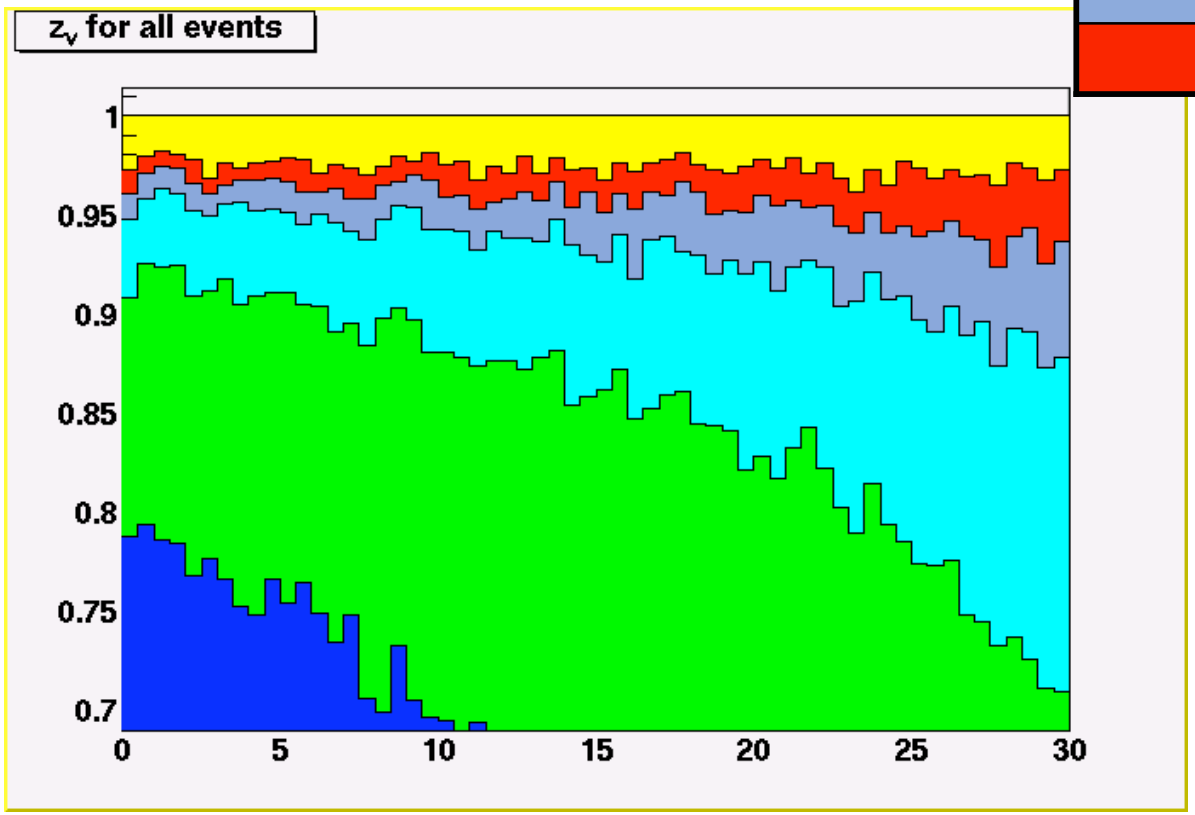
$b_2 \rightarrow a_1\pi \rightarrow \pi^+ + \pi^0 + \pi^0 + \pi^0$

color	l cm	z_d cm	o_c cm
	50	-6	10
	50	-6	6
	50	-6	4
	50	-6	3
	50	-6	2

detection efficiency as a function of vertex location along the beam direction



color	l cm	z_d cm	o_c cm
	50	-6	10
	50	-6	6
	50	-6	4
	50	-6	3
	50	-6	2

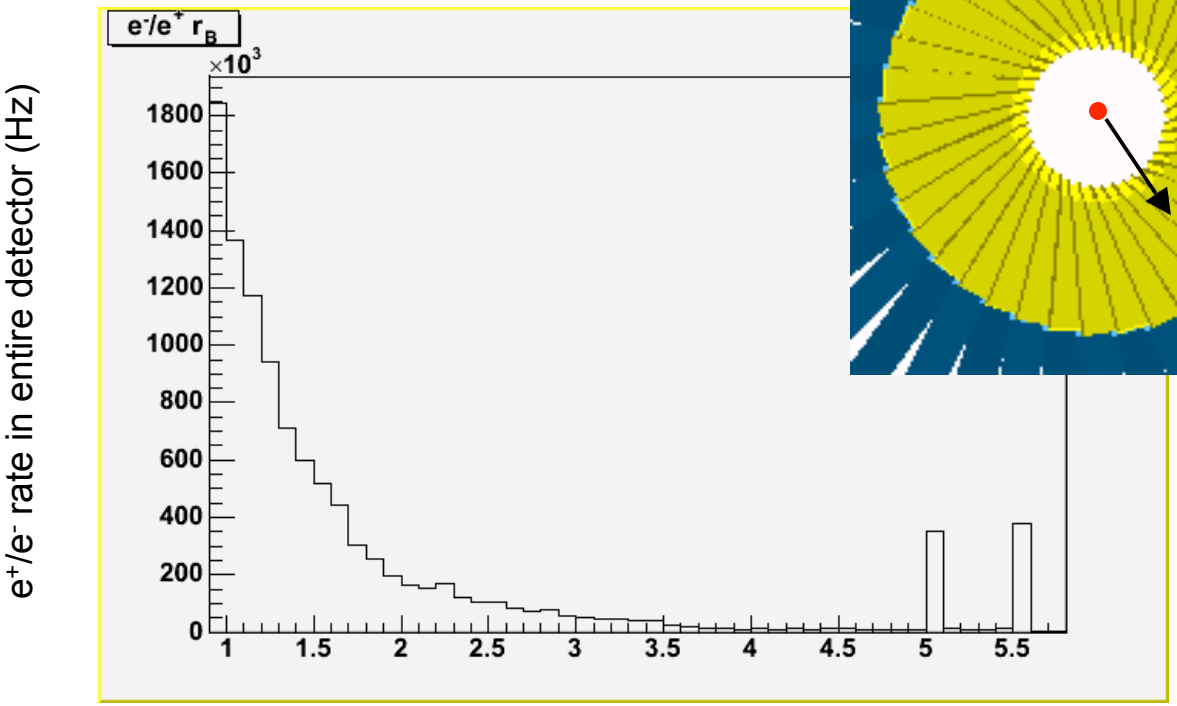


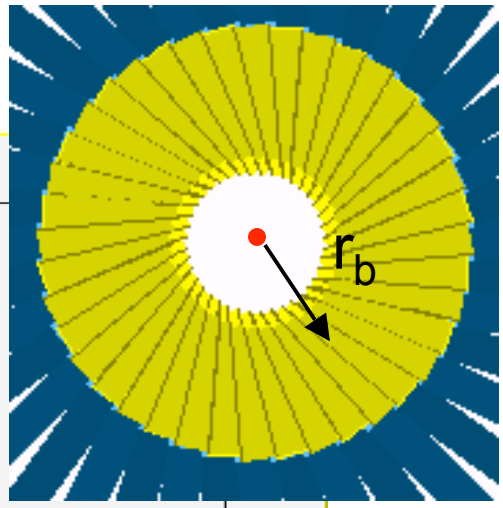
close up

Rate Studies

- electromagnetic background simulated with GEANT
- photon flux 10^8 γ/s
- 5 mm collimator
- 30 cm LH_2 target

total charged rate : ≈9 MHz
per scintillator : 225 kHz





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

  - single ended readout
  - time jitter due to light propagation ±2 ns

Cost Estimate

		Channels	Total Units	Unit Price	Total Price
Number of detectors	40				
scintillaor (EJ200)			40	600	24000
sides	1				
light guides (1mm)	1	42	1680	1.5	2520
PMT			40	2100	84000
HV					10000
UV lamp					7000
Glue & Materials					10000
Mech construction (support & conncectors)					15000
Cables&Conncectors					5000
TOTAL					157520

Future work to be performed

- further optimize geometry
- study performance of PMT in magnetic field
- design and proto type light guides & connectors
- study front end readout possible ?
- design support structure for scintillators
- alternative readout systems: SiPM (double sided)
- fast wavelength shifting fibers

Summary

- current design satisfies requirements
- can be completed within 2 years after funding
- new technologies (SiPM etc) can enhance detector performance