CKOV-1 PROGRESS

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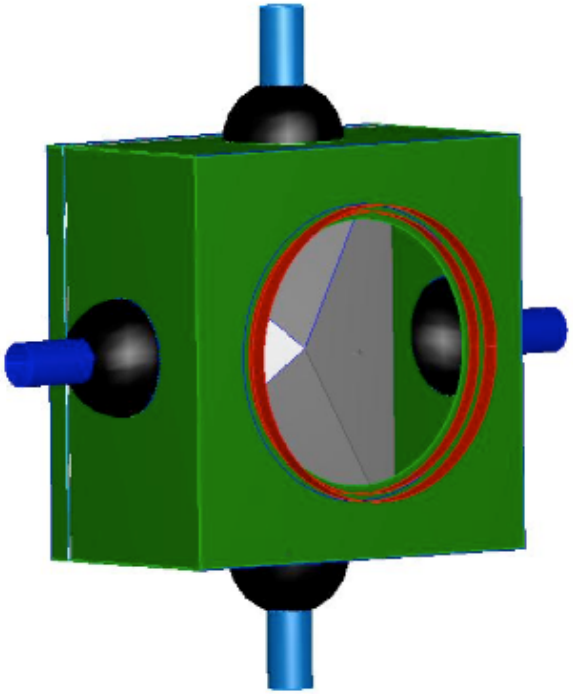
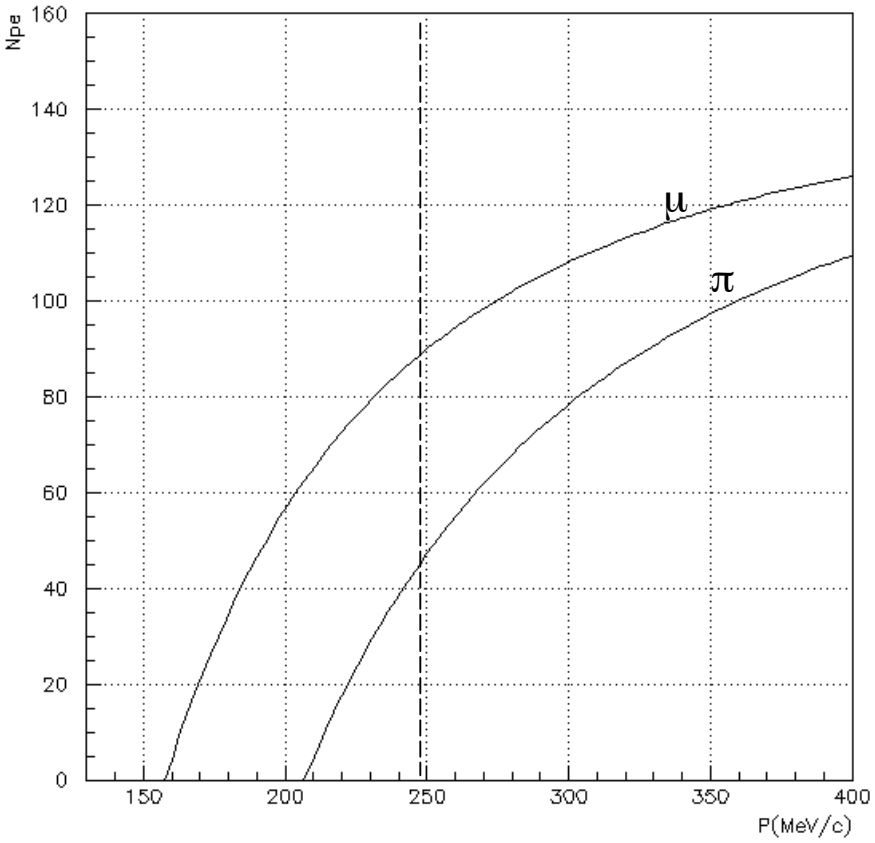


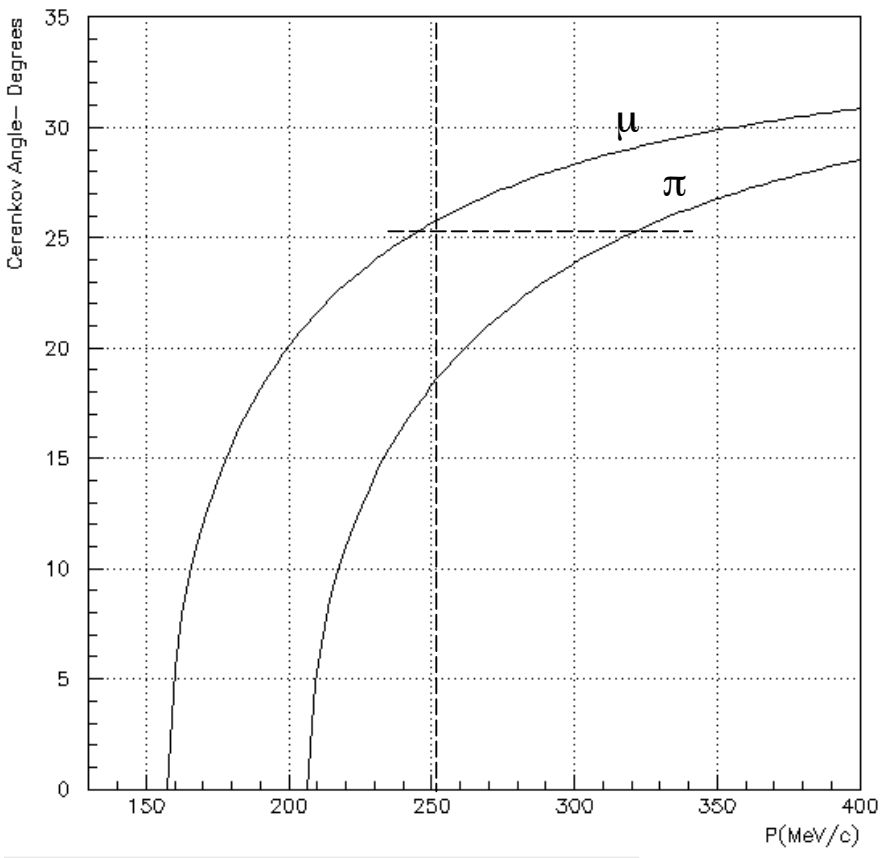
- Uniformity Studies
- TOF CKV Concept

RADIATOR OPTIONS - FOCUSING ON LN2

Photo-Electrons



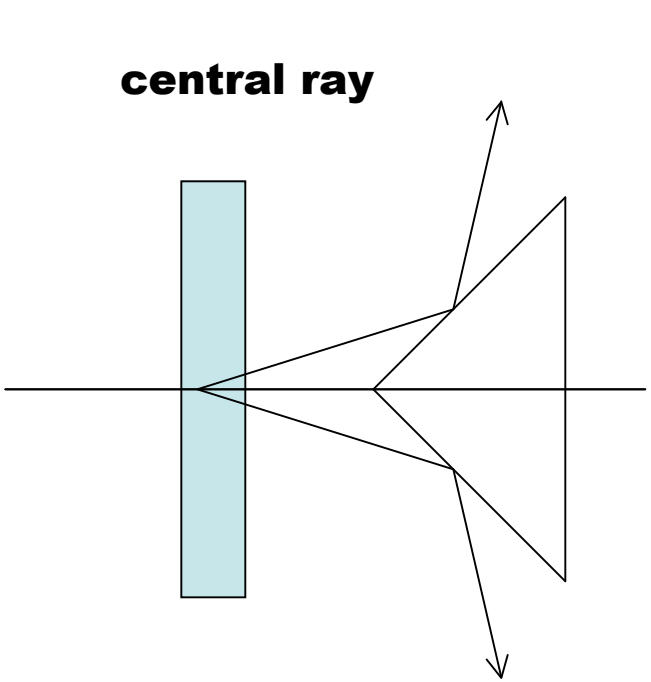
Cerenkov Angle

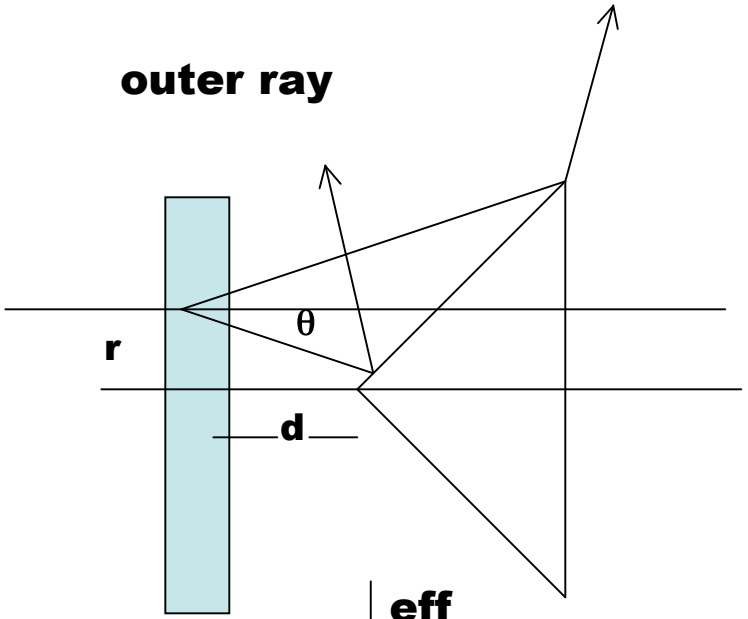


240-300 MeV/c

- ***About 40 pe separation x 2/3 light collection efficiency ~ 25 pes.***
- ***Light Collection Uniformity issues.***
- ***About 4 - 7 degrees of angular separation. Not Used.***

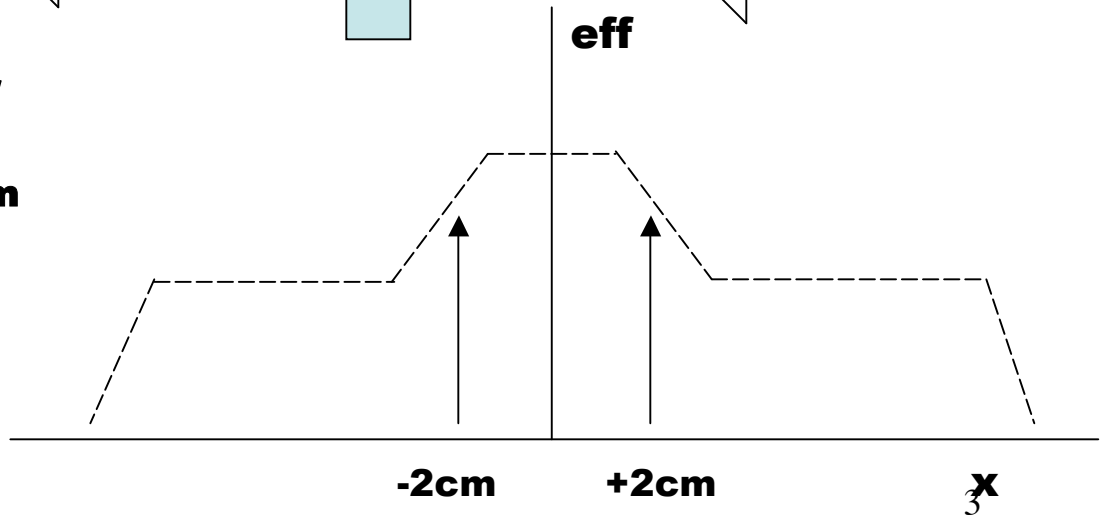
Track Position Dependency of Light Collection



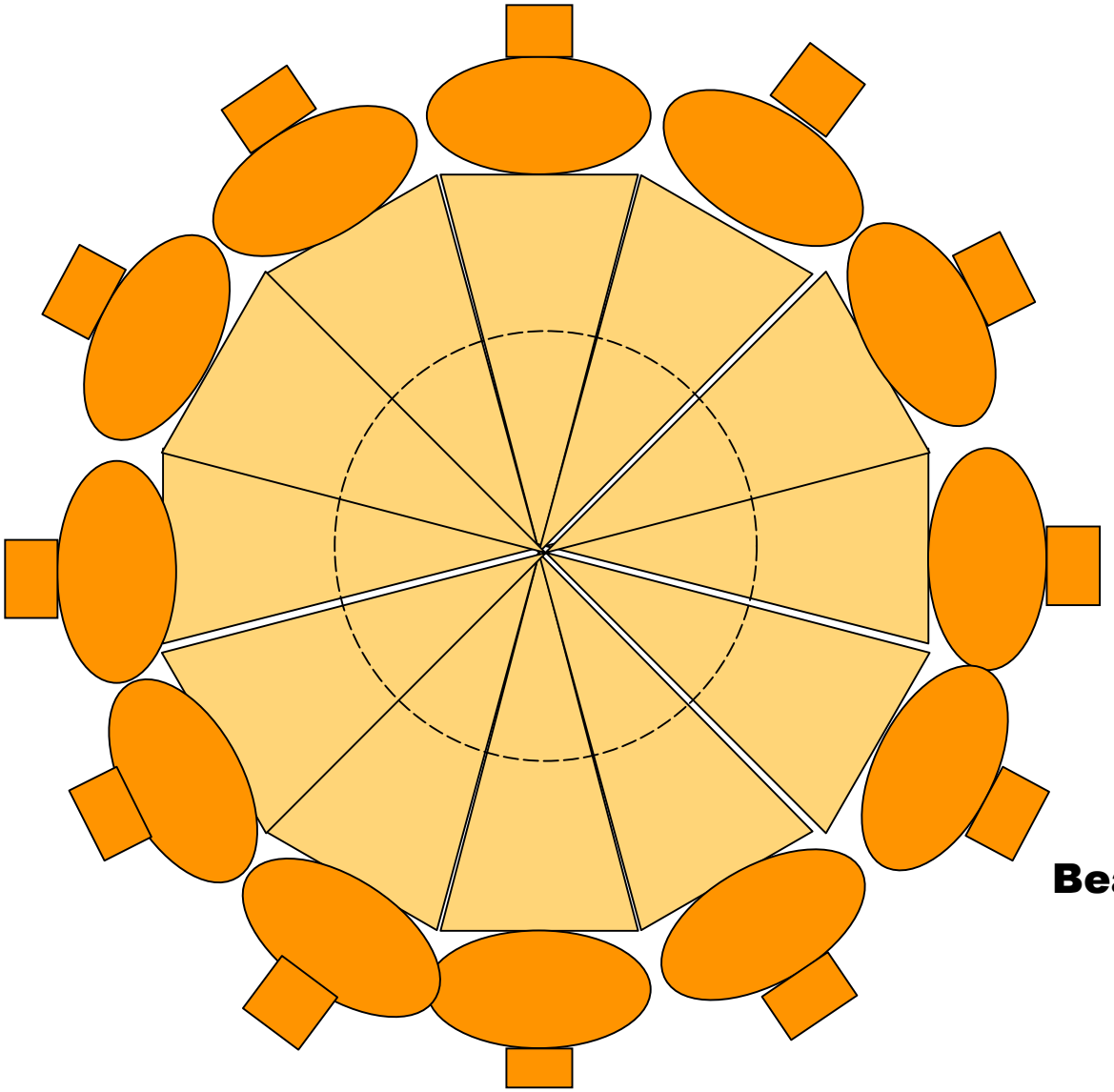


Collection Drop at -

x ~ d sin θ = 5cm sin 26° = +-2cm



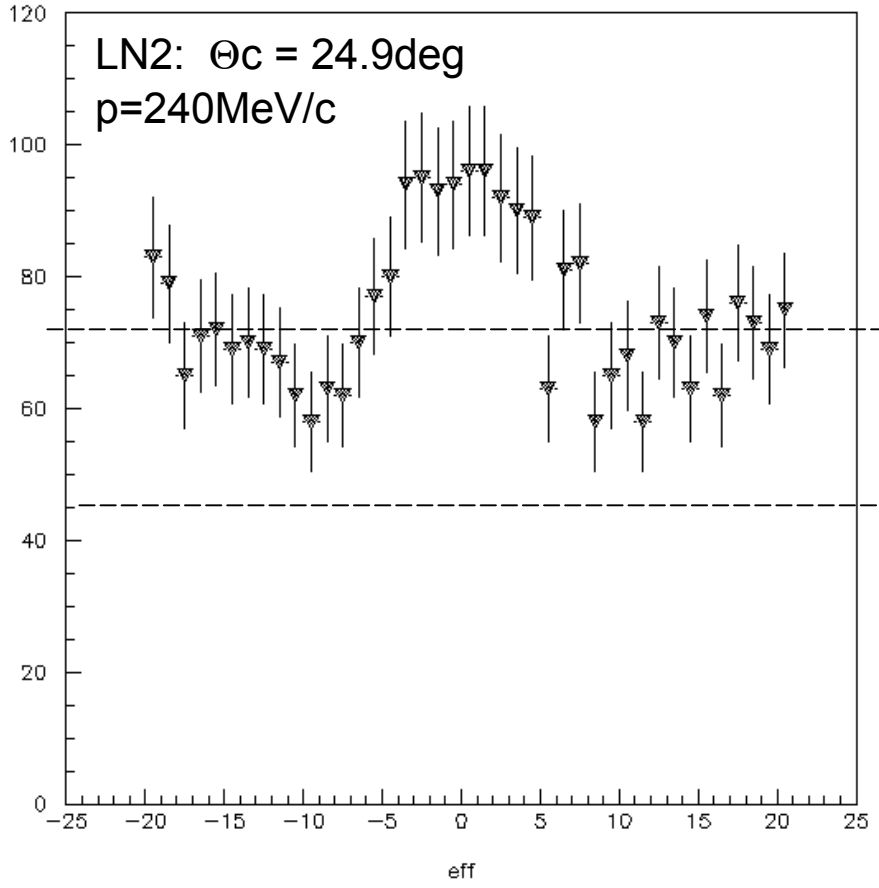
4--> 8-> 12 PMT Model helps Collection Uniformity



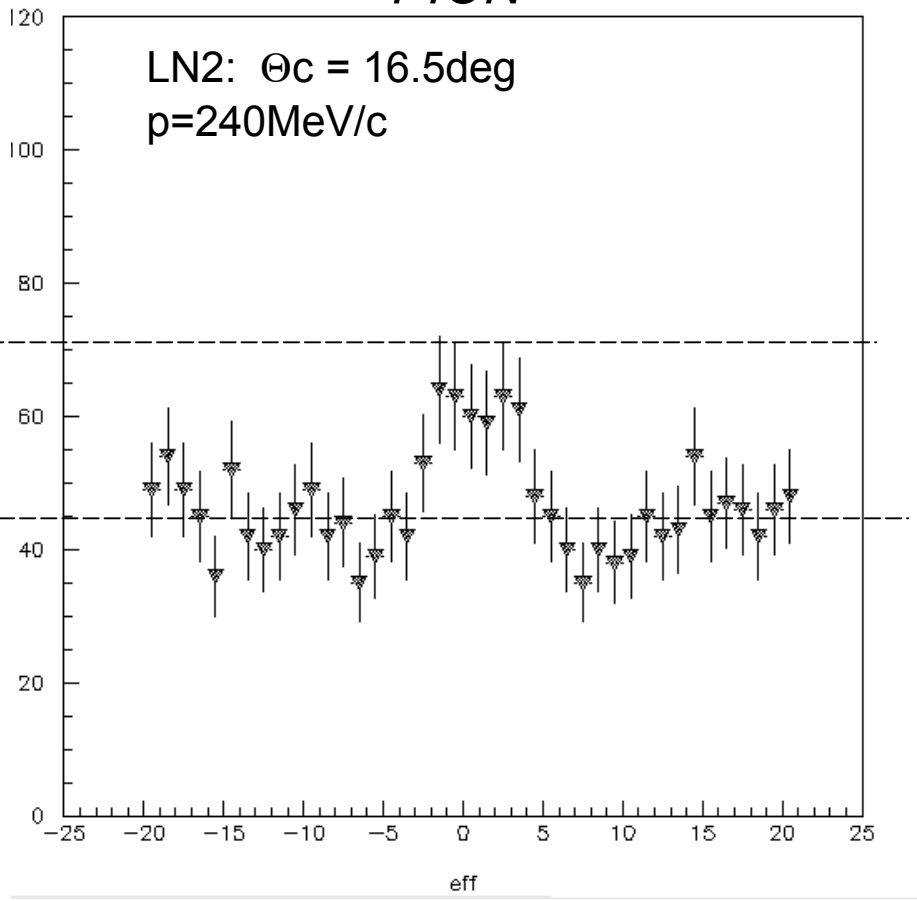
Beam view

8- PMT/Mirror Model @ 240 MeV/c

MUON



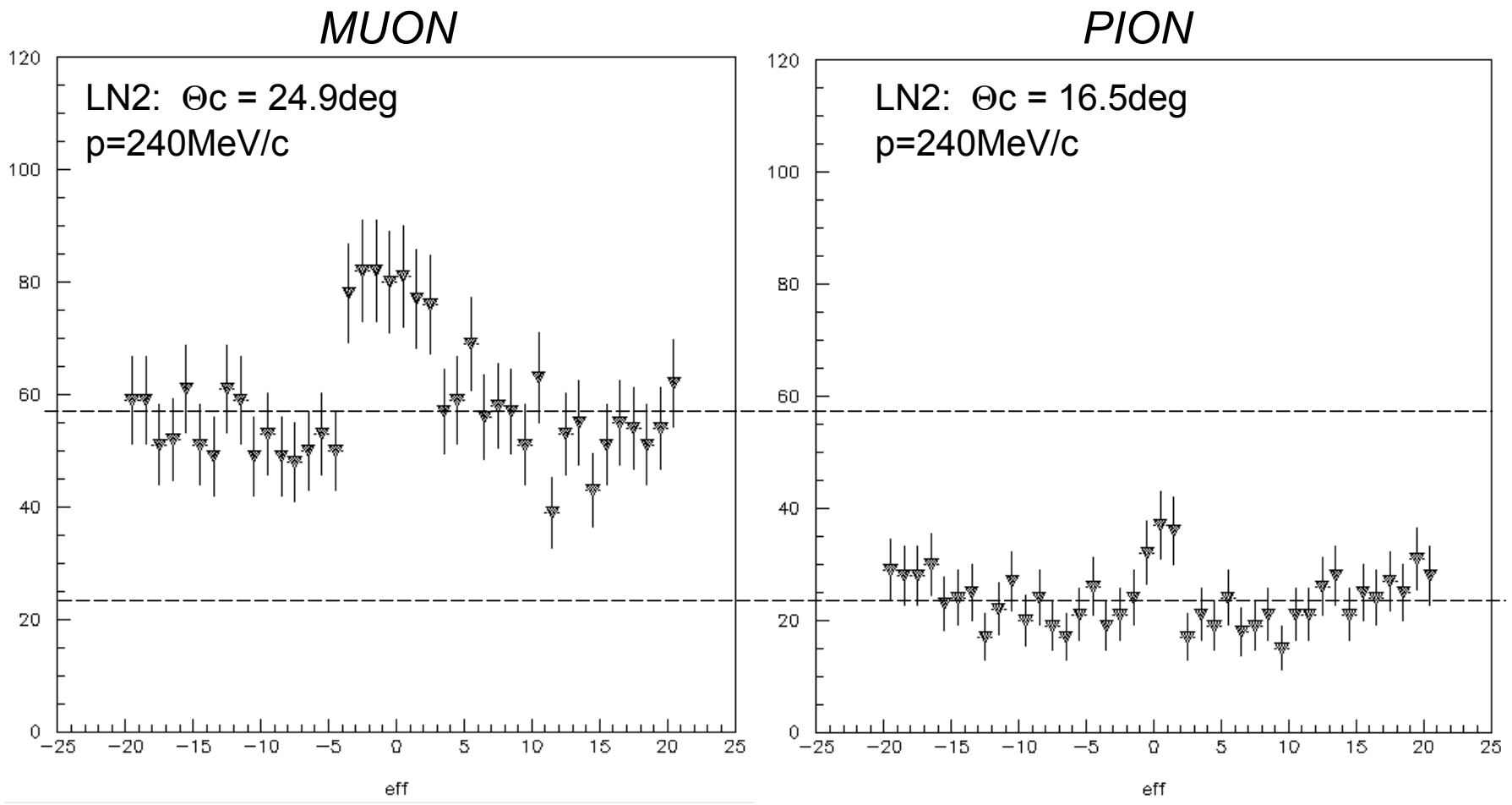
PION



- Particle scan across radiator face.

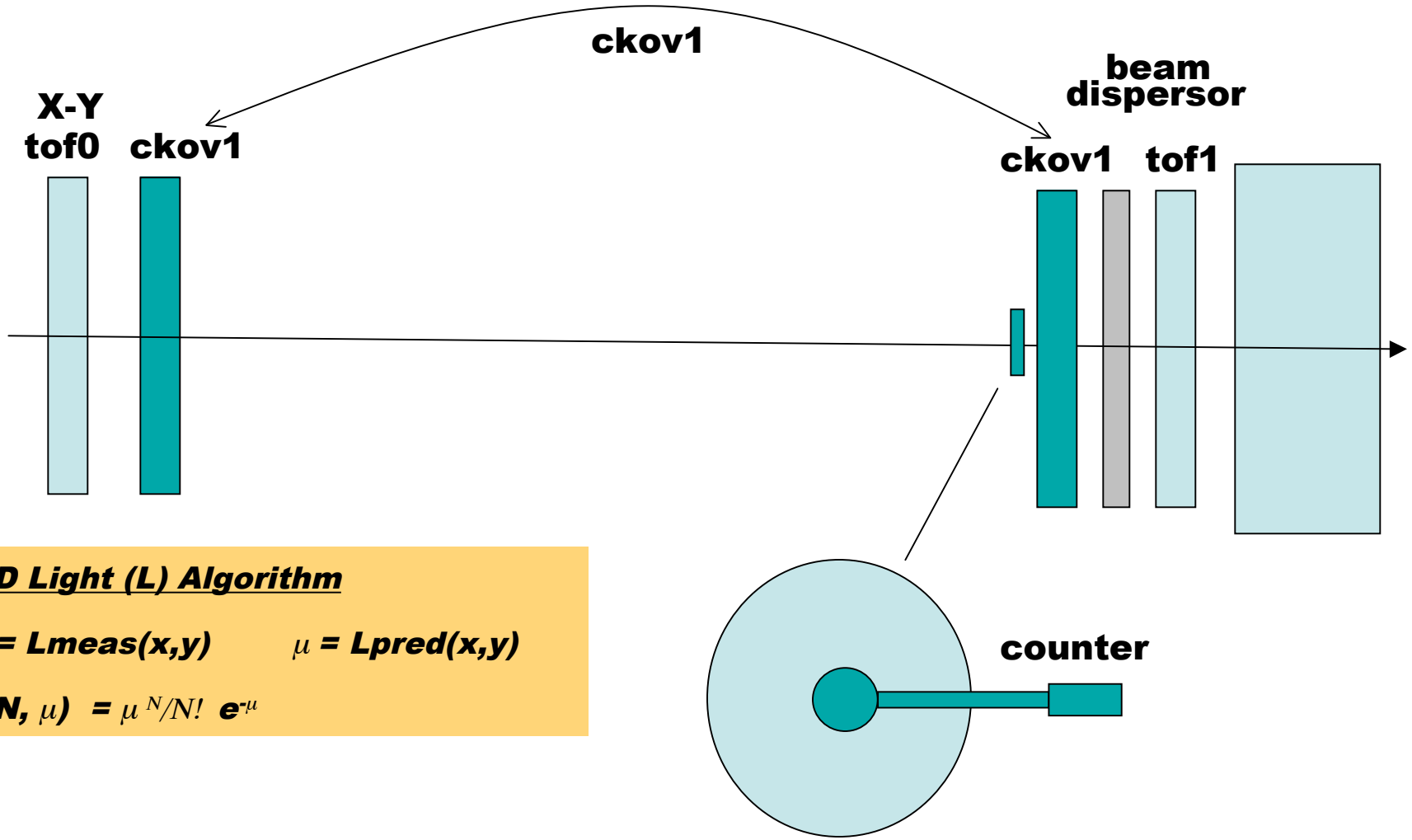
-Light collection enhanced in the central region and wing.

12 - PMT/Mirror Model @ 240 MeV/c



- **Uniformity problem partially solved by increasing # Mirror/PMTs.**
- **X-Y position from TOF0/TOF1 Central Trigger Scintillator may be useful.**

X-Y POSITION at CKOV1



PID Light (L) Algorithm

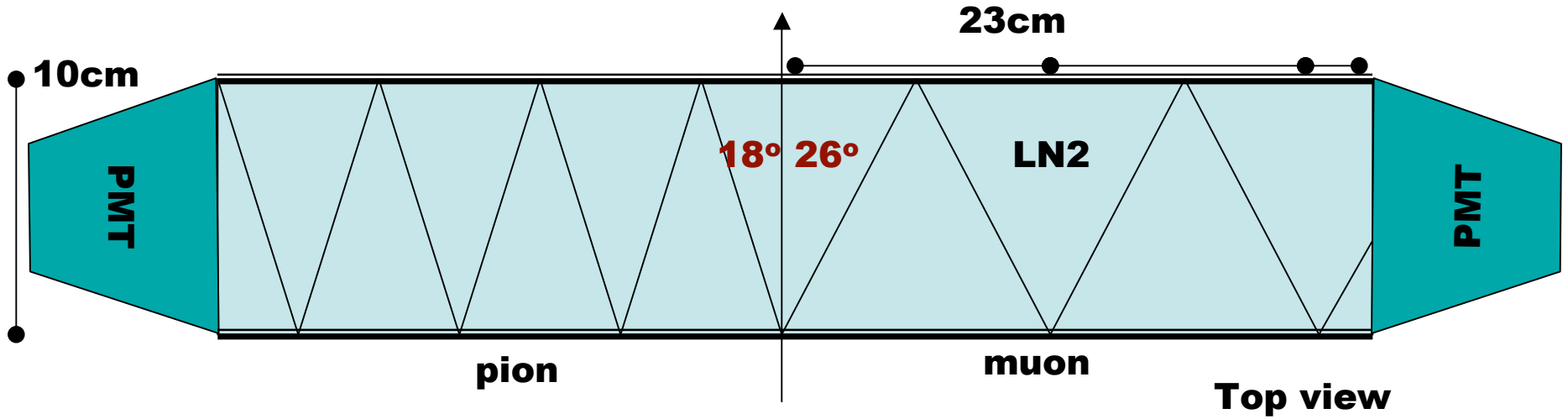
N = Lmeas(x,y) μ ***= Lpred(x,y)***

P(N, μ***)*** $= \mu^N/N!\ e^{-\mu}$

TOF CKOV CONCEPT

mu 26º -> 0.450rd --> 4.5 cm/bounce --> 4-5 bounces $\varepsilon = 0.9^{4.5} = 62\%$

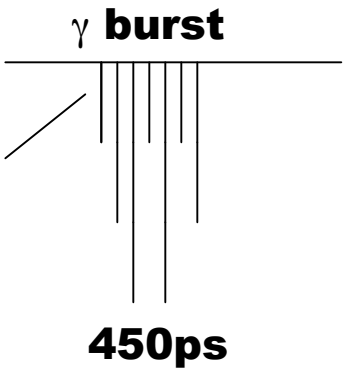
pi 18º -> 0.310rd --> 3.1 cm/bounce --> 7-8 bounces $\varepsilon = 0.9^{7.5} = 45\%$

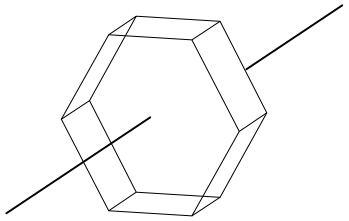


75cm --> (3.0+-0.2)ns
+-0.2ns slewing

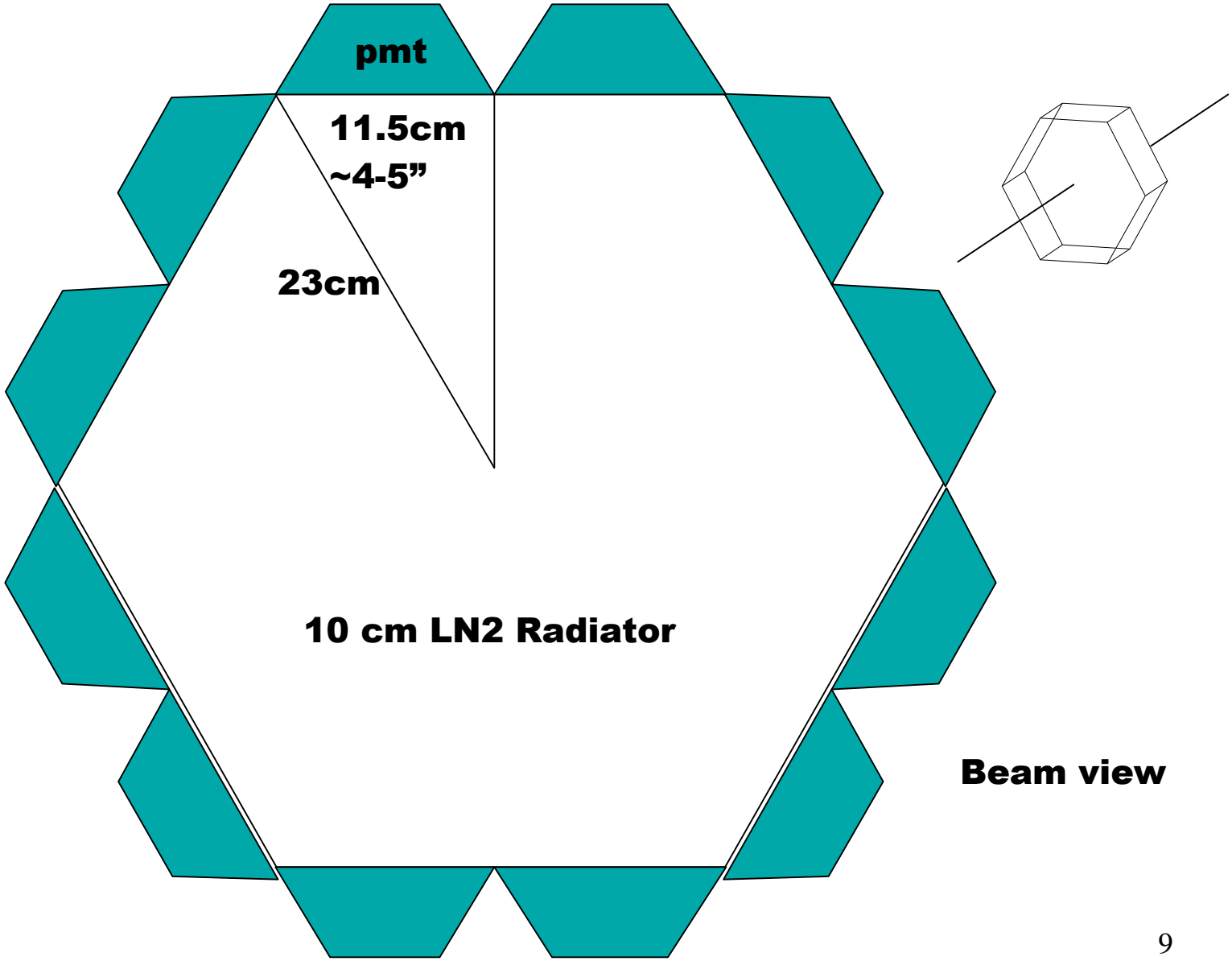
50cm --> (2.0 +- 0.2) ns
+- 0.2ns slewing

Timimg off leading 1-2 pe??

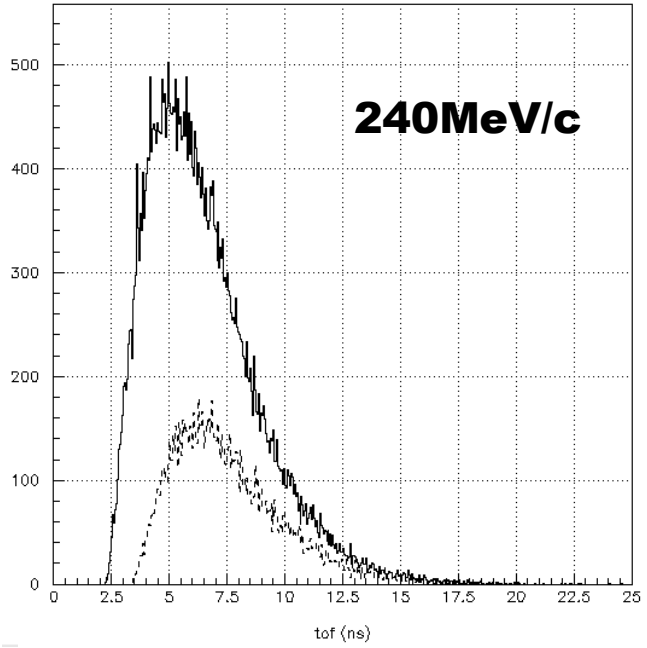


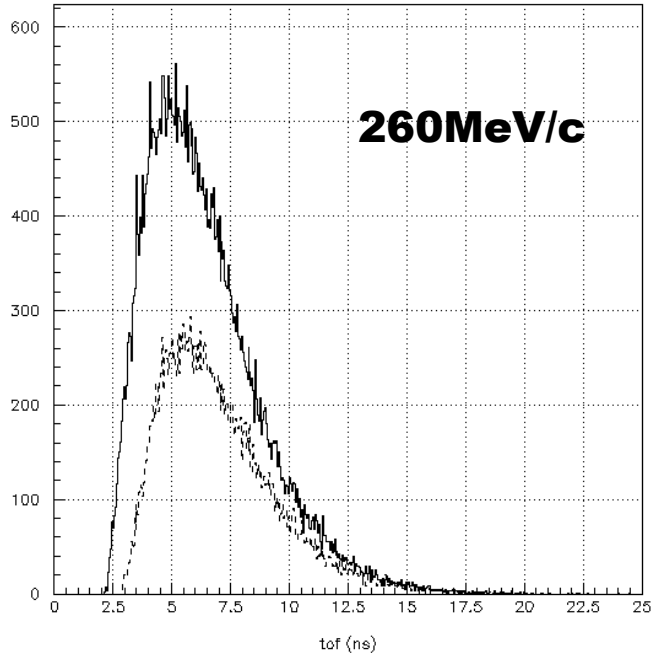


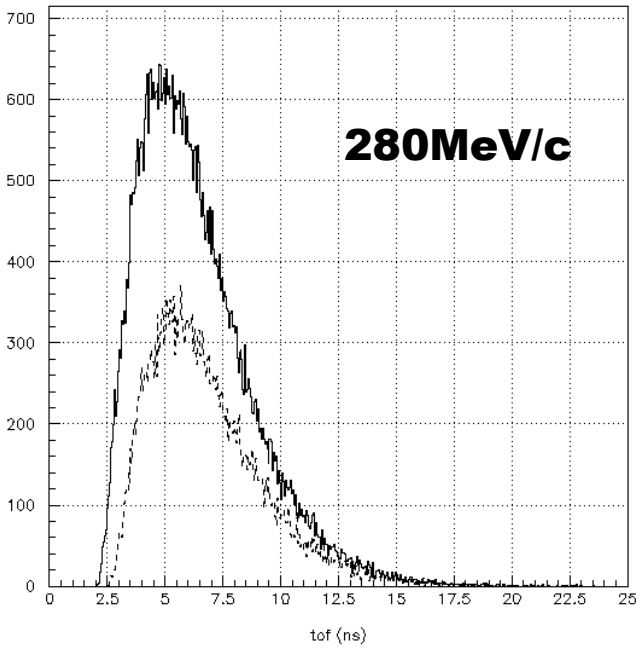
TOF CKOV CONCEPT

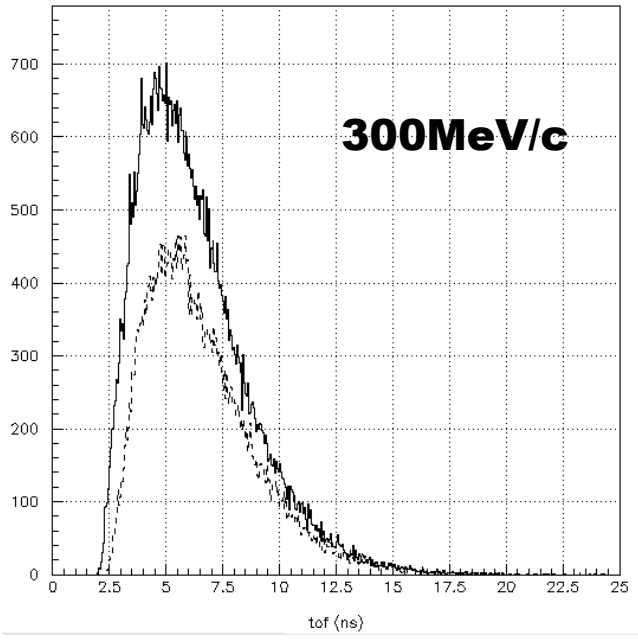


PMT Response vs Time - 50ps/bin









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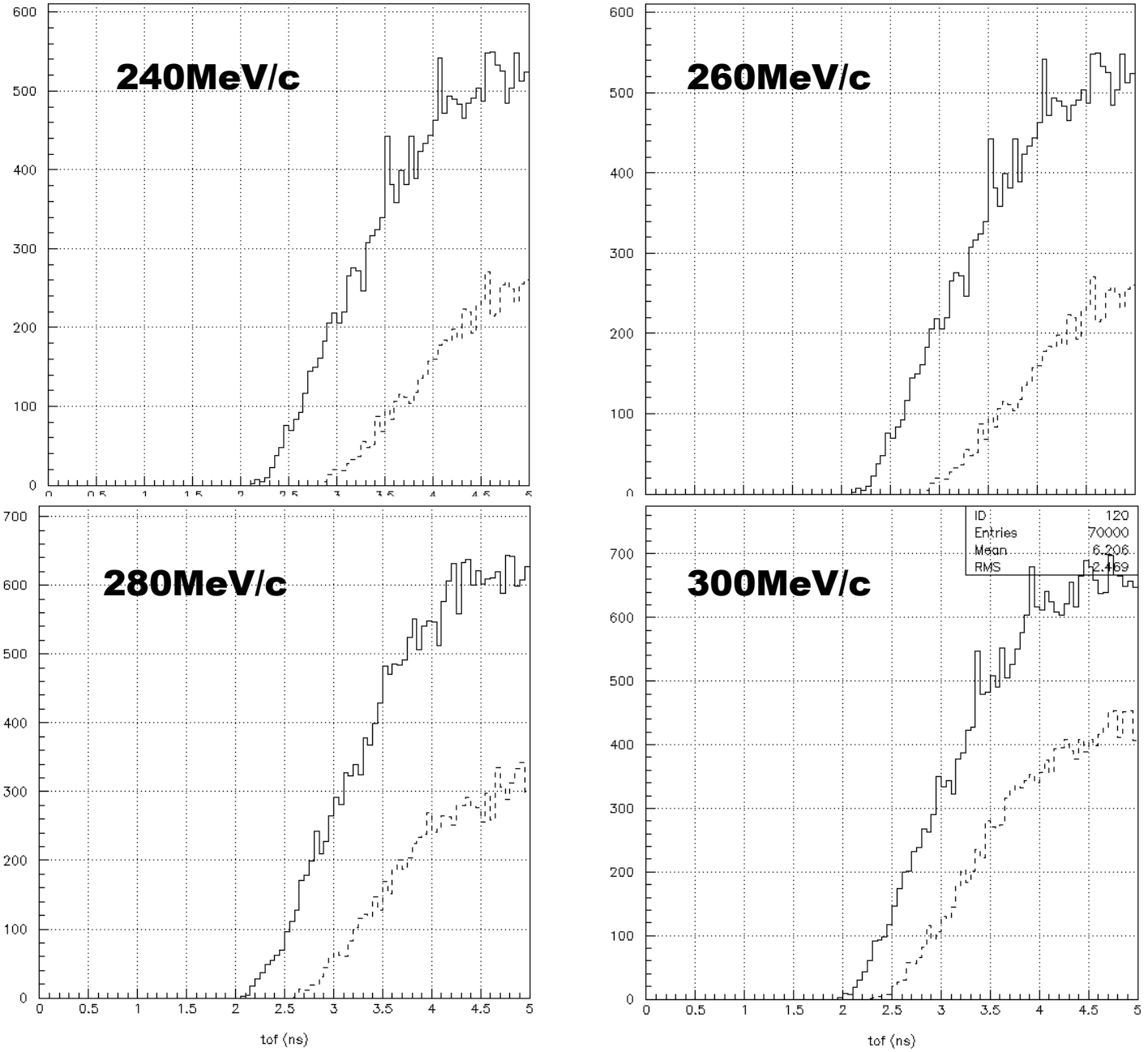
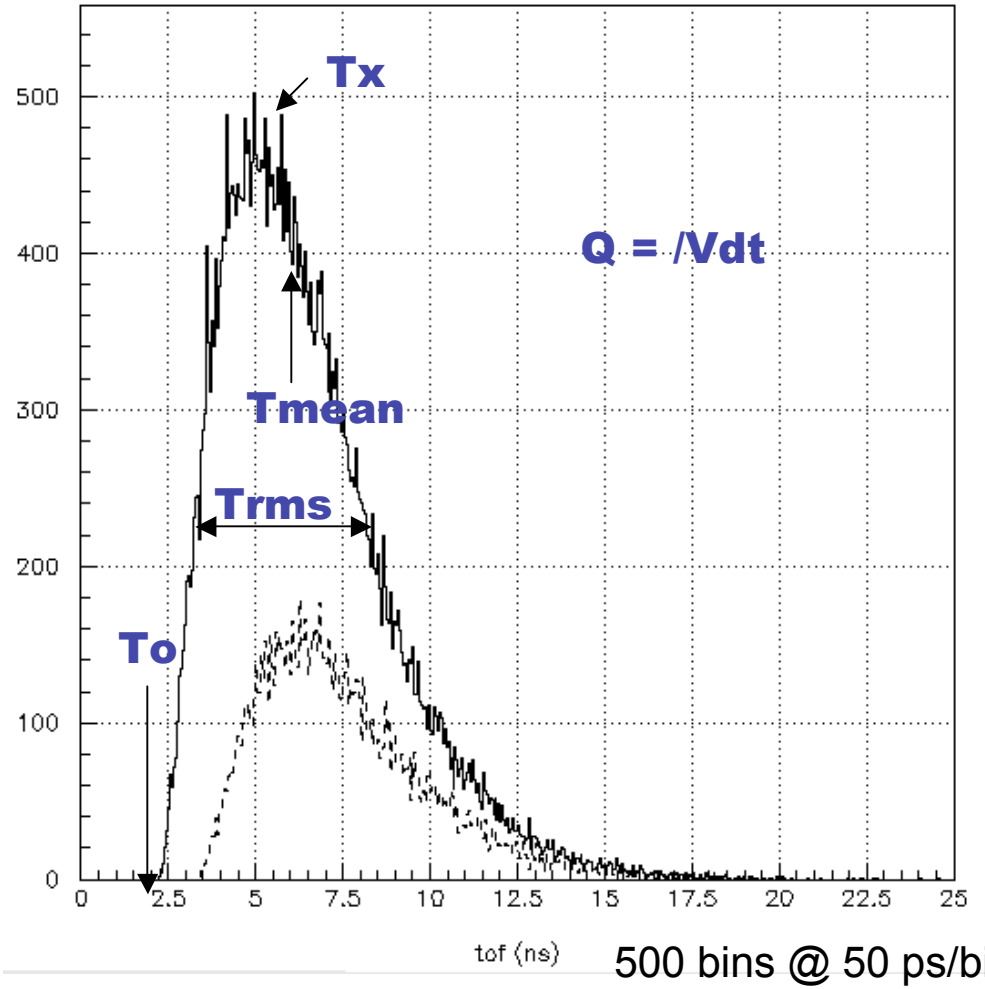


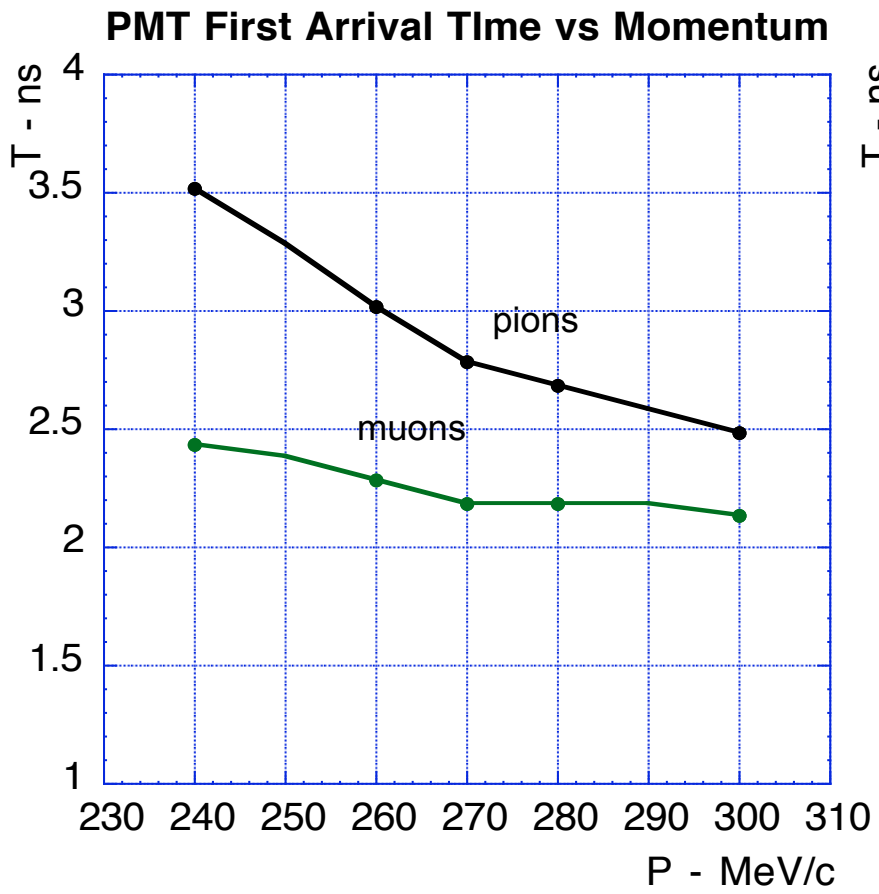
Crude Analysis

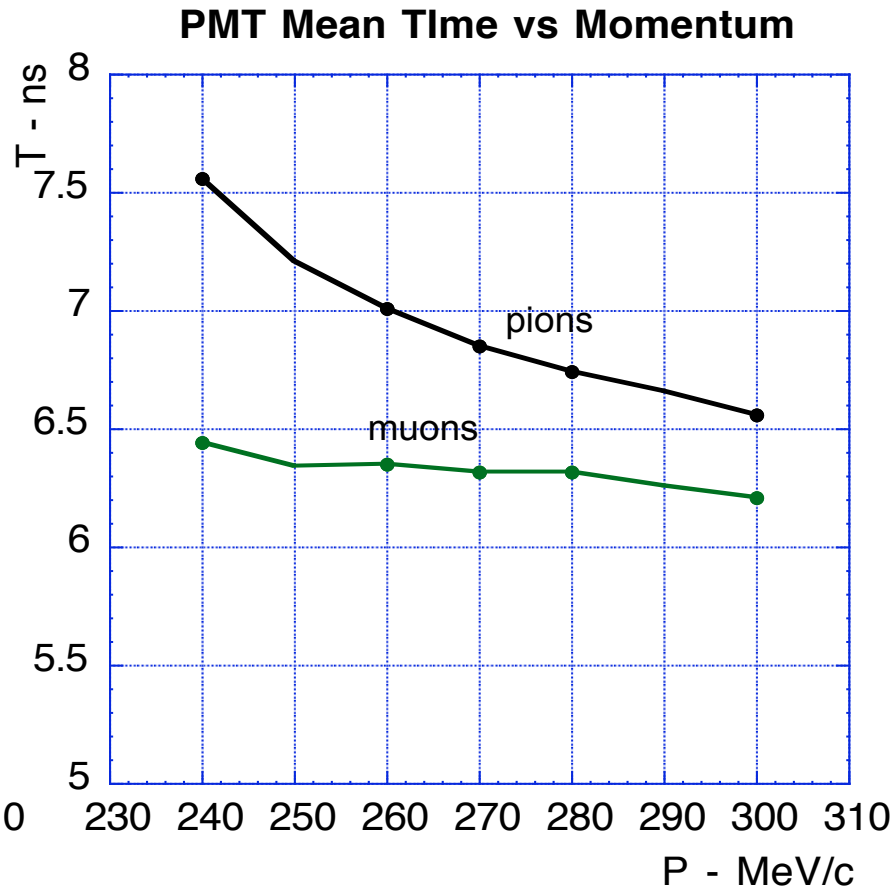


500 bins @ 50 ps/bin

To = first arrival
Tx = cross over time
Tmean = mean time
Trms = r.m.s
Q = integrated charge

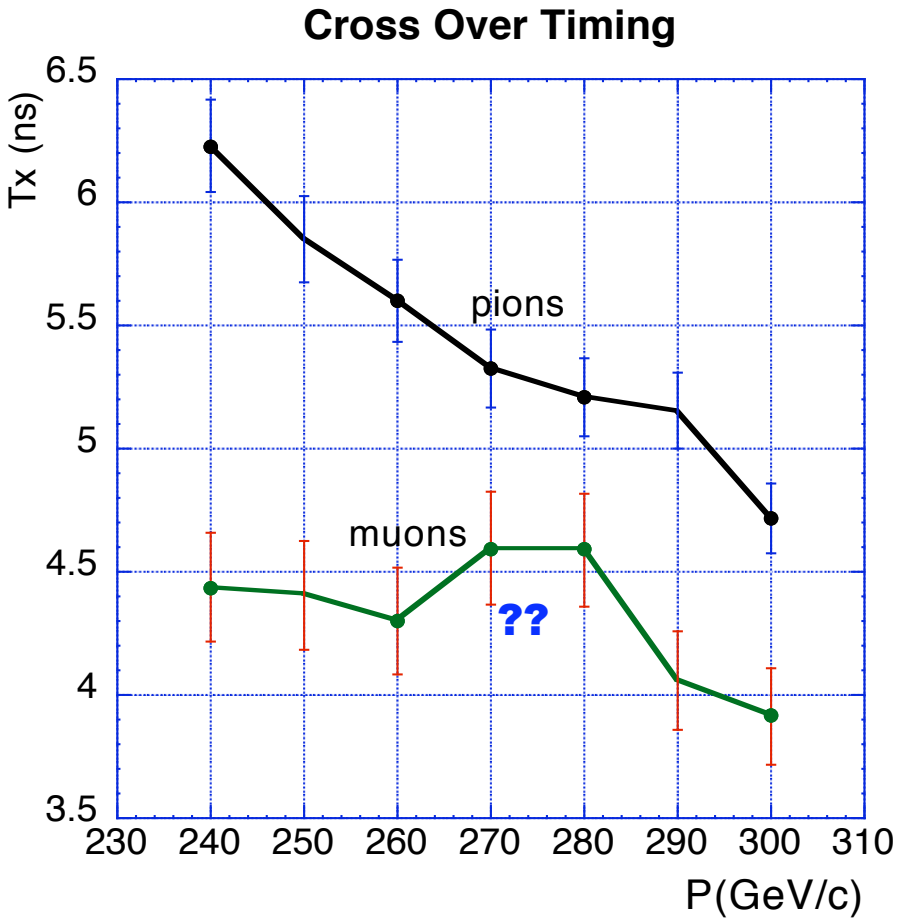
Timing Plots w mu/pi @ x,y = (0.,0.)

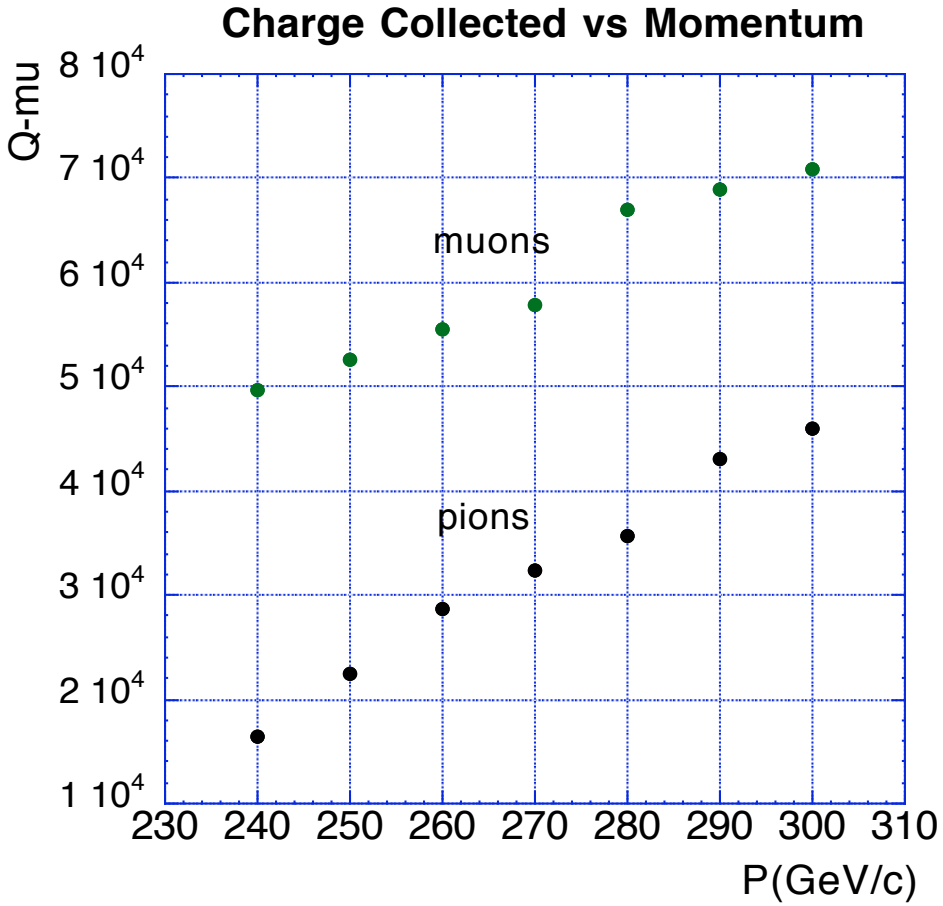




- **Timing separation varies from 1ns to ~0.5 ns.**

PLOTs at x0=0. y0=0.





- **Crossover timing may be more robust. Some fluctuations??**
- **Ratio of Charge collected rather flat due to extra bounces for pions.**

Photonis 2” PMT
TTS = 150 ps

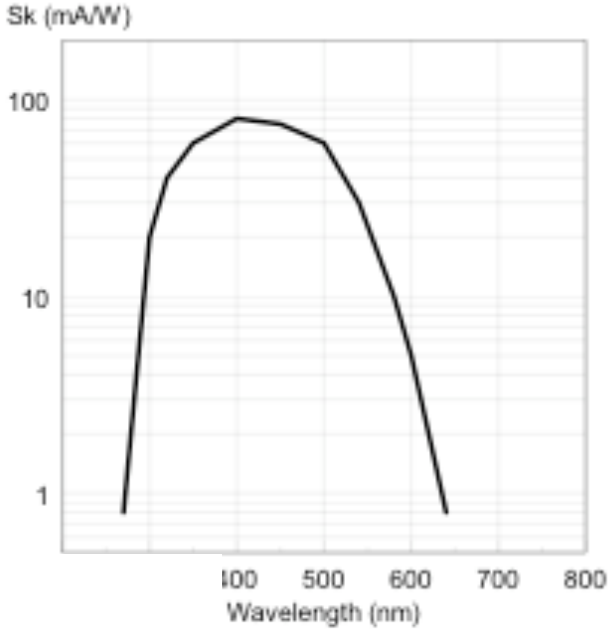
photomultiplier tubes **XP2020/UR**

product specification

Ultra fast, 12-stage, 51 mm (2") round tube

Applications :	High and medium energy physics where the number of photons to be detected is very low and where utmost time characteristics are required. This tube features a good linearity, a very low background noise extremely good time characteristics and good single electron spectrum resolution.		
Description :	Window :	Material :	borosilicate glass
		Photocathode :	bi-alkali
		Refr. index at 420 nm :	1.48
	Multiplier :	Structure :	linear focused
		Nb of stages :	12
	Mass :	240 g	

spectral characteristics



Characteristics with voltage divider C ⑥ :		**C**	**A**	
For a supply voltage of :		3000	3000	V
Gain :		$6x10^6$	$3x10^7$	
Linearity (2%) of anode current up to :		70	25	mA
Anode pulse ⑦	Rise time :	1.4	1.6	ns
	Signal Transit Time :	28	27	ns
	Duration at half height :	2.3	3.7	ns
	Transit Time Spread Standard deviation :	0.15		ns
Capacitance	anode to all :		7	pF
	grid to K + D1 + D5 :		20	pF

R5320 Hamamatsu PMT
TTS = 160 ps

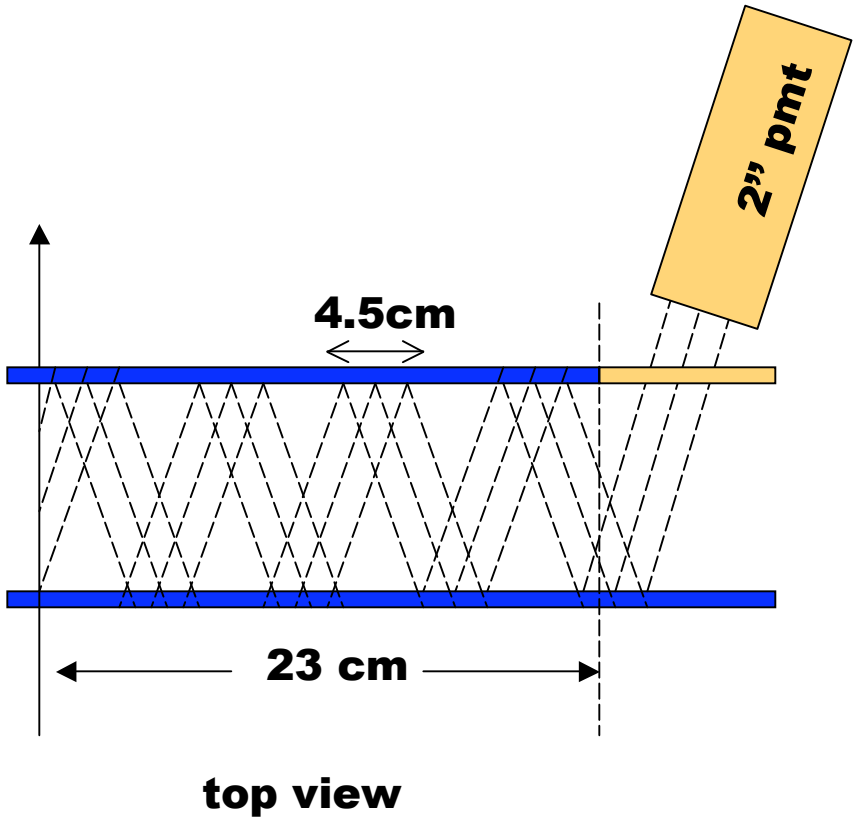
Part Number	Type	Head on / Side on	Size [mm]	Amplifier
H5321	PMT	HO	25	N

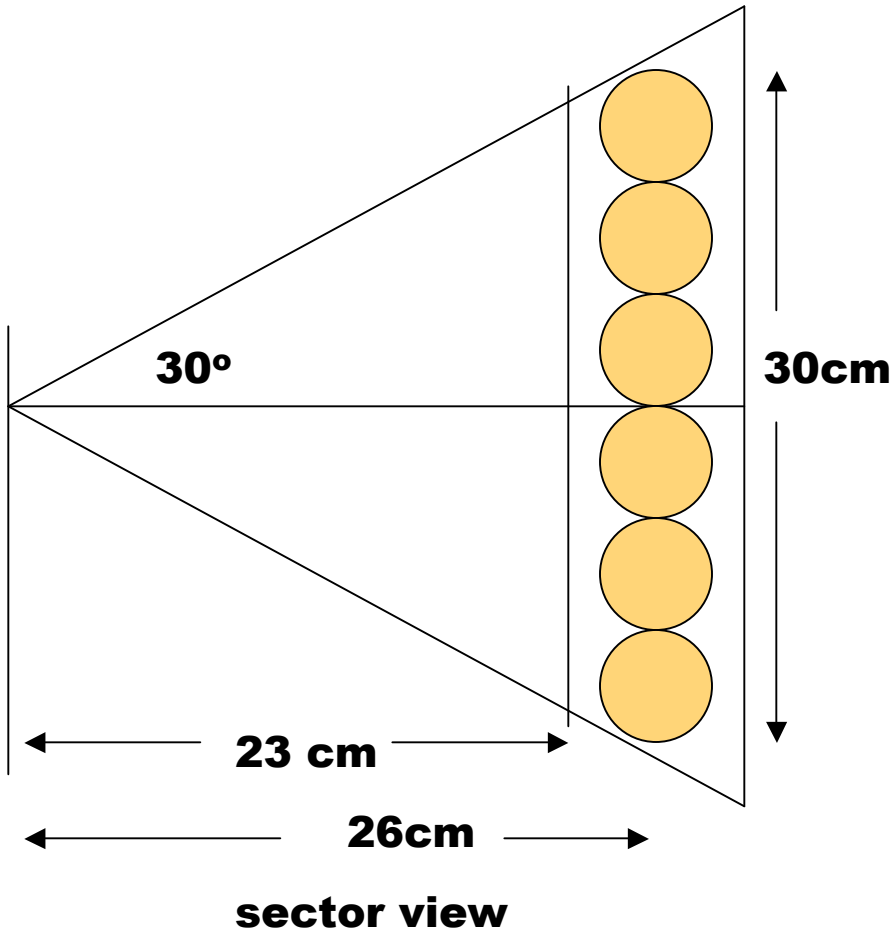
Head on assembly using R5320. Spectral response of 160nm - 650nm. Has SHV connector for HV supply and BNC connector

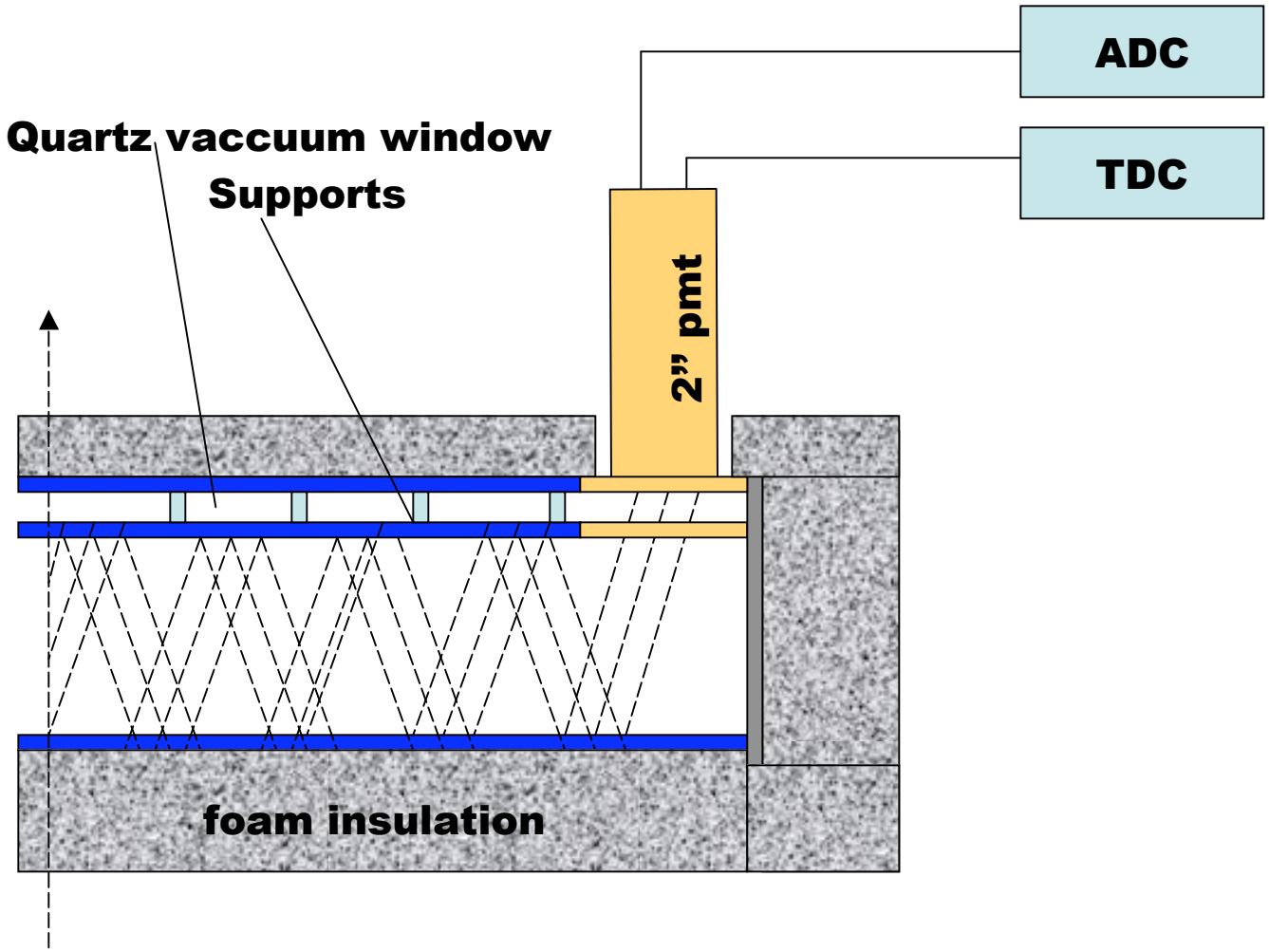
Key Specifications

Part Number	H5321
Type	PMT
Head on / Side on	HO
Size	25mm
Effective Area	20mm
Cathode Type	Bialkali
Peak Wavelength	420nm
Radiant Sens at peak	72mA/W
Window Material	Silica Glass
Min Wavelength	185nm
Max Walength	650nm
Cathode Luminous Sensitivity	70µA/lm
Cathode Blue Sensitivity	9µA/lmb
Anode Luminous Senstivity	400A/lm
Gain	5.7E+06
Dark Current	100nA
Rise Time	0.7ns
Transit Time	10ns
Dynode Structure/ Number of Stages	L/10
Multi Anode	N
Output Type	Current Output
A/D Converter	N
Photon Counting	N
Amplifier	N
PMT Part Number	R5320

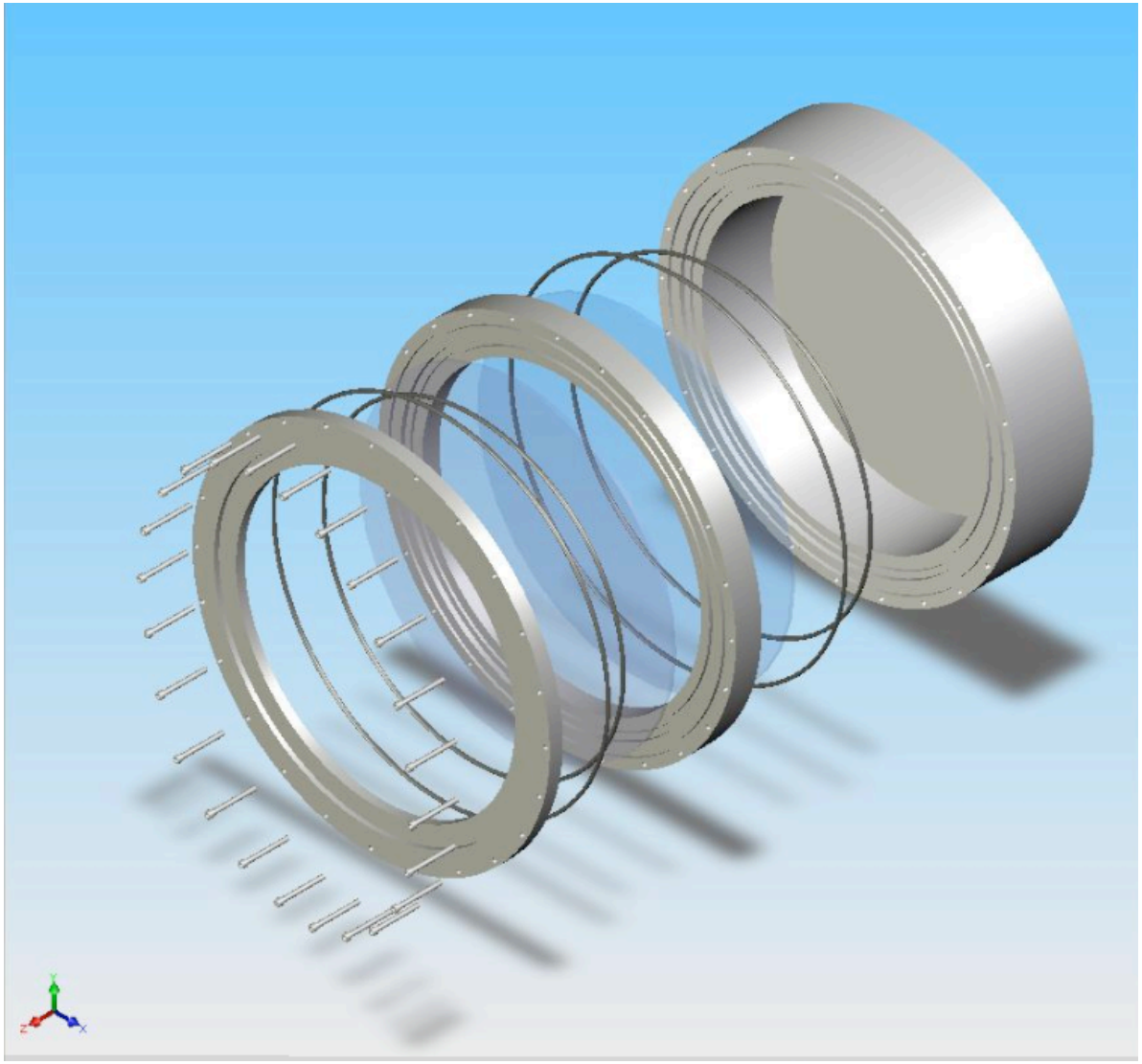
TEST BEAM PROTOTYPE






ADC
TDC
Quartz vaccuum window
Supports
2" pmt
foam insulation

LN2 VESSEL PROTOTYPE



SUMMARY

- **8 and 12 Mirror/PMT CKOV1 counter studied.**
- **Collection efficiency ~ 2/3 to 1/2.**
- **12 Mirror/PMT Better uniformity.**

- **LN2 Radiator/ Mirror Box needs x-y measurement to make proper pe light prediction.**

- **TOF CKOV concept works well in Simulation.**

- **2” pmt w ~200ps TTS available from Photonis or HARP exp.**

- **LN2 Vaccuum Windows in fabrication for tests.**