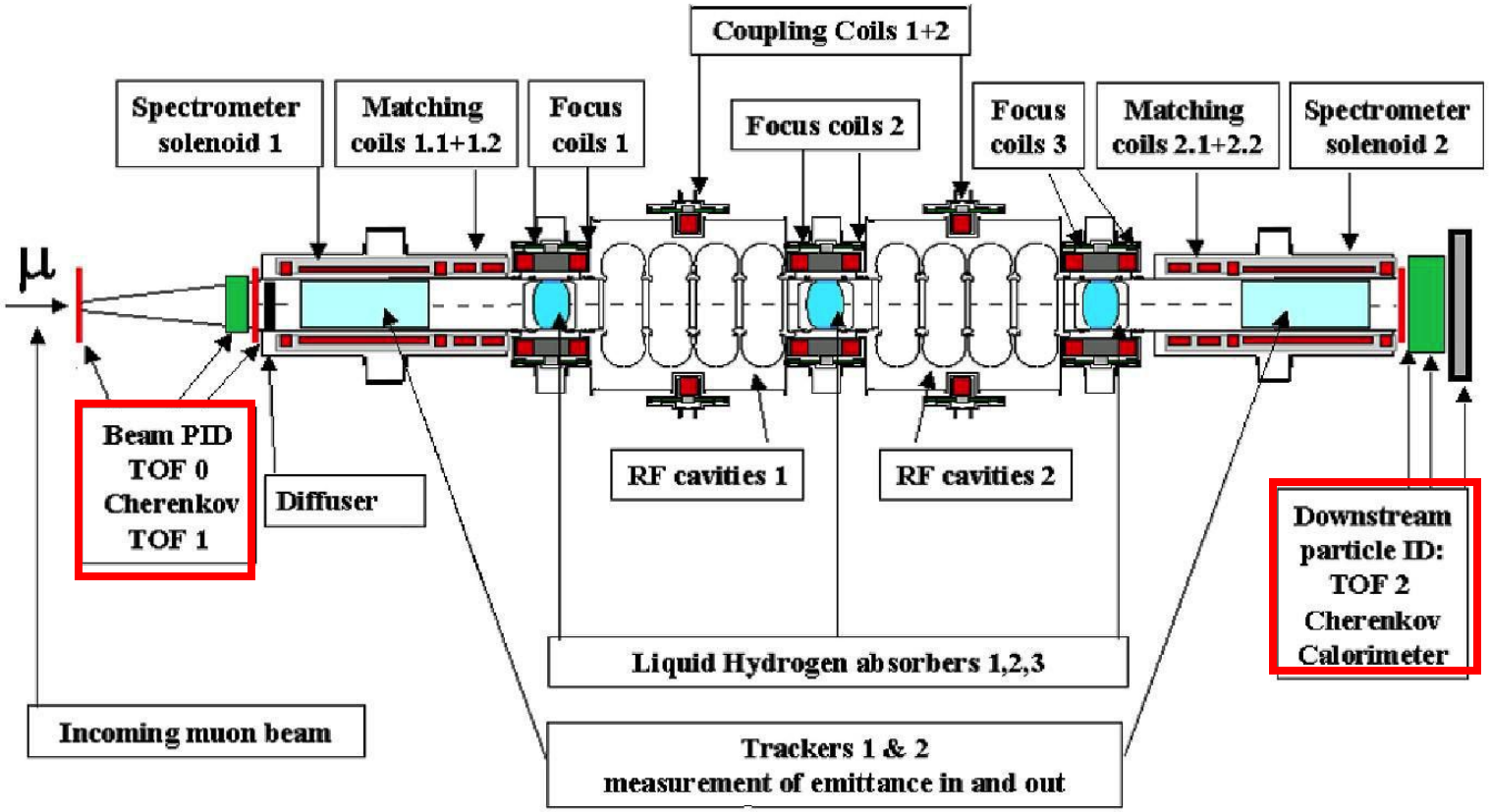
PID Analysis Report - CM31

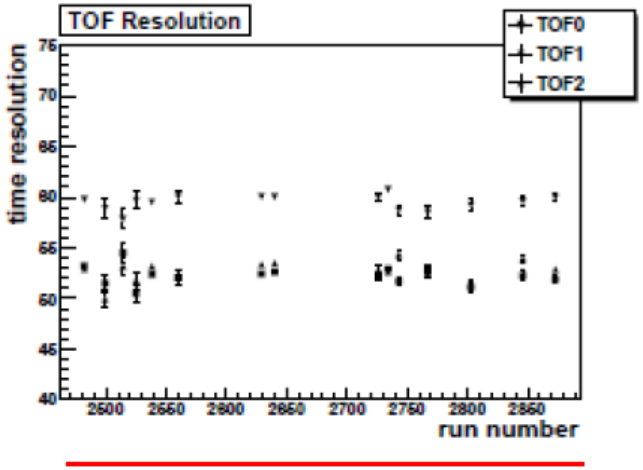
•Muon purity is assured by **three Time-of-Flight** (TOF) measurements, **two threshold Cherenkovs** (μ/π), and **a low energy muon/electron ranger** KL/EMR (μ/e).



• **TOF0,1,2 -** Three time of flight stations (~40x40cm2, 42x42cm2, 60x60cm2) are positioned in the MICE channel at the start (TOF0), mid (TOF1), and rear (TOF2) positions.

• TOF0(1,2) station consists of a 10 (7,10)X and 10 (7,10)Y array constructed of BC404(420) scintillator bar assemblies with dual R4998 PMT readout with modified high rate active HV divider. Each assembly gives typically Δ_{to}~50-60ps.

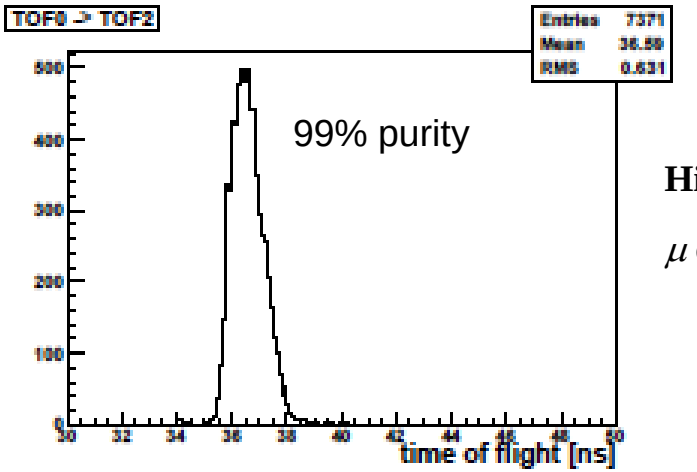
•The expected resolution on TOF between 2 stations is
$\Delta TOF_{ab} \sim 2\Delta_{to}^2 + \sigma^2_{calib} \leq (80\ ps)^2$ well matched to a 100 ps requirement.



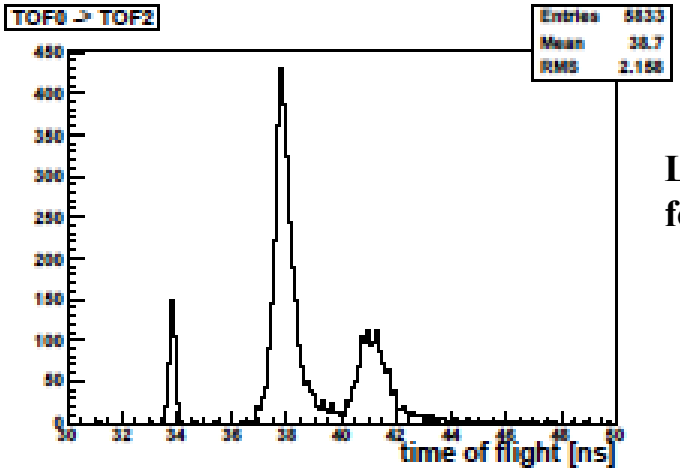
Intrinsic time resolution Δ_{to}:
- TOF0 – 52 ps
- TOF1 – 60 ps
- TOF2 – 53 ps.

1 month running time

$\Delta t=(d/c)*\sqrt{1 + (m/p)^2}$



High emittance muon beam (to study μ cooling)



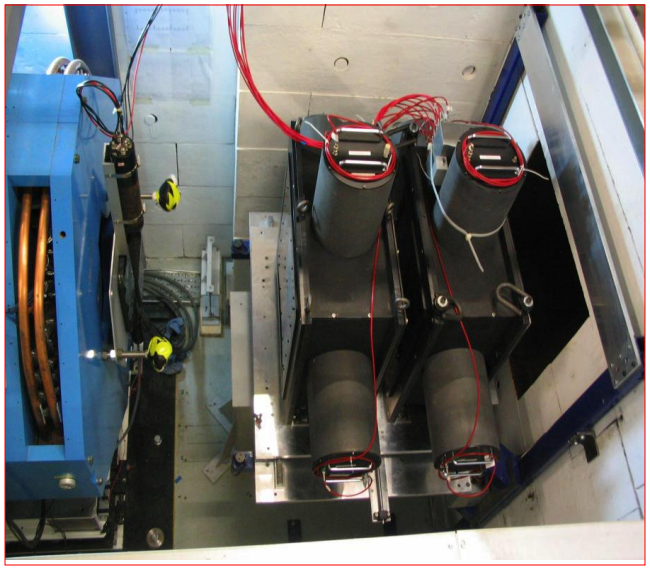
Low emittance calibration beam, for detectors characterization.

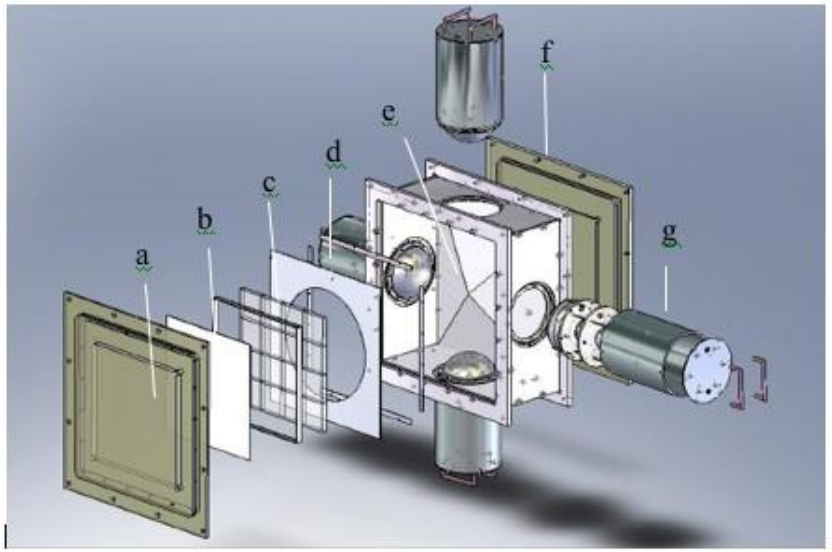
• **CKOVab-** Two threshold Cherenkov detectors positively identify muons from pions in the upstream MICE beamline.

•High density aerogels of n=1.12 and n=1.07 were chosen with momentum thresholds for muon i.d. between 220-360 MeV/c.

Aerogel Cherenkov counters blowup: a) entrance window, b) mirror, c) aerogel mosaic, d) acetate window, e) GORE reflector panel, f) exit window g)8 inch PMT in iron shield.

	Pth_{μ}(MeV/c)	Pth_{π}(MeV/c)
Aerogel 1.12	220	280
Aerogel 1.07	280	360





G4MICE Software Package transitioning to MAUS.

G4MICE

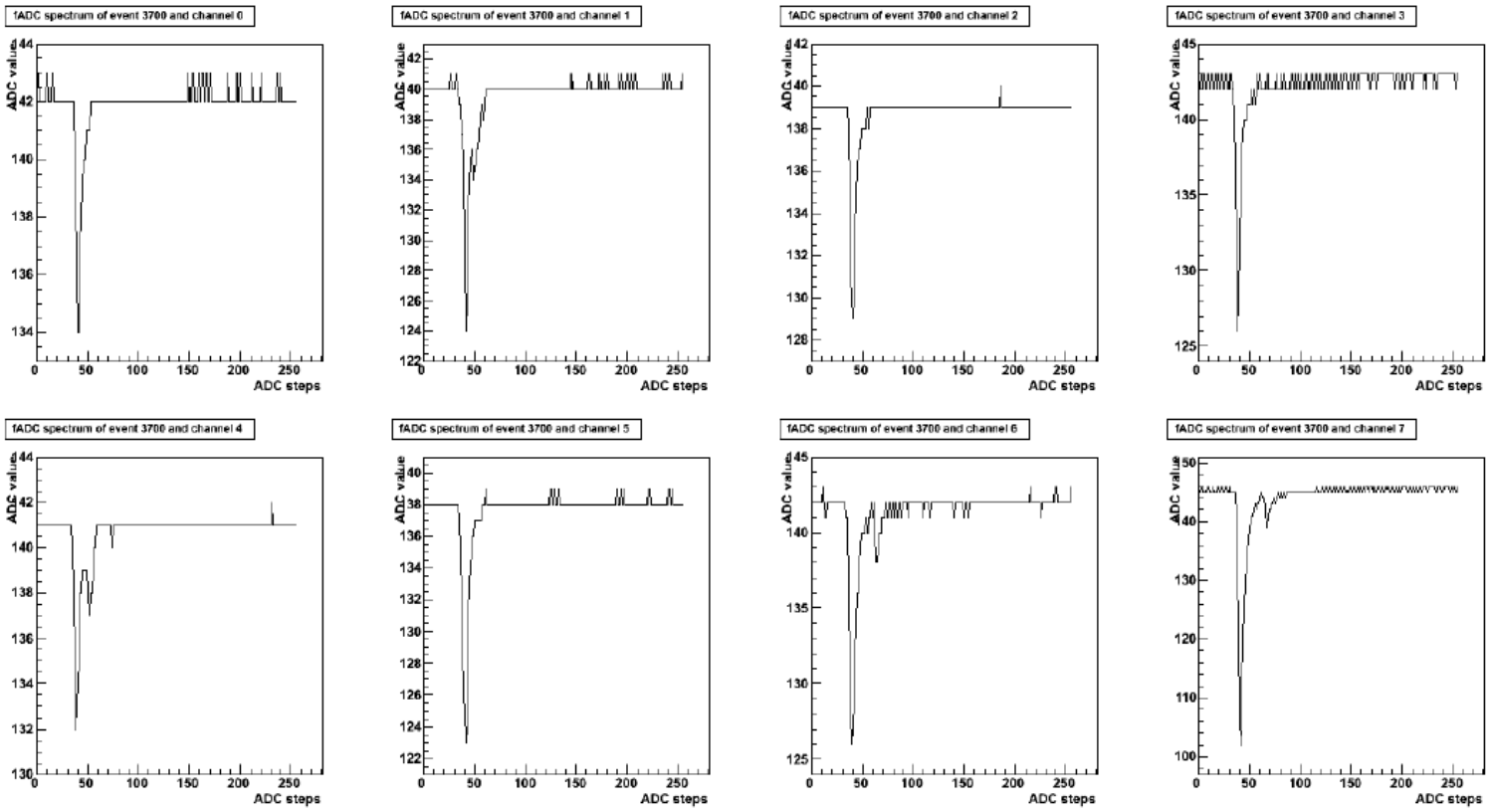
- CkovReco.cc associates fADC channels with Ckov detectors.
- CkovDigit class provides only one field for a photo electron count per PMT (4 per detector).

New G4MICE standalone

- New CkovReco.cc to associate fADCs, runs multipeak finding, integrates peaks, generates coincidences, and reports coincidence timing, and maximum coincidence in event.
- Inline Pedestal finder.
- Fills CkovDigit vector in MICEEvent with #PE per tube.

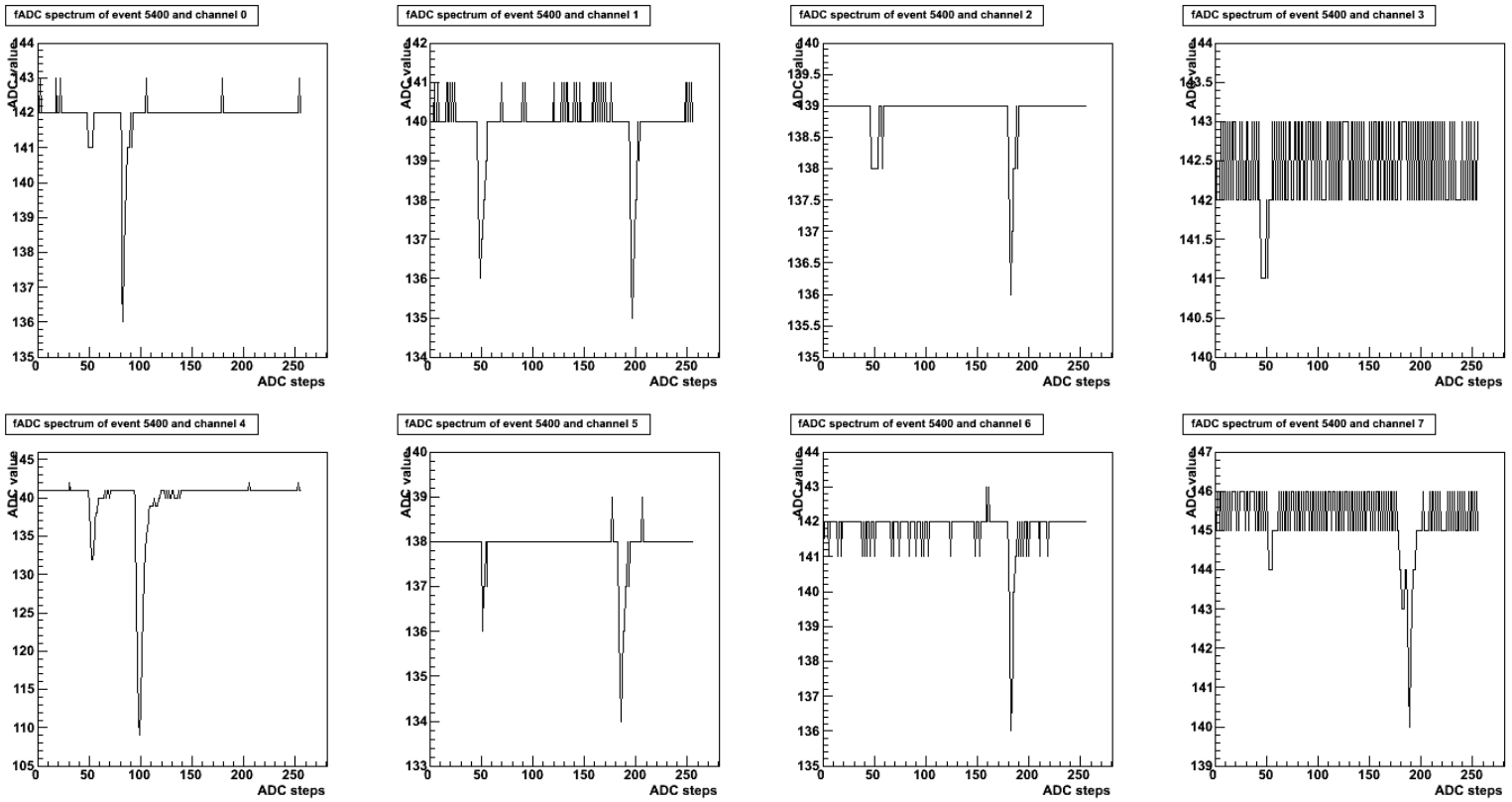
Standard Event in CKOVa (top), CKOVb(bot) (1cnt = 2ns)

	ncands	toarrival	pe1	pe2	pe3	pe4	coin_level
ckova	1	45	3	4	4	3	4
ckovb	1	43	2	5	5	4	4

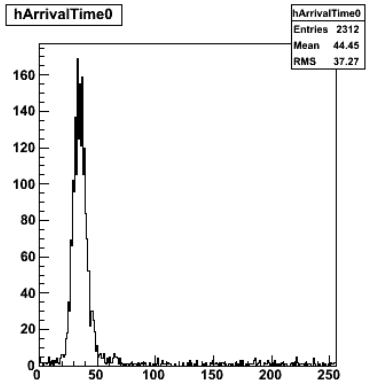


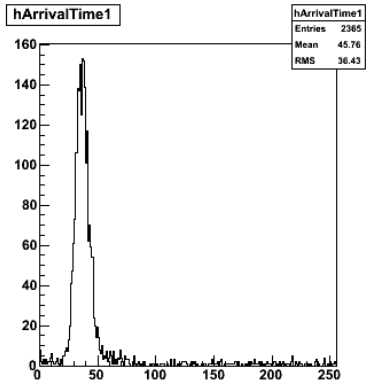
Complex Event in CKOVa (top), CKOVb(bot) (1cnt = 2ns)

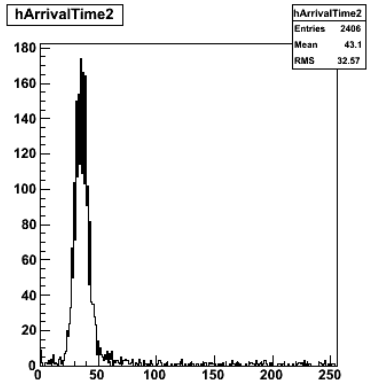
	ncands	toarrival	pe1	pe2	pe3	pe4	coin_level
ckova	2	45_1, 200_2	……..				
ckovb	2	50_1, 200_2	……..				

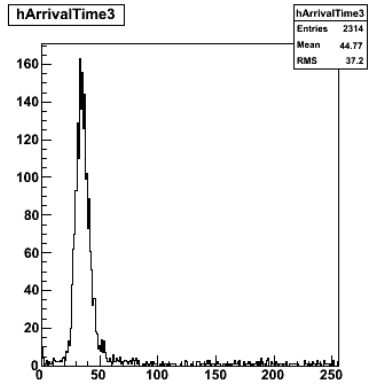


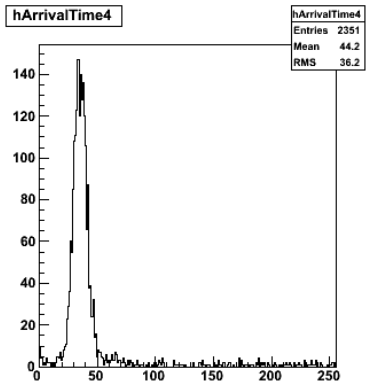
Good beam arrival time = tckv –tof0 (1cnt = 2ns)

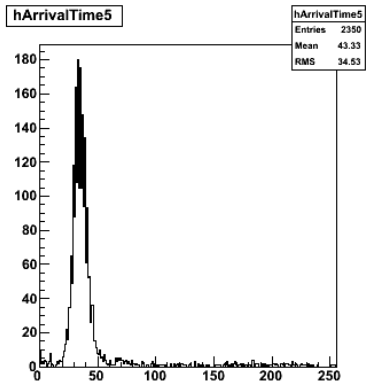


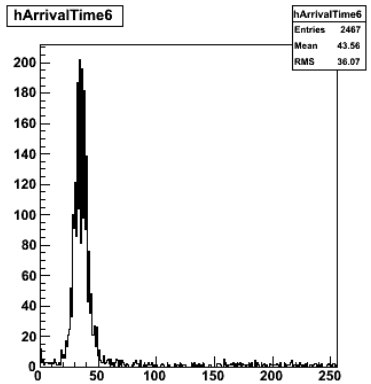


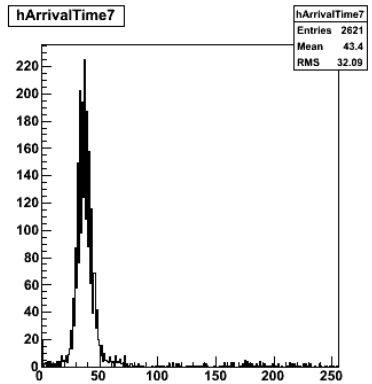




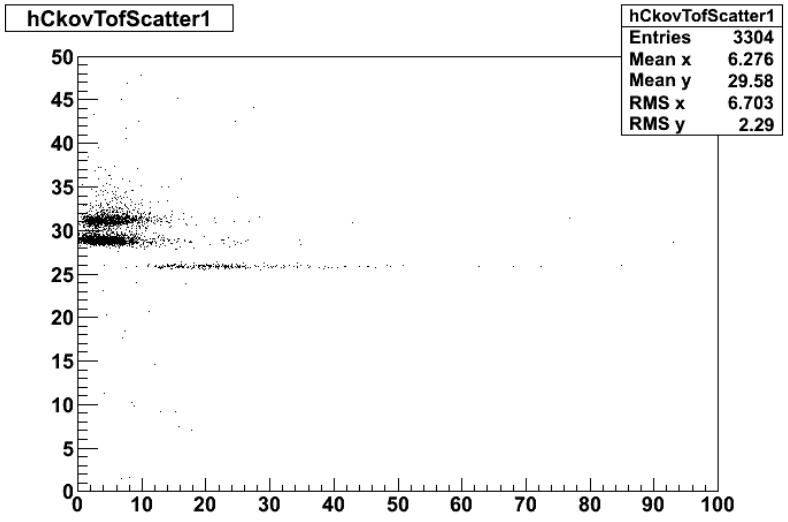


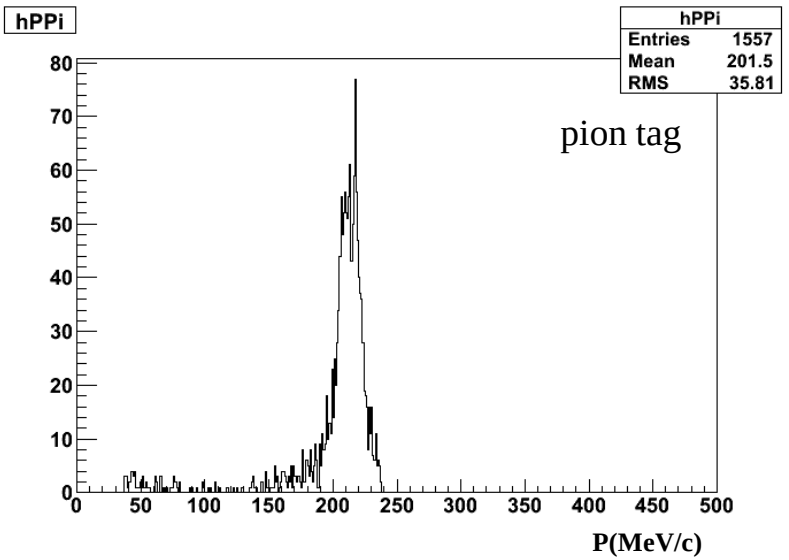


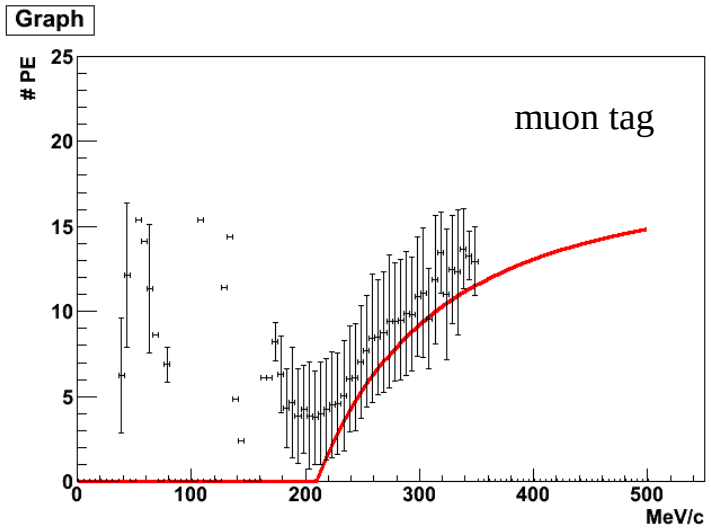


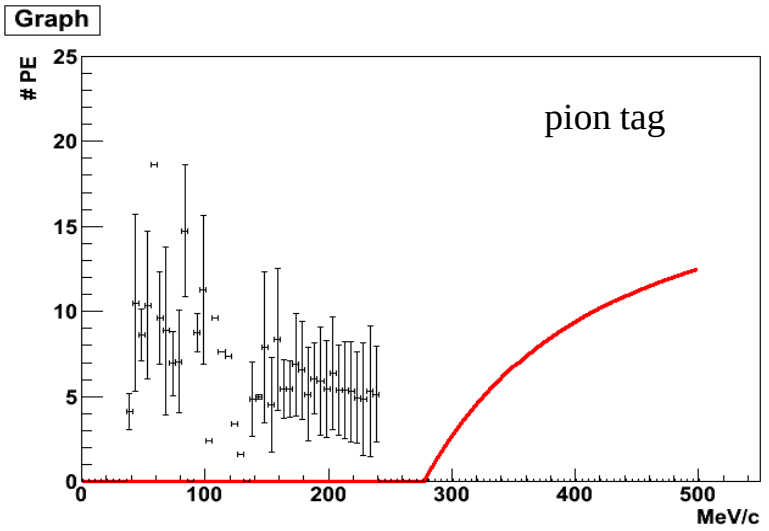


Light below pion threshold!



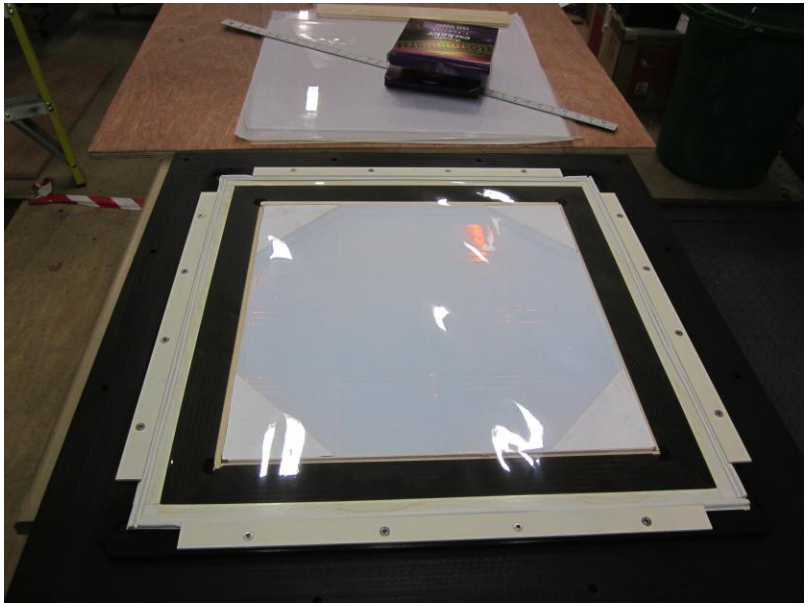


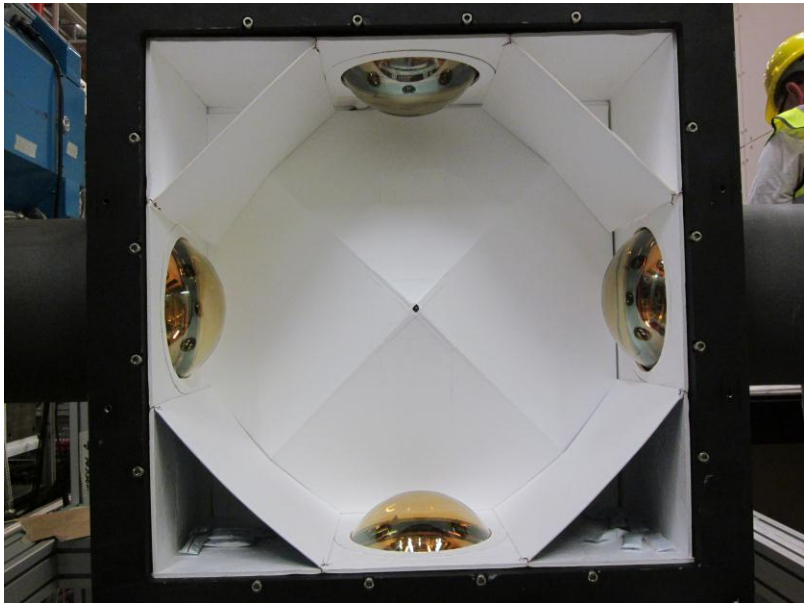




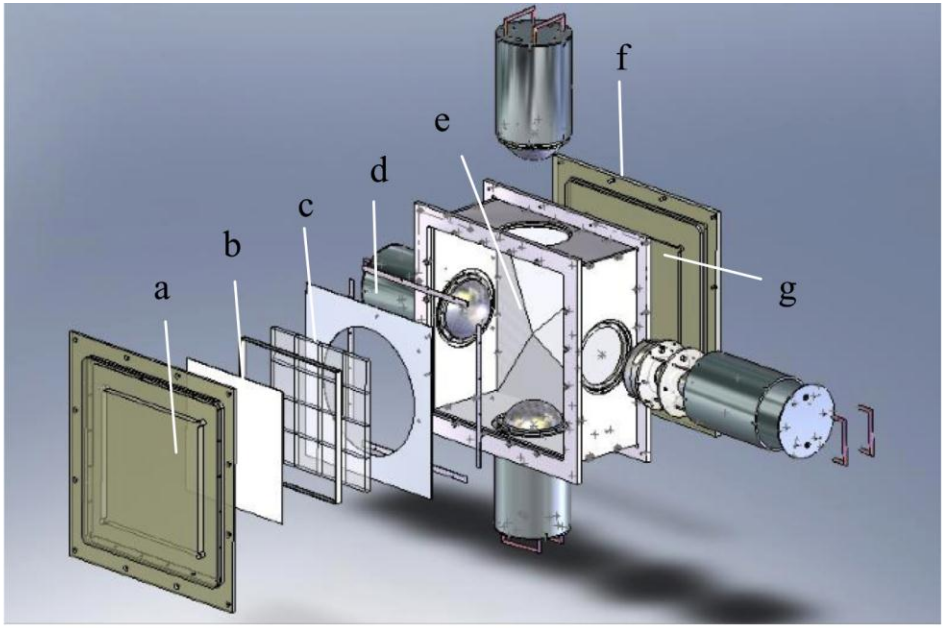
June 2011

- Replaced 2mm Schott Glass window with 5mil Acetate to reduce background in CKOVa/b.
- Replaced Tyvek with GORE Reflector Panels in CKOVb, replaced in DSA.
- Re-established HV connections and supplies.





Radiation Length and Multiple Scattering.



Radiation length comparable to TOF assemblies.

Material	Δz(mm)	Xo(cm)	ρ(g/cc)	X/Xo %
a - Delrin front window	2	32	1.42	0.63
b - Flat mirror - lexan	2	34.6	1.2	0.5
c – Aerogel (n=1.07/1.12)	23	[b]105 / [a]73.6	[b]0.26 / [a] 0.37	[b]2.2 / [a]3.1
d - Acetate window (3 mil)	.076	27.3	1.42	0.0003
e - Foam Core Reflector	6.4	728	0.12	0.08
f - Foam Core Back Support	12.7	728	0.12	0.17
g- PVC exit window	3.2	32	1.4	1.0

[a]CKOV1 [b]CKOV2

← Might reduce Here.

Summary

- G4MICE Software written by Peter Sonnek a good starting point for porting to MAUS.
- Full Analysis of CKOVs most effective with TOF information and vice versa.
- Fundamental problems with the CKOVs needs to be investigated ASAP and will need working G4MICE or MAUS packages.
- Hoping the hardware issues are addresses by CM32.