The HPS hodoscope: Overview and commissioning plans

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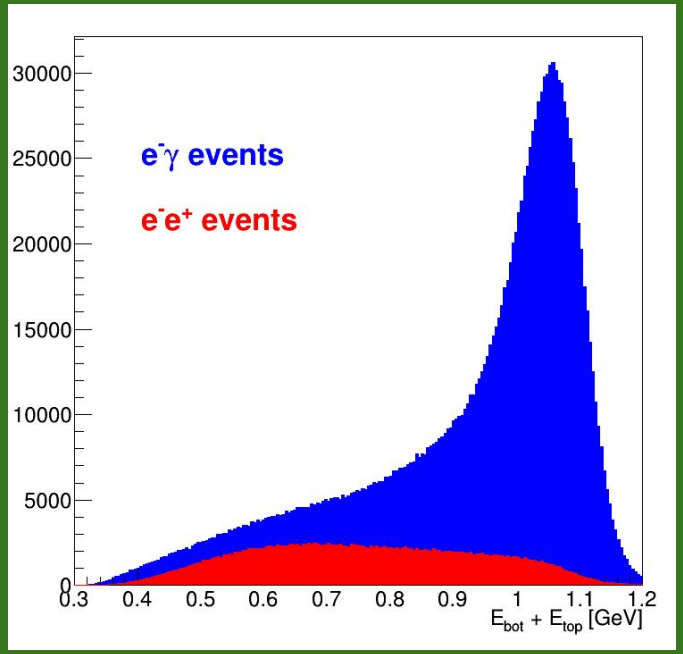
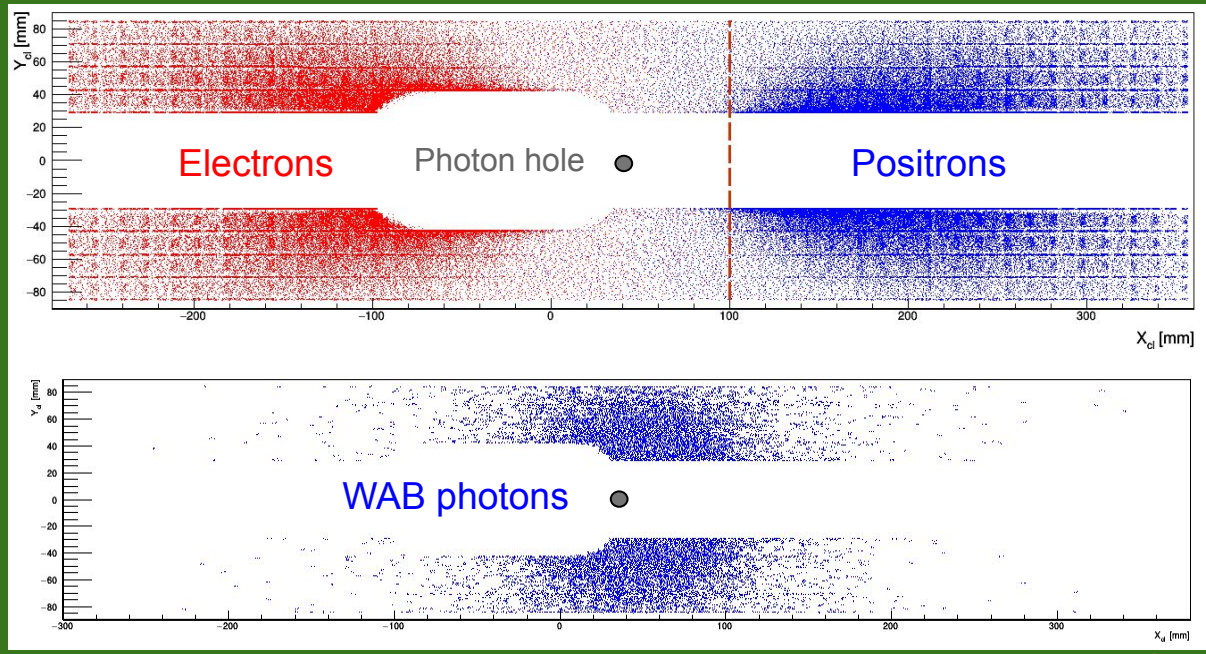
HPS collaboration meeting at JLab, May 29-31, 2019

Main trigger in 2015 and 2016 runs

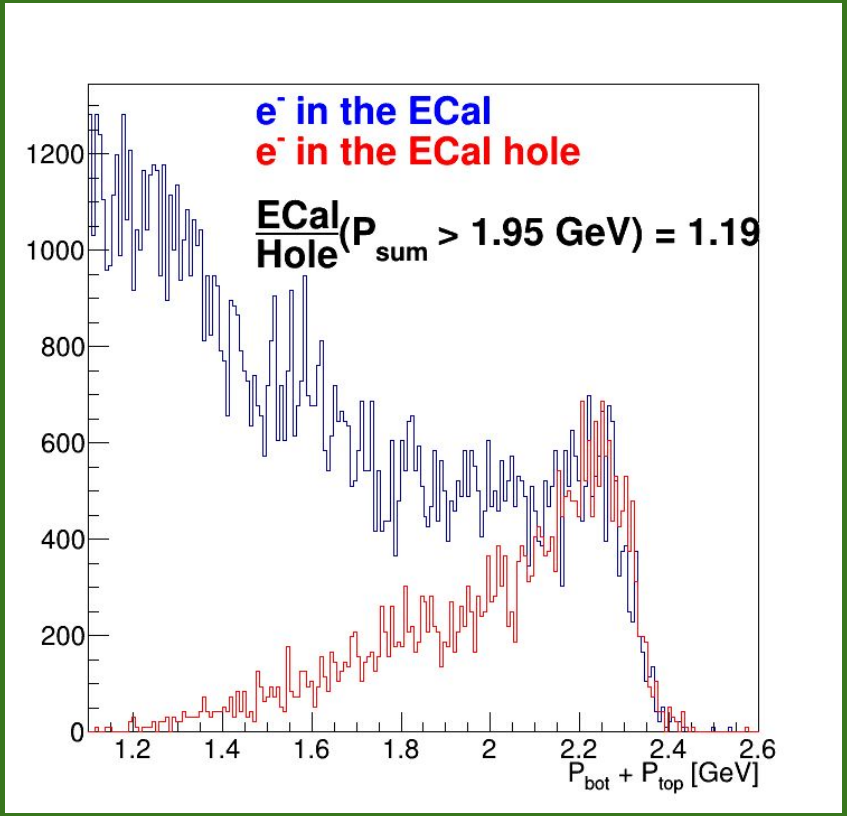
Pair1: Two coincident clusters, one in each detector half, and being coplanar

Tridents, where electrons passes through to the ECal gap, will be lost
Actual e-e+ pairs are only a small fraction of pair1 triggered events, pair1 is dominated by WABs





Events with electron in the ECal hole

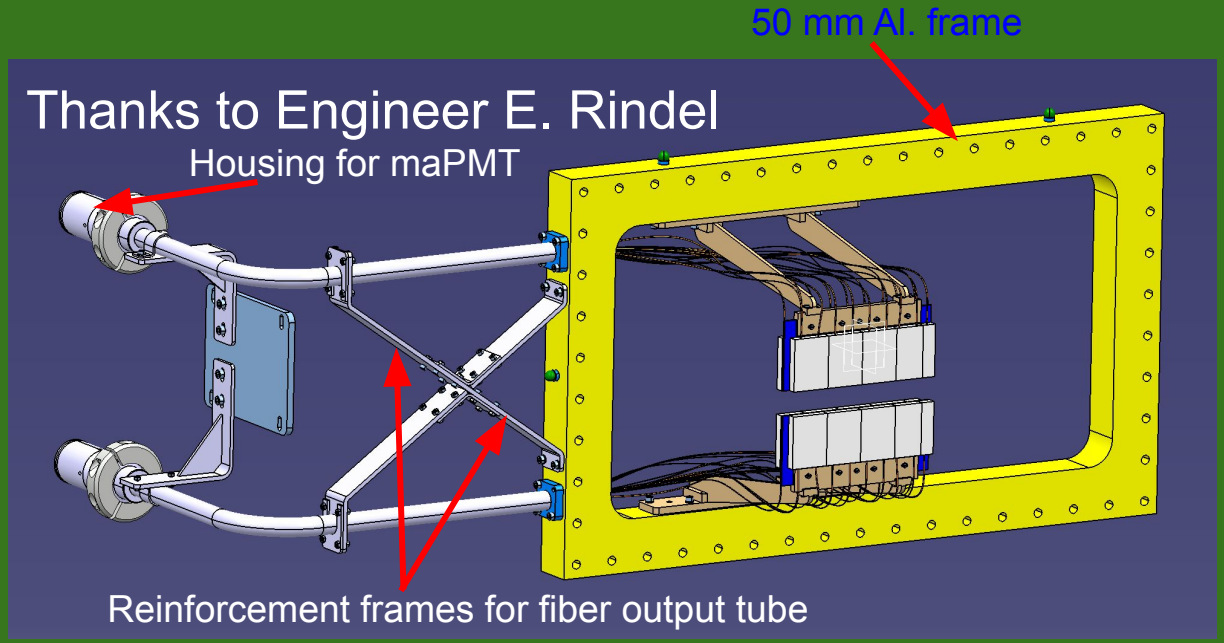


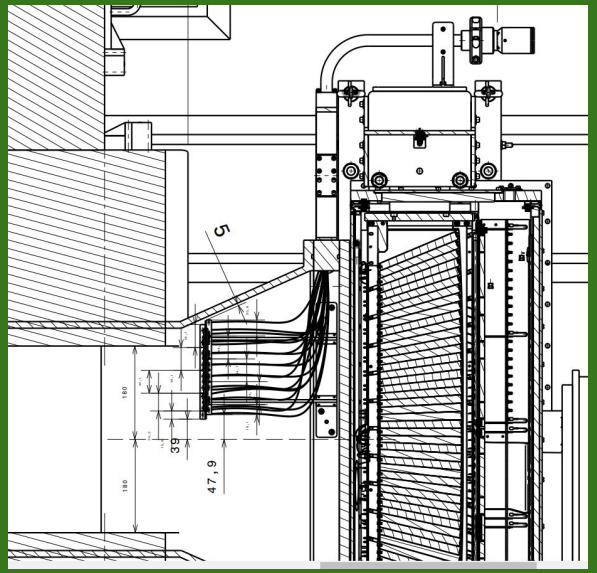
≈ Half of events with Esum >0.85 E_b, have electrons escaped through ECal hole

Triggering only on clusters in the positron side will recover these events, however, just the ECal rate on the positron side is quite large (exceeds DAQ capabilities). This large rate dominated by high energy photons from WABs.

Placing a hodoscope before the Calorimeter will help to suppress photons, and bring the rate down to an acceptable level for the DAQ

Engineering design





Hodo is placed In between the L6 and the ECal

The ECal with ECal vacuum chamber will be moved downstream by 50 mm

Prototyping and tests

All parts were available by Sep 2018

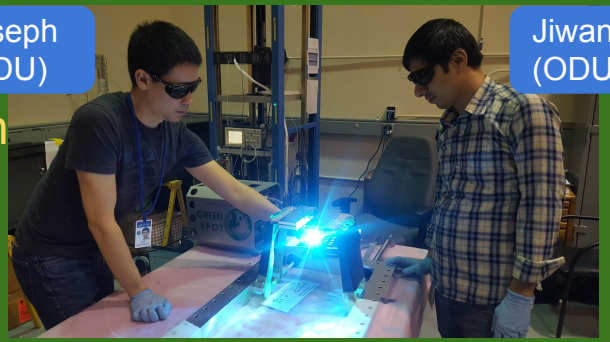
Prototyping and tests started in the fall of 2018

Almost all tests are completed by Jan 2019

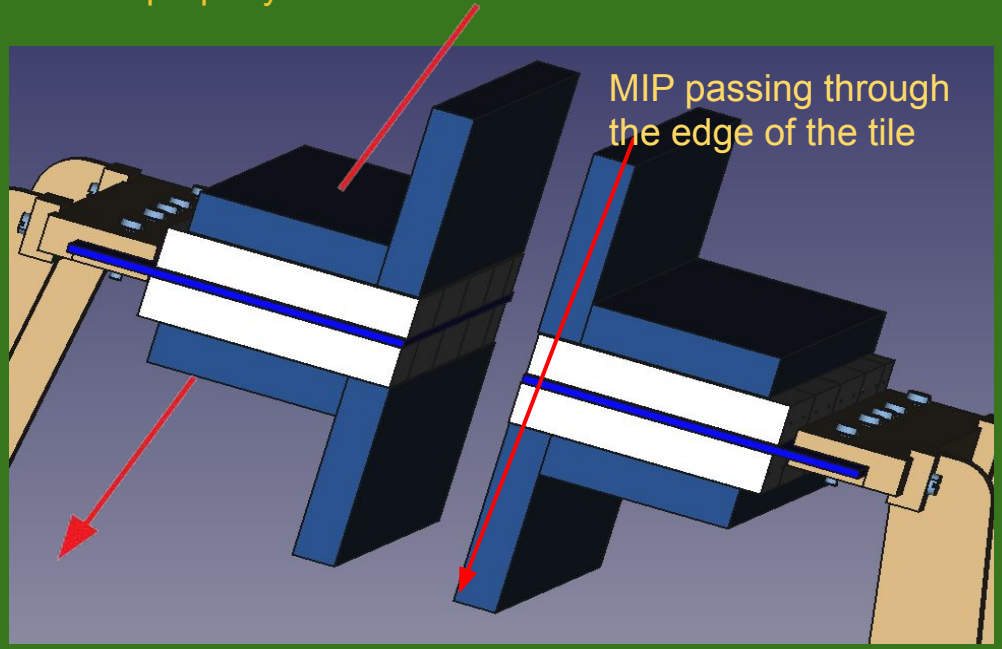
Tiles are polished and wrapped with Aluminized mylar early Feb.

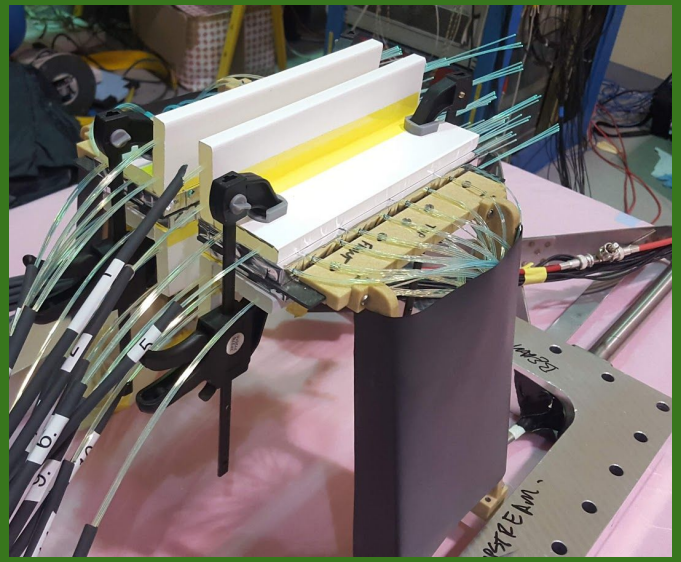
In March, the assembly is finished

Before moving to the Hall, the assembly was tested with cosmic muons



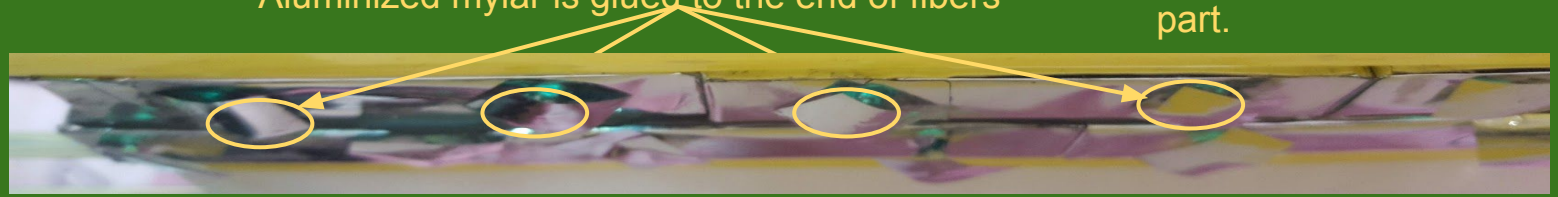
Before moving the Hodoscope to the hall, it is being tested with Cosmic muons to check whether all channels function properly

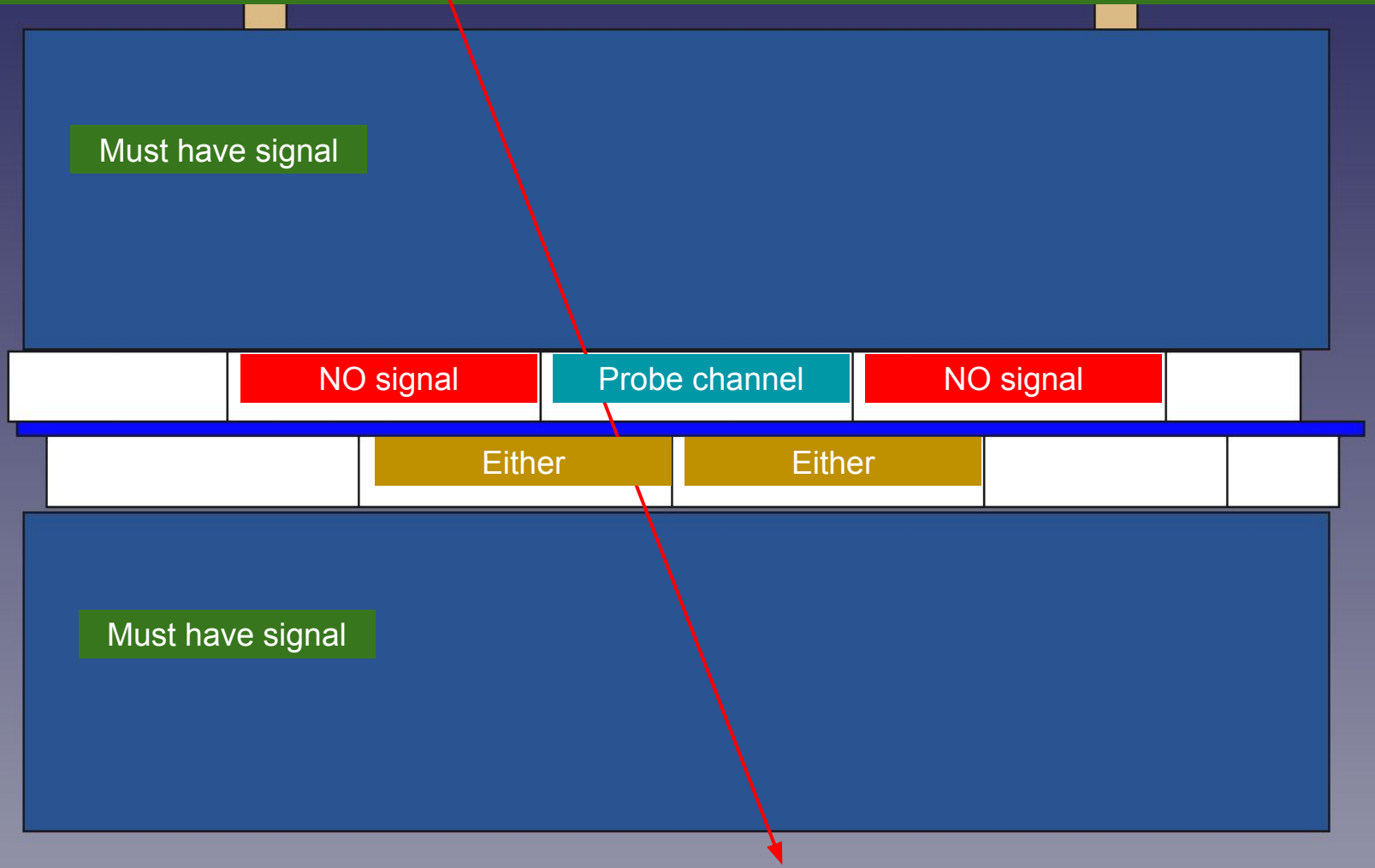




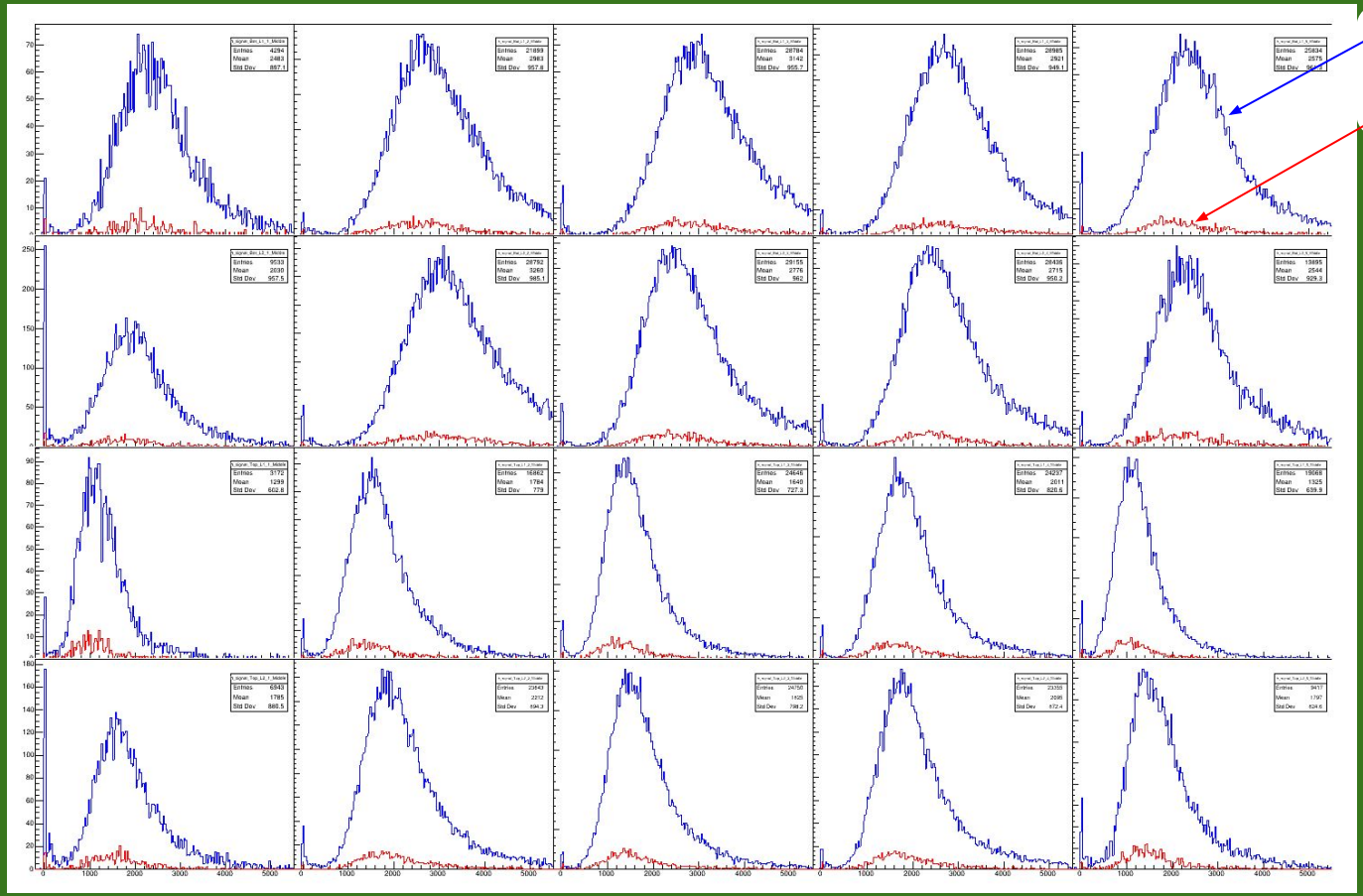
The edge is checked in particular in order, to check if UV light damaged the fiber end part.

Aluminized mylar is glued to the end of fibers




Must have signal
NO signal
Probe channel
NO signal
Either
Either
Must have signal

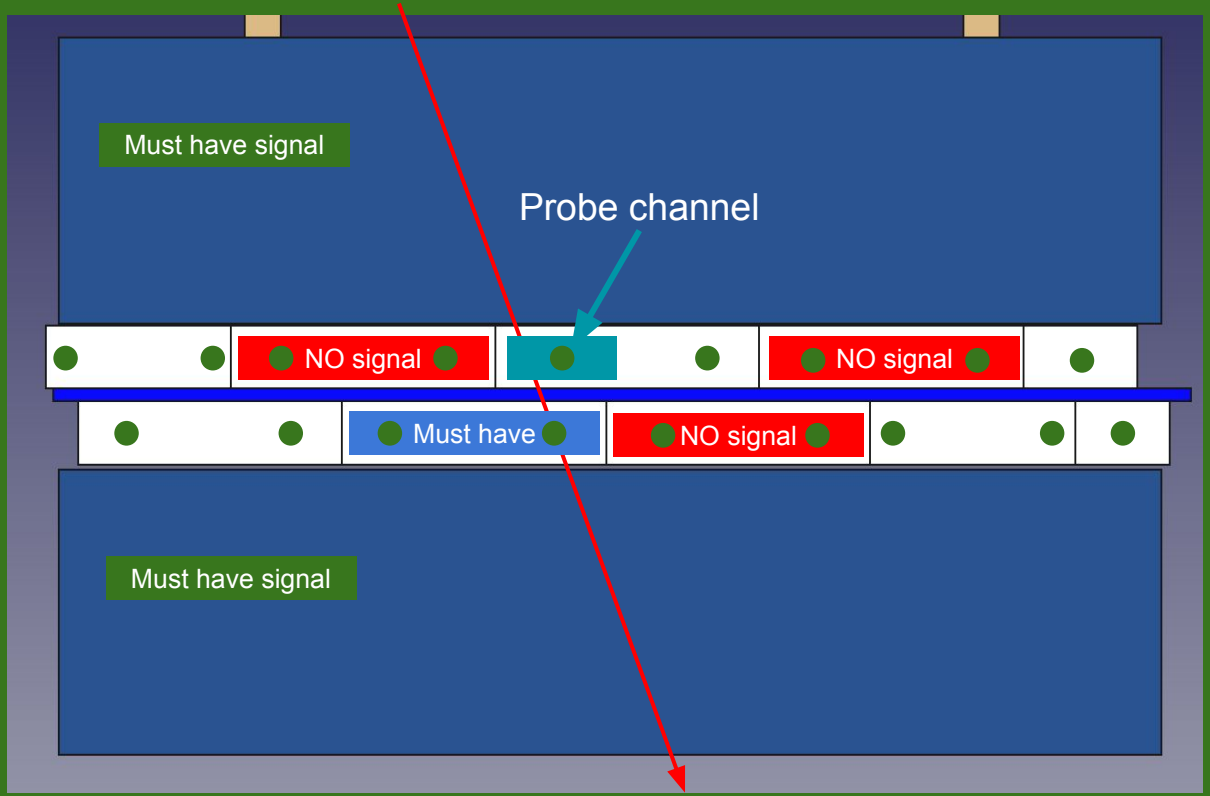
Raw ADC signals from all tiles



Calibration using cosmic runs

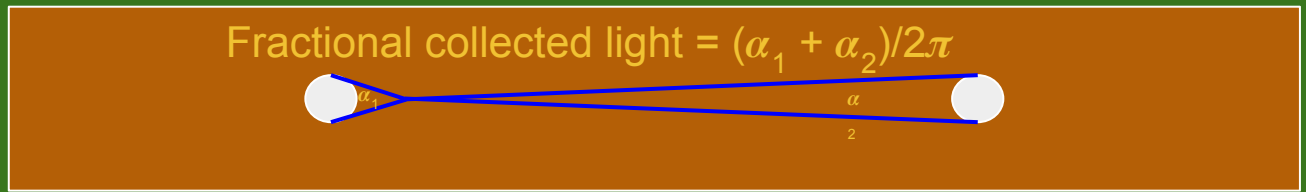
From the trigger point of view it is convenient to put the same threshold cut for all tiles

Gains are chosen such that signal from each distribution to be peaked at 1000 (An almost arbitrary unit)



Light collection as a function of hit position

Depending on the hit position in the tile, the collected light will be different

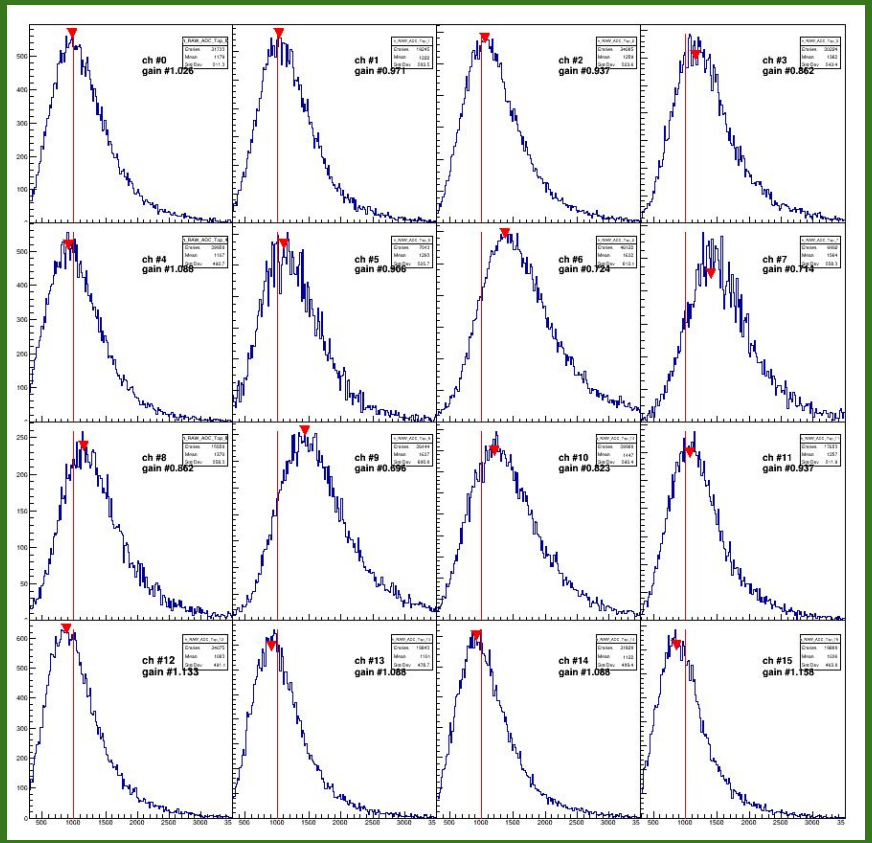


6 out of 10 tiles are read out with 2 PMT channels

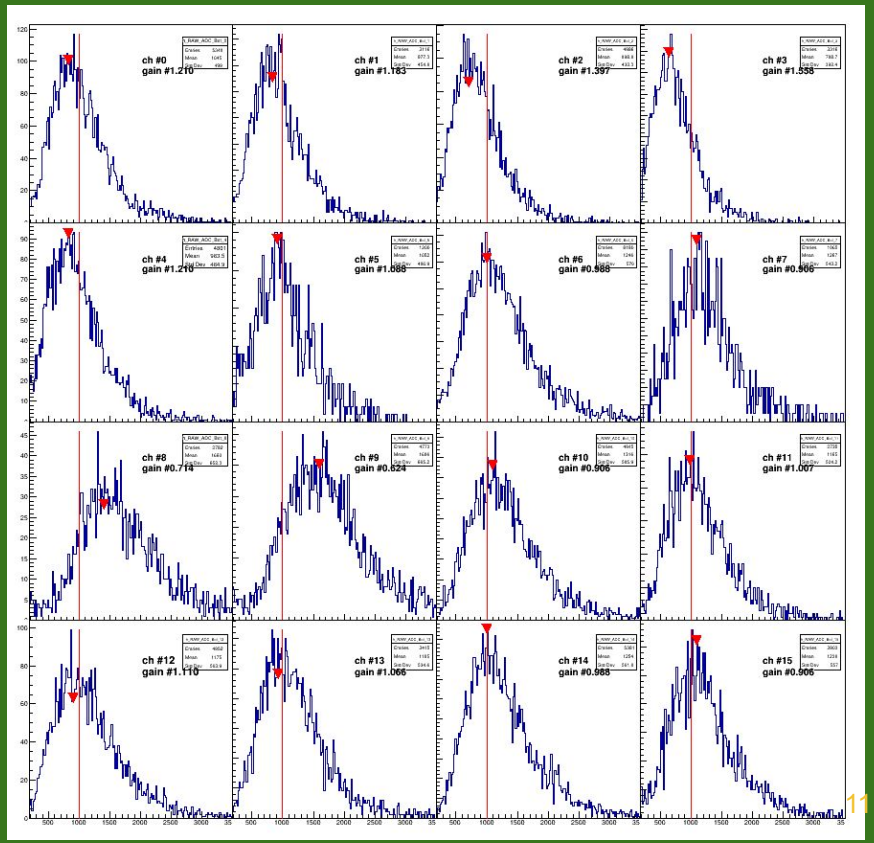
With cosmic setup we selected events that are ‘likely’ to pass close to the corresponding hole

Gains

Top Gains: PMT-SA3857, HV 880V (Run 349)



Bot. Gains: PMT-SA3980, HV 925V (Run 344)

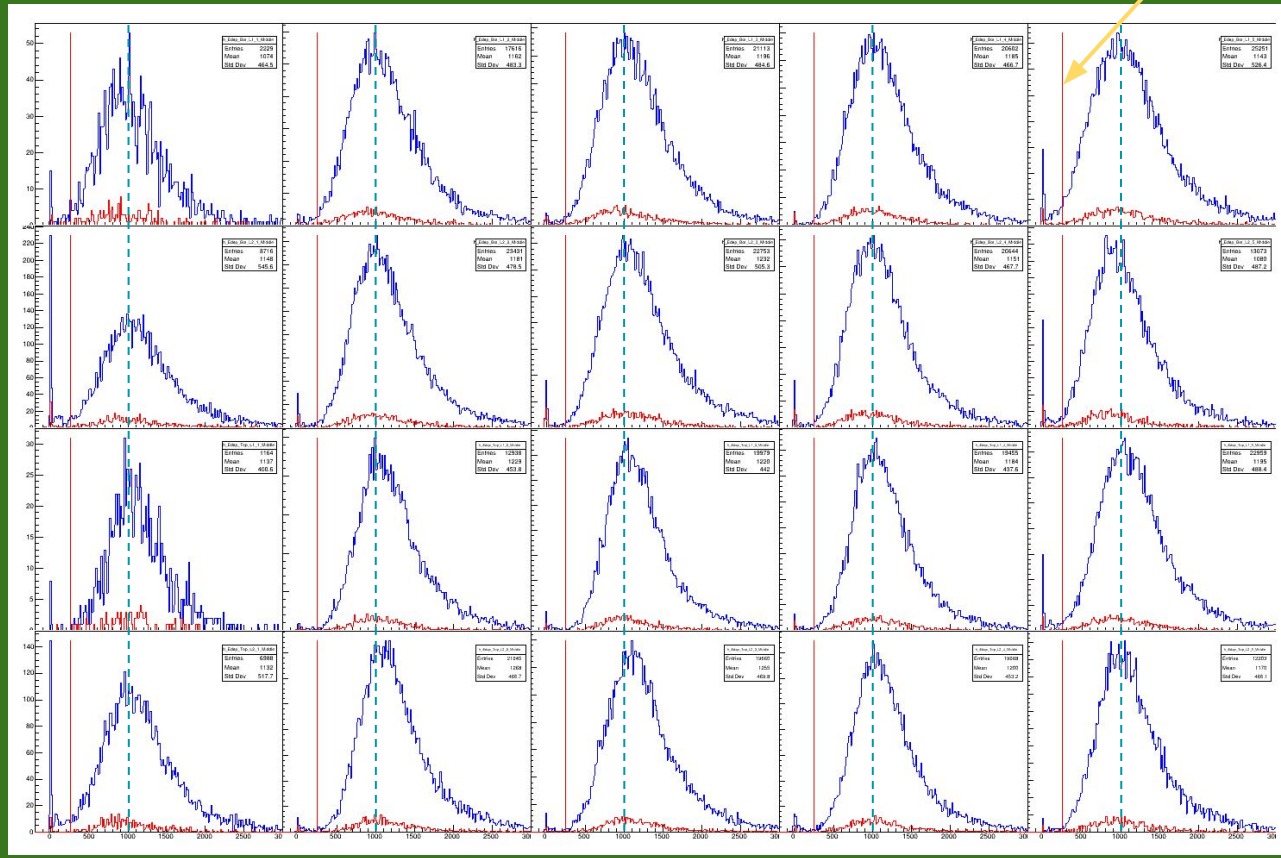


Calibrated signals

Signals in a single channel tiles is scaled by gain

Signals in a two channel tiles is scaled by gain*1.25/2.

Threshold for all tiles is 200



Calibrated signals

Jefferson Lab Alignment Group

Data Transmittal

TO: S. Stepanyan, M. Cook IV, B. Miller, C. Wiggins **DATE:** 25 Apr 2019

FROM: Kelly Tremblay **Checked:** **#:** B1918

DETAILS: data: fiduc\hallb\hps\190318a & calcs\hallb\2019_hps

The Hall B HPS Hodoscope was fiducialized and inspected March 18th, 2019. The ideal data was calculated from the JT file, Beamline_Assy_hps_2019.jt. The found data is from our survey results. The found coordinates were transformed to the designed
The flange points are the interior projected interior corners (not radii). The Ideal and delta values are in the first table and the found data is in the second table.
+z coordinate is from the hall center, +x left is to the straight ahead beam left (same as target), +y is above the beam.

	Design				Deltas [design - found]			
	corner	x[mm]	y[mm]	z[mm]	corner	x[mm]	y[mm]	z[mm]
downstream bottom detector	bot- left	330.20	-74.20	18297.89	bot- left	-0.52	-0.02	-0.03
	bot-right	147.90	-74.20	18297.89	bot-right	-0.19	-0.45	-0.60
	top -left	330.20	-14.20	18297.89	top -left	-0.96	0.18	-0.41
	top - right	147.90	-14.20	18297.89	top - right	-0.72	-0.32	-0.98
downstream top detector	bot- left	330.20	14.20	18297.89	bot- left	0.11	0.80	0.92
	bot -right	147.90	14.20	18297.89	bot -right	0.01	0.82	0.14
	top - left	330.20	74.20	18297.89	top - left	-0.06	0.99	0.45
	top - right	147.90	74.20	18297.89	top - right	0.08	0.89	-0.33
upstream bottom detector	bot - left	324.86	-74.20	18275.89	bot - left	-1.89	-1.01	-0.04
	bot - right	142.56	-74.20	18275.91	bot - right	-2.01	-1.00	-0.44
	top - left	324.86	-14.20	18275.89	top - left	-1.50	-0.95	-0.58
	top - right	142.56	-14.20	18275.89	top - right	-1.70	-0.70	-1.00
upstream top detector	bot - left	324.86	14.00	18275.89	bot - left	-1.53	-0.26	0.63
	bot - right	142.56	14.00	18275.89	bot - right	-1.93	0.48	0.30
	top - left	324.86	74.20	18275.89	top - left	-1.79	-0.03	0.36
	top - right	142.56	74.20	18275.89	top - right	-1.62	0.91	0.02

Flange Data

design flange				Delta [design – found]			
corner	x[mm]	y[mm]	z[mm]	corner	x[mm]	y[mm]	z[mm]
F_bot_bl	425.175	-167.400	18494.891	F_bot_bl	0.06	-0.02	0.07
F_bot_br	-225.175	-167.400	18494.891	F_bot_br	0.02	-0.12	0.01
F_top_bl	425.175	167.400	18494.891	F_top_bl	-0.01	0.03	0.08
F_top_br	-225.175	167.400	18494.891	F_top_br	-0.02	-0.09	0.02

	Found Corner Points			
	found points	x[mm]	y[mm]	z[mm]
downstream bottom detector	bot- left	330.72	-74.18	18297.92
	bot-right	148.09	-73.75	18298.49
	top -left	331.16	-14.38	18298.30
	top - right	148.62	-13.88	18298.87
downstream top detector	bot- left	330.09	13.40	18296.97
	bot -right	147.89	13.38	18297.75
	top - left	330.26	73.21	18297.44
	top - right	147.82	73.31	18298.22
upstream bottom detector	bot - left	326.75	-73.19	18275.93
	bot - right	144.57	-73.20	18276.35
	top - left	326.36	-13.25	18276.47
	top - right	144.26	-13.50	18276.89
upstream top detector	bot - left	326.39	14.26	18275.26
	bot - right	144.49	13.52	18275.59
	top - left	326.65	74.23	18275.54
	top - right	144.18	73.29	18275.87

us face of flange corners

corner	x[mm]	y[mm]	z[mm]
F_bot_bl	425.1169	-167.3836	18494.817
F_bot_br	-225.194	-167.2784	18494.878
F_top_bl	425.1853	167.37237	18494.814
F_top_br	-225.159	167.4896	18494.875

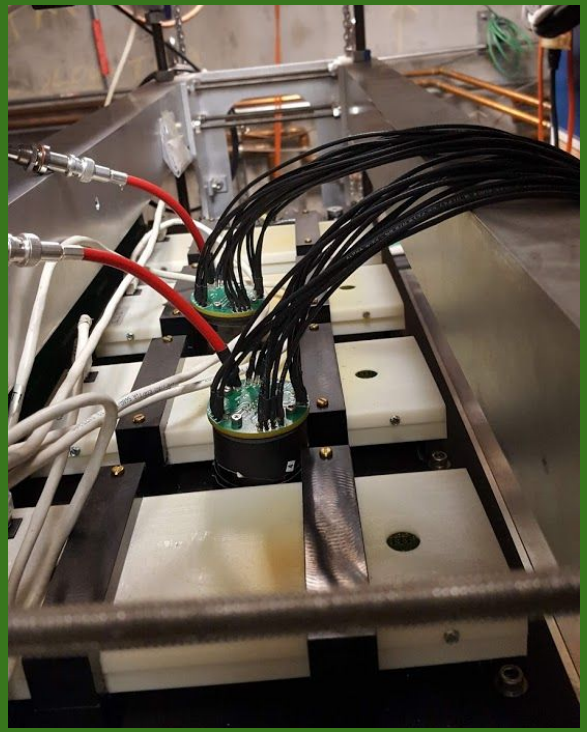
Sub mm deviations from the nominal position

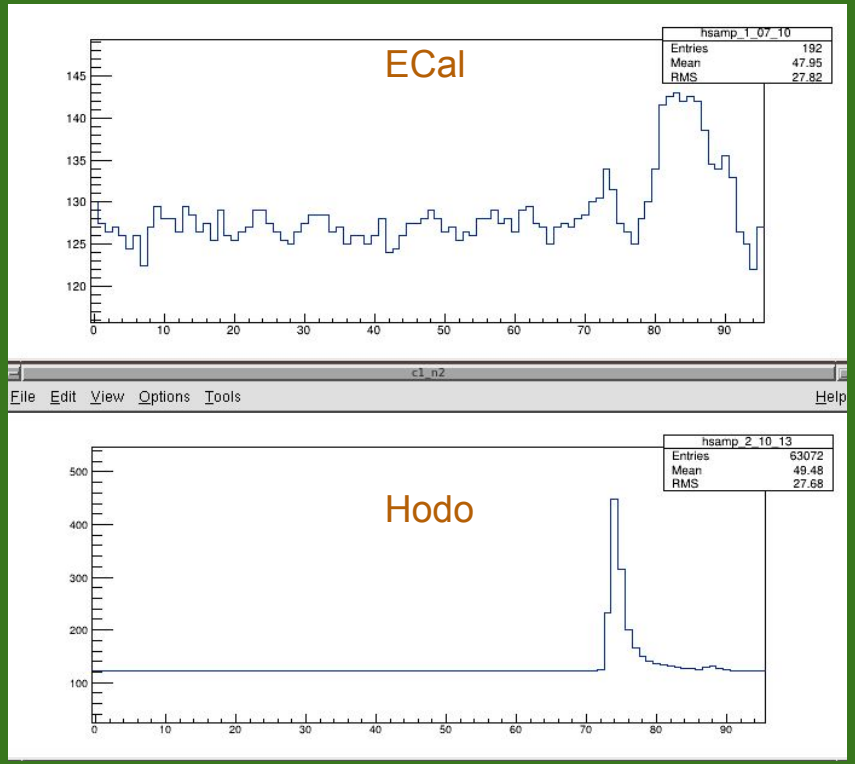
This is OK, values were compared to the old design, where L1 was 2mm to the beam right.

ECal vs Hodo timing

Small Scintillator tiles are coupled to PMTs and placed on to of the ECal to get a preliminary time difference between the Hodo and ECal

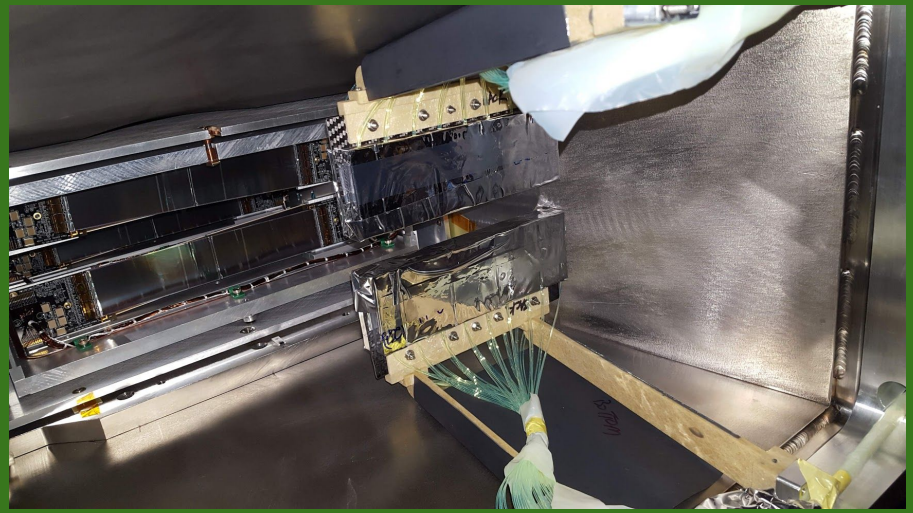
About 20 ns difference between ECal and the Hodo. With fibers this difference will be within 5 ns

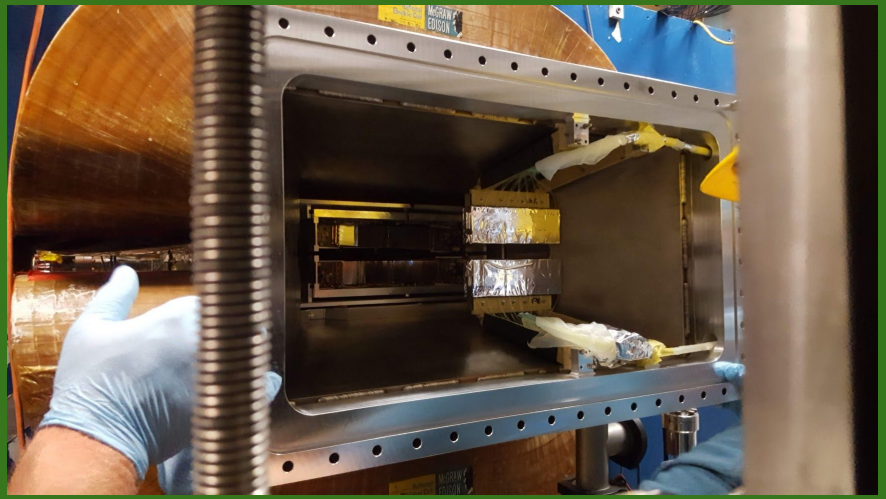




Some pictures of the hodo in the hall

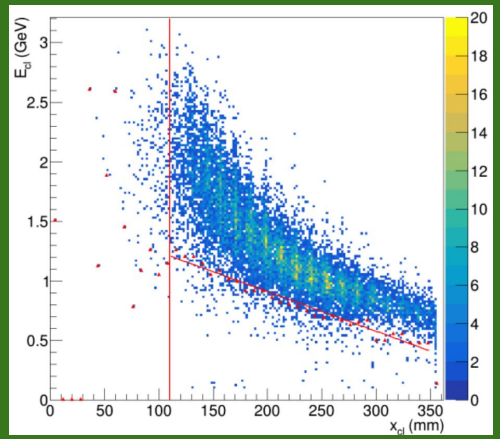
Hodoscope has been moved to the hall on May 21





PMTs and the magnetic shielding will be installed once the work on ECal will be closed
Then The hodoscope will be surveyed

The trigger



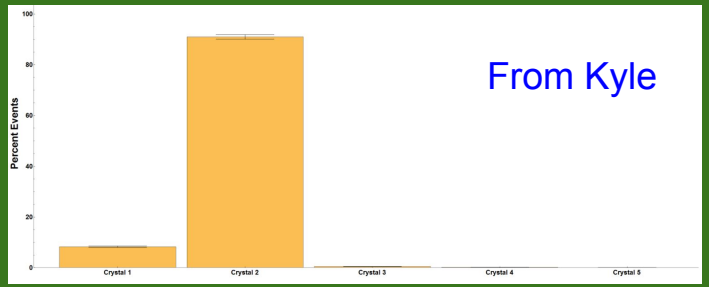
ECal crystal with i_x >= 5

L1 x L2 x ECal

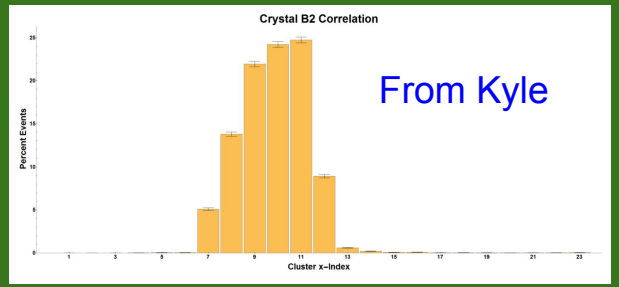
For each L1 Hit there should be L2 hit and ECal cluster in a certain range

Just the ECal itself using the position dependent energy cut, keeps the trigger rate under 20 KHz, keeping more than 90% of tridents.

Hodoscope will in addition help to reduce this rate down



From Kyle



From Kyle

Details in Kyl's talk

Software side

EVIO 2 lcio conversion is done

Reconstruction is almost done

Next step is to add monitoring plots in the ECal-monitoring (Jeremy, after the recon)

Event Display (Jeremy, after the recon)

Comissionning

Hodoscope will not require much commissioning.

- Check signals are in the readout window

- Gains obtained from cosmic should be good enough, Cosmic Muons enter with angles close to the poistron angles
- Three short runs (10-15 minutes) with positron side ECal clusters with different HV settings

- Random trigger run to validate the ECal single cluster trigger

- Trigger with EC single cluster to validate Hodo trigger(s), x dependent ECal and Hodo ⊗ ECal (x dependent)

Summary

Hodoscope trigger is expected to recover event at high ESum that will be lost with pair1 trigger

Assembly of the hodoscope is finished in March

Test setup in EEL building showed good performance of all tiles

Using Cosmic data PMTs are calibrated, gains are obtained for each channel. This is expected to be a good enough for beam too.

Hodoscope itself is surveyed in EEL and final survey will be performed soon in the hall

Hodoscope is now installed in the hall

Software work is ongoing, we expect it to be finished before the run starts