The Hodoscope performance

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Outline

- Initial gain calibration
- Installation
 - Vacuum Issue
- Sensitivity to light:
- HV adjustment
- Gain as a function of the Luminosity and the run number
- Hodoscope Efficiency

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)



Before installation, the Hodoscope was tested in EEL building and for each channel cosmic gains are obtained

Cosmic Gains





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



Note: gains and HV settings were obtained with cosmics: Pretty low rate environment!

Things become quite different when the it was placed under the beam



Initial vacuum check suggested a leak in the adapter nd flange seal

Then we have applied an optical cement, which fixed the leak!





Hodoscope with the beam

With the beam the hodoscope was tripping (though the trip limits was about 5 μ A above idling current)

This high rates was unexpected, simulations didn't show this high rate.

It is probably the photons from walls of vacuum chamber (or any other material) hit fibers.

Quote from H8711 datasheet

<u>The maximum average anode current is defined as 5%</u> <u>of divider current when standard high voltage is</u> <u>applied.</u>



So this apparently forced us to reduce the HV on PMTs, otherwise the anode current goes too high

HV scan

200 I_b [nA]



Target 8μ W

The beam current was rumped up to 220 nA

- This was the max luminosity we were thinking at that time

Chose the highest HV setting, that will not exceed the 5% limit too much.

The Top 800 V, and Bot 740V was chosen

Gain calibration

As soon HVs are set, gains for each PMT channel

Idea is similar to the cosmic calibrations:

Using geometrical matching between positive track, ECal cluster, and a hit in the next layer, we constrained the trajectory of the positive track to pass close to the given fiber



- A Hit in the next layer, that geometrically matched to the probe channel, and absence of a hit in the rest of Hodo channels.
- A positive track
- A cluster in the positron side, that is geometrically matched to the Hodo tile

The "Gain" is defined a number, that brings the MIP peak value to 1000. Note: actual PMT gain is inversely proportional to this "Gains".

After run gain calibrations

From each run, 30 files were cooked: 1st 10, last 10 and middle 10 files

Most of tiles have a lot of statistics, except the most right tiles, where there are very limited tracks are passed through.



Run min	Run max	l beam [l targ [n/	Lumin
10022	10047	100	8	800
10048	10059	200	8	1600
10060	10067	100	8	800
10068	10069	125	8	1000
10070	10104	150	8	1200
10105	10129	150	8	1200
10130	10130	150	4	600
10131	10170	150	8	1200
10171	10185	175	8	1400
10186	10239	150	8	1200
10240	10329	200	8	1600
10330	10358	200	8	1600
10359	10359	100	8	800
10360	10361	55	20	1100
10362	10364	200	8	1600
10365	10368	80	20	1600
10369	10375	100	20	2000
10376	10378	120	20	2400
10379	10407	100	20	2000
10408	10418	110	20	2200
10419	10445	120	20	2400
10446	10463	120	20	2400
10464	10497	100	20	2000
10498	10507	110	20	2200
10508	10511	120	20	2400
10512	10514	110	20	2200
10515	10522	300	8	2400
10523	10524	110	20	2200
10524	10535	200	8	1600
10536	10624	120	20	2400
10625	10652	120	20	2400
10653	10654	80	8	640
10655	10676	120	20	2400
10677	10697	120	20	2400
10698	10719	120	20	2400
10720	10739	120	20	2400
10740	10740	120	20	2400

Run selection

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- Each time the Luminosity was changed, the 1st run was selected
 - If the luminosity didn't change within 2 days, new runs in between are added



Gains for different Runs and Lumins



Reminder: higher values corresponds to lower gain

- Higher Luminosity Higher gains
- Gain drop during the time

We might consider obtaining new PMTs for next runs to compensate the gain drop.

The hodoscope Efficiency



- Events from Single2 trigger
- Cluster in positron side
- Positive track
- Track-Matched with track
- Matching hit in the other Layer of Hodo

The average efficiency is better than 99%

Potential improvements

- Some improvements in the offline reconstruction (relation between cluster and hits)
- Cover fibers with for future runs
- Get New PMTs

Backup slides

ECal Efficiency



Production trigger efficiency

Data with single2 trigger was used (ECal only PDE trigger)

Single3 trigger (The prod. trigger)

- Hit in L1 is above threshold
- Hit in L2 is above threshold
- L1xL2 geom and time matching
- L1xECal_X geom and time matching
- L2xECal_X geom and time matching
- ECal PDE (validated earlier)



Requirements on clusters and tracks

Clusters

- In-time cluster
- E_{cl} < 3 GeV

$$- X_{cl}^{''} > 105$$

Tracks

- P > 0.85 GeV
- chi2/NDF < 5 (to avoid fake tracks)
- Positive charge

Track-Cluster matched

About 2% failed

≈ half of failed events failed " $X_{Hodo} \otimes X_{ECal}$ "

See next slide for these failed events



Inefficiency is 1.3%