

What can we learn from a snapshot of SHMS Rates?

(while it was serving as the hadron arm in C(e,e'p) at 3-pass)

Dave Mack

2/1/18

V2 Corrections in red, in body and below.

I just quickly checked the 5-pass xscaler hodo rates. No big change from 3-pass. The S1X rate is similar, near 1 MHz. The other hodo rates are 10%-20% higher, so the z-dependent fall off of the hodo rates is not as steep. DD said the S/B is expected to be lower at 5-pass, so HODO 3 out of 4 could be dirtier.

Motivation and Overview

In hadron detection, where we often use a 3 out of 4 hodoscope trigger, the triggers can be significantly contaminated with accidental coincidences from soft backgrounds.

This is not an insurmountable problem since we have a large number of offline cuts available. But it does make it harder to find quickly find small signals and to measure the tracking efficiency, especially in the single-arm detection of hadrons.

The SHMS is brand-new, and its bend angle is small, so it's important to see if there are unexpected problems.

The xscalers information on the following slides is from the 3-pass, SHMS setting for the CT experiment. These data should be a low S/B challenge for the SHMS:

- the relatively high Q2 ensures a small QF e+p signal, and
- the combination of thick carbon target, downstream beamline, and a beam current of 50 μA should provide large soft photon and neutron backgrounds.

https://logbooks.jlab.org/entry/3522729

Beam on

SHMS Trigger & Beamline							
S1X	1.02e+06	S1Y	6.22e+05	S2X	4.48e+05	S2Y	2.19e+05
S1XS1Y	1.29e+06	S2XS2Y	5.93e+05	pTREF3	47394.2	AERO	0.00e+00
HCER	2.28e+05	NCER	1.72e+05	EDTM	3.1	PRLO	24433.7
PRHI	9223.5	13/13	0.00e+00	13/14	0.00e+00	13/15	0.00e+00
13/16	0.00e+00	13/17	0.00e+00	13/18	0.00e+00	13/19	0.00e+00
13/20	0.00e+00	13/21	0.00e+00	13/22	0.00e+00	13/23	0.00e+00
13/24	0.00e+00	BCM4A	6.54e+05	BCM4B	3.12e+05	BCM1	4.73e+05
BCM2	4.42e+05	BCM17	1.04e+05	Unser	5.47e+05	1Mhz	9.97e+05

Click channel button for history plot. Click "Show Rates" or "Show Counts"

HELP QUIT Show Rates (Hz) Show Counts

Beam off

I think I can safely ignore these beam off scaler rates. But I noticed:

- S2Y is nice and quiet.
- NCER rate is quite high with beam off.
- **HCER looks quieter . (It was noted in the meeting that both Cerenkovs have 4 pmt's, so the rates are apples to apples.)**

I don't know if this is their usual dark rates, or activation due to the carbon target.

SHMS Trigger & Beamline							
S1X	1859.8	S1Y	1030.0	S2X	1552.8	S2Y	172.6
S1XS1Y	2649.1	S2XS2Y	1682.4	pTREF3	9.3	AERO	0.00e+00
HCER	22704.9	NCER	98416.5	EDTM	3.1	PRLO	87.3
PRHI	52.4	13/13	0.00e+00	13/14	0.00e+00	13/15	0.00e+00
13/16	0.00e+00	13/17	0.00e+00	13/18	0.00e+00	13/19	0.00e+00
13/20	0.00e+00	13/21	0.00e+00	13/22	0.00e+00	13/23	0.00e+00
13/24	0.00e+00	BCM4A	5475.3	BCM4B	5129.4	BCM1	2.50e+05
BCM2	2.50e+05	BCM17	2130.6	Unser	3.50e+05	1Mhz	1.00e+06

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SHMS Trigger

pTRIG1	42572.1	pTRIG2	3848.6	pTRIG3	308.1	pTRIG4	295.0
pTRIG5	0.00e+00	pTRIG6	4.1	12/6	3.1	12/7	0.00e+00
12/8	0.00e+00	12/9	0.00e+00	hTRIG1	295.0	hTRIG2	41.8
hTRIG3	3.1	hTRIG4	0.00e+00	hTRIG5	0.00e+00	hTRIG6	0.00e+00
pSTOF	60716.2	pEL_LO_LO	23496.0	pEL_LO	1524.9	pEL_HI	2631.8
pEL_REAL	3848.6	pEL_CLEAN	308.1	12/22	0.00e+00	12/23	0.00e+00
hSTOF	610.8	hEL_LO_LO	295.0	hEL_LO	16.1	hEL_HI	28.8
hEL_REAL	41.8	hEL_CLEAN	3.1	12/29	0.00e+00	12/30	0.00e+00

Click channel button for history plot. Click "Show Rates" or "Show Counts"

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Show Rates (Hz) Show Counts

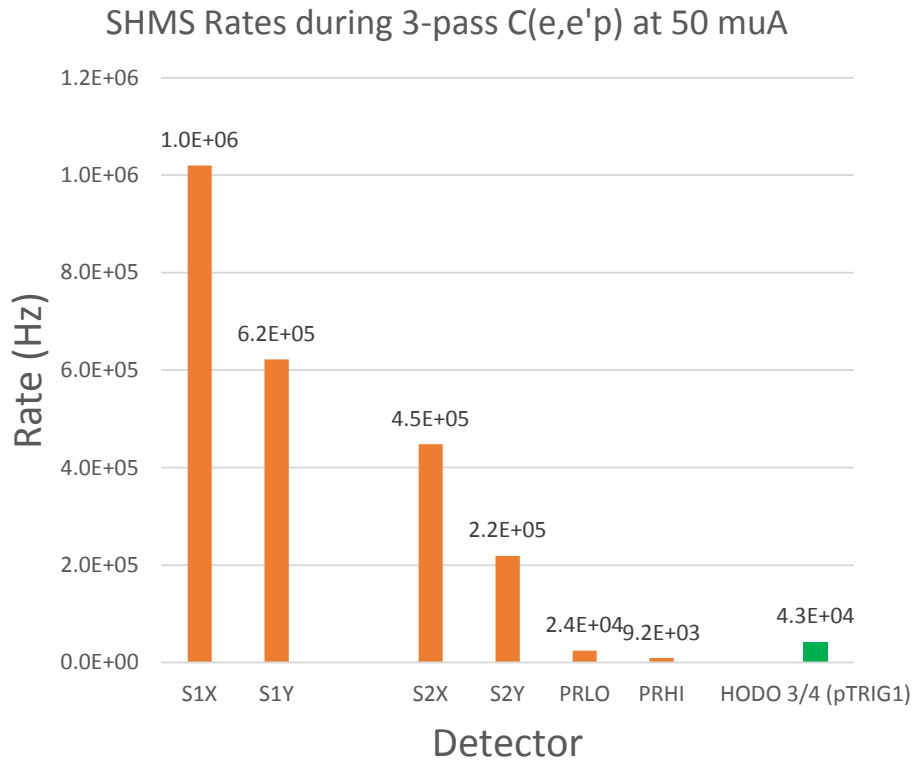
SHMS Trigger

pTRIG1	5.4	pTRIG2	2.7	pTRIG3	0.00e+00	pTRIG4	9.0
pTRIG5	0.00e+00	pTRIG6	2.7	12/6	2.7	12/7	0.00e+00
12/8	0.00e+00	12/9	0.00e+00	hTRIG1	9.0	hTRIG2	3.2
hTRIG3	0.00e+00	hTRIG4	0.00e+00	hTRIG5	0.00e+00	hTRIG6	0.00e+00
pSTOF	7.2	pEL_LO_LO	5.9	pEL_LO	0.00e+00	pEL_HI	2.7
pEL_REAL	2.7	pEL_CLEAN	0.00e+00	12/22	0.00e+00	12/23	0.00e+00
hSTOF	11.3	hEL_LO_LO	9.0	hEL_LO	0.5	hEL_HI	2.7
hEL_REAL	3.2	hEL_CLEAN	0.00e+00	12/29	0.00e+00	12/30	0.00e+00

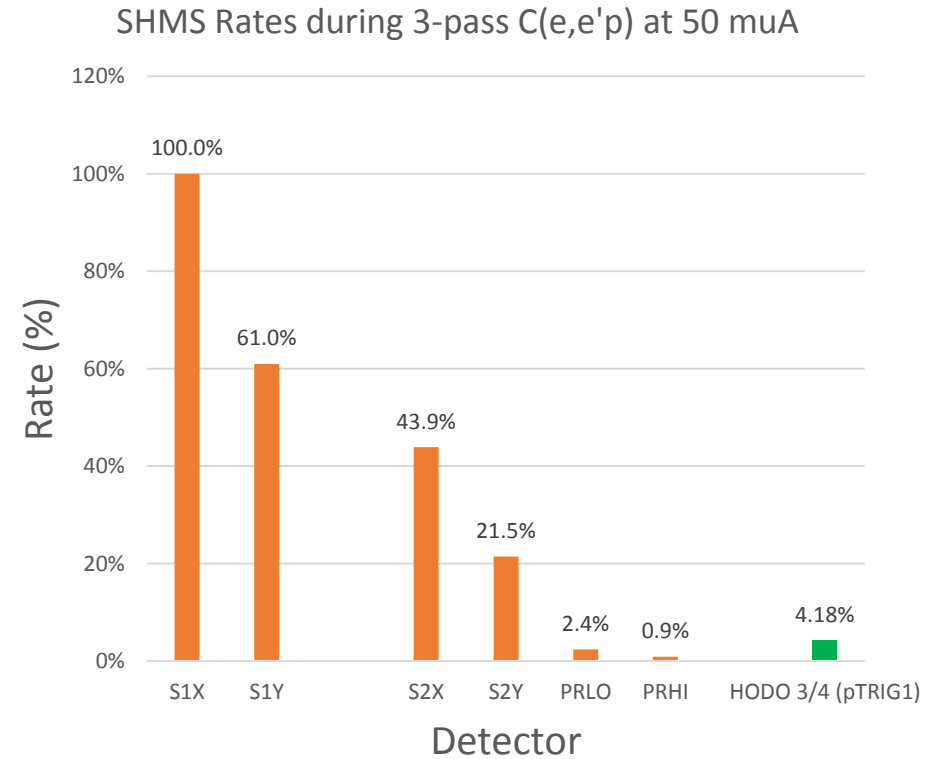
Click channel button for history plot. Click "Show Rates" or "Show Counts"

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Show Rates (Hz) Show Counts



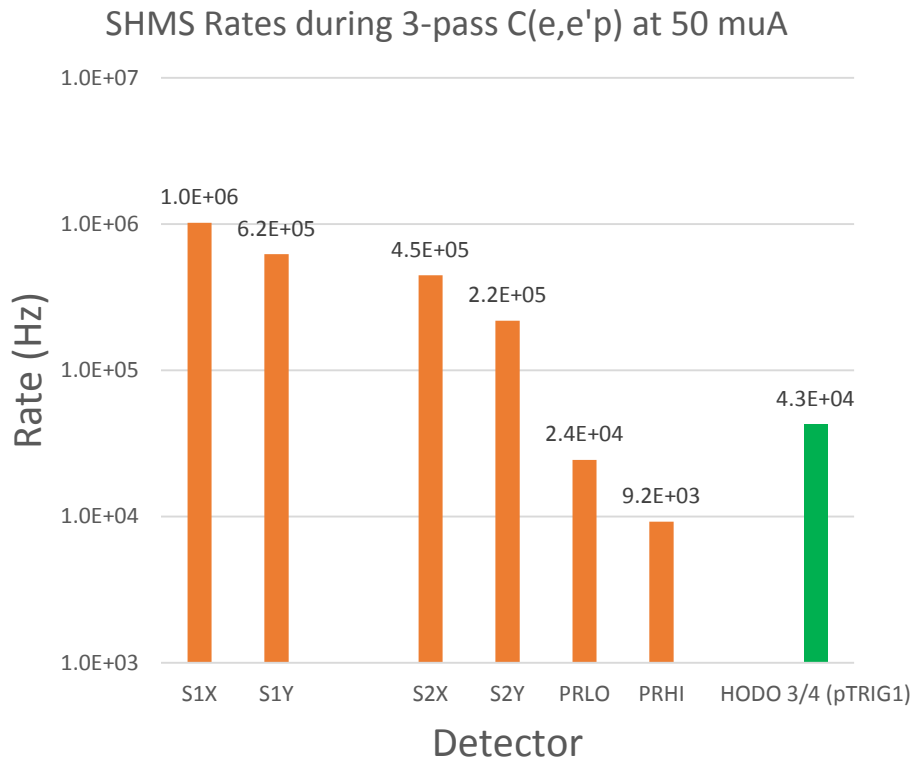
Same plot as on left, but expressed as percentages of S1X rate:



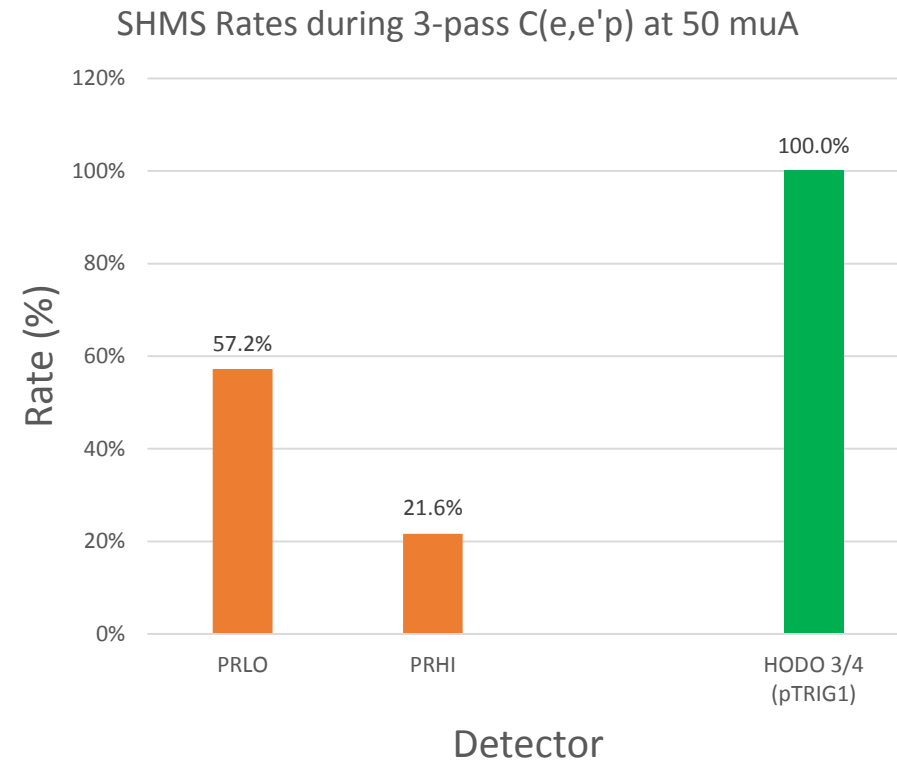
Takeaway:

- The S1X rate was ~ 1 MHz .
- Most of the hodoscope paddle rate is background (ie, it is 0.5 to 1.5 orders of magnitude larger than the HODO 3 out of 4 rate).
- The hodo background drops as one gets away from the dipole exit.
- The above is not completely unexpected, but the steep increase toward S1X is a surprise. It raises questions S1X pmt lifetime and whether we'll be making significant corrections for electronic deadtime.

Same plot on a log scale to emphasize the lower and cleaner rates.



The lower and cleaner rates, normalized to the HODO 3 out of 4 rate.



Takeaway:

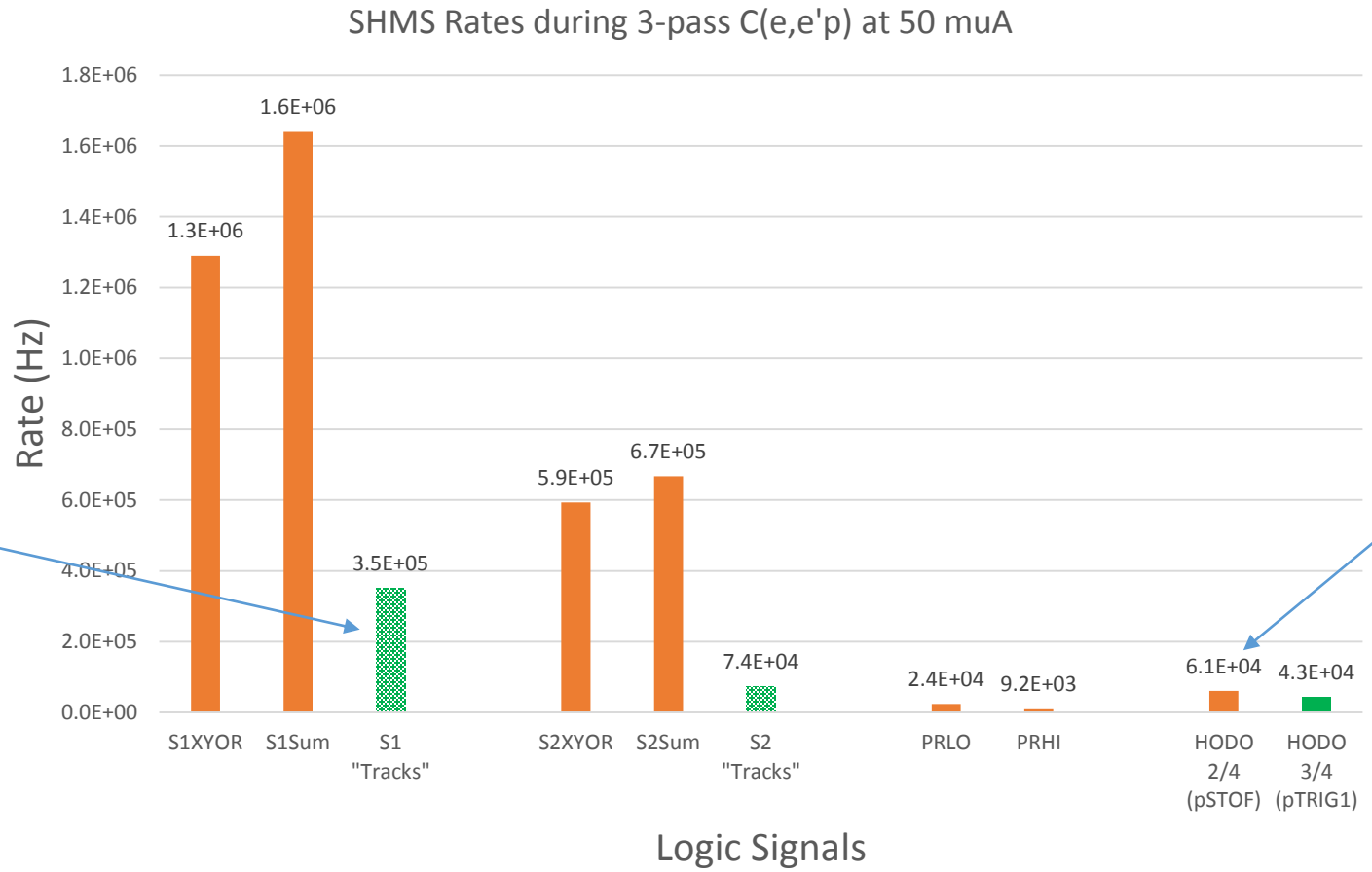
- The HODO 3 out of 4 rate is not far from the sum of PRLO and PRHI. (Remember, these tracks are mostly pi+ and protons, and there may still be some accidentals in the hodo trigger.)

An optimistic interpretation of the above is:

- The HODO 3 out of 4 is a not-too-dirty estimate of the rate of tracks in the acceptance, and
- low threshold calorimeter information is efficient enough to use in a robust, single-arm wire chamber efficiency for hadrons.

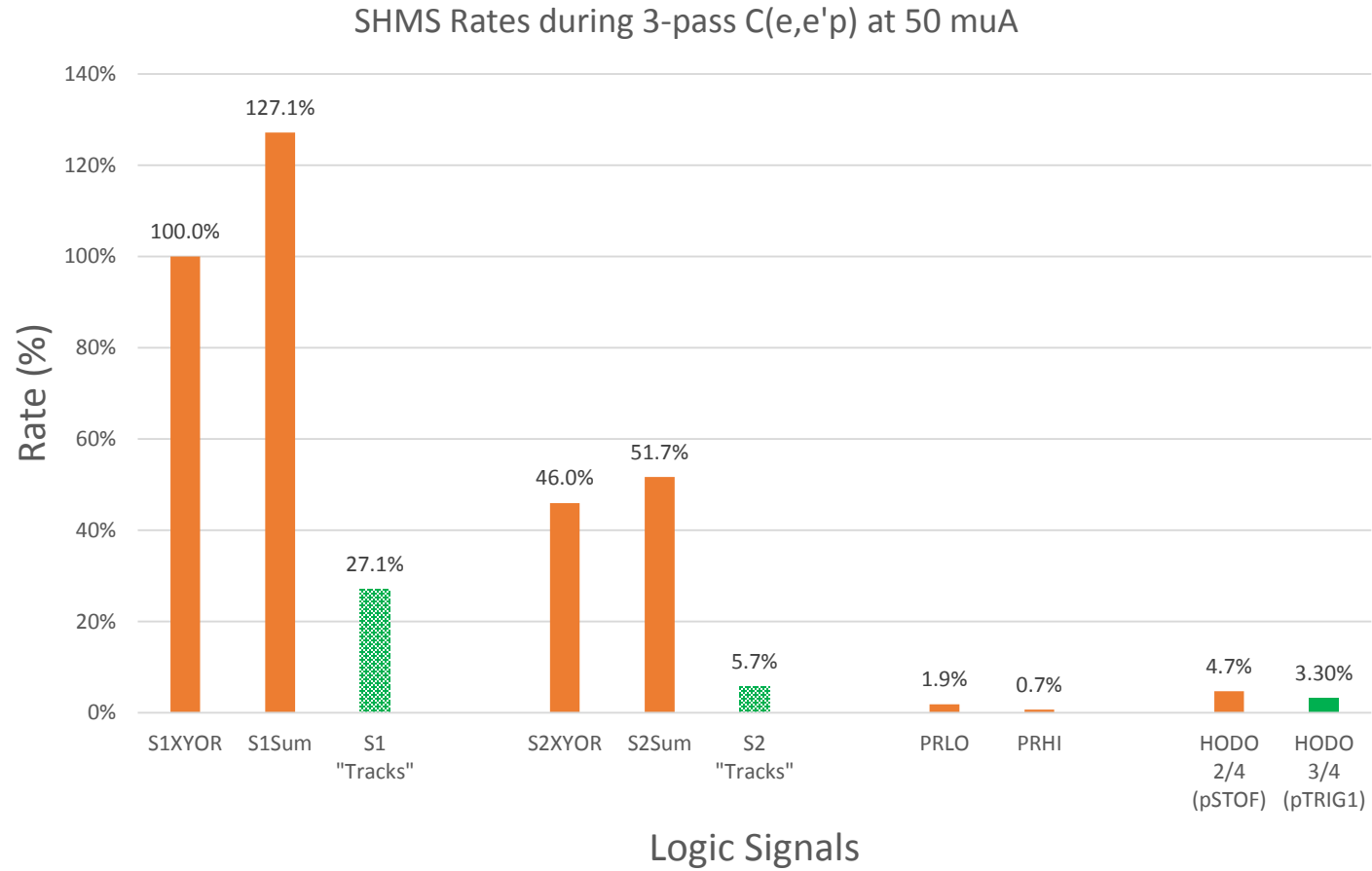
Now emphasizing more of the logical signals:

I infer a local track rate from $(S1X+S1Y) - (S1X.or.S1Y)$, etc.

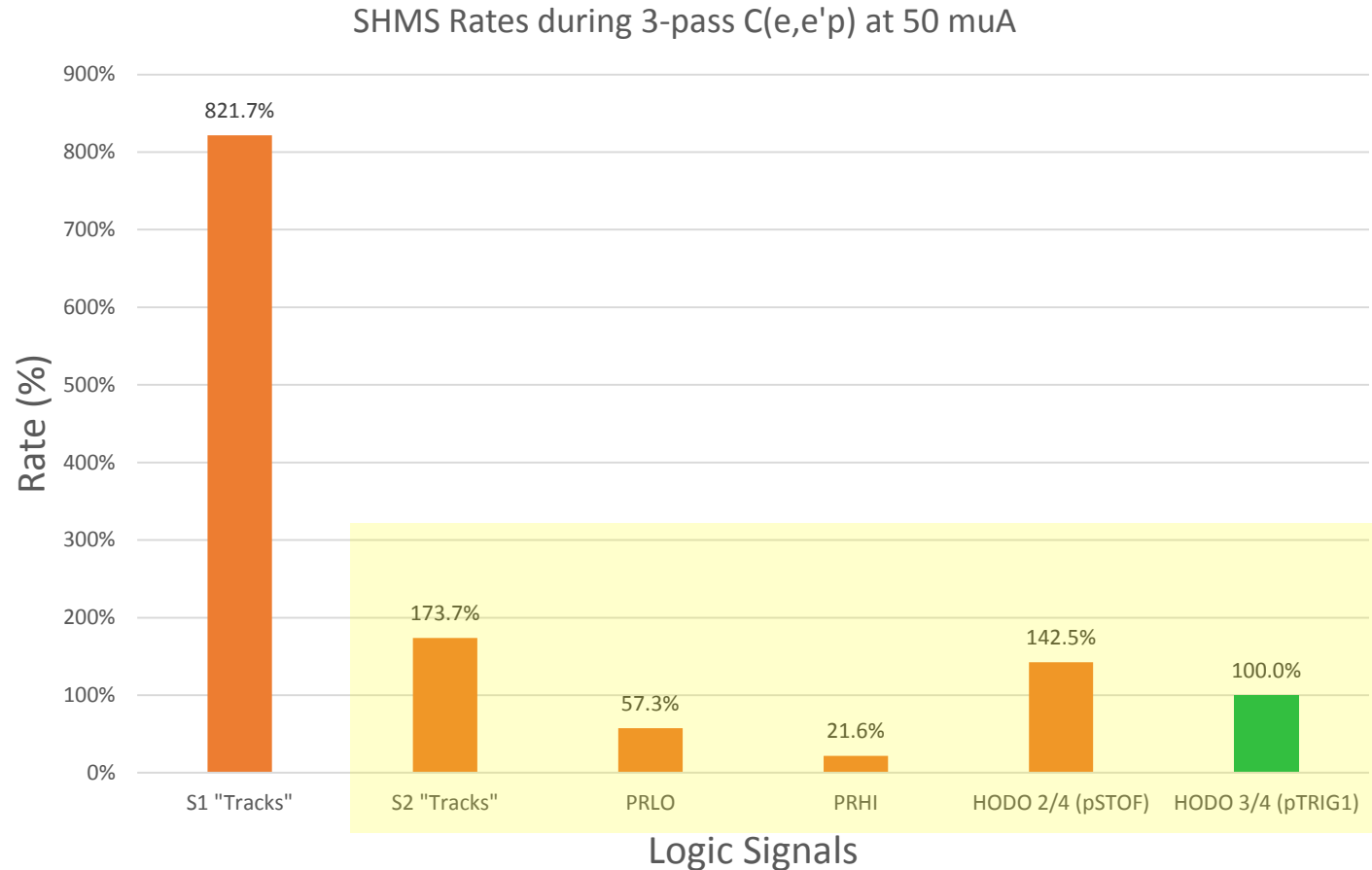


I added HODO 2 out of 4.

Same plot as on previous page, but normalized to S1X.or.S1Y rate.

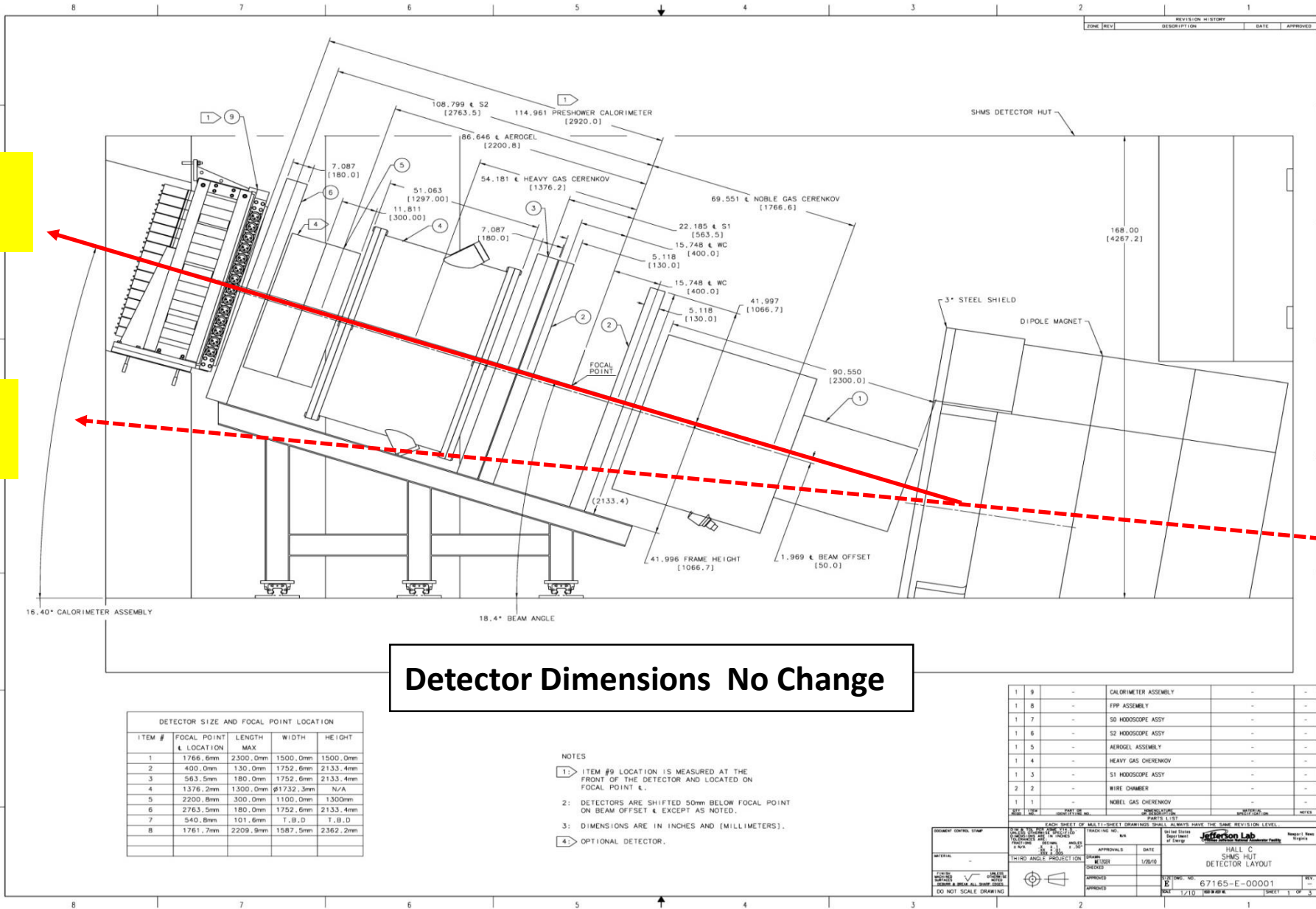


Emphasizing the rates naively with the potential to be associated with a good track:



Takeaway:

- Most of the inferred track rate in S1 doesn't make it to S2. Either the bkg tracks in the S1 region are too soft, or too large an angle.
- By contrast, the majority of the inferred track rate at S2 does show up in the HODO triggers. They are mostly in the acceptance, and clearly hard enough to fire at least one S1 counter.
- The HODO 2 out of 4 looks promising: its rate is only ~40% larger than the 3 out of 4.
- Without additional cuts on HODO 3 out of 4, I would conservatively assume it has O(10)% accidentals.



Good tracks

Gamma Beam?

Detector Dimensions No Change

DETECTOR SIZE AND FOCAL POINT LOCATION				
ITEM #	FOCAL POINT & LOCATION	LENGTH MAX	WIDTH	HEIGHT
1	1766.6mm	2300.0mm	1500.0mm	1500.0mm
2	400.0mm	130.0mm	1752.6mm	2133.4mm
3	563.5mm	180.0mm	1752.6mm	2133.4mm
4	1376.2mm	1300.0mm	617.52.3mm	N/A
5	2200.8mm	300.0mm	1100.0mm	1300.0mm
6	2763.5mm	180.0mm	1752.6mm	2133.4mm
7	540.8mm	101.6mm	T.B.D	T.B.D
8	1761.7mm	2209.9mm	1587.5mm	2362.2mm

- NOTES
- 1) ITEM #9 LOCATION IS MEASURED AT THE FRONT OF THE DETECTOR AND LOCATED ON FOCAL POINT &.
 - 2) DETECTORS ARE SHIFTED 50mm BELOW FOCAL POINT ON BEAM OFFSET & EXCEPT AS NOTED.
 - 3) DIMENSIONS ARE IN INCHES AND (MILLIMETERS).
 - 4) OPTIONAL DETECTOR.

REV	DATE	DESCRIPTION	BY	CHKD
1	9	CALORIMETER ASSEMBLY	-	-
1	8	FWP ASSEMBLY	-	-
1	7	S0 HODOSCOPE ASSY	-	-
1	6	S2 HODOSCOPE ASSY	-	-
1	5	AEROGEL ASSEMBLY	-	-
1	4	HEAVY GAS CERENKOV	-	-
1	3	S1 HODOSCOPE ASSY	-	-
1	2	WIRE CHAMBER	-	-
1	1	NOBLE GAS CERENKOV	-	-

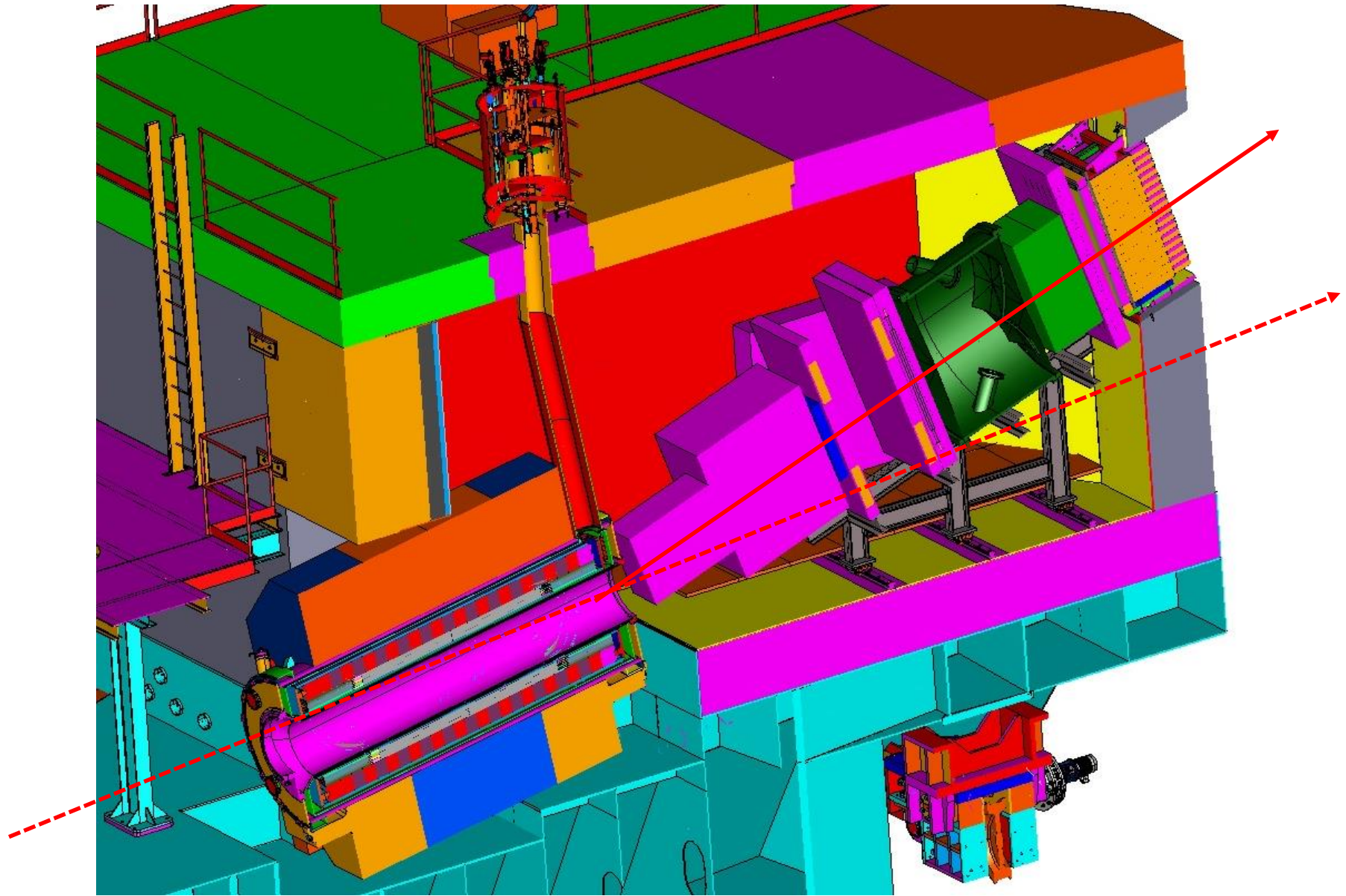
PROJECT CONTROL STAMP

DATE: 10/20/10
 DRAWN BY: J. J. J. J.
 CHECKED BY: J. J. J. J.
 APPROVED BY: J. J. J. J.

REVISION NO. 67165-E-00001

DATE: 1/2/10

SHEET 1 OF 3



Summary

Hodo rates were $O(1)$ MHz near the SHMS dipole exit. The background appears to be a soft and/or highly angled.

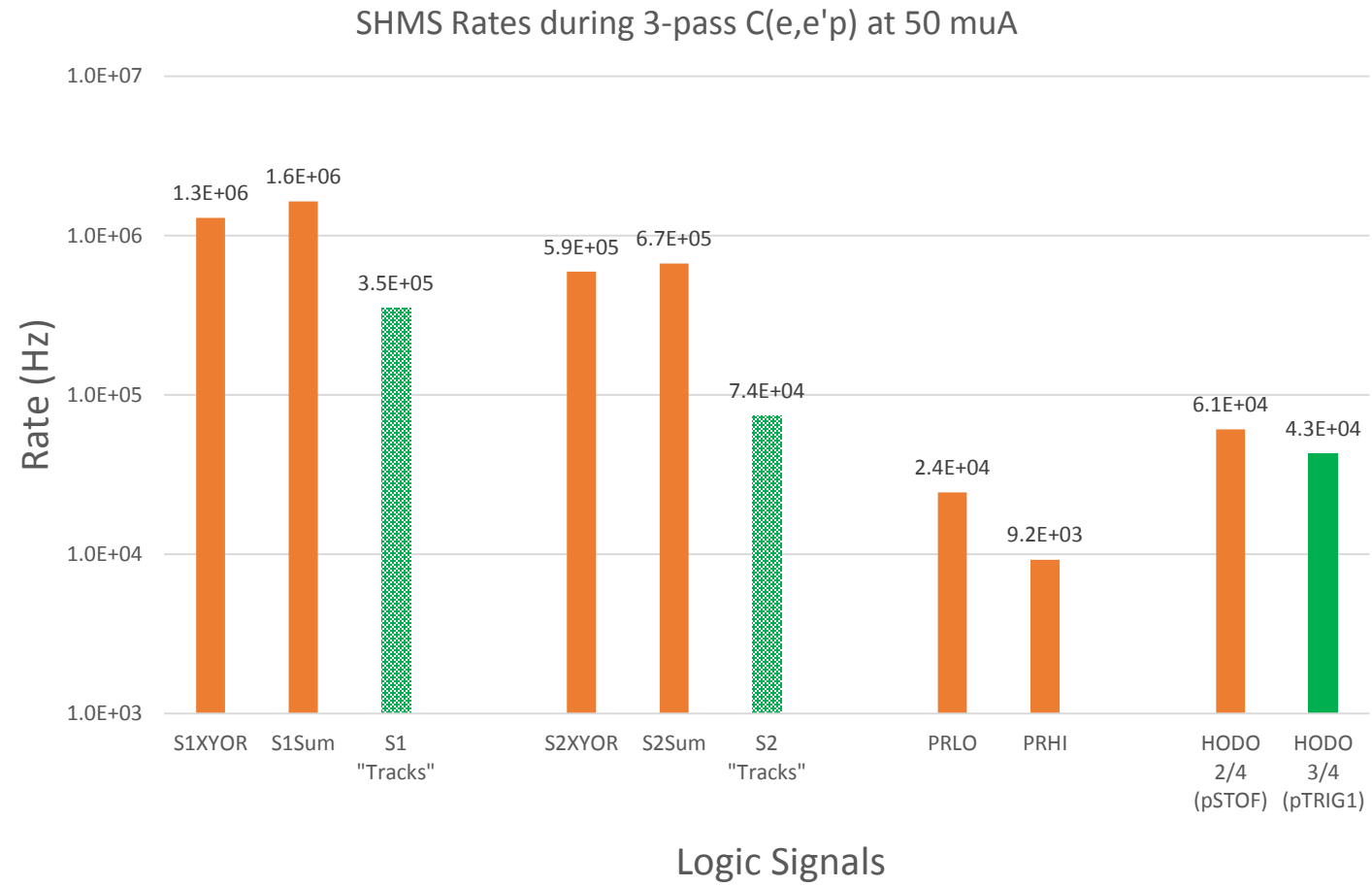
Only roughly 5% of the rate in S1 is due to tracks in the acceptance. This is actually not so unusual. What is surprising is how the background grows exponentially as one draws near the dipole exit.

We need to think about whether we're OK wrt electronic deadtime and PMT lifetime in S1.

It looks like there's often enough energy in the calorimeter from a typical hadron (eg, in PRLO) to help clean up the HODO 3 out of 4 triggers to help determine an accurate tracking efficiency. (A loose beta cut could should also help remove uncorrelated hits in the hodoscopes.) Just remember: we can't use cut quantities that use SHMS wire chamber information.

backups

Log scale



I didn't bother to histograms rates for individual paddles. The rate varies only a factor of ~2.5 from the super-elastic(?) side of S1 on the bottom (eg, phod1x1+) to the inelastic side on the top (phod1x13+).

1X | 1Y | 2X | 2Y | Trigger | Trigger | Trigger

SHMS Hodoscope Plane 1X

phod1x1+	27335.5	phod1x2+	48545.5	phod1x3+	52163.5	phod1x4+	52919.8
phod1x5+	69664.0	phod1x6+	69067.8	phod1x7+	66679.8	phod1x8+	66632.2
phod1x9+	67165.0	phod1x10+	62047.5	phod1x11+	68363.8	phod1x12+	71328.8
phod1x13+	51381.8	6/11	13.2	6/14	3.0	6/15	3.0
phod1x1-	30775.8	phod1x2-	56121.8	phod1x3-	59874.5	phod1x4-	64492.0
phod1x5-	72023.2	phod1x6-	69708.2	phod1x7-	65377.8	phod1x8-	64456.5
phod1x9-	65911.0	phod1x10-	62293.2	phod1x11-	67968.8	phod1x12-	69325.2
phod1x13-	51149.8	6/27	3.0	6/29	3.0	6/31	3.0

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 Show Rates (Hz)
 Show Counts