ORR Meeting: Hodoscope & NIM Trigger Subsystem

SpinQuest/E1039 Collaboration

April 17, 2023

Hodoscope & NIM Trigger Subsystem

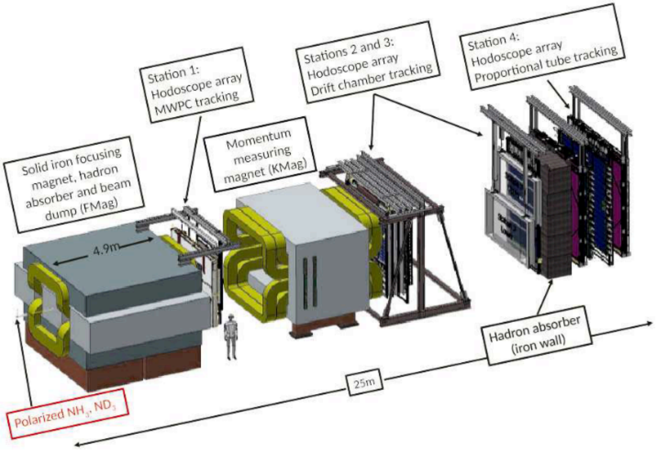


Figure 1: SpinQuest/E1039 spectrometer.

- We have four hodoscope stations in the SpinQuest/E1039 spectrometer.
- We name them as `H1, H2, H3, H4`.

Hodoscope & NIM Trigger Subsystem

- We are currently using five NIM trigger system for cosmic ray tracking.

```
NIM1: a 4 fold trigger -> H1 and H2 and H3 and H4
NIM2: a 2 fold trigger -> H1 and H2
NIM3: a random trigger
NIM4: a 2 fold trigger -> H2 and H4
MATRIX5: a 2 fold trigger -> (H1 and H2) or (H2 and H4)
```

- Timing adjustment in `MATRIX5` is reverse beam-like.
- RF timing is included in `NIM1`, `NIM2` and `NIM4` triggers.

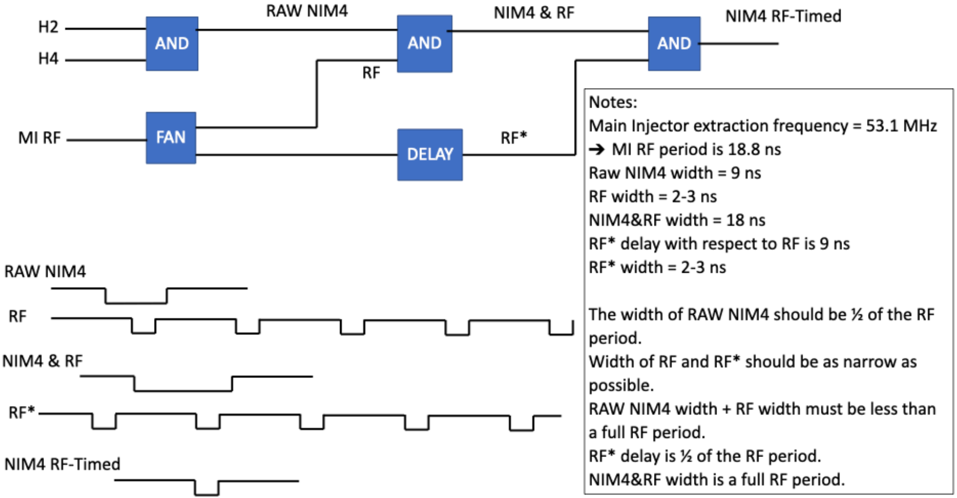


Figure 2: Trigger logic diagram used for RF timed trigger. Credit S. Pate.

Hardware and Electronics

- We are currently maintaining a 20% of the spare `NIM/CAMAC` modules for beam time.
- We have setup a test bench for electronic module testing.

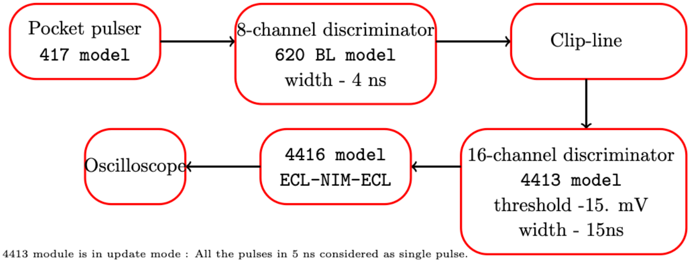
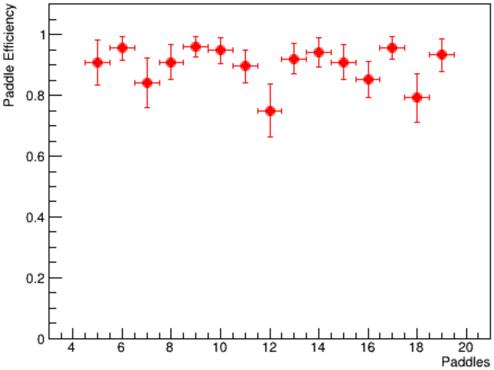


Figure 3: Block diagram of the test bench set up.

Hodoscope Efficiencies

- We use `NIM2` and `NIM4` triggers to calculate the hodoscope efficiencies.
- We use runs taken from 04-03-2023 to 04-09-2023 days.

Hodoscope Efficiencies



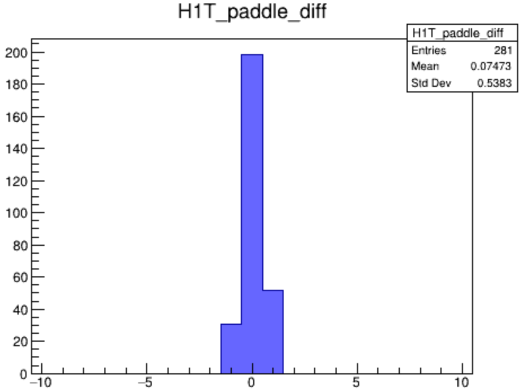


Figure 4: H1T paddle efficiency.

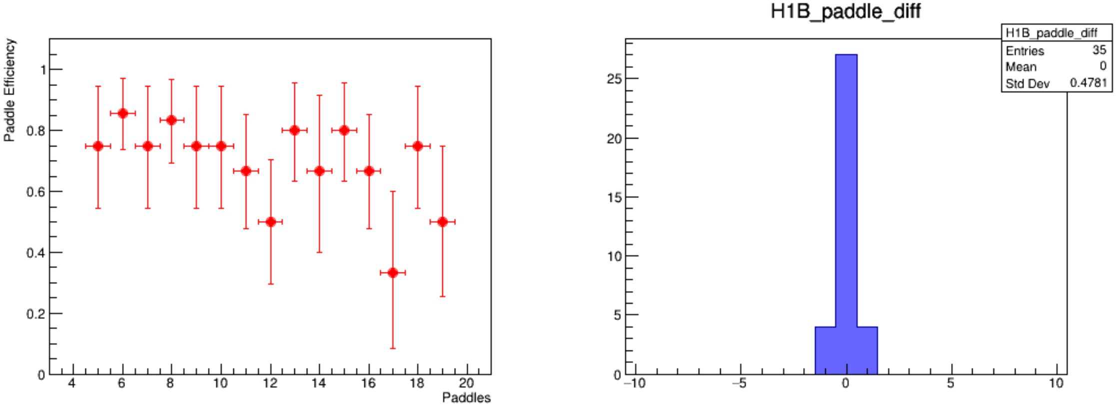
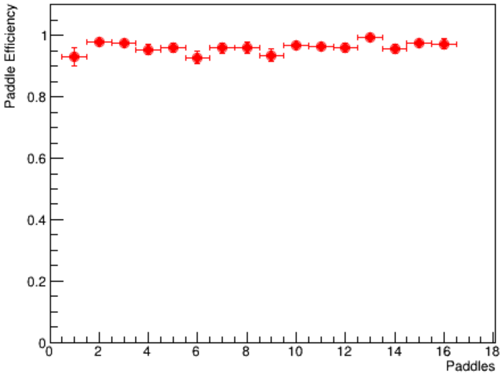


Figure 5: H1B paddle efficiency.

- Due to the angle of the detector it is hard to get good tracks in this plane. But this is issue will be resolved with beam.

Hodoscope Efficiencies



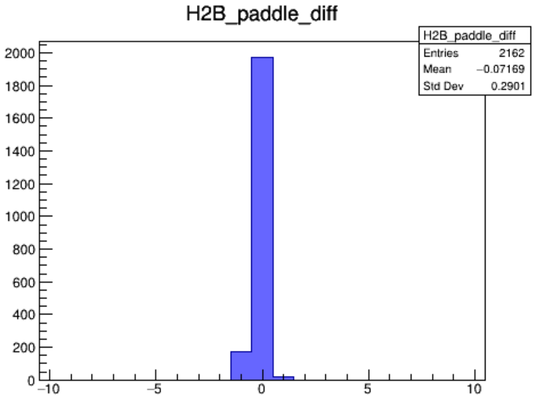


Figure 6: H1B paddle efficiency.

Hodoscope Efficiencies

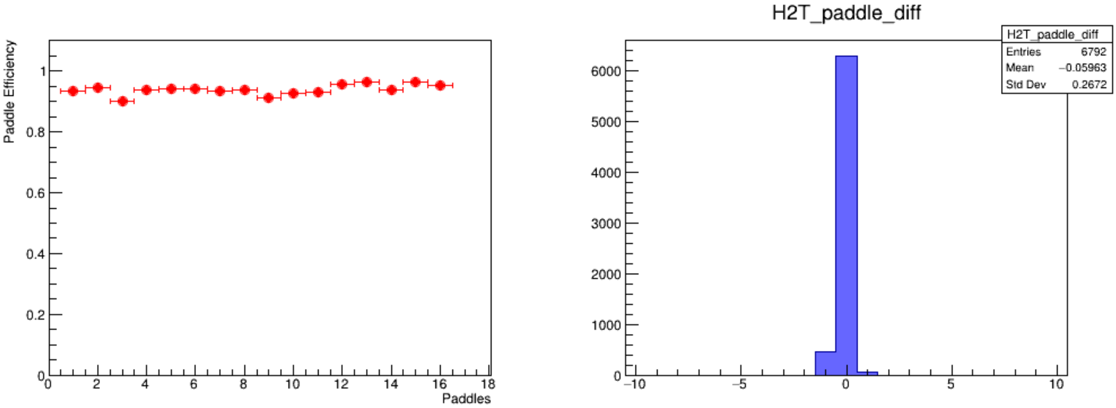


Figure 7: H2T paddle efficiency.

Hodoscope Efficiencies

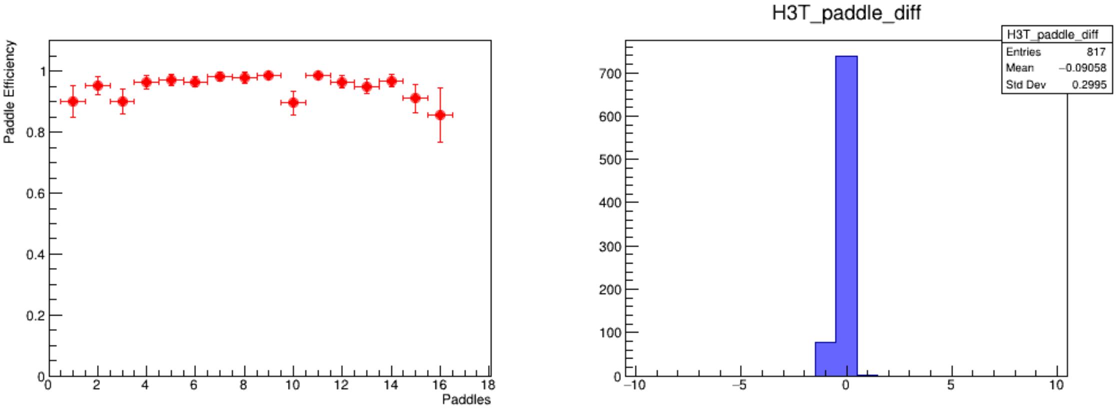


Figure 8: H3T paddle efficiency.

Hodoscope Efficiencies

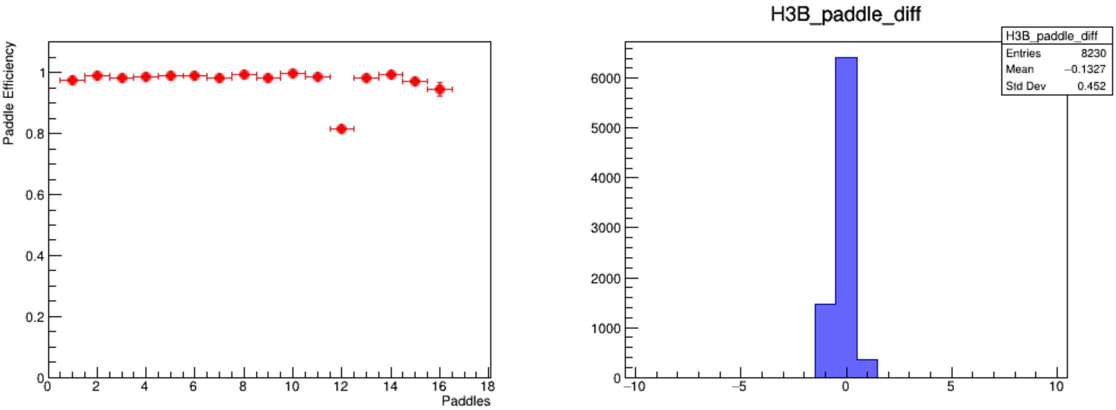


Figure 9: H3B paddle efficiency.

Hodoscope Efficiencies

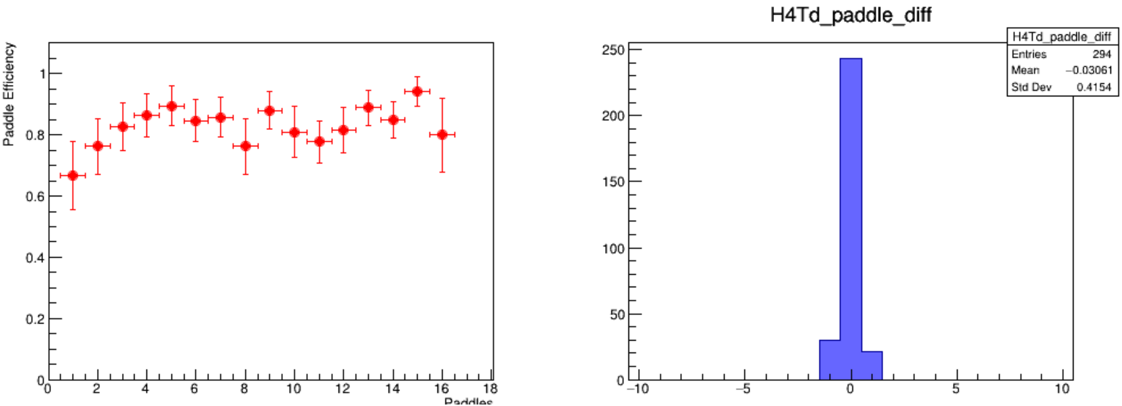


Figure 10: H4Td paddle efficiency.

Hodoscope Efficiencies

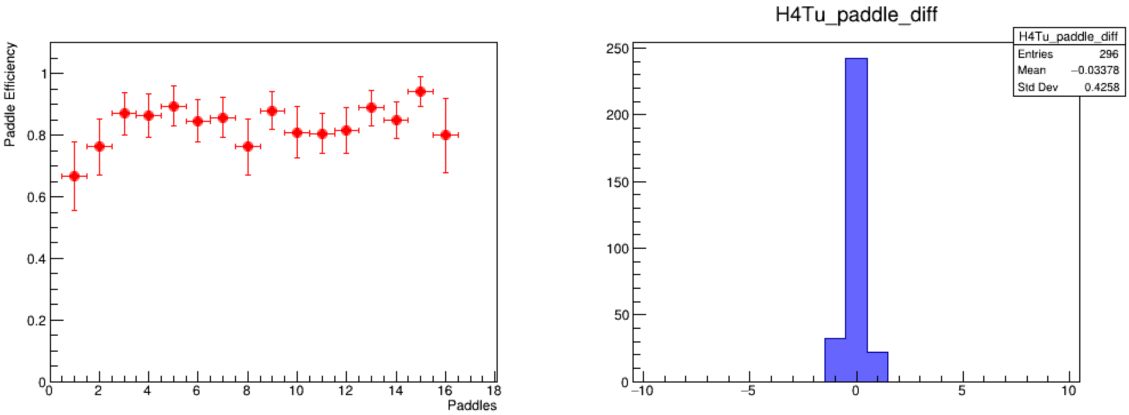


Figure 11: H4Tu paddle efficiency.

Hodoscope Efficiencies

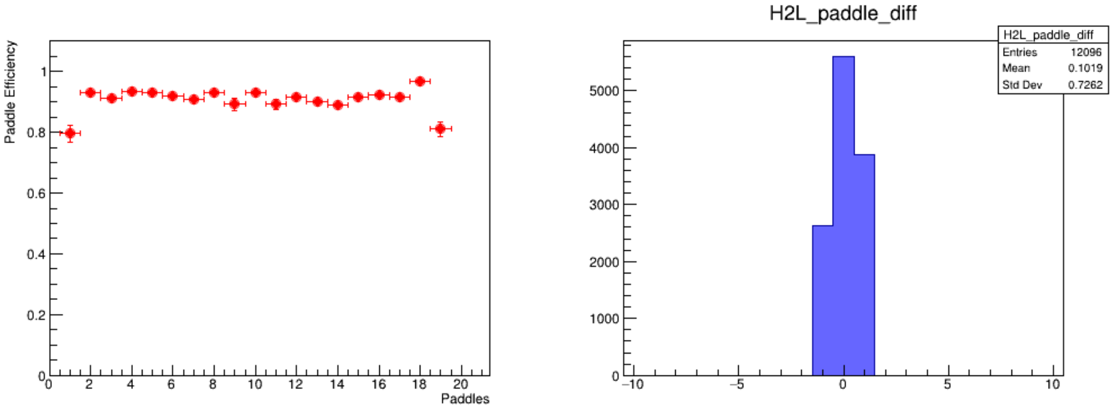


Figure 12: H2L paddle efficiency.

Hodoscope Efficiencies

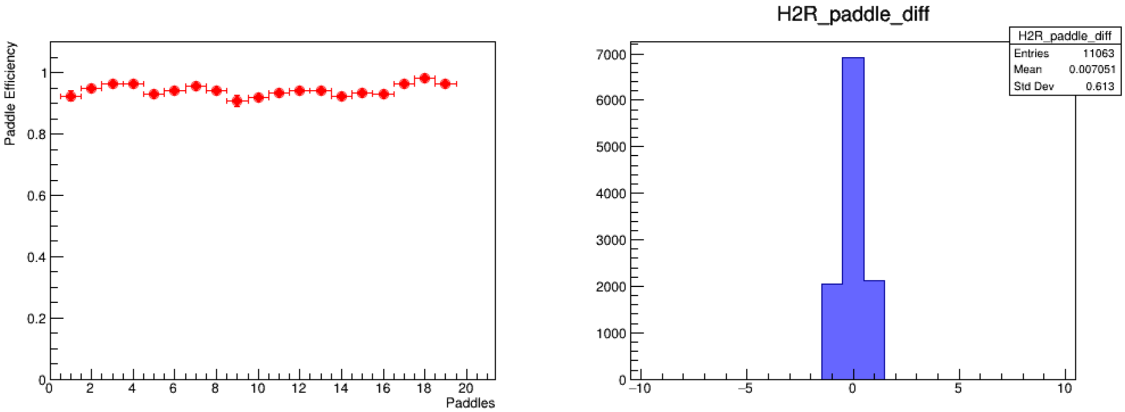


Figure 13: H2R paddle efficiency.

Hodoscope Efficiencies

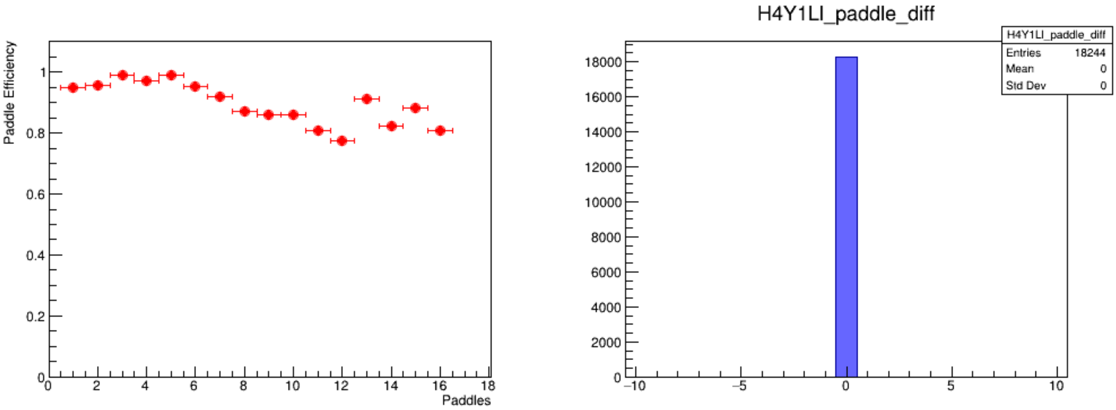


Figure 14: H4Y1Ll paddle efficiency.

Hodoscope Efficiencies

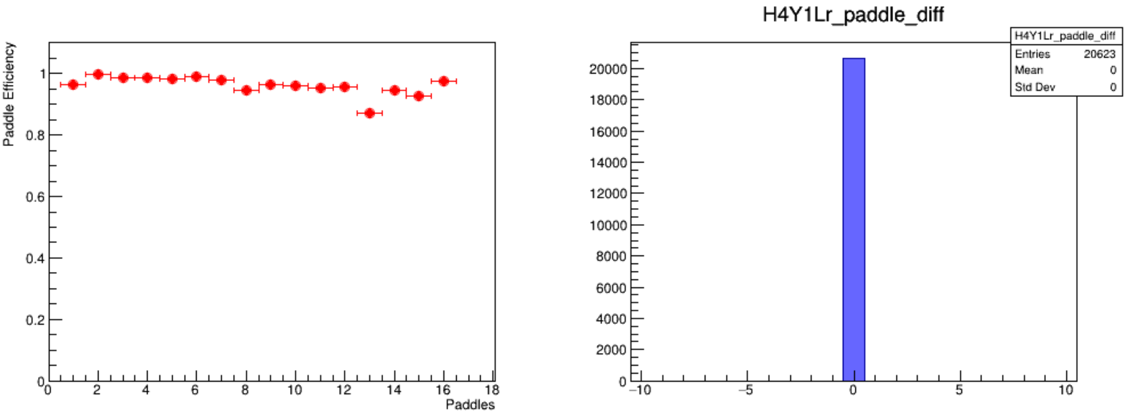


Figure 15: H4Y1Lr paddle efficiency.

Hodoscope Efficiencies

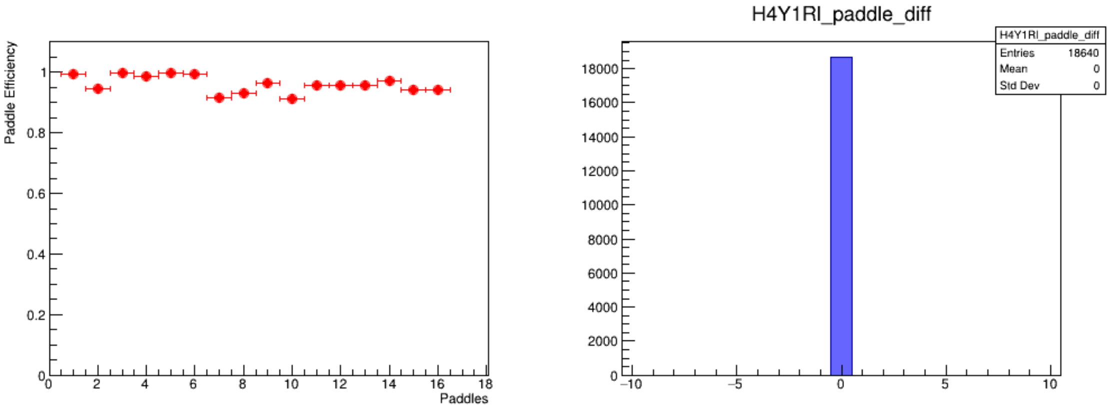


Figure 16: H4Y1Rl paddle efficiency.

Hodoscope Efficiencies

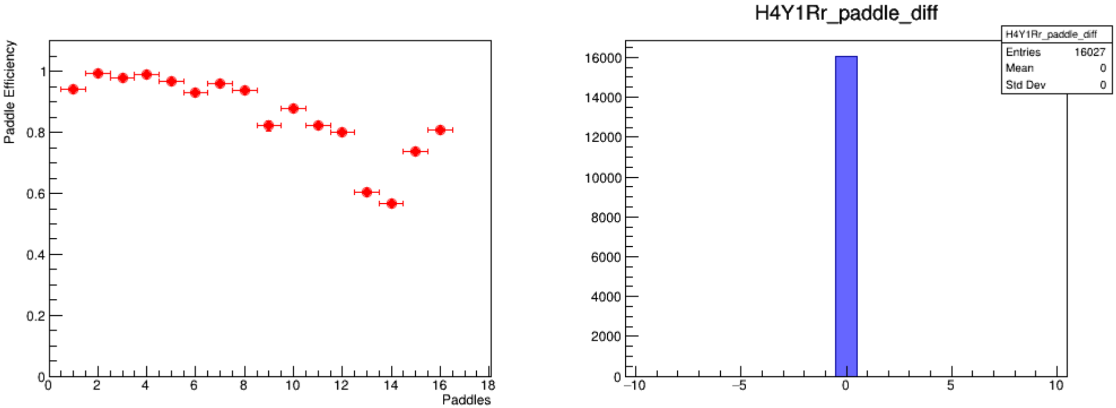
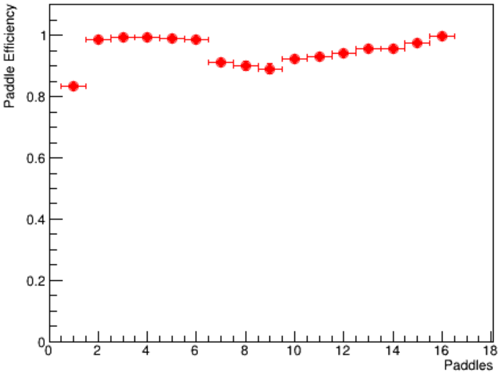


Figure 17: H4Y1Rr paddle efficiency.

Hodoscope Efficiencies



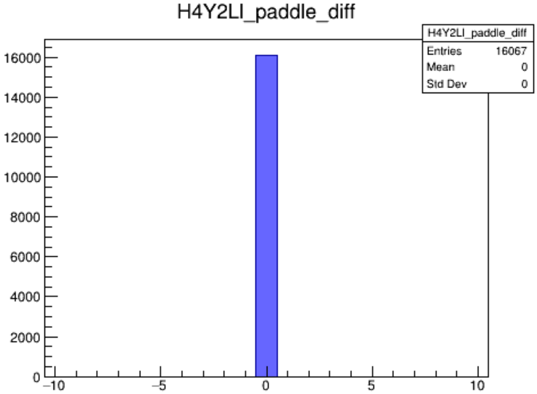
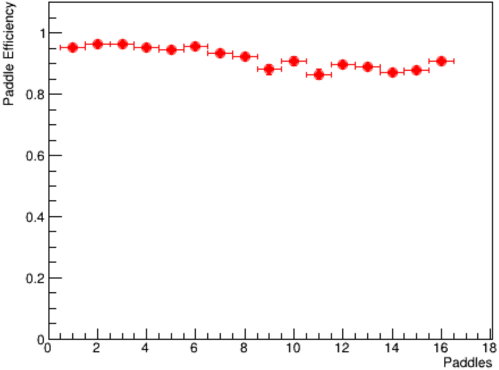


Figure 18: H4Y2Lr paddle efficiency.

Hodoscope Efficiencies



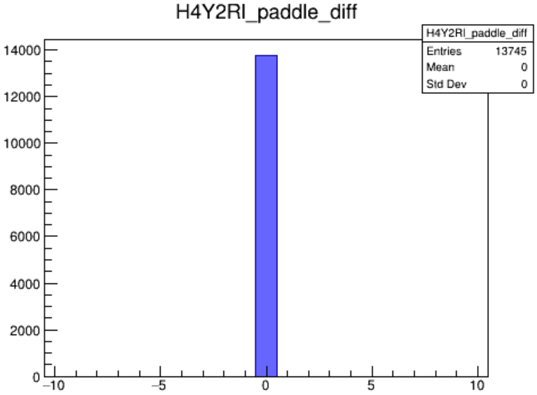


Figure 19: H4Y2Rr paddle efficiency.

Monitoring the Hodoscope Subsystem Remotely

- We have prepared a GUI/CL tools to easy debugging the hodoscopes without accessing the experimental hall.
- This tool will be useful during the beam-time to debug hodoscope.

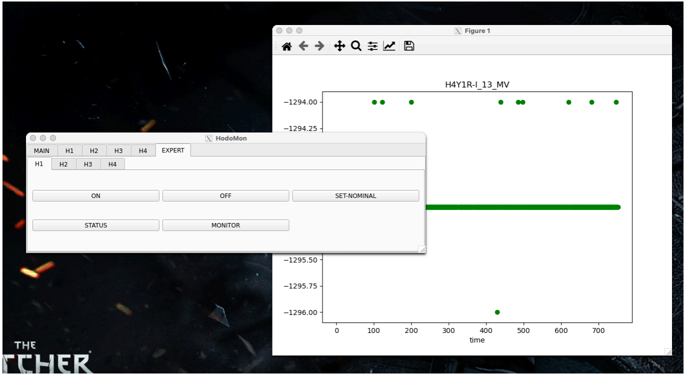


Figure 20: Hodoscope monitoring GUI.

Timing Resolution

Detector	Width (cm)	Resolution (ns)	Detector	Width (cm)	Resolution (ns)
H1T	7.32	24.4	H3T	14.59	48.6
H1B	7.32	24.4	H3B	14.59	48.6
H1L	7.32	24.4	H4T	19.65	65.5
H1R	7.32	24.4	H4B	19.65	65.5
H2T	13.04	43.5	H4Y1L	23.48	78.3
H2B	13.04	43.5	H4Y1R	23.48	78.3
H2L	13.07	43.6	H4Y2L	23.48	78.3
H2R	13.07	43.6	H4Y2R	23.48	78.3

Plan for Spectrometer Commissioning

- We plan to fine tune the detector efficiencies during the spectrometer commissioning. We have prepared software for this task. Using the current version it take 1 min 10.24 s to analyse 720k events.
- For this we plan to use 4 fold trigger similar to `NIM1`.
- We have prepared a handbook for Hodoscope/NIM subsystem. This can be used during the shifts. Link
- We have developed software to calculate hodoscope efficiencies and remote debugging.