

# MCenter Tuning Study June 20 ,2021

NOvA/AD MCenter Beam Meeting

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# Settings

- Op = Operational Tune
- Op Pol = Operational Polarity New tune (CJJ)
- Halfway = (Op + Op Pol)/2

	Start	1	2	3	4	5	6	7	8	9	10
MC6Q1	Op	Op	Op	Half way	Half way	Op Pol	Op Pol	Op Pol	Op Pol	Op Pol	Op Pol
MC6Q2											
MC6Q3											
MC6Q4	Op	Op Pol	Half way	Half way	Op	Op	Op Pol	Half way	1/4	3/4	Half way
MC6Q5											
MC6Q6											
Spills	9016 9030	9031 9057	9058 9078	9079 9082	9083 9093	9094 9100	9102 9123	9124 9166	9167 9180	9181 9197	9198 9200

## Settings

Current Settings	Operational Polarity	Operational	Halfway	1/4	3/4
MC6Q1I	44.47	19.38	31.9	-	-
MC6Q2I	-793.3	-649.5	-721.4	-	-
MC6Q3I	76.4	37.23	56.8	-	-
MC6Q4I	-70.5	-49.93	-60.2	-55.1	-65.4
MC6Q5I	730.7	577.2	654	615.6	692.3
MC6Q6I	-42.7	-30.19	-36.5	-33.3	-39.6

# START

- All profiles in this presentation are at the NOvA target
- This talk includes some part of the data
- Before trying different settings we got a few spills

MC6Q1I	19.38	Operational
MC6Q2I	- 649.5	
MC6Q3I	37.23	
MC6Q4I	- 49.93	Operational
MC6Q5I	577.2	
MC6Q6I	- 30.19	
MC6CV	10.2	

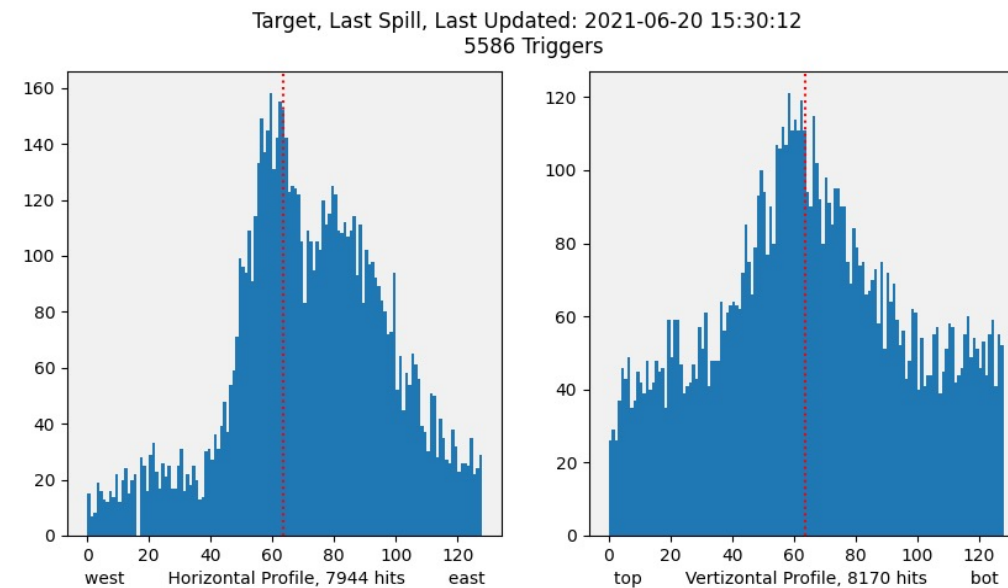


Fig 1. Spill 9016

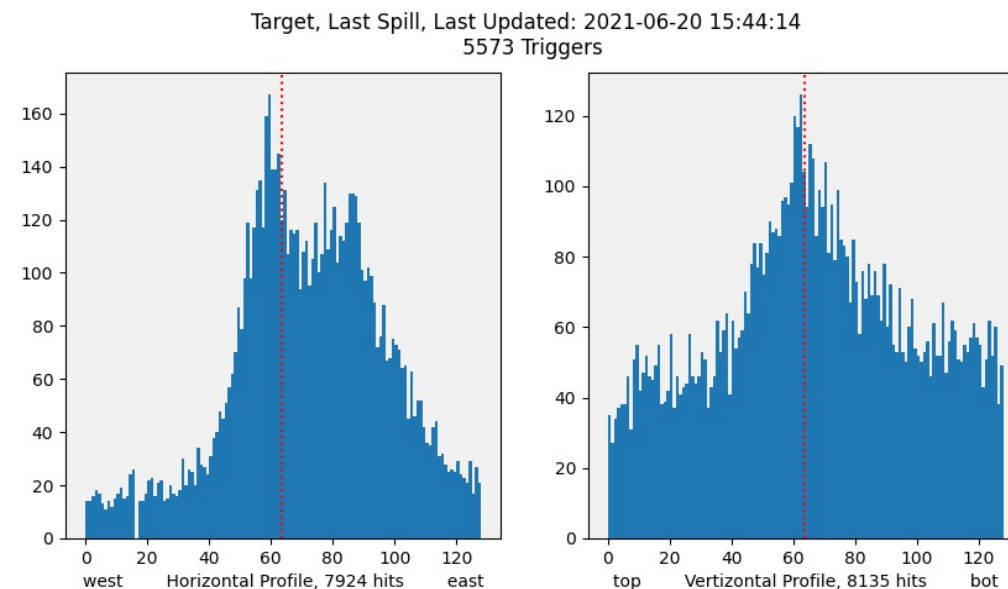


Fig 2. Spill 9030

1

MC6Q1I	19.38	Operational
MC6Q2I	-649.5	
MC6Q3I	37.23	
MC6Q4I	-70.5	Operational → Operational Polarity
MC6Q5I	730.7	
MC6Q6I	-42.7	
MC6CV	10.2	

- DS quad settings changed from Operational Tune to Operational polarity Tune
- More pronounced double peak in horizontal
- Vertical peak shifted to the left (up)
  - 20 mm above the center

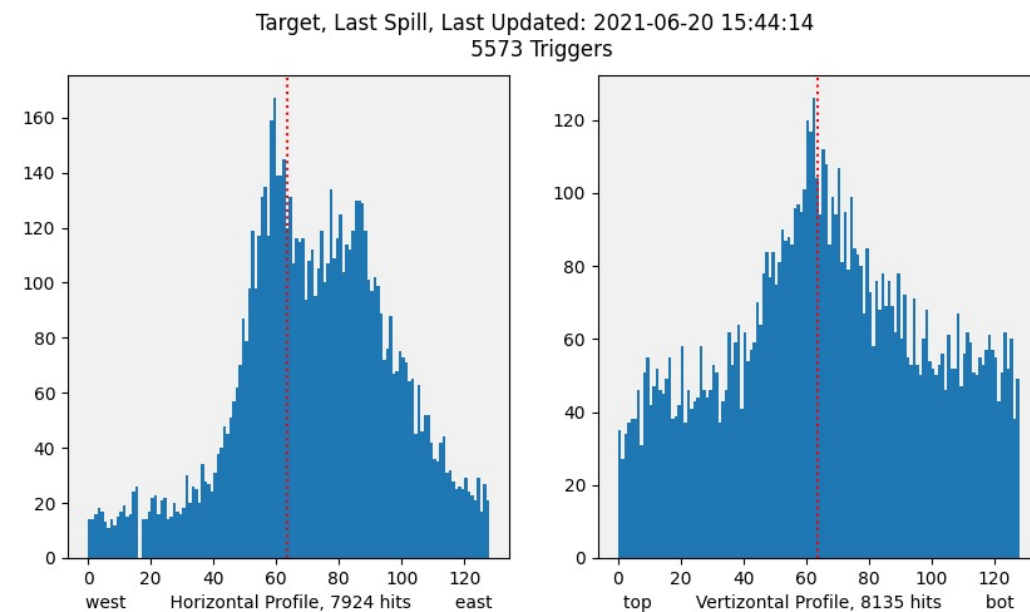


Fig 3 Spill 9030

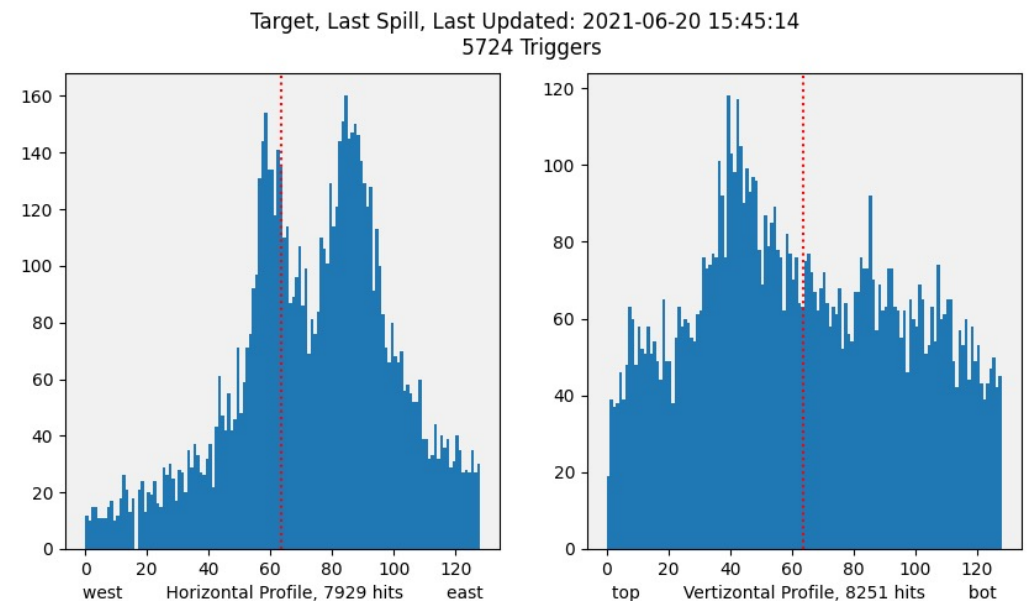


Fig 4 Spill 9031

# Collimator Scan

MC6CV	Spill
6.0	9044
10.2	9032
20.2	9038

Fig 5. Spill 9044

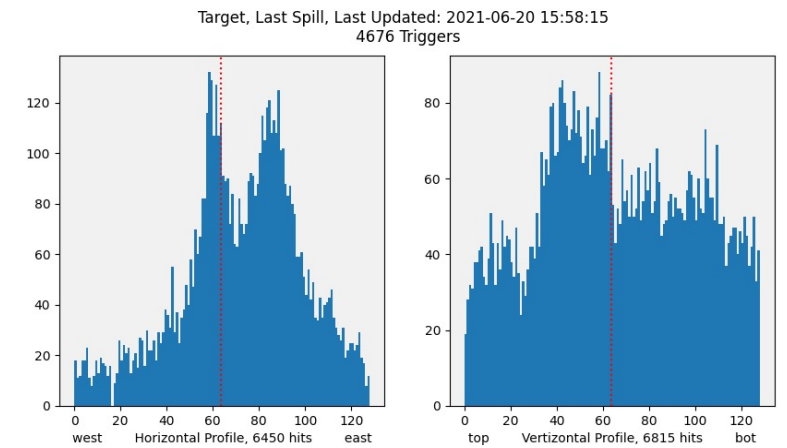


Fig 6. Spill 9032

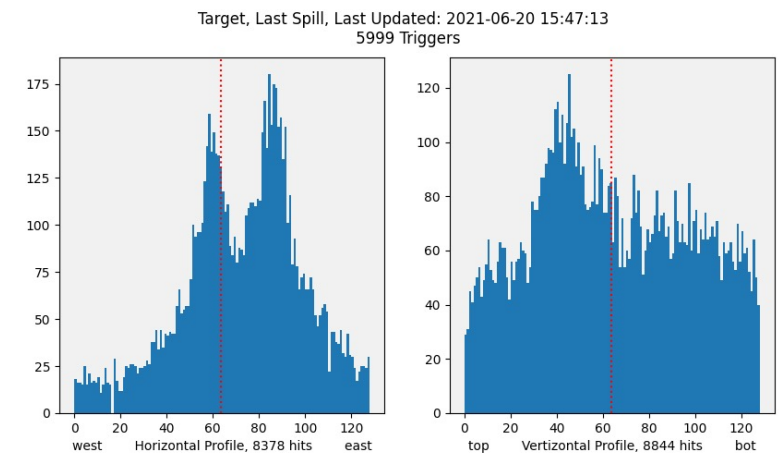
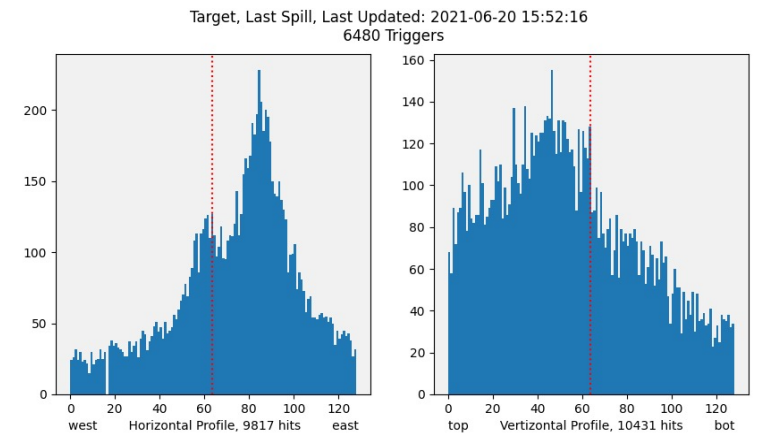


Fig 7. Spill 9038



2

MC6Q1I	19.38	Operational	
MC6Q2I	-649.5		
MC6Q3I	37.23		
MC6Q4I	-60.2	Operational Polarity → Halfway	
MC6Q5I	654		
MC6Q6I	-36.5		
MC6CV	20.3		

- DS Quads changed from Op Pol to Halfway
- Vertical peak shifted to the right (down) with a better shape
  - 8mm above the center

For Spill 9057 and 9058  
 MC6V1 is 10  
 MC6V2 is 54.95

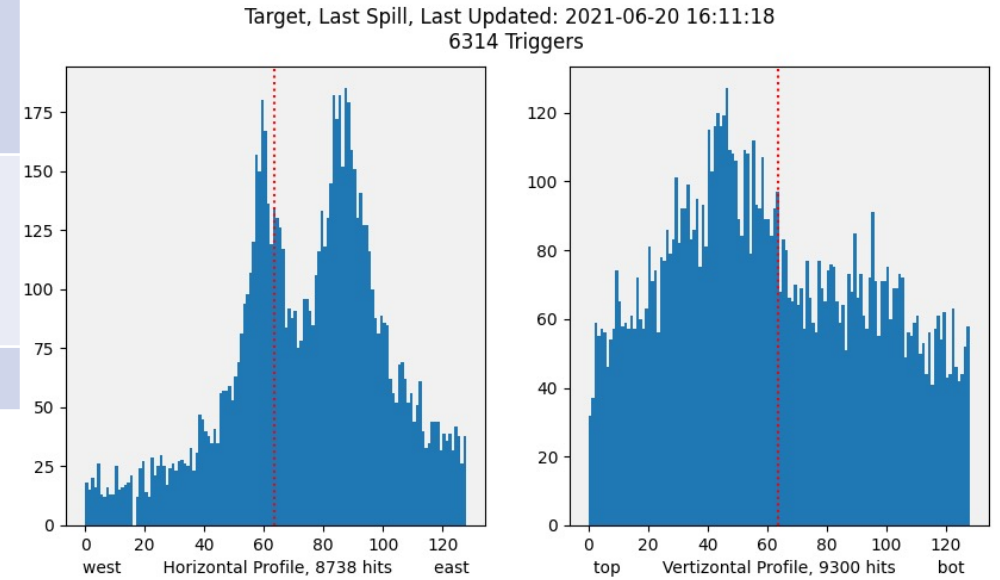


Fig 8. Spill 9057

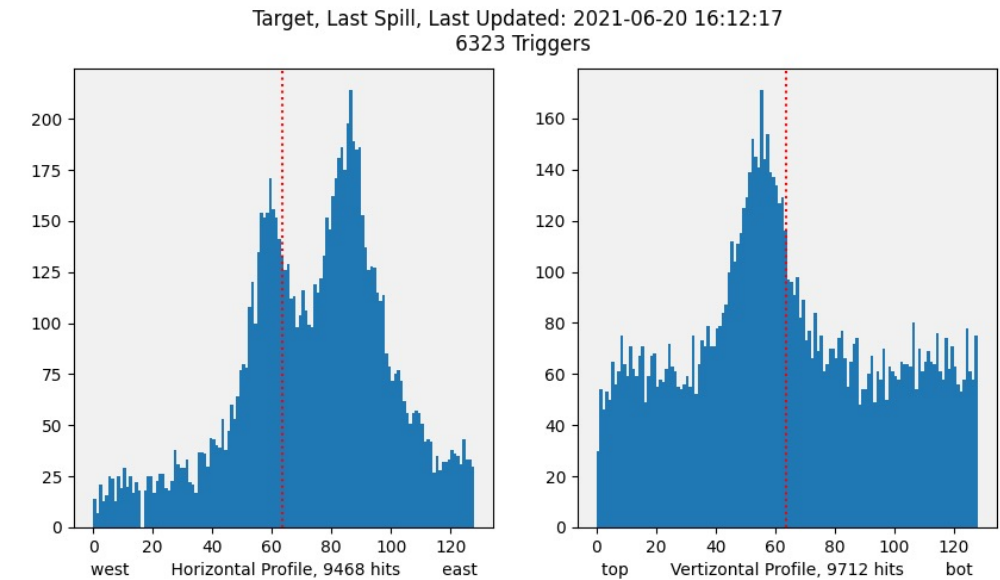


Fig 9. Spill 9058

# Collimator Scan

- When we closed the collimator, the background fuzz went down

MC6CV	Spill
20.3	9072
10.5	9074

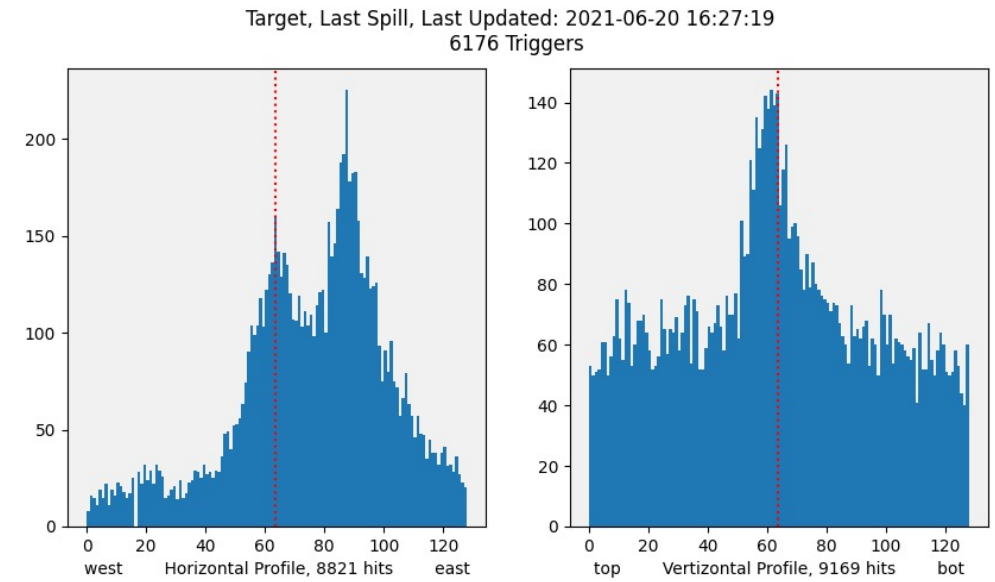


Fig 10. Spill 9072

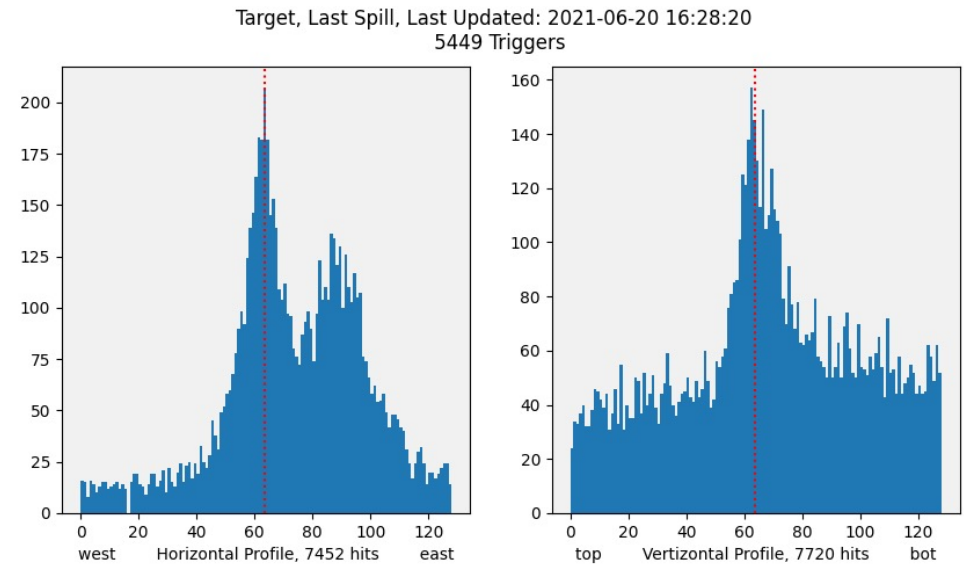


Fig 11. Spill 9074



3

MC6Q1I	31.9	Operational → Halfway
MC6Q2I	-721.4	
MC6Q3I	56.8	
MC6Q4I	-60.2	Halfway
MC6Q5I	654	
MC6Q6I	-36.5	
MC6CV	10.5	

- US quad settings changed from operational to halfway
- Vert peak shifted to the left (up)
  - 16 mm above the center

For Spill 9078 and 9079

MC6V1 is 10

MC6V2 is 15

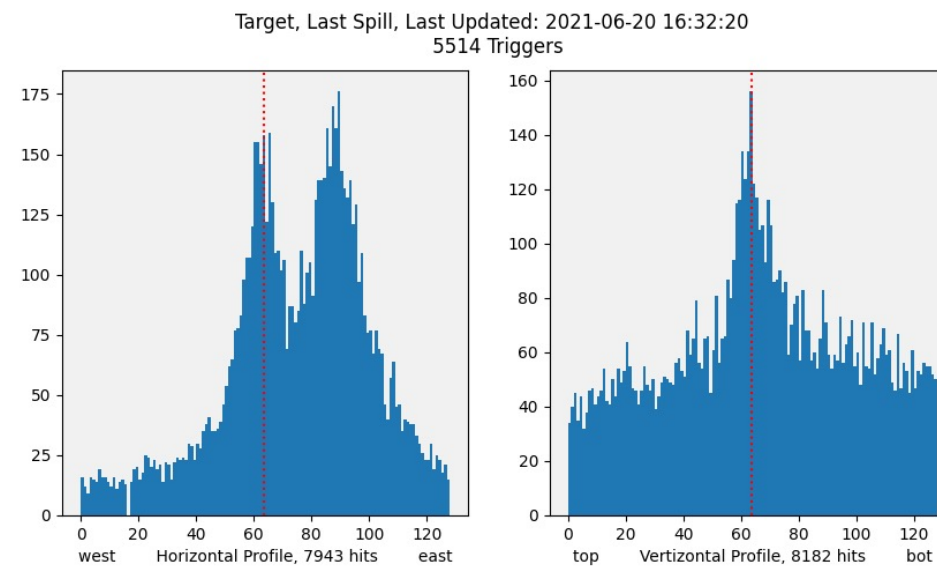


Fig 12. Spill 9078

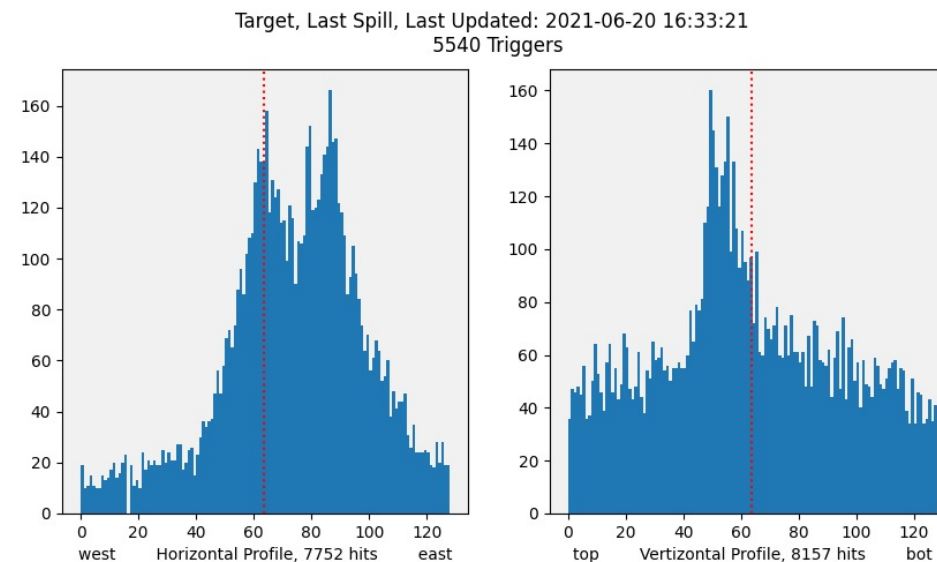


Fig 13. Spill 9079

4

MC6Q1I	31.9	Halfway
MC6Q2I	-721.4	
MC6Q3I	56.8	
MC6Q4I	-49.93	Halfway → Operational
MC6Q5I	577.2	
MC6Q6I	-30.19	
MC6CV	19.9	

- DS quad settings changed from halfway to Operational tune
- No double peak in horizontal
- Vertical peak shifted to the right (down)
  - Centered
  - Wider peak

For Spill 9082 and 9083

MC6V1 is 10

MC6V2 is 15

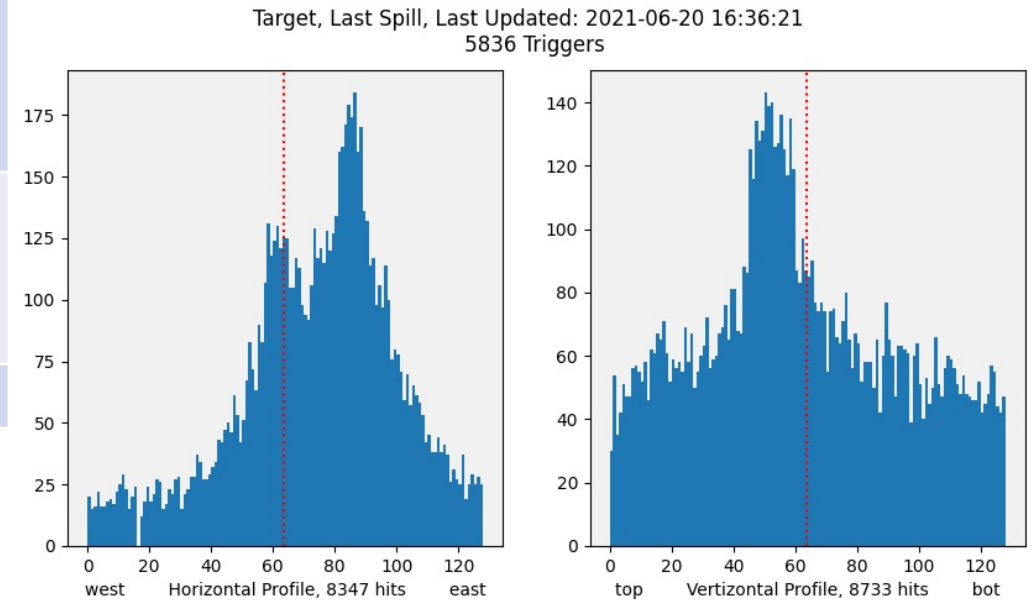


Fig 14. Spill 9082

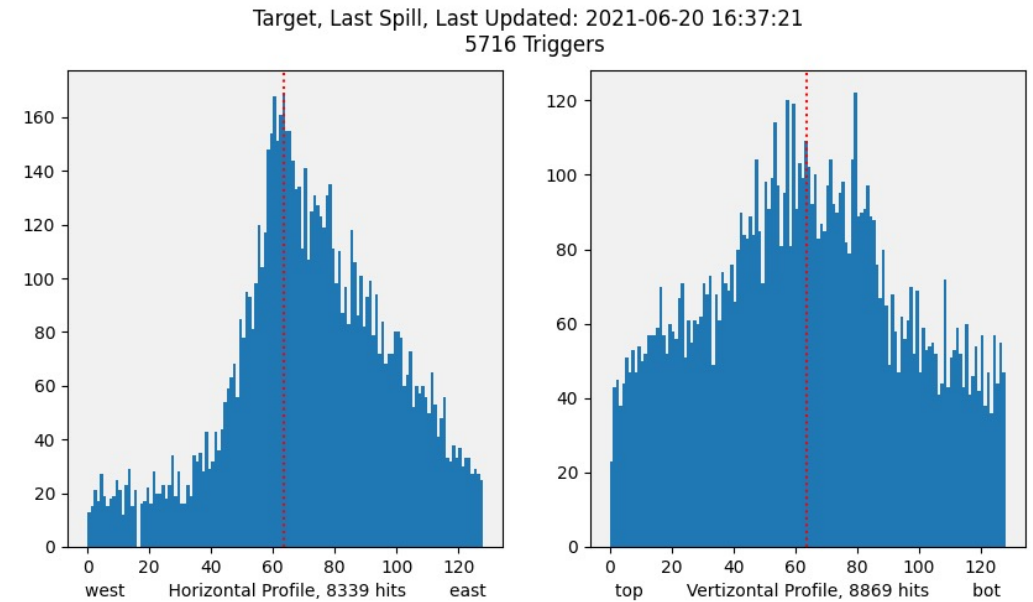


Fig 15. Spill 9083

5

MC6Q1I	44.47	Halfway → Operational Polarity
MC6Q2I	-793.3	
MC6Q3I	76.4	
MC6Q4I	-49.93	Operational
MC6Q5I	577.2	
MC6Q6I	-30.19	
MC6CV	10.1	

- US quad settings changed from Halfway to Operational Polarity
- Better peak in horizontal
- Vertical peak shifted to the left (up)
  - 6mm above the center

For Spill 9093 and 9094

MC6V1 is 10

MC6V2 is 15

Target, Last Spill, Last Updated: 2021-06-20 16:47:22  
5363 Triggers

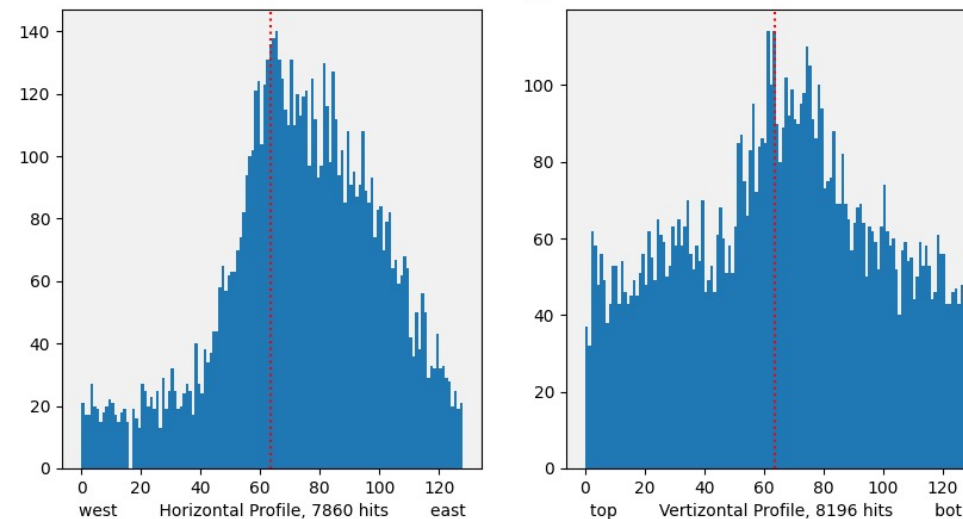


Fig 16. Spill 9093

Target, Last Spill, Last Updated: 2021-06-20 16:49:21  
5588 Triggers

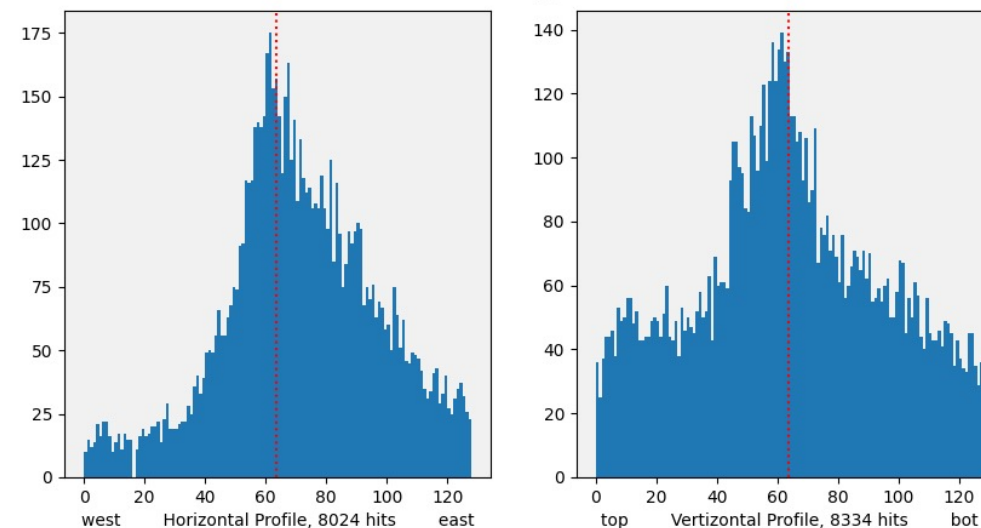


Fig 17. Spill 9094

# Collimator Scan

MC6CV	Spill
10.1	9096
20.0	9099

Target, Last Spill, Last Updated: 2021-06-20 16:50:23  
5585 Triggers

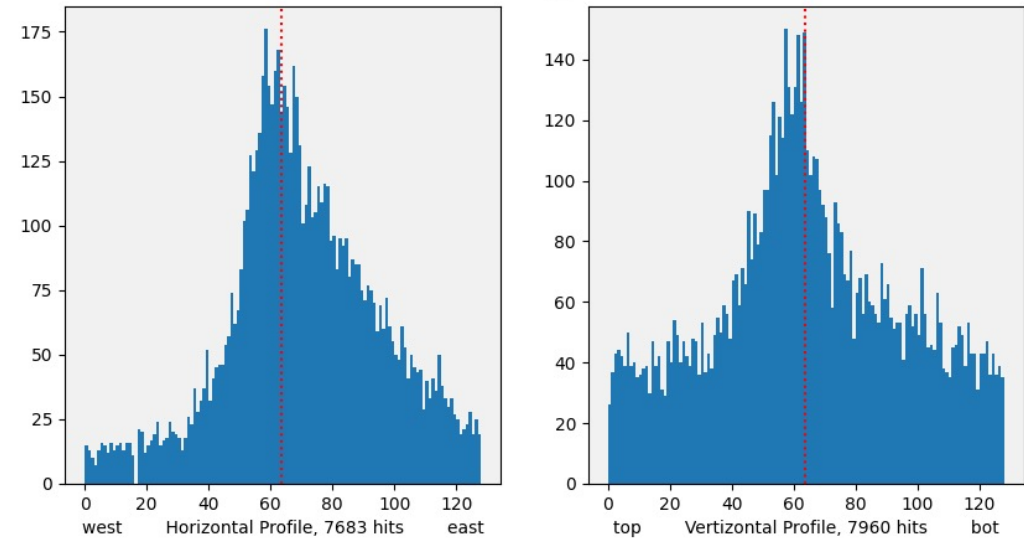


Fig 18. Spill 9096

Target, Last Spill, Last Updated: 2021-06-20 16:53:23  
6376 Triggers

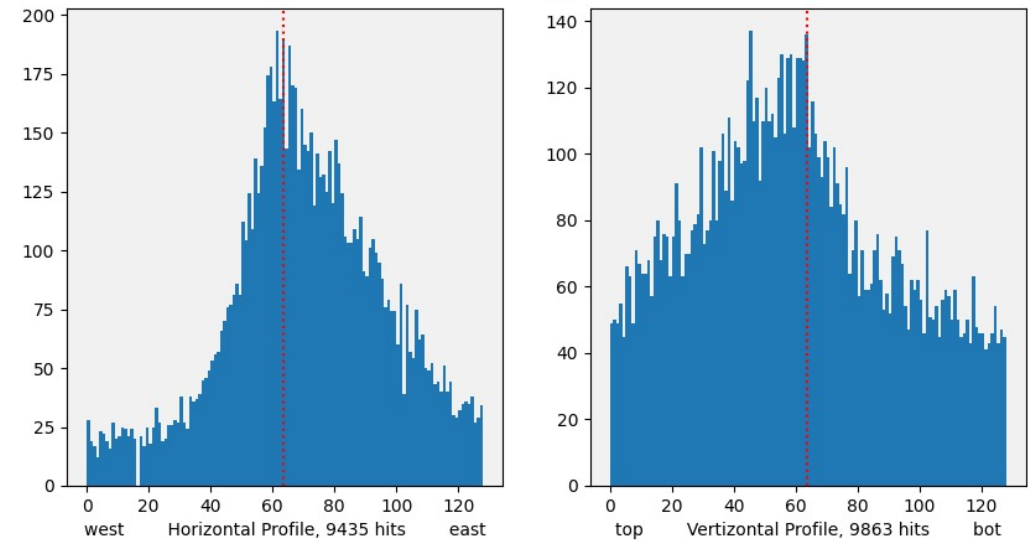


Fig 19. Spill 9099

6

MC6Q1I	44.47	Operational Polarity	
MC6Q2I	-793.3		
MC6Q3I	76.4		
MC6Q4I	-70.5		
MC6Q5I	730.7		Operational → Operational Polarity
MC6Q6I	-42.7		
MC6CV	20.0		

- DS quads changed from Operational tune to Operational Polarity tune
- Double peak came back in horizontal
- Vertical peak shifted to the left (up)
  - 46 mm above the center

For Spill 9100 and 9102

MC6V1 is 10

MC6V2 is 15

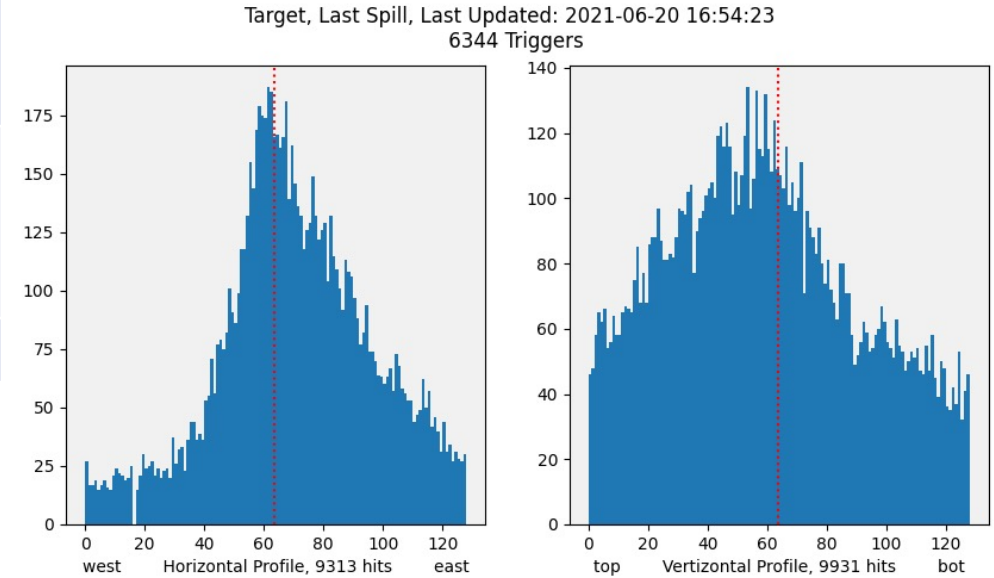


Fig 20. Spill 9100

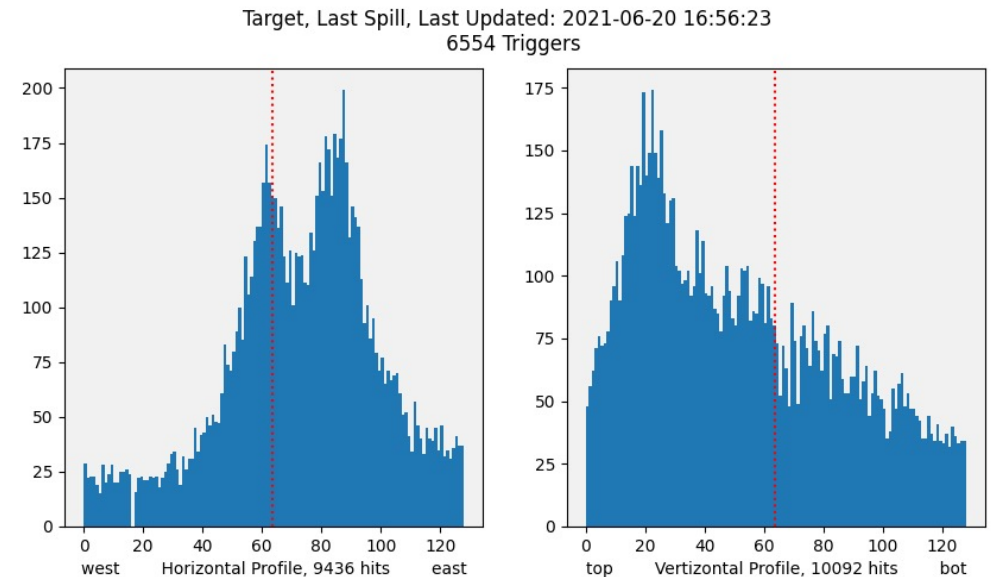


Fig 21. Spill 9102

# Collimator Scan

MC6CV	Spill
20.0	9104
10.2	9117

Target, Last Spill, Last Updated: 2021-06-20 16:58:24  
6436 Triggers

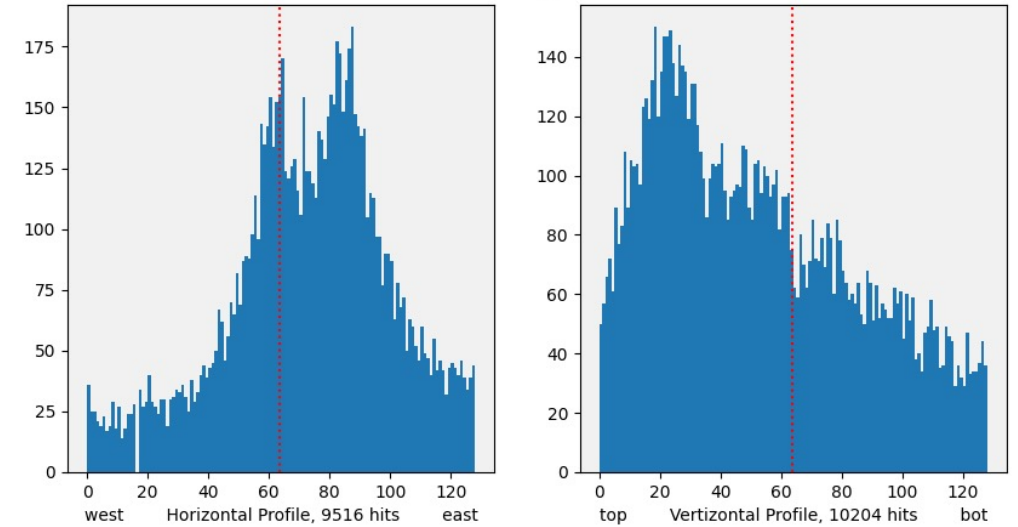


Fig 22. Spill 9104

Target, Last Spill, Last Updated: 2021-06-20 17:11:26  
5607 Triggers

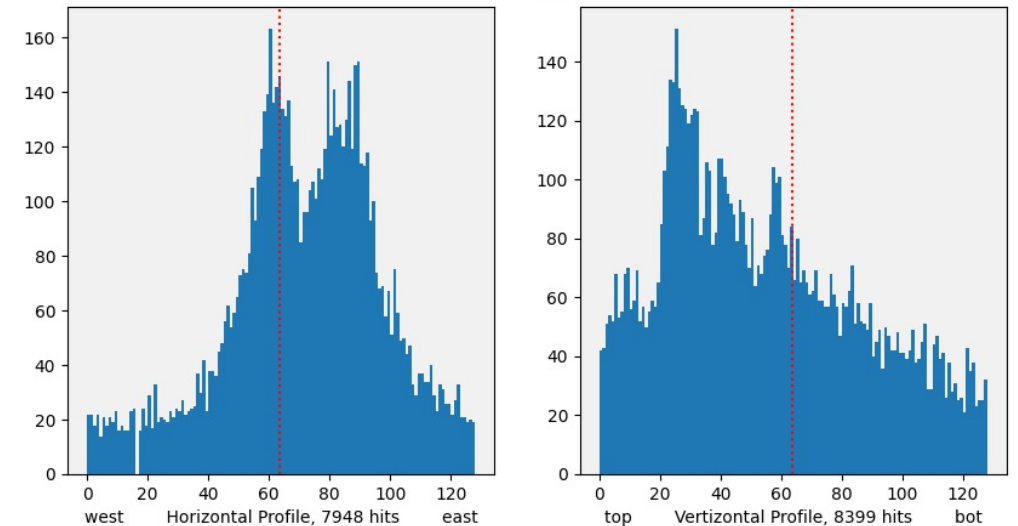


Fig 23. Spill 9117

# 7 Half Magic

MC6Q1I	44.47	Operational Polarity
MC6Q2I	-793.3	
MC6Q3I	76.4	
MC6Q4I	-60.2	Operational Polarity → Halfway
MC6Q5I	654	
MC6Q6I	-36.5	
MC6CV	10.2	

- DS quad settings changed from Operational Polarity to Halfway
- Double peak disappeared
- Better profiles in both horizontal and vertical
- Vertical peak shifted to the right
  - 22 mm above the center

For Spill 9123 and 9124

MC6V1 is 10

MC6V2 is 15

Target, Last Spill, Last Updated: 2021-06-20 17:17:26  
5557 Triggers

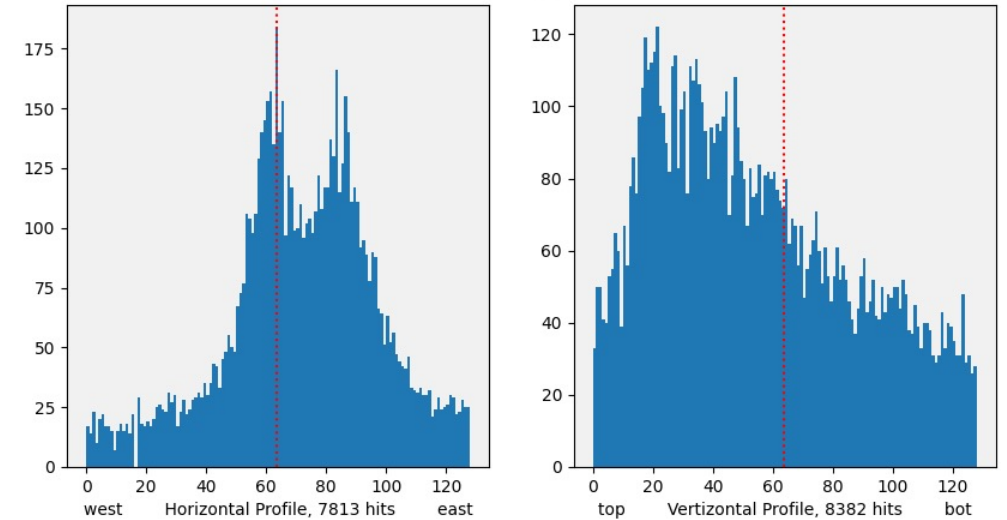


Fig 24. Spill 9123

Target, Last Spill, Last Updated: 2021-06-20 17:18:26  
5618 Triggers

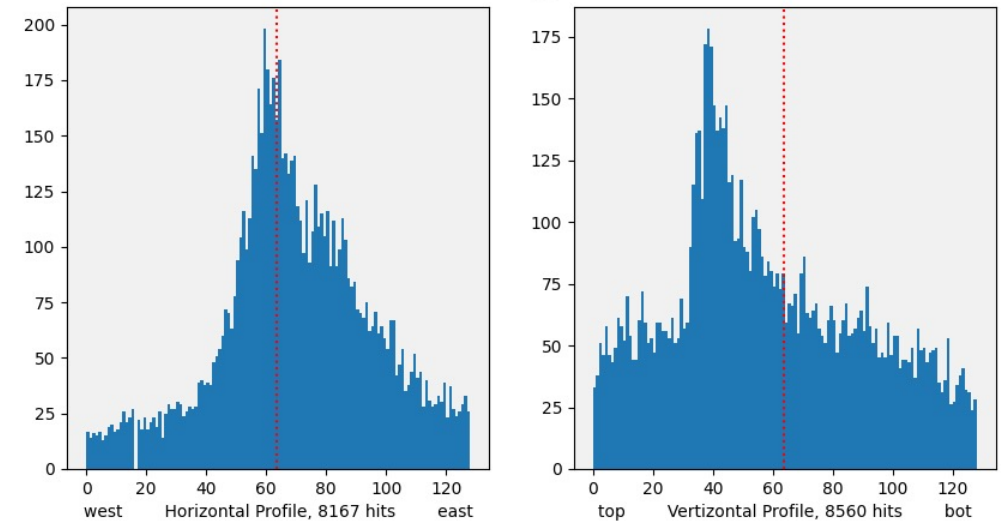


Fig 25. Spill 9124

# Collimator Scan

MC6CV	Spill
10.3	9153
14.2	9157
20.0	9161

Fig 26. Spill 9153

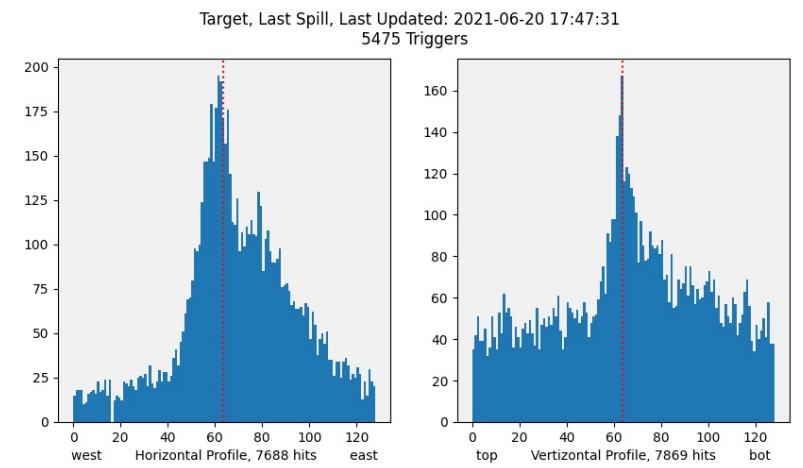


Fig 27. Spill 9157

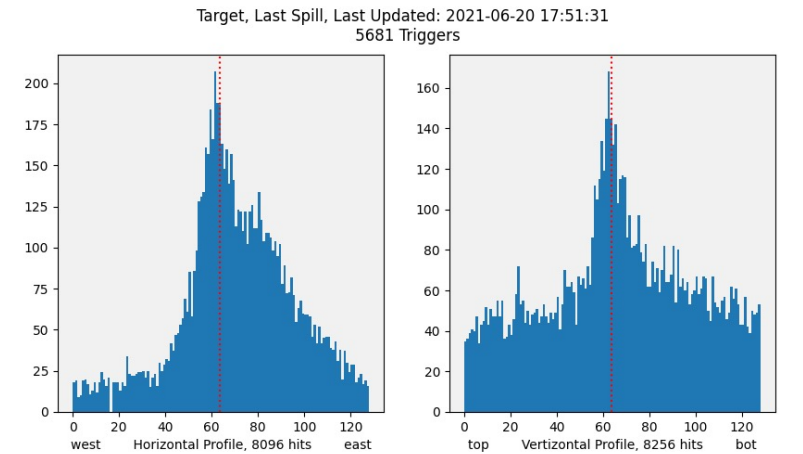
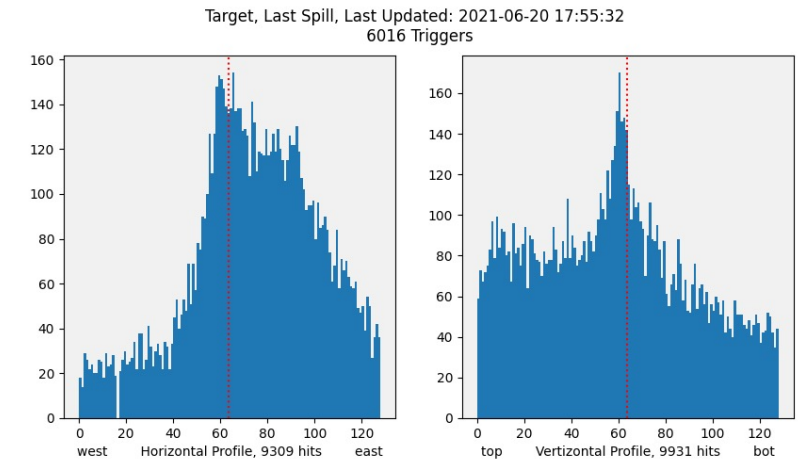


Fig 28. Spill 9161





8

MC6Q1I	44.47	Operational Polarity
MC6Q2I	-793.3	
MC6Q3I	76.4	
MC6Q4I	-55.1	Halfway → 1/4
MC6Q5I	615.6	
MC6Q6I	-33.3	
MC6CV	20.1	

- Ds quad settings changed from halfway to 1/4
- No change in horizontal
- Background went up in vertical profile

For Spill 9166 and 9167

MC6V1 is 80

MC6V2 is 80

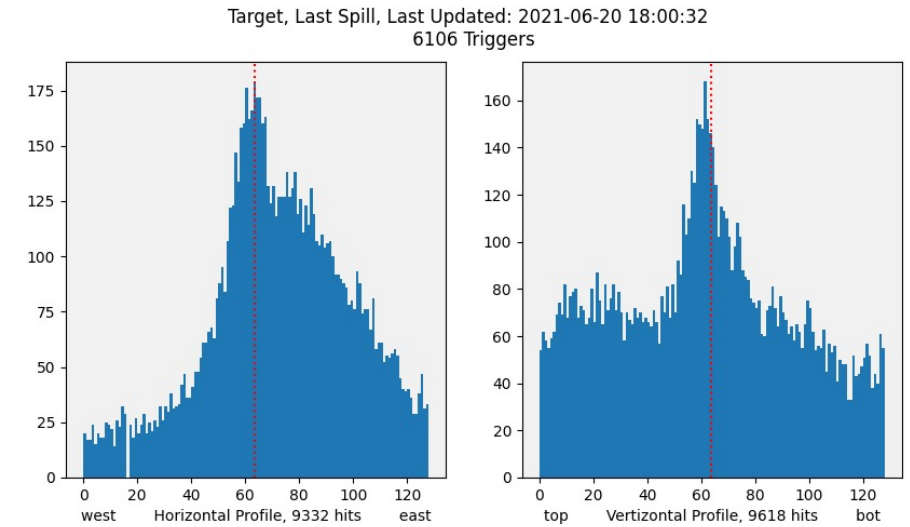


Fig 29. Spill 9166

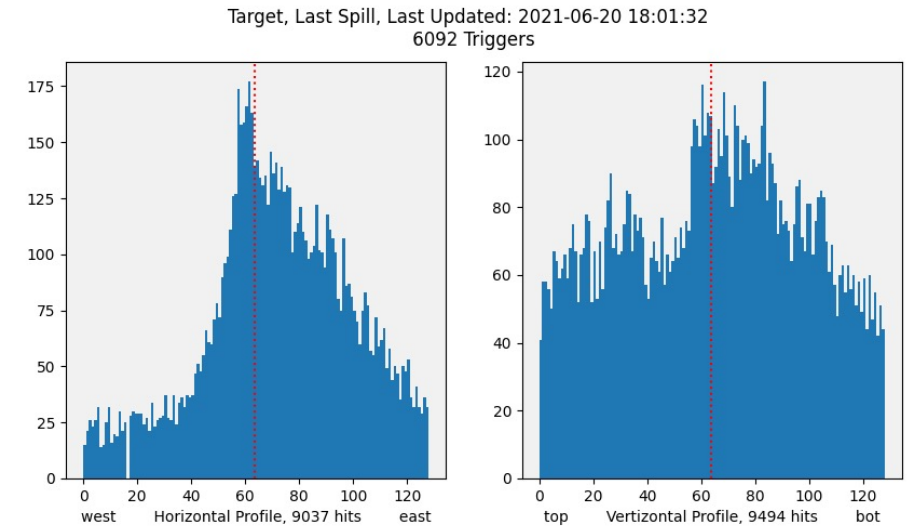


Fig 30. Spill 9167

9

MC6Q1I	44.47	Operational Polarity
MC6Q2I	-793.3	
MC6Q3I	76.4	
MC6Q4I	-65.4	$\frac{1}{4} \rightarrow \frac{3}{4}$
MC6Q5I	692.3	
MC6Q6I	-39.6	
MC6CV	9.9	

- DS quad settings changed from 1/4 to 3/4
- Vertical peak shifted to the left (up)
- Better profile in vertical

For Spill 9180 and 9181

MC6V1 is 80

MC6V2 is 80

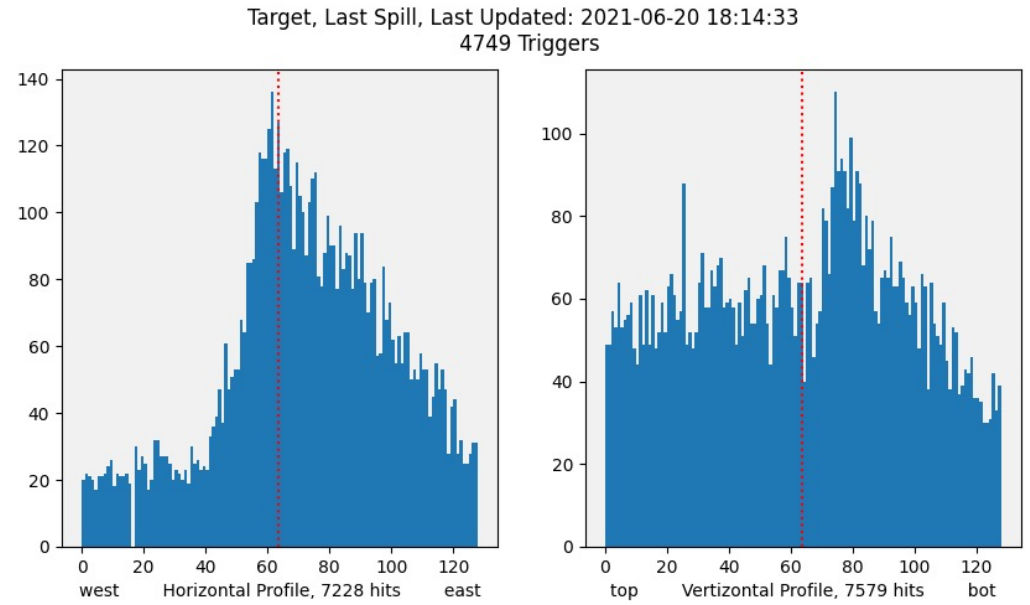


Fig 31. Spill 9180

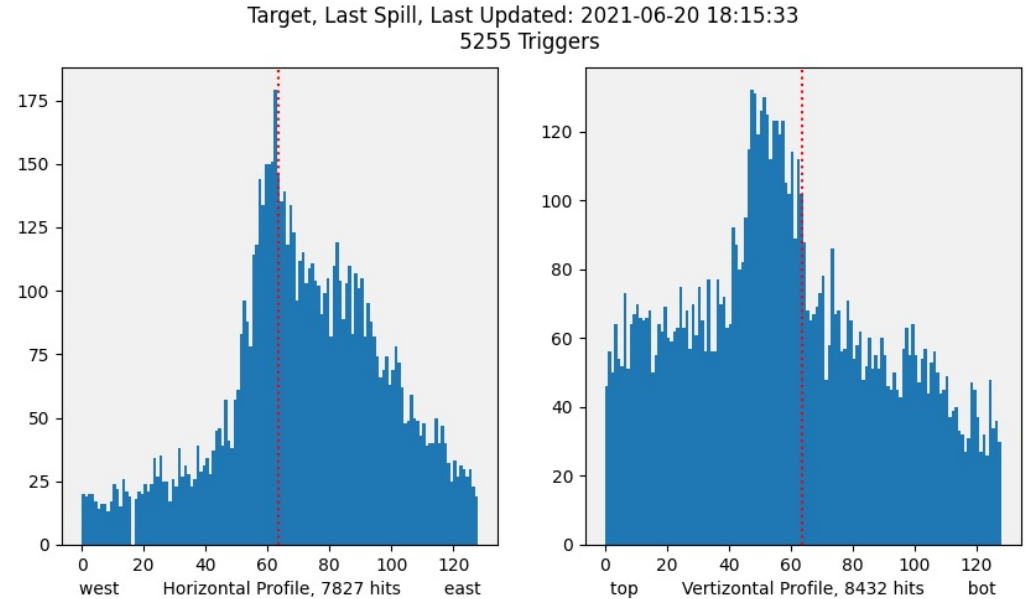


Fig 32. Spill 9181

10

MC6Q1I	44.47	Operational Polarity
MC6Q2I	-793.3	
MC6Q3I	76.4	
MC6Q4I	-60.2	$3/4 \rightarrow 1/2$
MC6Q5I	654	
MC6Q6I	-36.5	
MC6CV	10.3	

- DS quad settings changed from 3/4 to halfway
- Vertical peak shifted to the right

For Spill 9197 and 9198

MC6V1 is 80

MC6V2 is 80

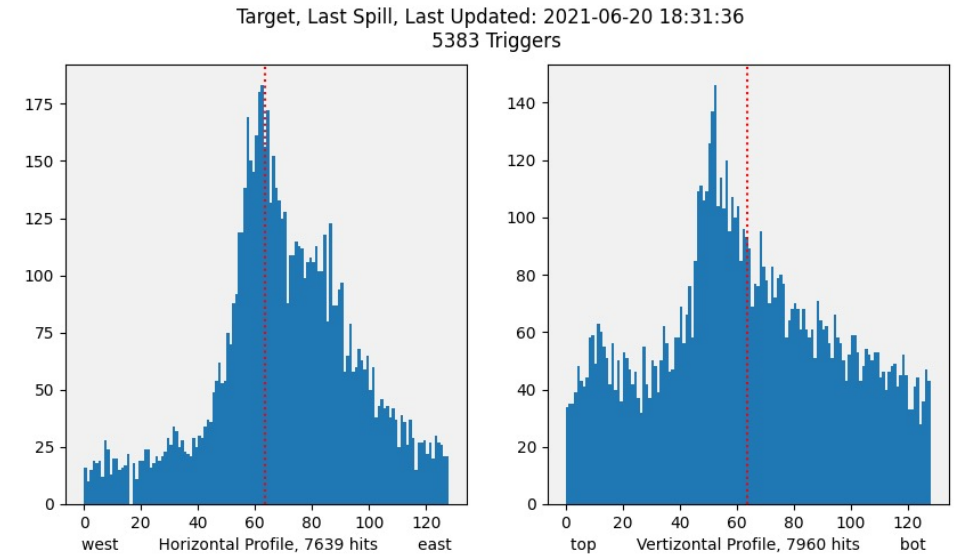


Fig 33. Spill 9197

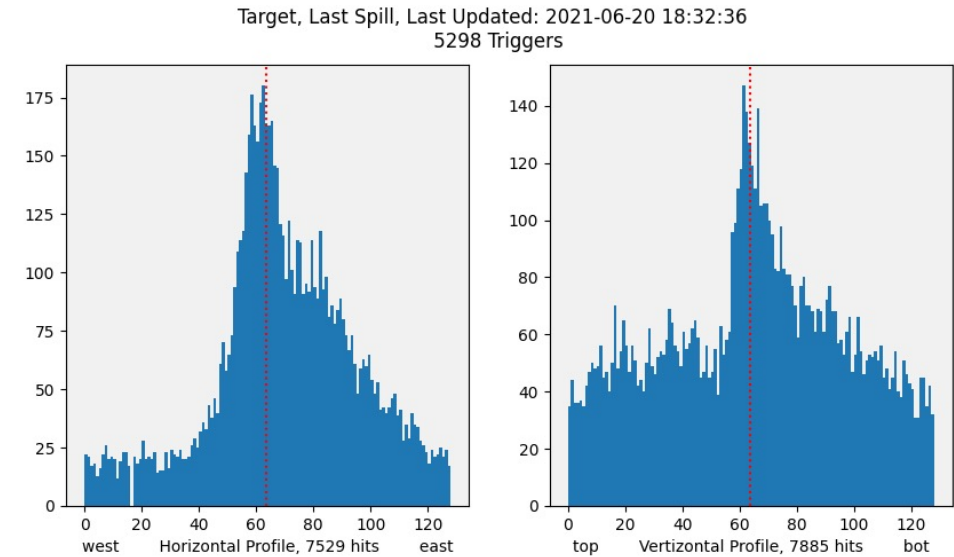


Fig 34. Spill 9198

# First and Last Profiles

MC6Q1I	19.38	Operational
MC6Q2I	- 649.5	
MC6Q3I	37.23	
MC6Q4I	- 49.93	Operational
MC6Q5I	577.2	
MC6Q6I	- 30.19	
MC6CV	10.2	

MC6Q1I	44.47	Operational Polarity
MC6Q2I	-793.3	
MC6Q3I	76.4	
MC6Q4I	-60.2	Halfway
MC6Q5I	654	
MC6Q6I	-36.5	
MC6CV	10.3	

Target, Last Spill, Last Updated: 2021-06-20 15:30:12  
5586 Triggers

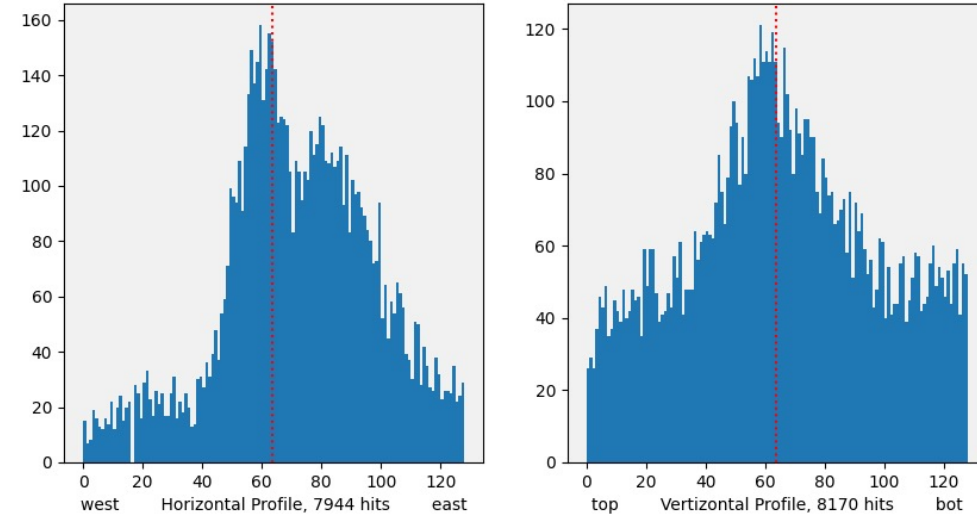


Fig 35. Spill 9016

Target, Last Spill, Last Updated: 2021-06-20 18:34:36  
5405 Triggers

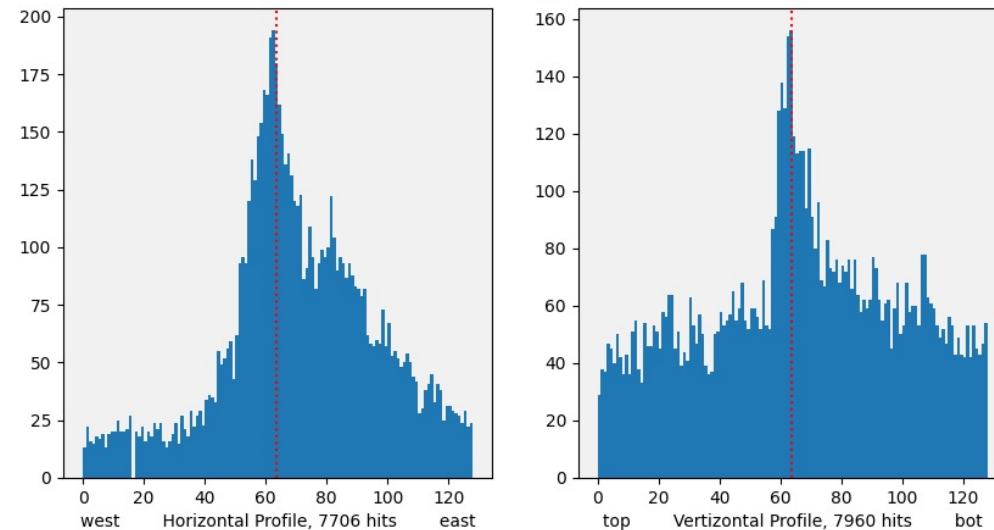


Fig 36. Spill 9200

# Summary

- We ran the beam study with different quadrupole and collimator settings and ended up with a nice profile
- When we closed down the collimator, background underneath the vertical peak started lowering
- We kept the Half Magic tune for the rest of the run

# Beam Studies

- April 19: Found magic settings during transition between operational tune and new (operational polarity) tune
  - Much better profiles on the Nova target
  - But beam fell off the top of the target
- June 20: interpolated between operational and (new) operational polarity tune in search of the "magic" settings from last study; ended up with the new "half-magic" operating point
- June 26 (morning): scans around the new operating point to explore the response
- June 26 (evening): study the double peak in horizontal profiles observed in earlier scans