

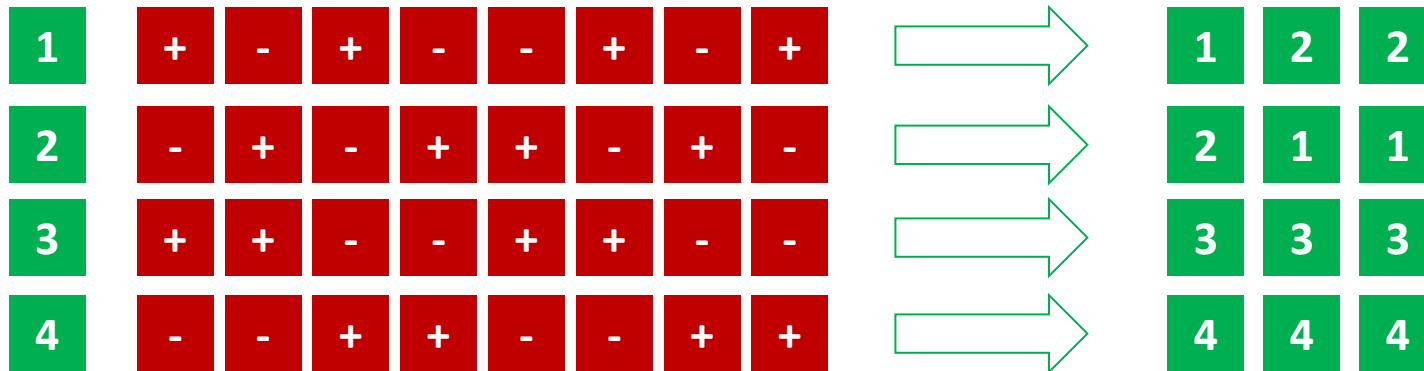
Spin Patterns for Run-2015

- For double helicity measurements:
 - Equal number of bunch crossings with same and opposite helicities
 - PHENIX needs even/odd cross checks
 - Abort gaps are aligned at PHENIX, STAR collides blue 1 with yellow 81
 - STAR wants different crossing pattern after abort gaps
 - Helicity states distributed equally over filled bunches
 - Change beam patterns from fill to fill, four basic beam patterns → eight different crossing patterns
 - Assumption: no empty bunches needed for e-lens

Basic Pattern with 24 Bunches

- 12 bunches possible, but very hard to equalize crossings for all requirements, i.e. to fulfill PHENIX even / odd
- Use 24 bunches instead

based on 2012 and before

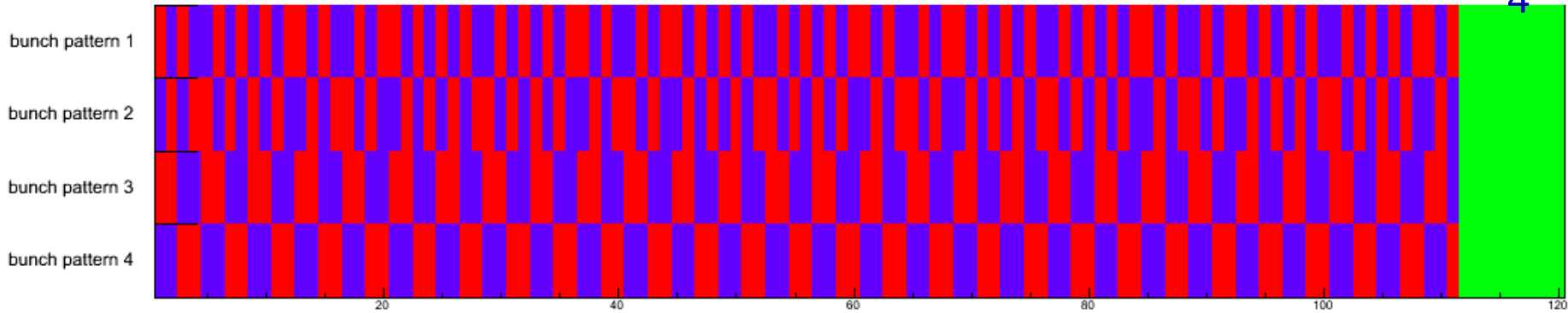


Combined crossing patterns

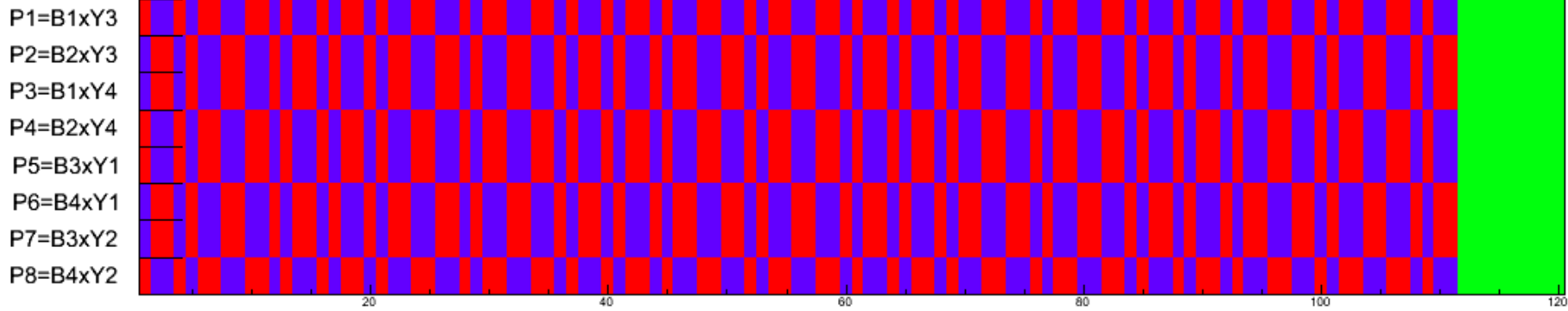
$$\begin{aligned}
 P1 &= B1xY3 & P5 &= B3xY1 \\
 P2 &= B2xY3 & P6 &= B4xY1 \\
 P3 &= B1xY4 & P7 &= B3xY2 \\
 P4 &= B2xY4 & P8 &= B4xY2
 \end{aligned}$$

beam patterns

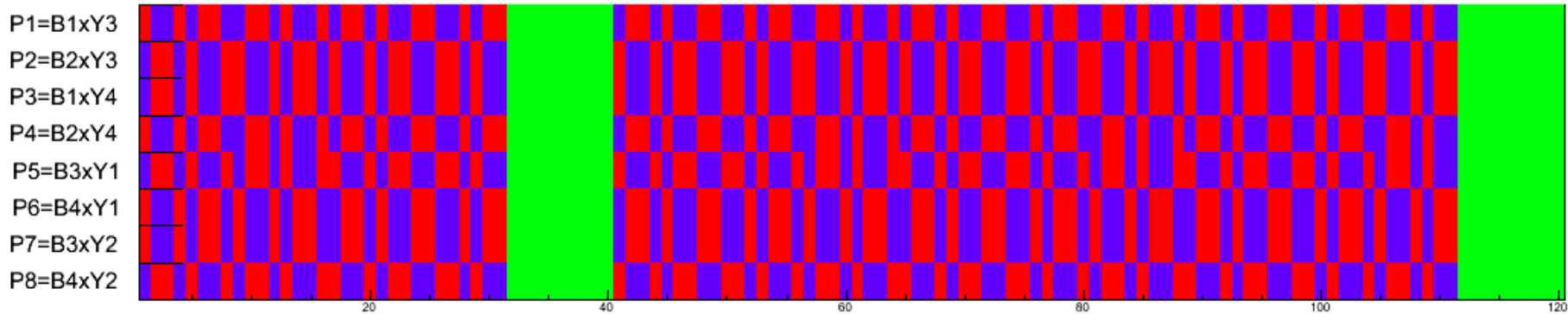
4



bunch crossing at PHENIX



bunch crossings at STAR



Bunch Crossings

based on 111 filled bunches

does not include short gaps for e-lens commissioning

5

	STAR				PHENIX							
										even	odd	
	++	+-	-+	--	++	+-	-+	--	++,--	+,-,+	++,--	+,-,+
P1=B1xY3	26	25	26	25	28	28	28	27	28	28	27	28
P2=B2xY3	26	25	26	25	28	27	28	28	28	28	28	27
P3=B1xY4	25	26	25	26	28	28	27	28	28	28	28	27
P4=B2xY4	25	26	25	26	27	28	28	28	28	28	27	28
P5=B3xY1	26	26	26	24	28	28	28	27	28	28	27	28
P6=B4xY1	26	24	26	26	28	27	28	28	28	28	28	27
P7=B3xY2	26	26	24	26	28	28	27	28	28	28	28	27
P8=B4xY2	24	26	26	26	27	28	28	28	28	28	27	28

What We HAD in 2012 and 2013

2013 What We Had

4 spin patterns per beam

Blue:

- 1 ++--++--++--
- 2 --++--++--++
- 3 --++++----++++----++++
- 4 ++----++++----++++----

Yellow:

- 4 ++----++++----++++----
- 3 --++++----++++----++++
- 2 --++--++--++
- 1 ++--++--++--

we will collide

- P21: B1xY3 P25: B3xY1
- P22: B1xY4 P26: B3xY2
- P23: B2xY3 P27: B4xY1
- P24: B2xY4 P28: B4xY2

What else:

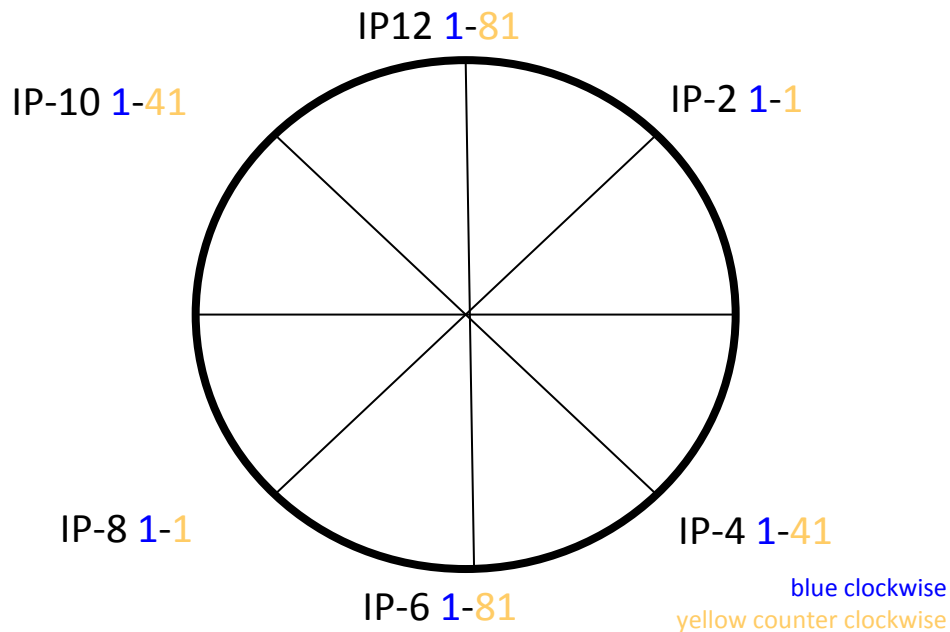
360 buckets, every 3rd filled

→ 120 bunches

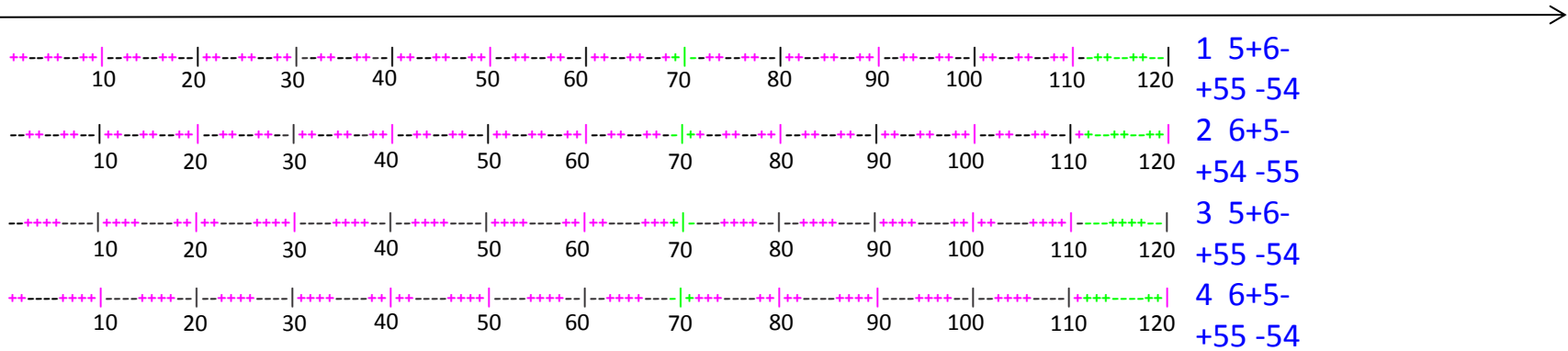
aboard gaps aligned in PHENIX
anti-aligned in STAR

bunch 70/71 empty in blue

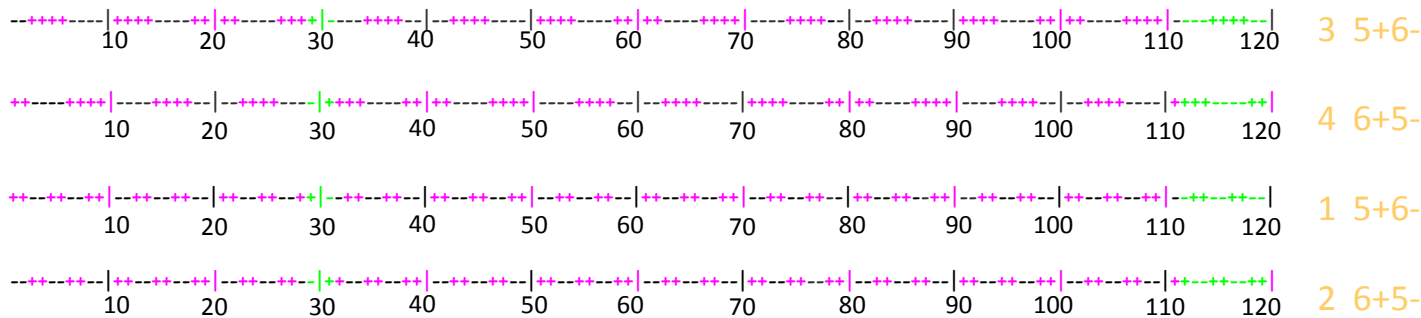
bunch 30/31 empty in yellow
(fixed for e-Lense)



WHAT We HAD 2013 Spin Pattern

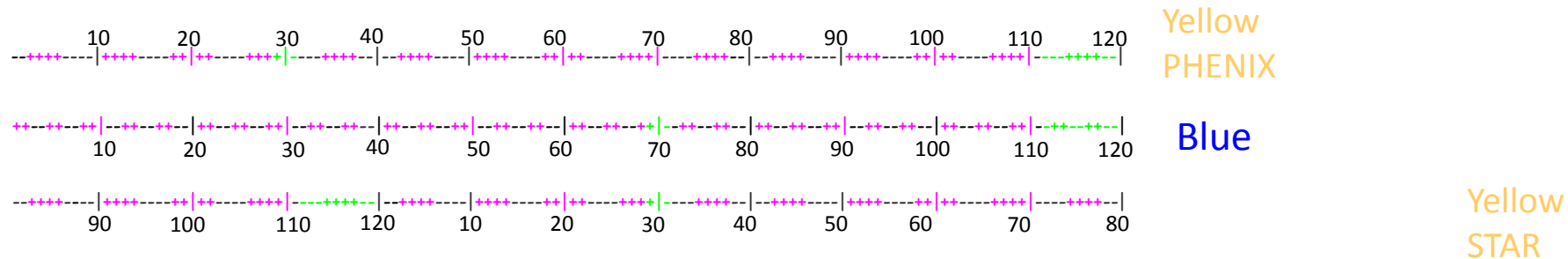


green bunches: empty bunches



2013 Continued WHAT WE HAD

P21: as example



Dropped Bunches

Colliding bunches

P21:	Y3: 5+/6-	B1: 5+/6-	STAR: 100x100	PHENIX: 107x107
P22:	Y4: 6+/5-	B1: 5+/6-	STAR: 100x100	PHENIX: 107x107
P23:	Y3: 5+/6-	B2: 6+/5-	STAR: 100x100	PHENIX: 107x107
P24:	Y4: 6+/5-	B2: 6+/5-	STAR: 100x100	PHENIX: 107x107
P25:	Y1: 5+/6-	B3: 5+/6-	STAR: 100x100	PHENIX: 107x107
P26:	Y2: 6+/5-	B3: 5+/6-	STAR: 100x100	PHENIX: 107x107
P27:	Y1: 5+/6-	B4: 6+/5-	STAR: 100x100	PHENIX: 107x107
P28:	Y2: 6+/5-	B4: 6+/5-	STAR: 100x100	PHENIX: 107x107

green bunches: empty bunches

2012 What WE HAD

4 spin patterns per beam

Blue:

1 +-+--+--+--+ also before 2012

2 -+--+--+--+ also before 2012

3 +++--+--+--+

4 ---+--+--+--+

Yellow:

1 +++--+--+--+ also before 2012

2 ---+--+--+--+ also before 2012

3 +-+--+--+--+

4 -+--+--+--+

we did collide

P1: B1xY1 P5: B3xY3

P2: B2xY1 P6: B3xY4

P3: B1xY2 P7: B4:Y3

P4: B2xY2 P8: B4:Y4

attention: P7: 38/39 missing in yellow, 78/79 in blue

What else:

360 buckets, every 3rd filled

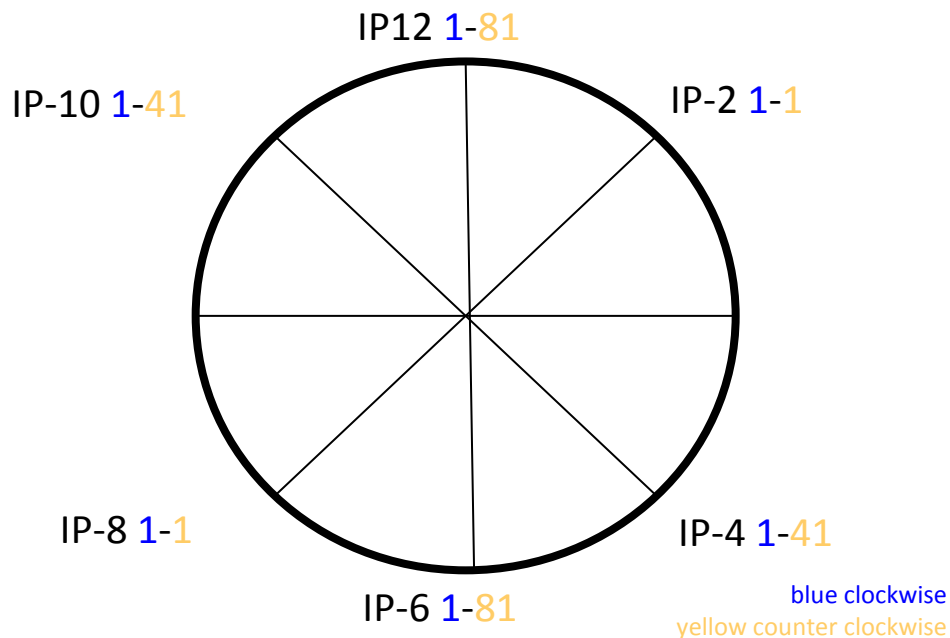
→ 120 bunches

aboard gaps aligned in PHENIX

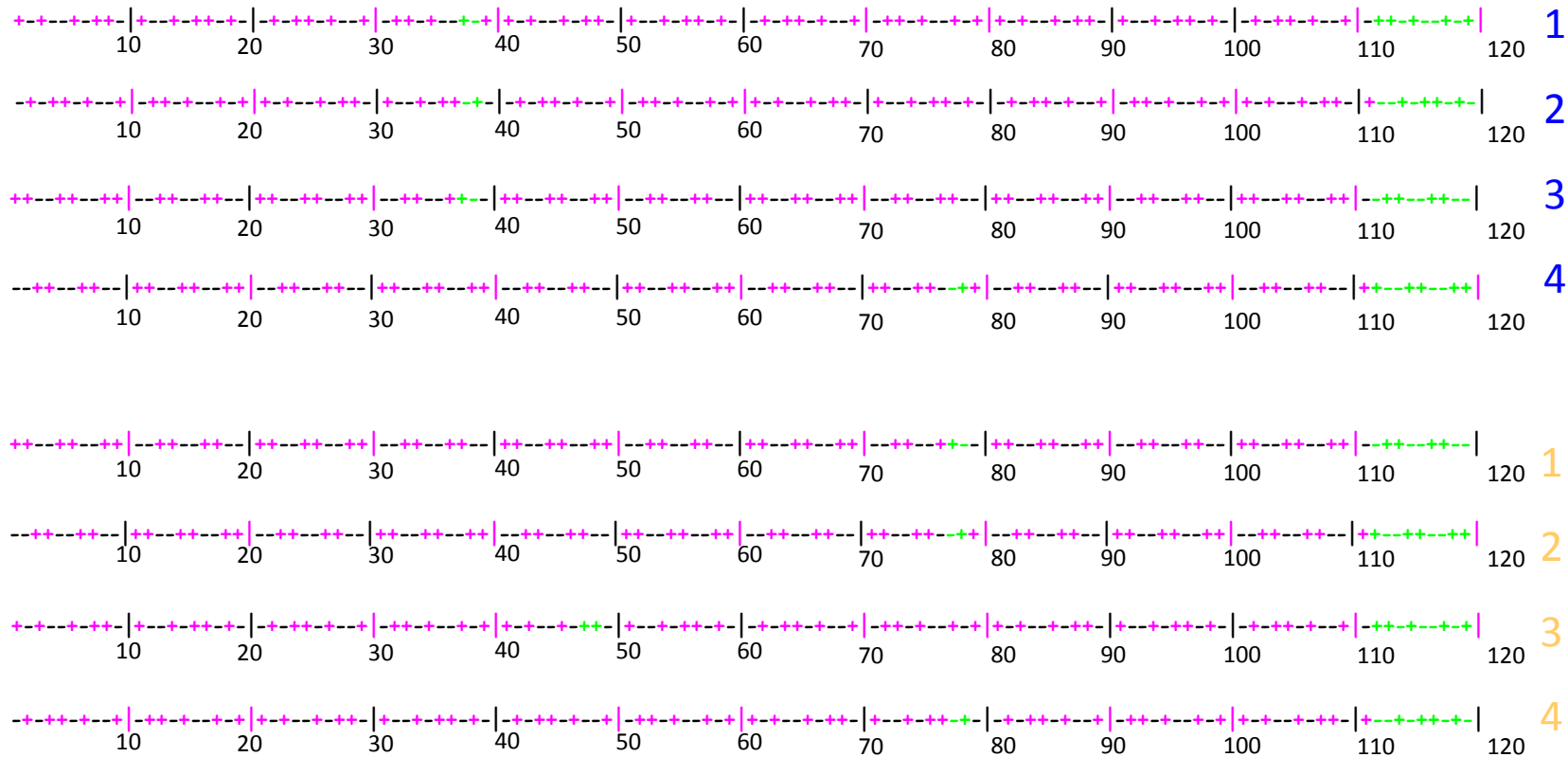
anti-aligned in STAR

bunch 38/39 missing in blue

bunch 78/79 missing in yellow



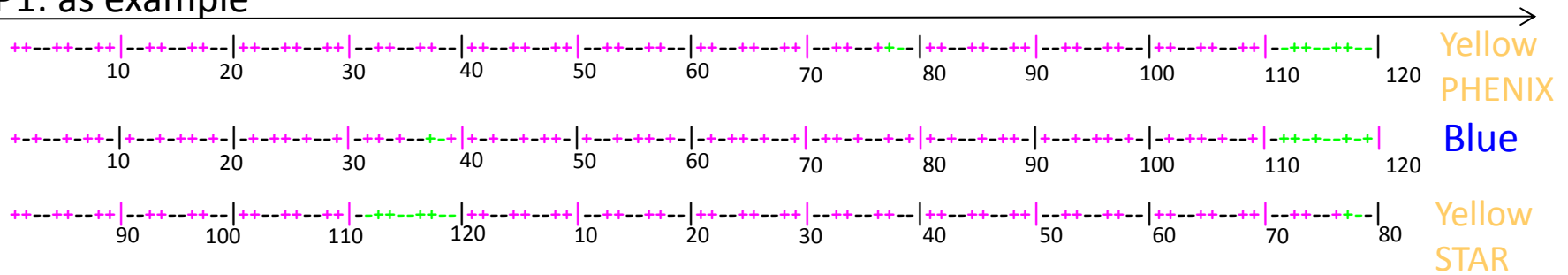
WHAT We HAD 2012 Spin Pattern



green bunches: empty bunches

2012 Continued WHAT We HAD

P1: as example



Dropped Bunches

Colliding bunches

P1:	Y: 5+/6-	B: 6+/5-	STAR: 102x102	PHENIX: 107x107
P2:	Y: 5+/6-	B: 5+/6-	STAR: 102x102	PHENIX: 107x107
P3:	Y: 6+/5-	B: 6+/5-	STAR: 102x102	PHENIX: 107x107
P4:	Y: 6+/5-	B: 5+/6-	STAR: 102x102	PHENIX: 107x107
P5:	Y: 6+/5-	B: 5+/6-	STAR: 102x102	PHENIX: 107x107
P6:	Y: 5+/6-	B: 5+/6-	STAR: 102x102	PHENIX: 107x107
P7:	Y: 7+/4-	B: 6+/5-	STAR: 100x100	PHENIX: 107x107
P8:	Y: 5+/6-	B: 6+/5-	STAR: 102x102	PHENIX: 107x107

← Pattern had a bug

green bunches: empty bunches