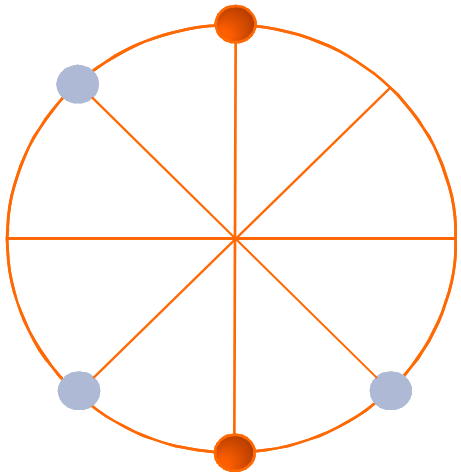
- Cogging
- Semi-Fine Adjust without collisions?
- Fine Adjust
- When?

COGGING MEETING

Sophie BARON

COGGING WITH BPTX - 1



- Cogging = find the phase of Frev to get 1x1 pilot bunches in buckets1
- By definition, buckets1 collide in P1 and P5
- Could we do it with other buckets?
- Buckets resolution = 1/RFfreq = 2.5ns (74.95cm between 2 consecutive bunches)
- To be done @ 450GeV
- No collisions required
- Can we keep the Frev1 constant and only move Frev2 (we set arbitrarily the bucket 1 of beam1 and we look for bucket 1 of beam2) ?
- Remember: 30cm=1ns

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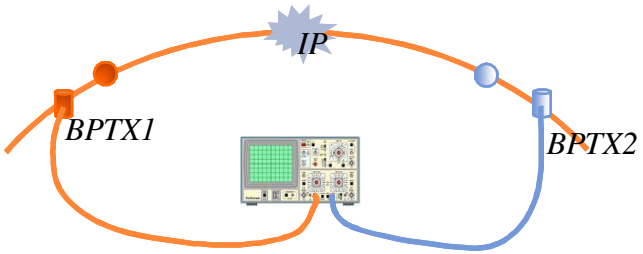
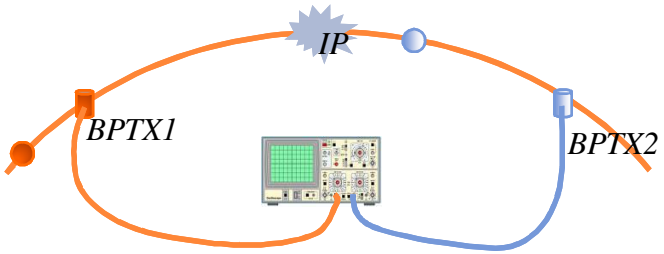
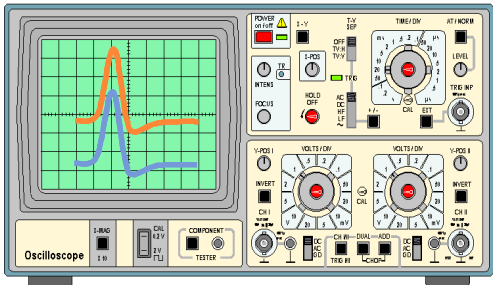
COGGING WITH BPTX - 2

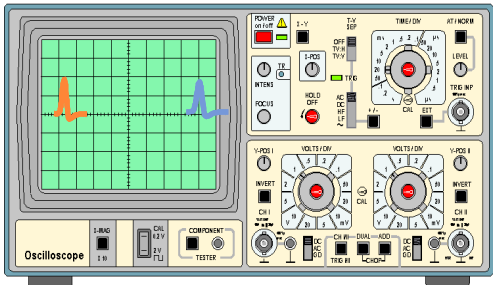


ATLAS & CMS (scope based)



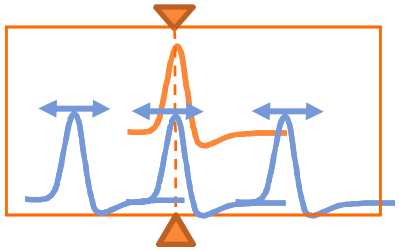
LHCb & ALICE(VME board based)

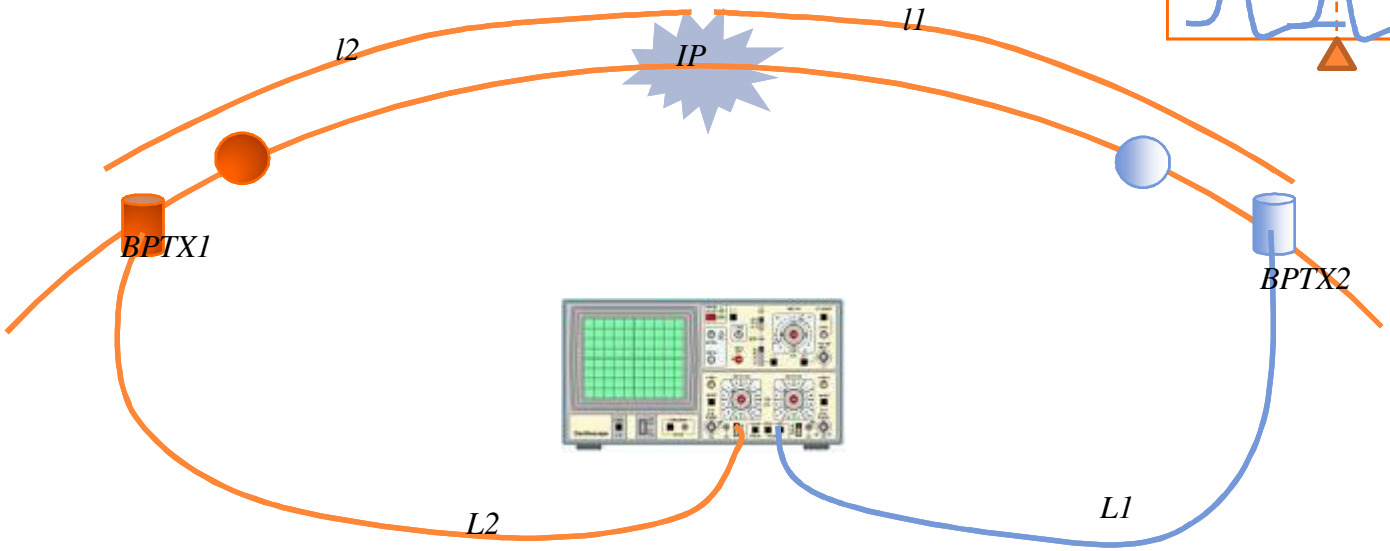




- Trigger on BPTX1
- BPTX of ATLAS and CMS should see (ideally) a zero time difference (T_beam1-T_beam2) between the two BPTXs
- ALICE and LHCb should see a time difference of 66693ns and 22231+3*25 ns respectively (using 88.924450us Frev period) => is it possible to compensate these delays in order to keep the nominal resolution of BPTXs?

COGGING WITH BPTX - 3





- To find the bucket1…
- Delay between bunch1 and bunch2 must be minimal after compensation of
  - The theoretical expected delay between bunches
  - the real distance of each BPTX from IP (*c)
  - the distance between each BPTX and the measurement device (*signal speed in copper= 20cm/ns=2c/3)
- To which precision do we know l1-l2 and L1-L2?
- Minimal absolute resolution required for BPTX is +-1.25ns (including uncertainties in l1, l2, L1 and L2)

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COGGING WITH BPTX - 4

- How do we exchange data there? Phone? DIP?
- Minimum configuration: ATLAS and CMS have both to be there (in case of trouble with one of the 2 systems). Would be great to have LHCb and ALICE too (they use a different system).
- Each bucket adjustment will require a full cycle with a resync and an injection.
- How many iterations will be expected?
- How long will it take?

SEMI-FINE ADJUSTMENTS WITHOUT COLLISIONS?

- Could we proceed to semi-fine adjustments without collisions? (only using BPTX)
  - Yes once the fine adjustment will have been done and the BPTX calibrated…
  - But what about doing it BEFORE?
- Of course, depends on l1-l2 and L1-L2 precision
- Goal: achieve a crossing point adjustement to within about 5 cm of the nominal.
- Detectors acceptance is designed for seeing interaction vertices from about -10 cm to +10cm

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FINE ADJUSTMENT -1

- During collisions
- Can be done continuously without resync
- Which scheme?
  - 2x2 @ $5^{e}10$
  - B1: 1 + 892
  - B2: 1 + 1786
  - All IPs
  - Collisions Rate >100Hz
- Precision on the RF side : 1/128deg of the 400 RF = 20ps (0.6cm)
- One fine adjust to be done for each energy level?
  - One at 450GeV
  - One at 1.1TeV (phase will slightly vary between injection and high energy if we keep the adjustments values of the injection)
  - One at 3.5TeV
  - …..?

FINE ADJUSTMENT -2

- Which sub-detectors are going to give the feedback?
  - If it is the trackers, will they take data? Will we be on STABLE BEAM?
  - What is the delay to get accurate feedback on the real rate?
  - 1 Bunch length = 33.6cm (1.12ns) => *is this value still true?*
  - 1 σ rms = 0.202ns=6.7cm => *and this one?*
  - Convolution of 2 bunch profiles (including RF phase jitter) => 95% of distribution within 18cm (0.6ns*) => and this one?*
  - What resolution could we hope to get with the feedback from experiments?
  - What is an acceptable adjustment value?
  - How do we exchange feedback? DIP?
  - How long will it take to get acceptable adjustment (5cm = 160ps)?
- With this adjustments, the BPTX will be calibrated => what will be the optimal resolution of BPTXs after calibration?

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When will it happen?

cogging

Fine adjust

450 GeV two beam operation	12	M	8	Two Beam Operation setting-up - 450 GeV	2x2, 5e9	Two beams stored, Lifetime ~10 hours
	12	A	8	Two Beam Operation setting-up - 450 GeV	2x2, 5e9	Common correction, …
	12	N	8	SF		
	13	M	8	450 GeV collision setting-up	Solenoids ON	
	13	A	8	450 GeV collision setting-up		Beams colliding in all IR, Long.pos. O.K.
	13	N	8	450 GeV collisions	2x2, 2e10	
Snapback and ramp to 3.5 TeV	14	M	8	Snapback- Ramp setting up - b1	with sol. ON	
	14	A	8	Snapback- Ramp setting up - b1 cont'd.		
	14	N	8	450 GeV collisions	2x2, 2e10	
	15	M	8	Snapback- Ramp setting up - b1 cont'd.		
	15	A	8	Protection device and collimator setting-up - b1 ramp		TCDQ, TCTs, collimators as aperture.
	15	N	8	450 GeV collisions	2x2, 3e10	
	16	M	8	Snapback- Ramp setting up - b2	with sol. ON	
	16	A	8	Snapback- Ramp setting up - b2, cont'd.		
	16	N	8	450 GeV collisions	4x4 3e10	
	17	M	8	Snapback- Ramp setting up - b2, cont'd.		
	17	A	8	Protection device and collimator setting-up - b2 ramp		TCDQ, TCTs, collimators as aperture.
	17	N	8	450 GeV collisions	4x4 3e10	
						BLM checks, energy tracking, LBDS BI
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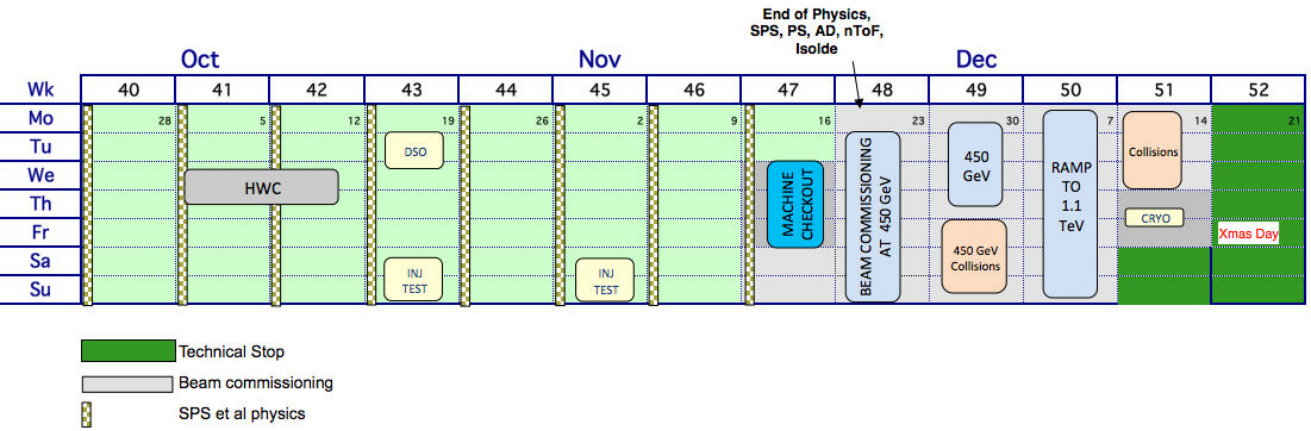

Mike, LPC, 26th of October