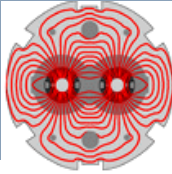


Update on 2018 start-up

J. Wenninger, R. Giachino, M. Albert,
M. Solfaroli, S. Fartoukh

Latest official 2018 start-up schedule



- ❑ **Powering tests** should be completed at the beginning of week 13.
- ❑ **Checkout** starts week 13, **opening of CMS vacuum valves is delayed** from Mo 26th March to Thu 29th March.
 - No BIS and full LBDS tests possible as long as CMS valves closed.
 - **T12/8 test** middle of week 13.
- ❑ **First beam** postponed by 4 days to second half of week 14.

	Jan				Feb				Mar					
Wk	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mo	1	8	15	22	29	5	12	19	26	5	12	19	26	
Tu		Controls Maintenance												
We						Technical stop (YETS)								
Th														
Fr									DSO test				G. Fri.	
Sa														
Su														

Powering tests completed

CMS vac valves open

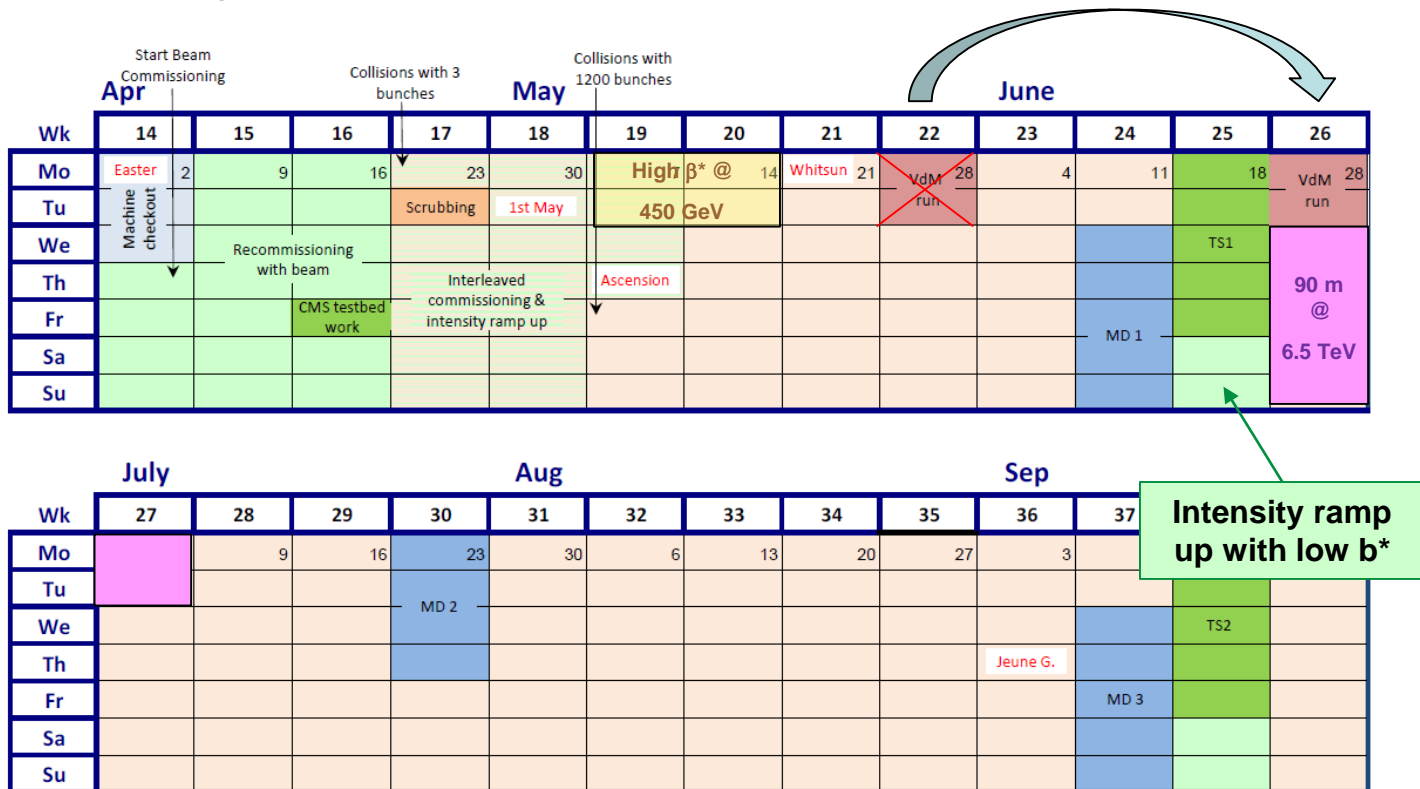
First beam

	Apr				May				June					
Wk	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Mo	Easter	2	9	16	23	30	7	14	Whitsun	21	VdM run	28	4	11
Tu	Machine checkout			Scrubbing	1st May									
We												TS1		
Th								Ascension						
Fr			CMS testbed work											
Sa											MD 1			
Su														

Special runs tentative planning

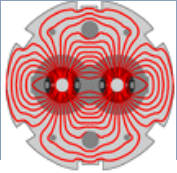


- ❑ **High beta test at injection** is foreseen in **weeks 19 or 20** (Mo or Tu).
 - 1 – 1.5 shifts.
- ❑ **VDM calibration** is currently foreseen just **after TS1**.
 - First some low-beta ramp up to ‘warm up’ some detectors (but not too much). This includes a 150 indiv fill for mu scan cross calibration.
- ❑ **High beta at 6.5 TeV (~90 m)** for TOTEM **follows the VDM in week 39**.
 - Commissioning of cycle & optics mid-may – mid June.





- ❑ **Low energy high beta run:**
 - Another test at injection in May with 2017 optics version.
 - If not successful → increase energy to 900 GeV + new optics (higher beta*).
 - Run will most likely be scheduled after the summer – tbc.
- ❑ **High energy (@6.5 TeV) high beta run:**
 - 90m like optics in IR5, IR1 tbd.
 - Optics will start from standard ATS injection, to be developed until end of April.
 - Baseline operation with 100 ns beam (~700 bunches, ~1E11 ppb), 50 ns as an option / test (LRBB).
- ❑ **VDM run** ~ same recipe as in 2017:
 - Reuse the 2016 settings once more.
 - This year crossing angles are back in IR1 and IR5 at injection and in the ramp.



- The MSWG requested a presentation on 23rd March of the beams required for LHC operation in 2018.
 - At least up to the summer, assuming all goes well.
- Beams for physics operation including **special runs**.
 - 100 ns and 50 ns: smallest reasonable emittance ~ OK.

Beam type	Intensity [10^{11} p/b]	Emittance [μm]	Date
Probe	0.05-0.2	-	startup
Nominal bunch	0.8-2	~2	startup
Vdm bunch	0.8-1	~3-3.5	W24
25 ns standard (4 batches)	1.15	2.5	W16
25 ns BCMS	1.1-1.3	1.5-1.9	W15
100 ns standard	0.8-1.1	1-2	W24
50 ns standard	0.7-1.1	1-2	W24

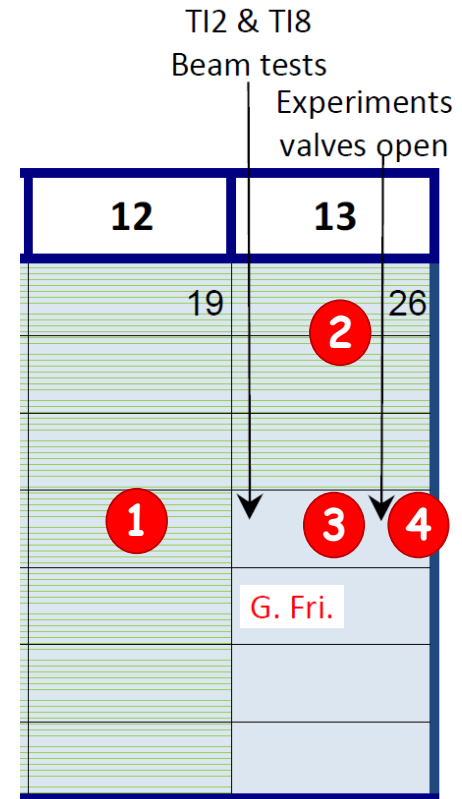


□ Week 12:

- Last powering tests,
- **Th 22.3**: Local BIS loop disconnected (LBDS test), reconnect LBDS to LHC BIS loops. 1

□ Week 13:

- Moving from powering tests to global machine checkout.
 - Checkout of full 2018 cycle down to β^* of 25 cm.
- **Mo 26.3** : UPS tests of LBDS.
- **Mo 26.3-We 28.3**: LBDS BETS tests with sectors 45,56,67,78. 2
 - RP interlocks tests – requires declaring **stable beams**.
 - MKI pulsing (with test key).
 - Experiments handshake tests.
 - Tests for SMP (energy, beta*).
- **Th 29.3**: All experiments vacuum valves opened. 3
 - Arm BIS loop and LBDS.
 - BIS and LBDS commissioning tests (start of).
- **Th 29.3**: TI2/TI8 tests to **downstream TEDs** 4
 - Beam will reach ALICE & LHCb.
 - MKI pulsing in nominal conditions.





□ **Week 14:**

- **Mo 2.4:** options if we progress well? 5
- **Tu 3.4 - We 4.4:** Complete BIS and LBDS commissioning without beam, and missing checkout tests. 6
 - Very likely ½ day of access to fix issues detected during checkout weekend.
 - Complete missing checkout tests.
- **Th 5.4:** Start of beam commissioning.

Start Beam Commissioning

Apr

Wk	14	
Mo	Eas 5	2
Tu	Machine checkout 6	
We		
Th		
Fr		
Sa		
Su		

↓

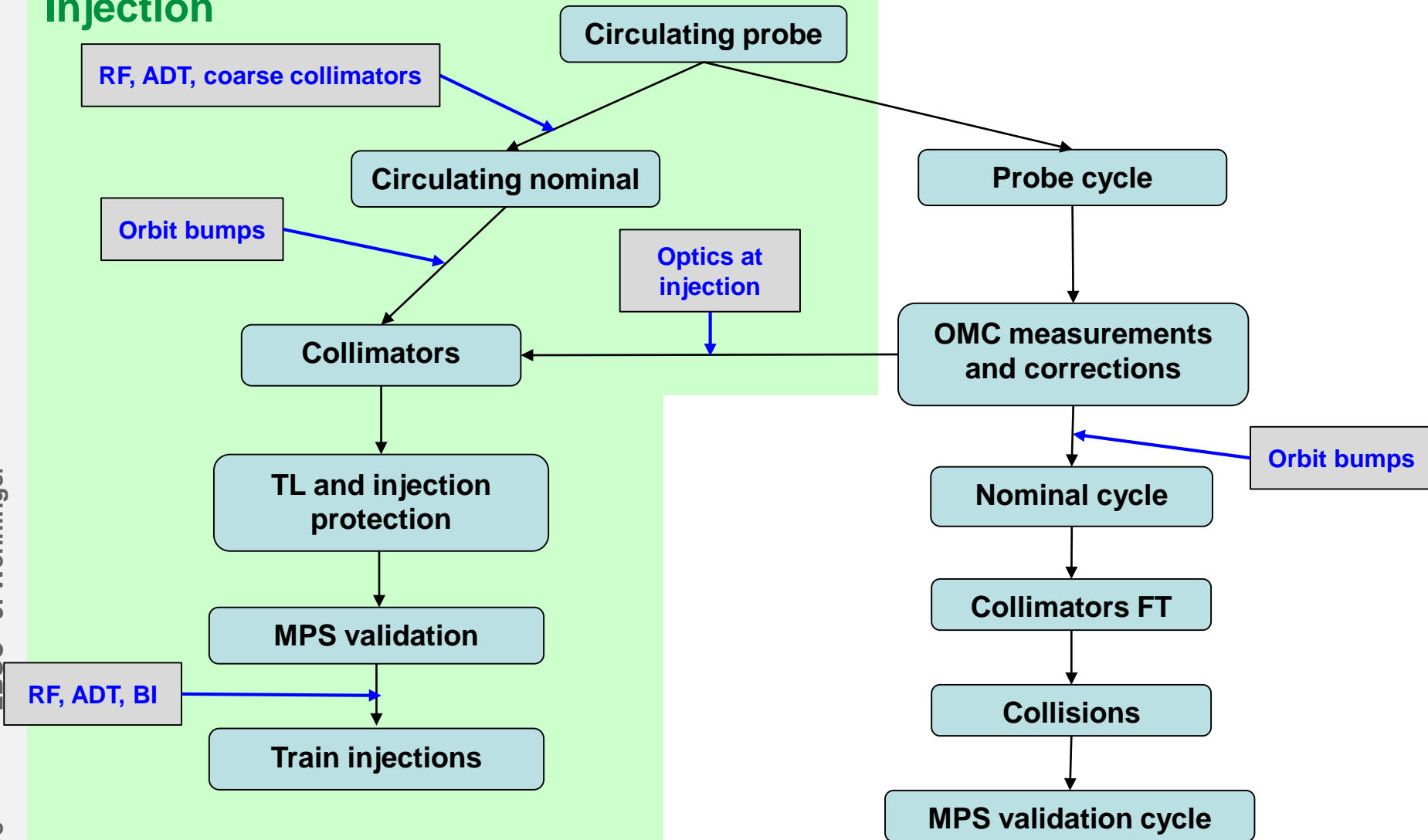


- ❑ Collected commissioning activities, incorporated into a tentative schedule.
- ❑ With the current input ~**2 ½ weeks** is a reasonable estimate for the time needed to first stable beams.
- ❑ Since S12 was not brought to room temperature, the **time for scrubbing** was reduced to ~ **24 hours** based on the experience of the previous years.

	Apr			May			June							
Wk	14	15	16	17	18	19	20	21	22	23	24	25	26	
Mo	Easter 2	9	16	23	30	1000	7	14	Whitsun 21	VdM 28	4	11	18	25
Tu	Machine checkout			Scrubbing	1st May									
We		Recommissioning with beam					2100						TS1	
Th				Interleaved commissioning & density ramp up		600		Ascension						
Fr			CMS testbed work	300		1200								
Sa											MD 1			
Su							2500							



Injection





- Shift-by-shift commissioning plan prepared based on the requests that were received – start on Thu 5th April.
- Google spreadsheet to plan & track:
 - https://docs.google.com/spreadsheets/d/1nnEb3f15L3NwxJ0RAnh-WkG_eiUUfJ9WGh2yxaT5Kjo/edit?usp=sharing
 - Aim to inject nominal bunch on Friday → open sufficient room for variety of activities during first weekend (after Easter).

Date	Shift	Time	Faults	Team	Status	Activity
05/04/2018						Thursday
	M	4				
Beam !	M	4		OP/RF		Injection, first turn, RF capture B1&B2 - closed orbit
	A	4		OP/BI		BI work: BPM phasing, BCT checks, multi-turn & AC dipole
	A	4		OP/BI		BI work: BPM phasing, BCT checks, multi-turn & AC dipole
	N	4		COLL		Coarse collimator set-up and loss map in preparation for ramp & ULO check
	N	4		OP		Probe through cycle to 30 cm
06/04/2018						Friday
	M	4		OP/RF/BI		Injection of nominal bunch
	M	4		OP		Reference orbit with nominal bunch
	A	4		COLL		Coarse collimator set-up and loss map in preparation for ramp & ULO check
	A	4		OMC		Optics at injection
	N	4		BI/OP		Shottky calibration (Q')
	N	4				
07/04/2018						Saturday
	M	4		ADT		ADT setup with probe / nominal bunch
	M	4		ADT		ADT setup with probe / nominal bunch
	A	4		OMC		Linear optics FT - 30 cm
	A	4		OMC		Linear optics FT - 30 cm
	N	4		OMC		Validation of NL corrections at 30 cm
	N	4		OP		Kick response T12/8
08/04/2018						Sunday
	M	4		OP		Cycle with nominal bunch to 30 cm
	M	4		OP		Cycle with nominal bunch to 30 cm - collisions??
	A	4		COLL		Aperture at 30 cm
	A	4		COLL		Aperture at injection



- The commissioning plan is accessible from the LBOC home page

The screenshot shows the LHC Beam Operation Committee website. The main content area features a large background image of the LHC tunnel with the text "LHC Beam Operation Committee" in red. Below this, it states: "The next meeting will take place on: Tuesday 6th February 2018 at 15:30 in room 874-1-011" and provides a link to the meeting page: <https://indico.cern.ch/event/689741/>. A list of committee members is also displayed:

- Chairman:** [J. Wenninger \(BE/OP\)](#)
- Deputy chairman:** [\[Name\]](#)
- Scientific secretaries:**
 - [T. Argyropoulos \(BE/OP\)](#)
 - [G. Trad \(BE/OP\)](#)
 - [X. Buffat \(BE/ABP\)](#)

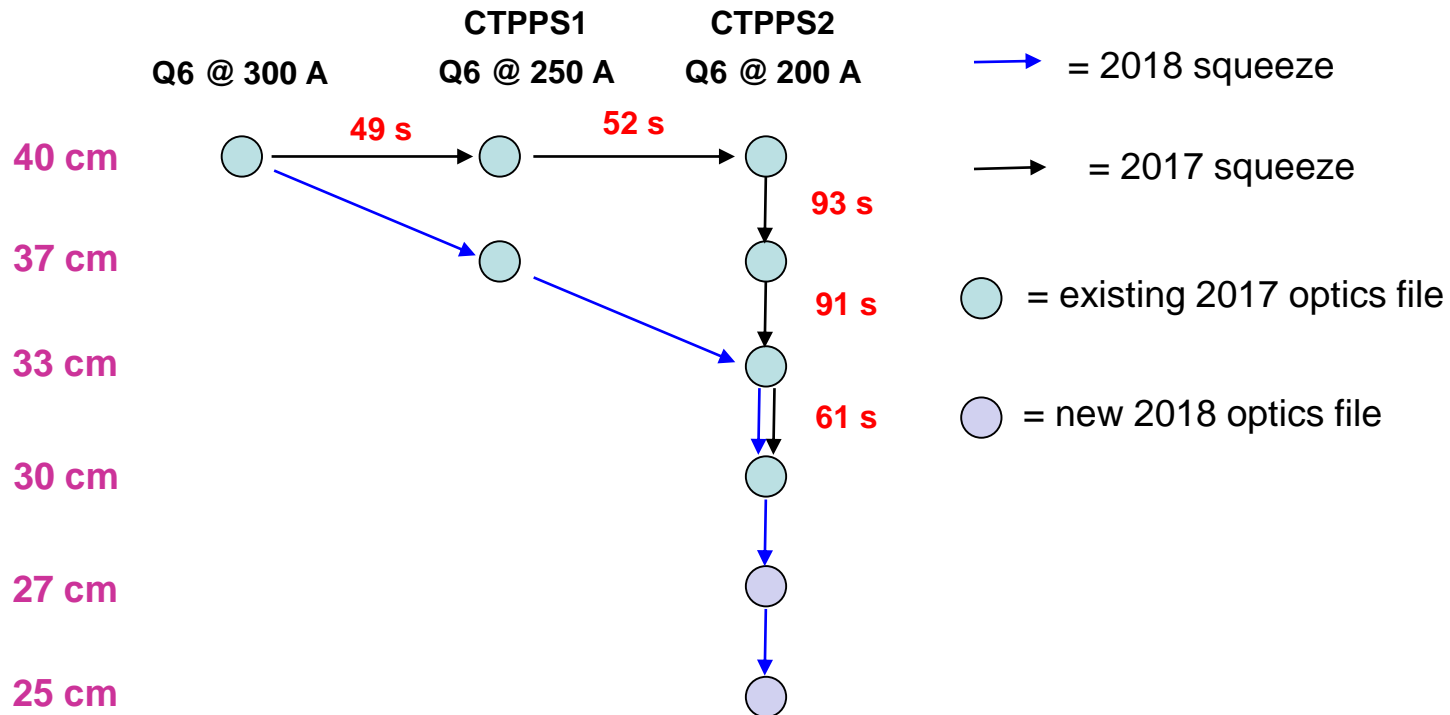
At the bottom of the page, there is a link to the "counter" [counter](#) (since 25.06.2012). On the left side, a dark blue navigation menu lists various links, with "2018 commissioning" highlighted by a yellow arrow pointing to the meeting information.



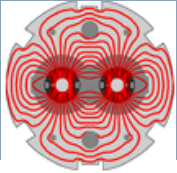
- ❑ **New sequence elements have been imported. Optics (re-)import to start soon.**
 - Wire collimator in IR1 and associated BPMs.
- ❑ **Ramp:** faster PPLP ramp.
 - The settings established during the 2017 MD will be used for bootstrapping.
 - Work starting this week...
- ❑ **Tune change:**
 - No change wrt 2017, **clone for 2018 in place.**
- ❑ **Squeeze:**
 - Merge squeeze segments 1m-40cm and 40cm-30cm,
 - Take a short cut to the CTTPS2 version (Q6 @ 200 A) – see next slide,
 - Reuse the 2017 settings for bootstrapping as much as possible.
- ❑ **Collisions:**
 - No change wrt 2017, **clone for 2018 in place.**
- ❑ **Squeeze for β^* levelling:**
 - New squeeze segment 30cm-27cm-25cm.
 - In preparation.
 - Must be setup eventually with colliding beams.
 - **Detailed scenario discussed next week at LBOC.**



- ❑ The 40cm-30cm squeeze segment will be merged with the 1m-40cm segment to form a single squeeze beam process covering 1m-30cm.
 - The end of the squeeze to 30 cm will be rebuild by taking a short cut towards the CTPP2 variant. This should save some ~100 s of squeeze time.
- ❑ Dedicated β^* levelling squeeze beam process 30cm-27cm-25cm.
- ❑ New optics files were delivered, upload as soon as the 2018 sequence is uploaded.



Spurious dispersion



- ❑ The crossing angle (and to some extent also the separation) bumps generate spurious dispersion that increases as β^* is reduced.
- ❑ For the ATS optics S. Fartoukh provides knobs that compensate the dispersion.
 - Not used in 2017.
- ❑ In order to remove a source of systematic errors on the emittance measurement, G. Trad asked if it would be possible to use the bumps and reduce the spurious dispersion that feeds into the beam sizes @ BSRT.
- ❑ Since the bumps are not very large (in the arc) and present no technical challenge, we **propose to use them in 2018**.
 - Nominal settings at 30 cm,
 - To be defined how we ramp the bumps up.
 - In the ramp \rightarrow nominal settings at FT (6.5 TeV / 1m),
 - In the squeeze \rightarrow nominal setting at 40 cm.

*Dispersion knobs for B2
@ 30 cm and 160 μ rad*

*Peak orbit excursion
 $\sim \pm 1.6$ mm*

*Drawn with +1 mm
ULO bump*





- Bumps values through the cycle.
 - The dispersion knobs are ramped up in the first points of the squeeze.

Bump	Injection	FT	30cm	collisions
Xing IR1	170	160	160	160
Xing IR2	170	200	200	200
Xing IR5	170	160	160	160
Xing IR8	-170	-250	-250	-250
Sep IR1	-2	-0.55	-0.55	0
Sep IR2	3.5	1.4	1.4	0
Sep IR5	2	0.55	0.55	0
Sep IR8	-3.5	-1	-1	0
Dispersion IR1	0	0	160	160
Dispersion IR5	0	0	160	160
IP shift IR2	0	0	0	-2
IP shift IR5	0	0	0	-1.8



- ❑ After considering all aspects with the LPCs we decided to drop the idea of crossing angle changes in IR8 (to replace the bunch length blow up for one of the polarities).
- ❑ The overhead for setup and validation was not worth $\sim 1\%$ of integrated luminosity gain for ATLAS & CMS.