ATS round MDs (MD3270)

<u>rMPP MD2 preparation meeting</u>

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Lumi, Beam-beam, Instability & ADT teams

Acknowledgement: X. Buffat

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MD setup

Combined Ramp and Double Squeeze (CRDS), immediately followed by Q-change and collision @ 65 cm

The pre-squeeze (11 m → 2 m) starts at 1 TeV
The tele-squeeze (2 m → 65 cm) starts at 2.7 TeV
→ Tele-index of 3 End of Ramp

Constant optics
Pre-squeeze
Tele-squeeze

Matched Point	Time [s]	Parabolic Fraction	Optics name	Tele-Index	β^* [cm] at IP1 &5	Energy [GeV]
1	0	0.1	R2017a_A11mC11mA10mL10m	1.000	1100.0	450
2	15	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	452
3	30	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	459
4	45	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	470
5	60	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	485
6	90	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	531
7	120	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	594
8	160	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	705
9	241	0.05	R2017a_A11mC11mA10mL10m	1.000	1100.0	1013
10	293	0.13	R2017a_A970C970A10mL970	1.000	970.0	1277
11	317	0.10	R2017a_A920C920A10mL920	1.000	920.0	1416
12	337	0.15	R2017a_A850C850A10mL850	1.000	850.0	1532
13	361	0.13	R2017a_A740C740A10mL740	1.000	740.0	1671
14	385	0.10	R2017a_A630C630A10mL630	1.000	630.0	1810
15	413	0.10	R2017a_A530C530A10mL530	1.000	530.0	1972
16	437	0.11	R2017a_A440C440A10mL440	1.000	440.0	2111
17	461	0.12	R2017a_A360C360A10mL360	1.000	360.0	2250
18	493	0.15	R2017a_A310C310A10mL300	1.000	310.0	2435
19	525	0.15	R2017a_A230C230A10mL300	1.000	230.0	2620
20	545	0.15	R2018a_A200C200A10mL300	1.000	200.0	2736
21	649	0.15	R2018aT200_A182C182A10mL300	**1.096**	182.5	3339
22	749	0.20	R2018aT200_A155C155A10mL300	**1.290**	155.0	3918
23	825	0.15	R2018aT200_A122C122A10mL300	**1.633**	122.5	4358
24	925	0.16	R2018aT200_A95C95A10mL300	**2.105**	95.0	4937
25	1025	0.20	R2018aT200_A77C77A10mL300	**2.581**	77.5	5516
26	1169	0.10	R2018aT200_A65C65A10mL300	**3.077**	65.0	6350
27	1210	0.05	R2018aT200_A65C65A10mL300	**3.077**	65.0	6500

Intensity ramp up strategy

- Validation shift with **setup beams** (see details later)
- First step with 1+12+144 = **157 bunches**
- Intermediate step with 1+12+ **3** × 144 = **445 bunches**
- Last step with 1+12+ **6** × 144 = **877 bunches**

(all bunches except the first INDIV are colliding at IP1/5, fully separated at IP2 and with typical separation at IP8)

→ Replacing the 3 steps by 1/2/5 SPS injection could be acceptable w/o rending inconclusive the MD results (a min. of 700 "packed" bunches is needed for e-cloud)

→ **1+12+2× 48= 109 bunches for the first step is possible,** but the filling scheme will have to change as of the second step, making partially inconclusive the BBLR and instability studies made at the first step.

Detailed MD activities (1/2)

Validation shift

Activity (and comments)	Time estimate [h]
Single_7b_1_1_1_5ncPilots2cNom (2 colliding nominal + 10 non-colliding probes) **New TCT/TCL4 functions (centres and Nsigma) and energy/b^* interlock thresholds** **All maskable interlocks (inc. collimator) masked** **New MO ramp function with positive polarity**	
- Setting up at injection, and injection → 0.5 h **- Combined ramp & double squeeze → 0.25 h** **- Betatron Loss maps at flat top (optional) → 0.25 h** **- Q-change immediately followed by the Physics BP, Establish and optimize collision → 0.5 h** **- Betatron Loss maps in collision @ 120 µrad → 0.25 h** **- 120 → 90 µrad X-angle reduction and lumi optimization → 0.25 h** **- Betatron Loss maps in collision @ 90 µrad → 0.25 h** **- 90 → 120 µrad X-angle increase and lumi optimization → 0.25 h** **- Off-momentum Loss maps in collision (both dp)@ 120 µrad → 0.5 h** **- Scraping (<5E10), de-bunching, asynchronous dump (TCT @ 11 σ) → 0.5h**	3.5
Total	3.5

Intensity ramp up

Activity (and comments)	Time estimate [h]
1rst Fill: BBLR studies with trains	
- Setting up at injection and injection → 0.75 h - Combined ramp & double squeeze → 0.25 h - Q-change and Setting up at flat top → 0.5h - Collision and lumi optimisation with trains→ 0. 5 h - MO polarity reversal, down to -570 A & Tune scan→ 0.5 h - X-angle reduction down to 100-90 μrad (if life time good enough) & Tune scan → 0.5 h - MO scan from -570 A to +200 A (2/3 cycles in one go for each step)→ 0.75 h - MO @ -570 A , X-angle back to 120 μrad and lumi levelling test→ 0. 25 h - Offset levelling test (fast and slow Vernier scan) and beam activity observation → 1.0 h	5.0
Dump & Ramp down	1.0
2d Fill: Intensity ramp up with 450 bunches	
- Setting up at injection and injection → 0.75 h - Combined ramp & double squeeze → 0.25 h - Q-change, Setting up at flat top, and heat-load/beam activity observation → 0.5 h - Collision and lumi optimisation with trains→ 0. 25 h - MO polarity reversal down to -570 A and X-angle reduction down to 100-90 μrad (if life time good enough) → 0. 25 h - Lumi optimization and heat-load/beam activity observation → 1.0 h	3.0
Dump & Ramp down	1.0
3rd Fill: Intensity ramp up with 900 bunches	
- Setting up at injection with probes and injection → 0.75 h - Combined ramp & double squeeze → 0.25 h - Q-change, Setting up at flat top, and heat-load/beam activity observation → 0.5 h - Collision and lumi optimisation with trains→ 0. 25 h - MO polarity reversal down to -570 A and X-angle reduction down to 100-90 μrad (if life time good enough) → 0. 25 h - Lumi optimization and heat-load/beam activity observation (optional: Vernier scan towards the end) → 2.0 h - Beam dump	4.0
Total	14.0

Summary & outlook

- Identifying and demonstrating an operational scenario with the CRDS (and MO@ 200 A EoR) **is <u>vital</u> to boost the LHC performance in Run III**

- Ideally, however, one would like to demonstrate the CRDS with negative MO polarity all along, which is more “risky” (instability-wise) in the Physics beam process, but on the other will avoid MO polarity reversal for colliding beams, (MO<0 is needed for life time but only at lower β^*/X-angle)

** If the offset levelling test is probing, as foreseen at MO=-570 A at the end of the first step, the MO polarity will be reversed to negative (Ramp # 3 available in the trim history) as of the second step of the intensity ramp up. **

→ If counter-indication from rMPP, one will NOT do this.