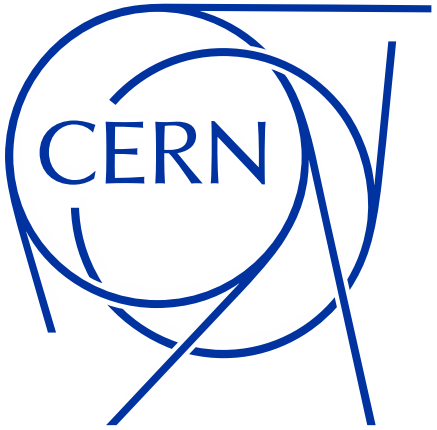

VdM MDs for Non-Factorization 11643/11644

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rMPP for MD1 | 03/05/2024

MD11643 Non-Factorization at Injection

Link to procedure: https://asm.cern.ch/md-planning/lhc-requests/11643/procedure

MD11643 Non-Factorization at Injection

The work is towards improving and understanding the Non-Factorization mechanisms for VdM beams, a large uncertainty of the luminosity calibration measurements

Goal:

- To measure the correlations between planes of specially prepared beams (in the PSB) at LHC injection via scraping measurements, to understand how correlations are transported along the chain in view of VdM runs.

Sketch:

- After injection, steps of scraping using the collimators will be done in plane V. (If time allows H in a different fill), and the profiles in H, V, and longitudinal will be measured, in order to see behaviour of two different bunch types.

MD11643 parameters

- 4 bunches per beam with 1e11ppb = **4e11pp beam**
- ε_N ~ 3 μm
- Different types

  A: without correlation

  B: large tails, highly correlated

  If there is time, we will test 2 more types of correlated beams, injecting 2 flavours at a time only

- Proton Physics optics, octupole 20 A
- **4/12** bunches of full MD11644 **filling scheme**: https://lpc.web.cern.ch/schemeEditor.html?user=lpc&scheme=2024/Special/Single_12b_12_0_4_MD11644.json

RF slot	Type
1	**A**
3411	**A**
5471	**B**
8941	A
10951	**B**
14411	B
16421	A
19891	B
21901	A
24631	B
27371	B
30111	A

MD11643 Procedure *BEAMFLAG=SETUP*

1. Inject 4 bunches (2 type A, 2 type B)
2. Mask maskable BLMs and collimator motion
3. Open collimator limits (V TCP in IR7, H in last two fills if time allows)
4. Alignment of the primaries (V TCP in IR7, H in last two fills if time allows)
5. Retract to 5.5 σ
6. Turn off orbit feedback
7. Move the primary collimator (V or H) in both beams in steps of ~(10 µm - 50 µm) every few s to until 2% intensity reduction
8. Scan with the WS, BSRT and longitudinal pickup, repeat step 7.
9. When 40% intensity is lost, retract the TCP
10. Dump and reinject (x 6)

MD11644 Non-Factorization with Stable beams

Link to procedure: https://asm.cern.ch/md-planning/lhc-requests/11644/procedure

MD11644 Non-Factorization with stable beams

Goal:

- To measure the correlations between planes of specially prepared bunches (at the PSB) in the LHC at stable beams (**VdM scans in ATLAS, CMS, beam-gas imaging at LHCb**) to understand how correlations are transported along the chain and up to flat top.
- To compare VdM results with profile scraping measurements.

Sketch:

- Injection of 12 bunches (two types), ramp, handover to experiments for VdM and BGI, then one end of fill scraping measurement in ADJUST like injection MD11643, in plane V.

MD11644 Beam parameters

- 12 bunches per beam ~ 1e11ppb = **12e11pp beam**
- ε_N ~ 3 µm
- Two different types
  - A: without correlation
  - B: large tails, highly correlated
- VdM optics, octupole 20 A/ 300 A
- Filling scheme: https://lpc.web.cern.ch/schemeEditor.html?user=lpc&scheme=2024/Special/Single_12b_12_0_4_MD11644.json
- Collisions (A-A, B-B) in ATLAS, CMS, LHCb with full separation at ALICE but long range for four bunches

RF slot	Type
1	**A**
3411	**A**
5471	**B**
8941	A
10951	**B**
14411	B
16421	A
19891	B
21901	A
24631	B
27371	B
30111	A

MD11644 Procedure *BEAMFLAG=STABLE, ADJUST*

1. Inject 12 bunches per beam (6 type A, 6 type B)
2. Ramp to *STABLE* beams and handover to experiments for ~ 6 hours
   For VdM scans in ATLAS, CMS, and beam-gas imaging in LHCb
3. Switch to *ADJUST* and scrape similar to injection MD (without masking BLMs) but more gently, wire scanner (< 12.5e11 intensity), BSRT, longitudinal profile

Similar scraping at 6.5 TeV with 2.7e13 intensity was already done: https://journals.aps.org/prab/pdf/10.1103/PhysRevAccelBeams.23.044802

TABLE III. Summary of the measurements performed at 6.5 TeV, where n is the total number of bunches, I_{st} is the total intensity at the start of the scraping, and I_s is the total intensity lost during scraping (including luminosity burnoff). σ_s is the scraped range in measured beam sigma starting from 5σ.

			Beam 1			Beam 2			Scans performed	
Fill	Date	n	I_{st} [10^{13} p]	I_s [10^{13} p] (% of I_{st})	σ_s	I_{st} [10^{13} p]	I_s [10^{13} p] (% of I_{st})	σ_s	Beam	Plane
4910	2016-05-11	313	2.7	0.26 (6%)	1.5	2.8	0.26 (5%)	1.5	B1/B2	H/V
5105	2016-07-20	2076	15.0	1.10 (7%)	1.5	15.0	0.91 (6%)	1.5	B1/B2	H/V
5834	2017-06-15	900	8.8	0.59 (7%)	1.5	9.0	0.33 (4%)	1.5	B1/B2	H/V
5848	2017-06-20	1741	12.0	1.20 (10%)	1.5	13.0	0.49 (4%)	1.5	B1/B2	H
5849	2017-06-21	2029	13.0	0.98 (8%)	1.5	13.0	0.52 (4%)	1.5	B1H	B2V
6052	2017-08-06	2550	19.0	2.30 (12%)	1.2	21.0	2.30 (11%)	1.3	B1/B2	H/V
6194	2017-09-13	224	2.7	1.10 (40%)	1.8	2.7	1.02 (36%)	1.9	B1/B2	H/V
7221	2018-09-26	2550	12.0	0.65 (5%)	1.2	15.1	0.34 (2%)	1.2	B1/B2	V
7264	2018-10-07	2550	13.0	0.82 (6%)	1.3	14.2	0.75 (5%)	1.4	B1/B2	H/V
7392	2018-10-30	300	2.1	0.23 (9%)	1.2	2.4	0.28 (10%)	1.2	B1/B2	H/V
7392[a]	2018-10-30	300	2.8	0.21 (10%)	1.2	3.1	0.26 (11%)	1.2	B1/B2	H/V

[a]Scraping done with unsqueezed, noncolliding beams.

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