

MD 2269 - Round Telescopic optics - revalidation and BBLR studies with trains

- MD setup
- Revalidation part
- BBLR part

MD set up

- **Hypercycle (35 cm telescopic optics starting from 1m pre-squeeze)**
 - RAMP-SQUEEZE-6.5TeV-ATS-1m-2017_V3_V1_TELE_ATS_CloneMD1
 - **nearly nominal ramp** (latest TCDQ/TCSP nominal ramps and limits)
 - TELE-ATS_knobs-2017_V1
 - **knob exchange**, standard vs. tele
 - SQUEEZE-TELE-6.5TeV-ATS-1m-35cm-2017
 - **Strictly telescopic squeeze from 1 m to 35 cm** (with crossing angle increased from 300 mrad to 340 mrad in IR1 and IR5)
 - QCHANGE-TELE-6.5TeV-ATS-2017_35cm_V1
 - **Tune jump** onto the nominal (design report) collision tunes, using the TELE knobs, from 62.28/60.31 to 62.31/60.32,
 - PHYSICS-TELE-6.5TeV-ATS-2017_35cm_V1
 - **Collapse the separation bumps and IP shift in IR2 and IR5**
- **Optics measured and corrected (MD1). Full mechanics demonstrated with 3E11 (MD3). New TCT functions calculated and uploaded (post-MD3). Nominal collimator in IR3/6/7**

Revalidation

- **One shift of 7(+2h) with 3E11**

- ✓ **Fill # 1: set up fill with 2 nominal and ~10 probes (<3E11)**

- (i) Loss maps before collision at 35 cm,

- (ii) Re-establishing collisions and loss maps in collision at 170 μ rad half-crossing angle,

- (iii) Crossing angle reduction down to 100 μ rad with “orchestration tool” and loss maps at 100 μ rad half-crossing angle,

- (iv) Roll back to 170 μ rad,

- (v) Intensity scraping down to 1-2 pilots and triplet aperture measurement.

- ✓ **Fill # 2: pure validation fill with 2 INDIVs (<3E11)**

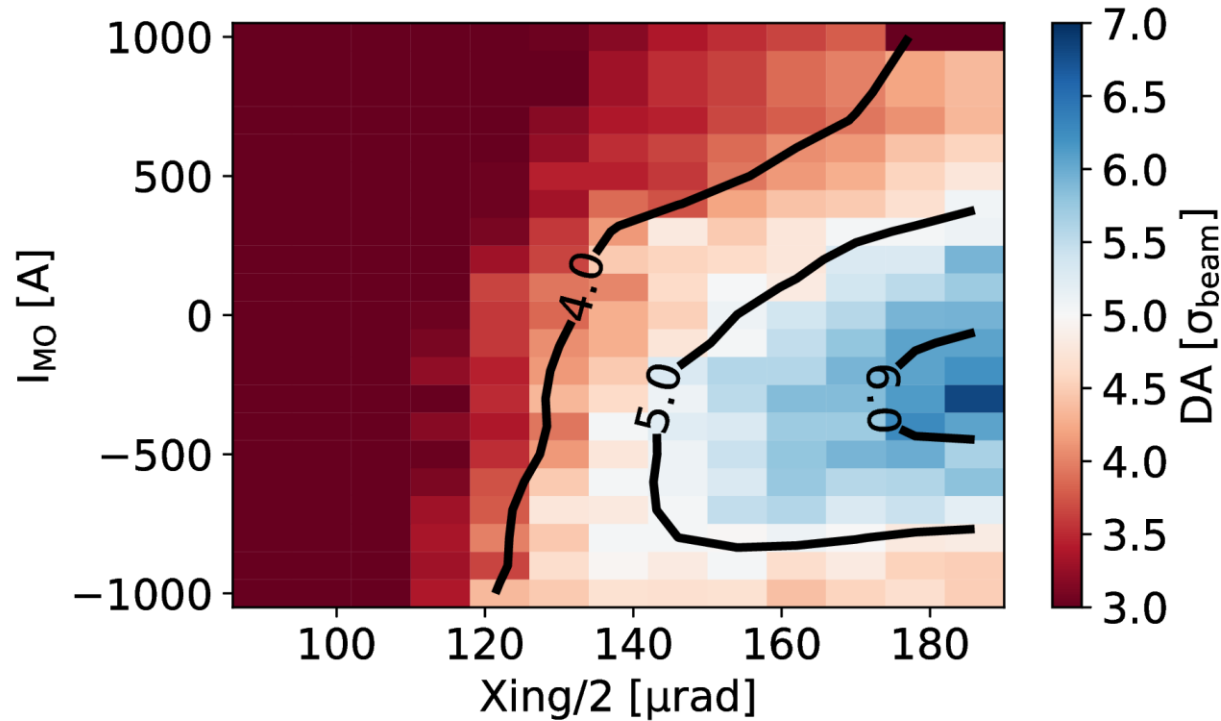
- No other activities than an asynchronous dump test in collision (with 8.4 σ TCT setting in IR1 and IR5, corresponding to the end point of the Nsigma TCT functions at 35 cm).

- **After discussion the MO>0 polarity is kept (negative knob), while the BBLR compensation occurs with MO<0 (see later)**

BBLR part (1/5): Dynamic aperture vs. MO and X-angle

ATS MD 2017; $\beta^* = 35$ cm; $Q = (62.31, 60.32)$;
 $Q' = 15$; $\epsilon = 2.5$ μm ; $I = 1.2 \cdot 10^{11}$ e; Min DA.

Courtesy of D. Pellegrini

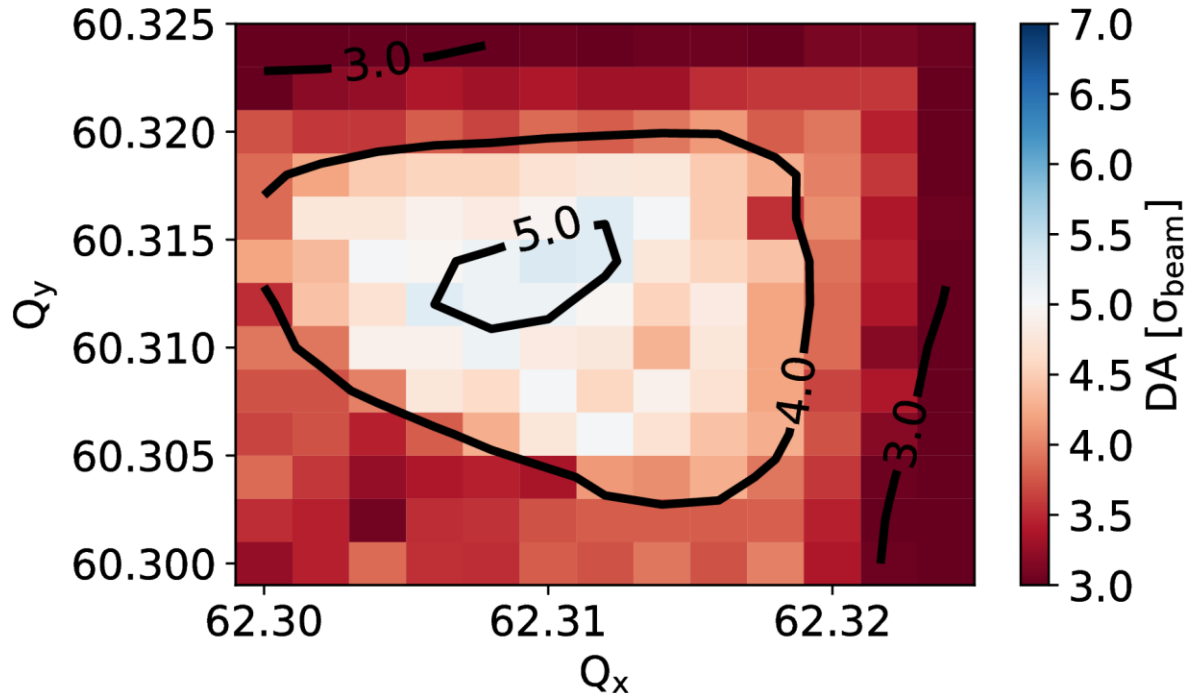


Significant **reduction** of Xing going from positive to negative octupole

BBLR part (2/5): X-angle reach

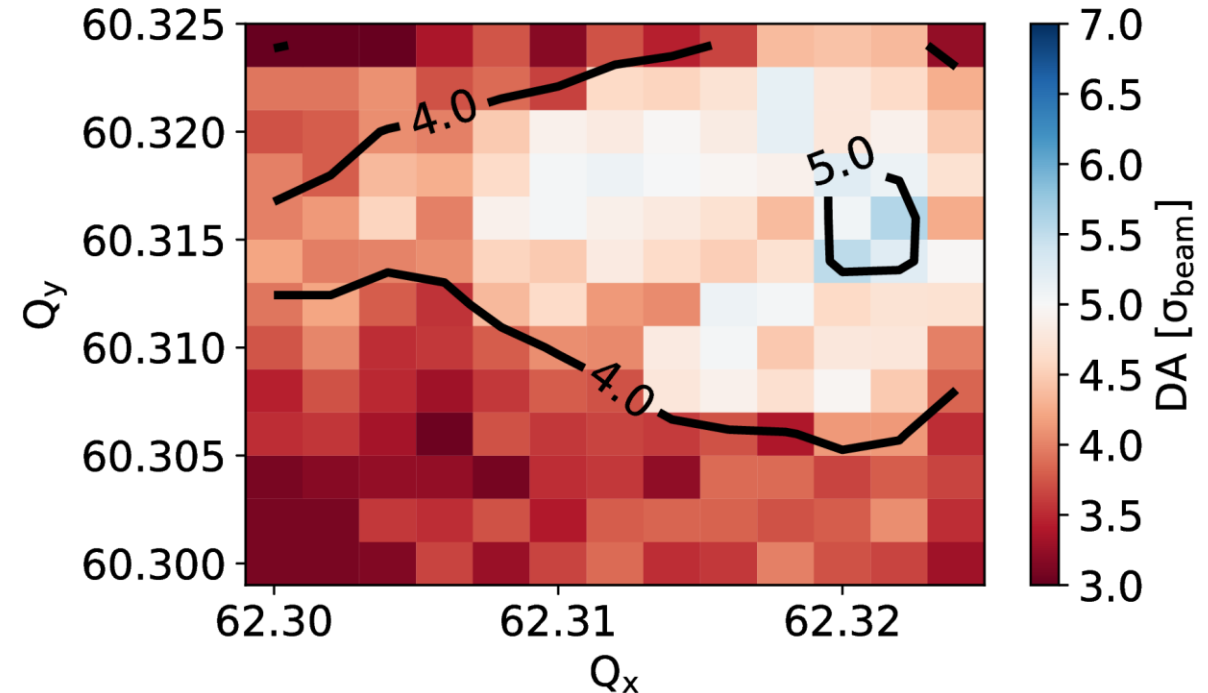
ATS MD 2017; $\beta^* = 35$ cm; $X_{\text{ing}}/2 = 150 \mu\text{rad}$

$I_{M0} = 500$ A; $Q' = 15$; $\epsilon = 2.5 \mu\text{m}$; $I = 1.2 \cdot 10^{11}$ e; Min DA.



ATS MD 2017; $\beta^* = 35$ cm; $X_{\text{ing}}/2 = 135 \mu\text{rad}$

$I_{M0} = -500$ A; $Q' = 15$; $\epsilon = 2.5 \mu\text{m}$; $I = 1.2 \cdot 10^{11}$ e; Min DA.



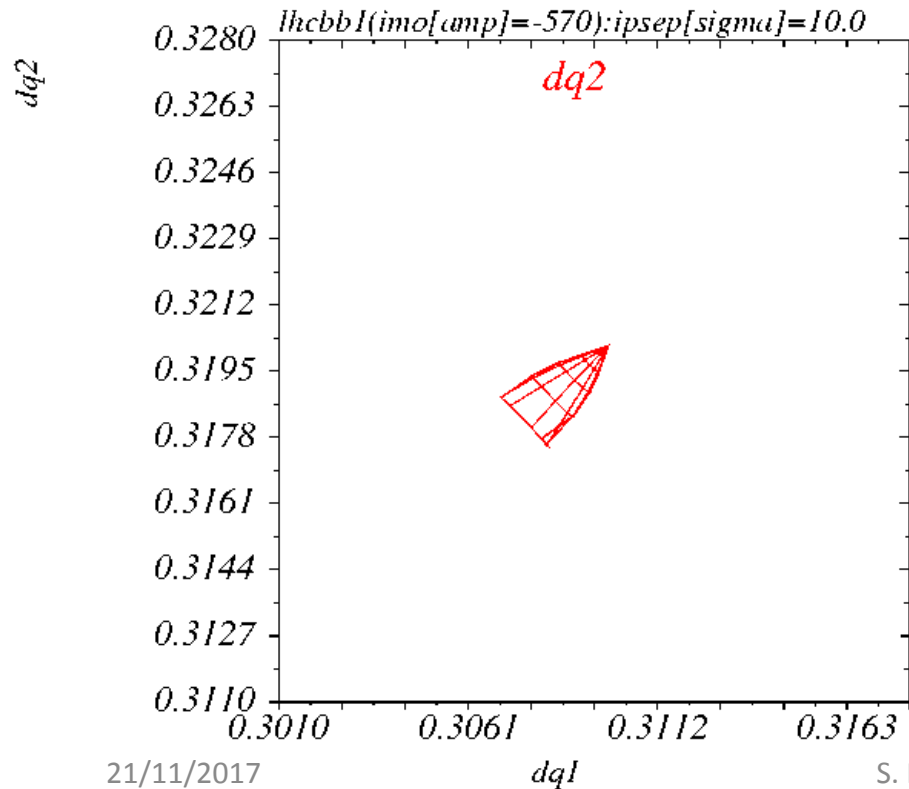
- Negative octupoles with the crossing angle reduced by $\sim 15 \mu\text{rad}$ give a comparable DA landscape in the tune space.
- Need to **re-optimize the tune** to profit!

BBLR (3/5): Choice of MO polarity and scan

→ Full cycle with $MO > 0$ (detailed settings still to be agreed)

→ Scanning the MO current from >0 to <0 only when colliding

Putting in collision with $MO < 0$ would collapse otherwise the footprint (as in 2012 prior TS2)

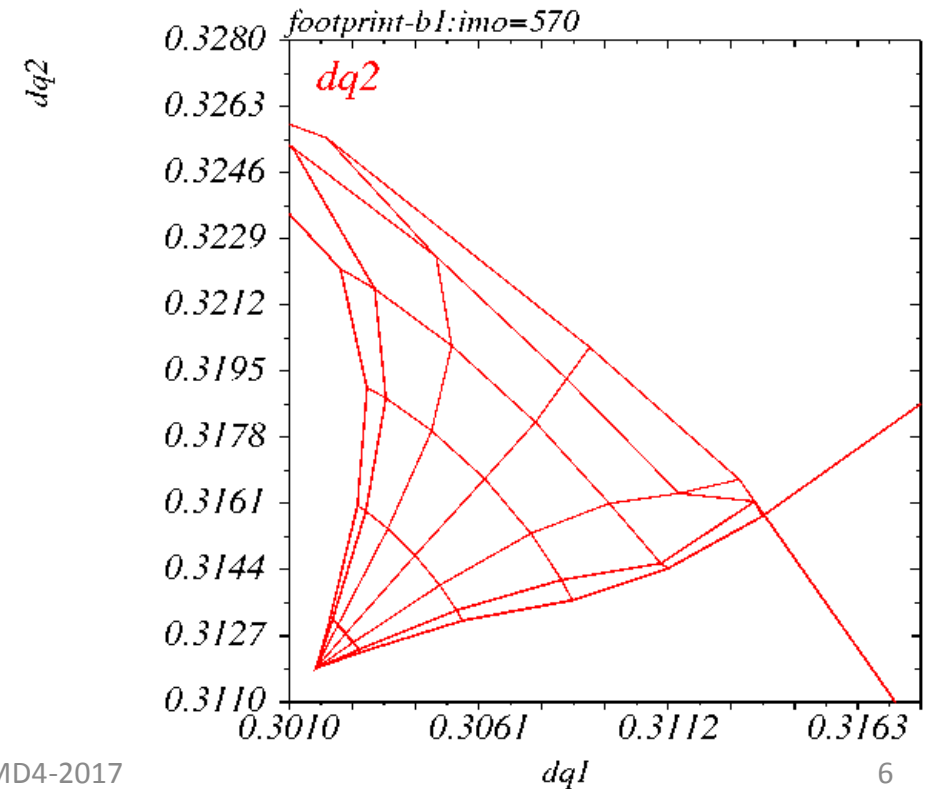


21/11/2017

$dq1$

S. Fartoukh, rMPP meeting part II for MD4-2017

Scanning the MO for >0 to <0 (colliding beams) should definitely improve the life time (and help reducing the crossing @ $MO < 0$)



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BBLR part (4/5): Filling scheme

LHC Injection Scheme editor v 1.3.10

RBA: lhcop kibana

INJECTION SCHEME EDITOR BUNCH PATTERN EDITOR

Injection scheme builder add injection request to scheme display existing injection request

Injection schemes

show filter clear filter

25ns_165_164_0_0_48bpi+8b4e_MD22

Scheme Name: 25ns_165_164_0_0_48bpi+8b4e_MD2269
 Inj scheme group: 25ns
 Creation Date: Sep 28, 2017 12:32:26 PM
 Description: Fillig scheme for ATS round optics MD#4
 Collisions in IP1: 162
 Collisions in IP2: 0
 Collisions in IP5: 162
 Collisions in IP8: 0

OverInjection CleaningEnabled

Pilot B1 **1601** Pilot B2 **1611**

RFBucket	Bu Tot	bu/btch	Spc/ns	PSbchs	I level	RFBucket	Bu Tot	bu/btch	Spc/ns	PSbchs	I level
1	1	1	0	1	NOM	311	1	1	0	1	NOM
711	12	12	25	1	INTR	711	12	12	25	1	INTR
1221	48	48	25	1	NOM	1221	48	48	25	1	NOM
2091	48	48	25	1	NOM	2091	48	48	25	1	NOM
2961	56	56	25	1	NOM	2961	56	56	25	1	NOM

COMPUTED INFO

A	B
Nbr OF BUNCHES B1	
Nbr OF BUNCHES B2	
Nbr COLLISIONS IP1	
Nbr COLLISIONS IP2	
Nbr COLLISIONS IP5	
Nbr COLLISIONS IP8	
PILOT POSITION B1	
PILOT POSITION B2	

COMPUTE SCHEME INFO
 DISPLAY HEAD-ON COLL
 COPY INTO SELECTED SCHEME

Shift group of injections

B1 B2

from bucket: 400 To 10000

Nbr of buckets: 10

shift direction << >>

DISPLAY BUCKET LIST

Refresh list Delete

CSV file new edit save cancel REMOVE>> FROM B1 REMOVE>> FROM B2

B1_25ns1Batch12Bu_bu621_I B2_25ns1Batch12Bu_bu701_I

14:37:10 - retrieving full injection scheme for 25ns_165_164_0_0_48bpi+8b4e_MD2269

165 bunches

- Collision in IR1/5 only
- 1 INDIV non-colliding
- 2 trains of 48 (colliding)
- 1 trains of 8b4e (colliding)

BBLR part (5/5): Procedure

Activity (and comments)	Time estimate [h]
Fill # 1 with up to 165 nominal bunches (25ns_165_164_0_0_48bpi+8b4e_MD2269)	
Setting up at injection with probes and injection of train(s) → 0.5 h - Combined Ramp & Squeeze → 0.25h - Setting up at flat top, Tele-knob exchange, tele-squeeze down to 35 cm → 0.5h - Find and optimize collisions at IP1 & IP5 → 0.5 h - X-angle reduction with orchestration tool down to 150 μrad (or less) for a substantial reduction of the life time and lumi re-optimization → 0.25 h	2.00
First MO scan from -1.8 (TBC) to 3 by step of 0.5 (knob value), lumi optimization and, life time inspection over 10-15 min. after each step → 3.5 h - New X-angle (life time) limit inspection with negative octupole at full current → 0.5 h - X-angle re-increase to 150 μrad and (relatively) fast MO ramp back initial settings (-1.8 in knob value, TBC), and lumi re-optimization → 0.5 h	4.50 (-1.0)
Second MO scan , possibly with another working point (.322/.316), requesting to cross the diagonal when in collision (TBC)	3.50 (-1.0)
- Beam separation test (instability) with negative octupole and 170 mrad → 1 h - Beam dump	1.00 (+2.0)
Contingency	0.00
Total	11.0