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 μrad half-crossing angle,

(iii) Crossing angle reduction down to 100 μrad with "orchestration tool" and loss maps at 100 μrad half-crossing angle,

(iv) Roll back to 170 μrad,

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

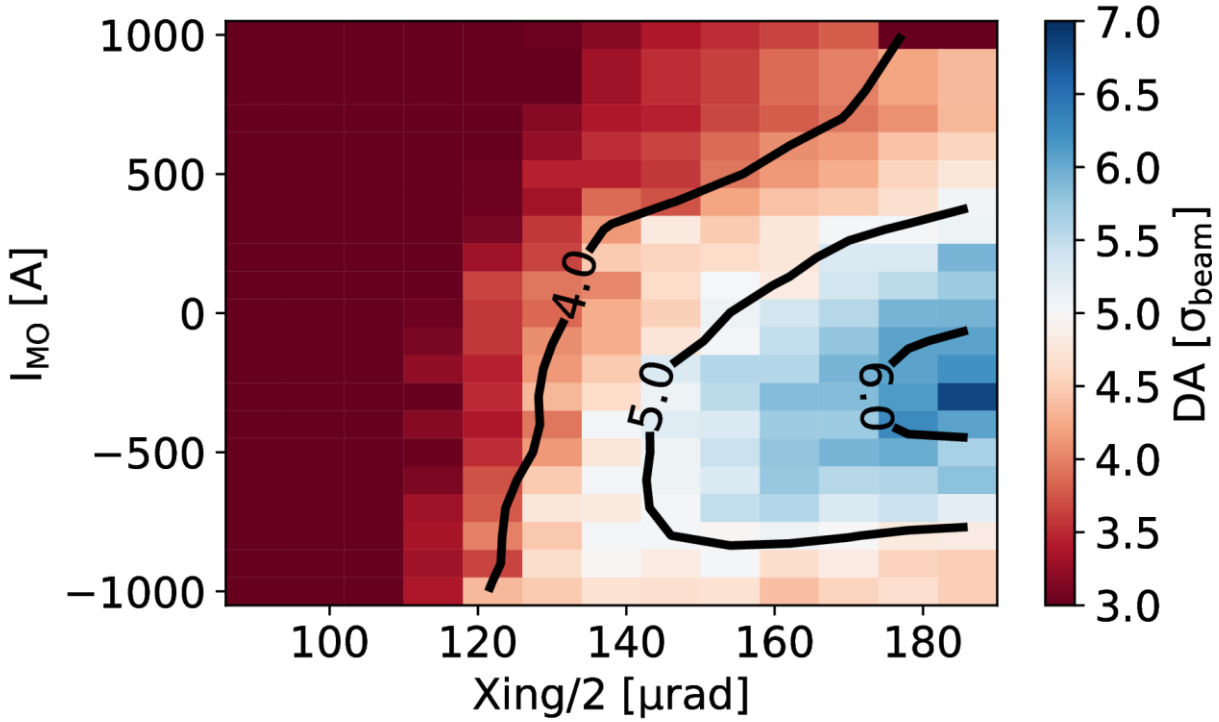
✓ **Fill # 2: pure validation fill with 2 INDIVs (<3E11)**

→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)**

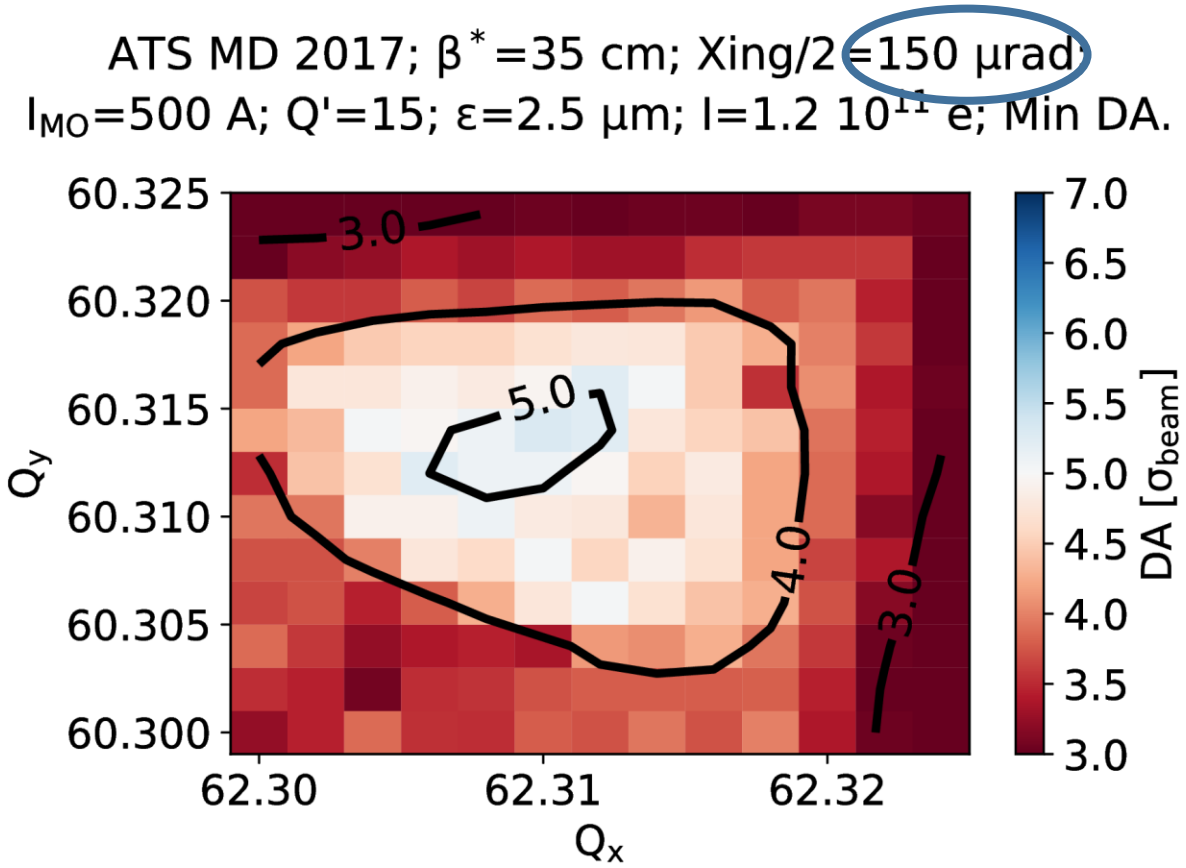
BBLR part (1/5): Dynamic aperture vs. MO and X-angle

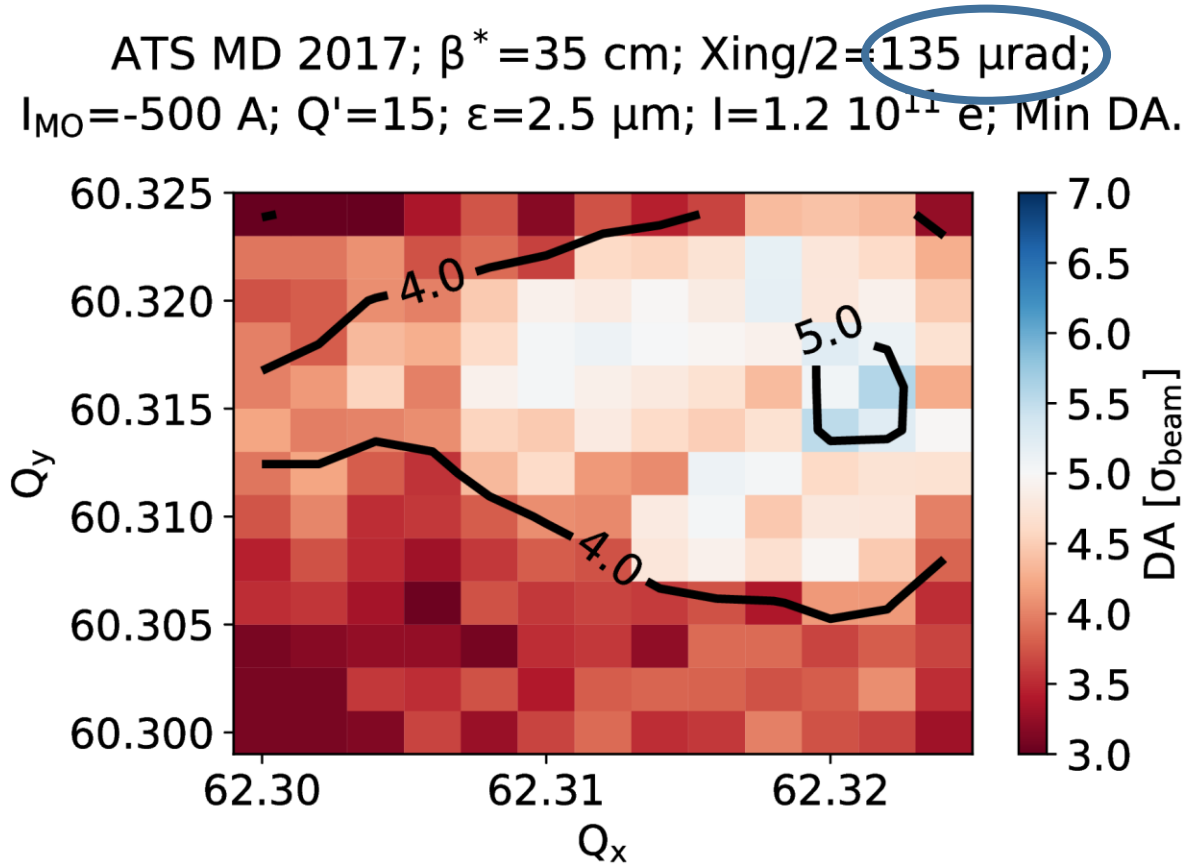
ATS MD 2017; β^*=35 cm; Q=(62.31, 60.32);
Q'=15; ε=2.5 μm; I=1.2 10^{11} e; Min DA. Courtesy of D. Pellegrini



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

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





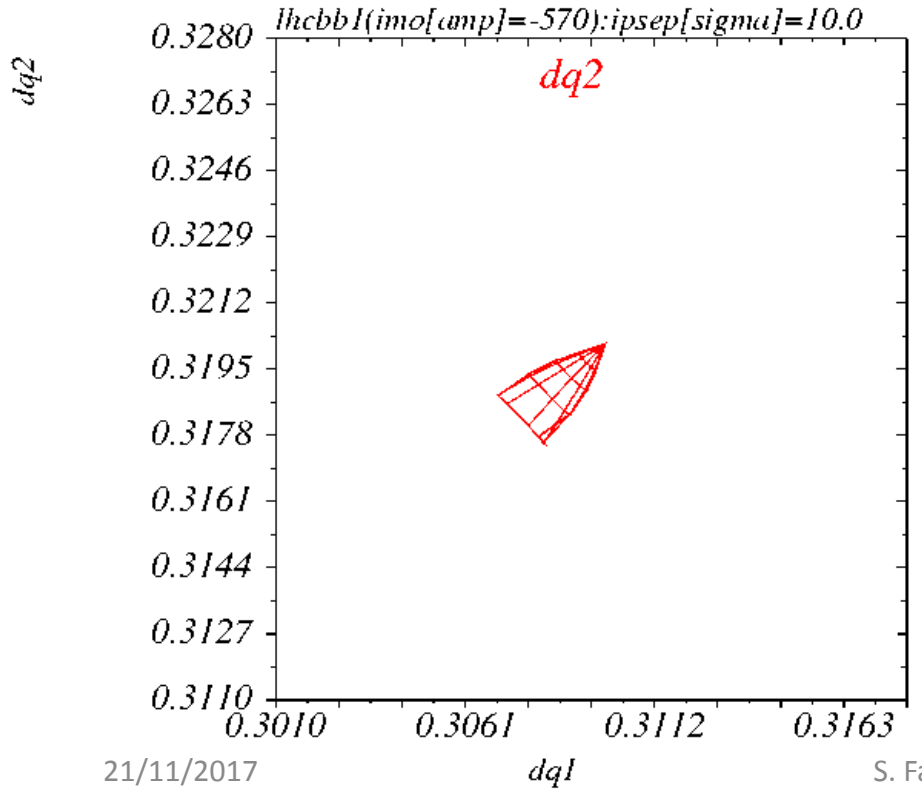
- Negative octupoles with the crossing angle reduced by ~15 μrad give a comparable DA landscape in the tune space.
- Need to **re-optimize the tune** to profit!

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

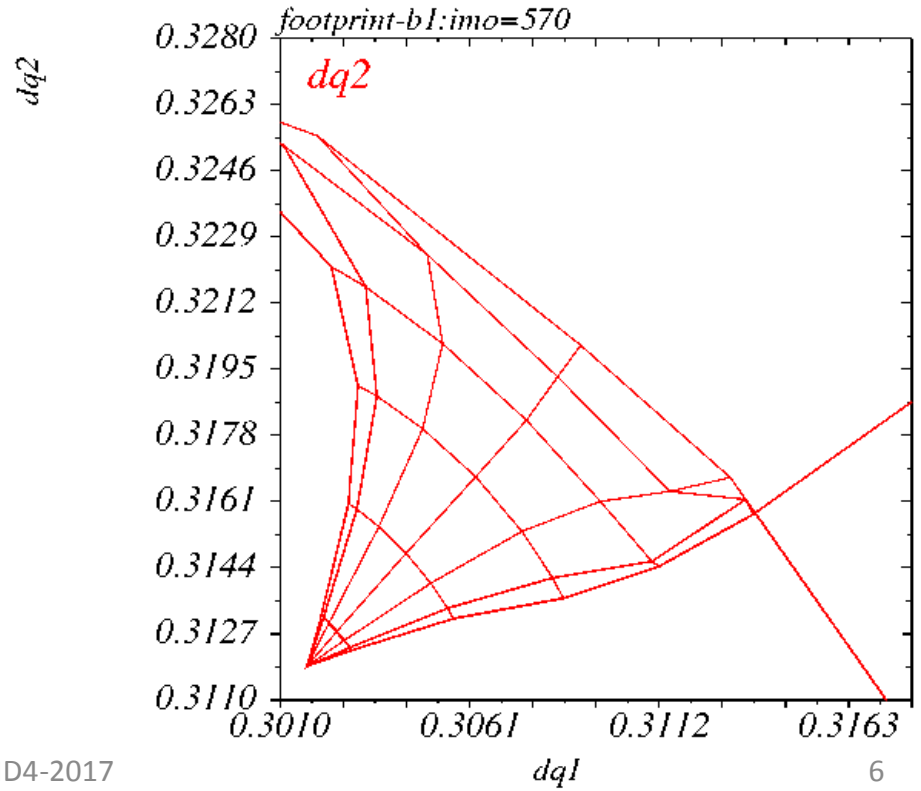
→ **Full cycle with MO>0 (detailed settings still to be agreed)**

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

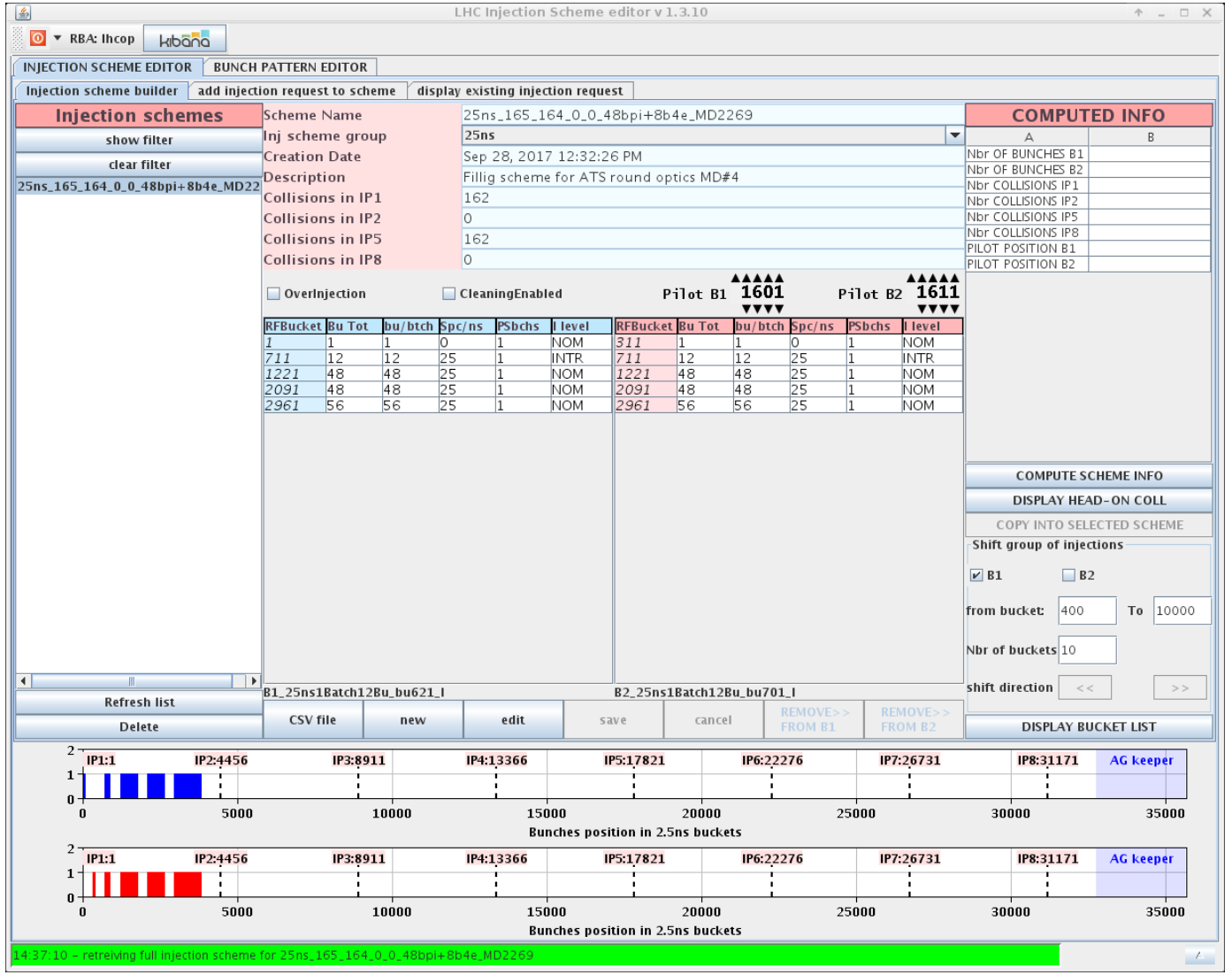
Putting in collision with MO<0 would collapse otherwise the footprint (as in 2012 prior TS2)



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



BBLR part (4/5): Filling scheme



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 an, 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