Update on the DA studies at injection for HL-LHC

F. Plassard, R. De Maria
Thanks to: M. Giovannozzi, N. Karasthatis, S. Kostoglou, F. Van der Veken

WP2 Meeting 25/02/2020

OUTLINE

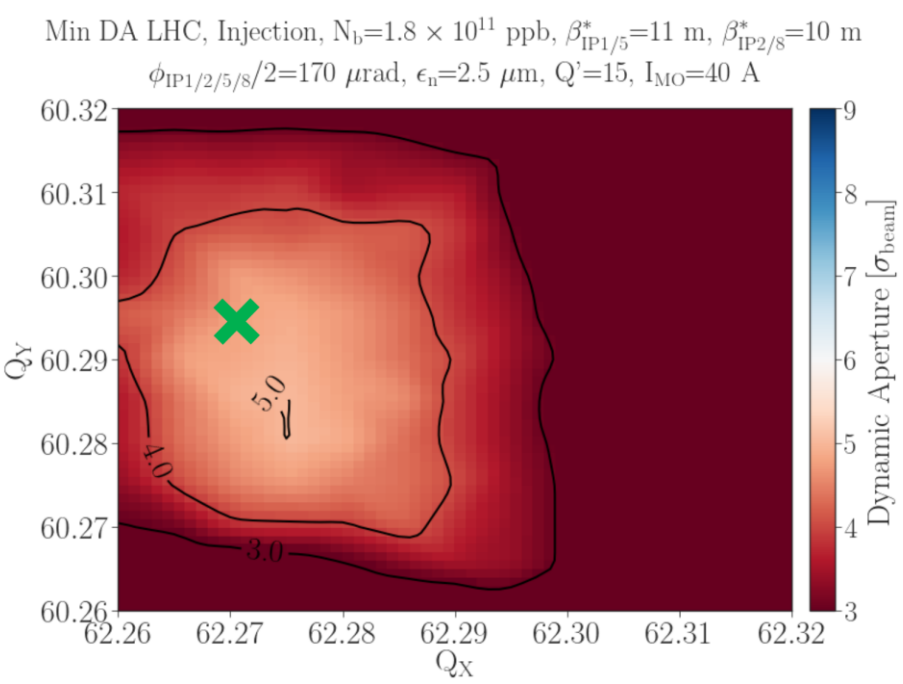
- Recall of previous simulations and observations
- Update on DA at injection including beam-beam
- Conclusions

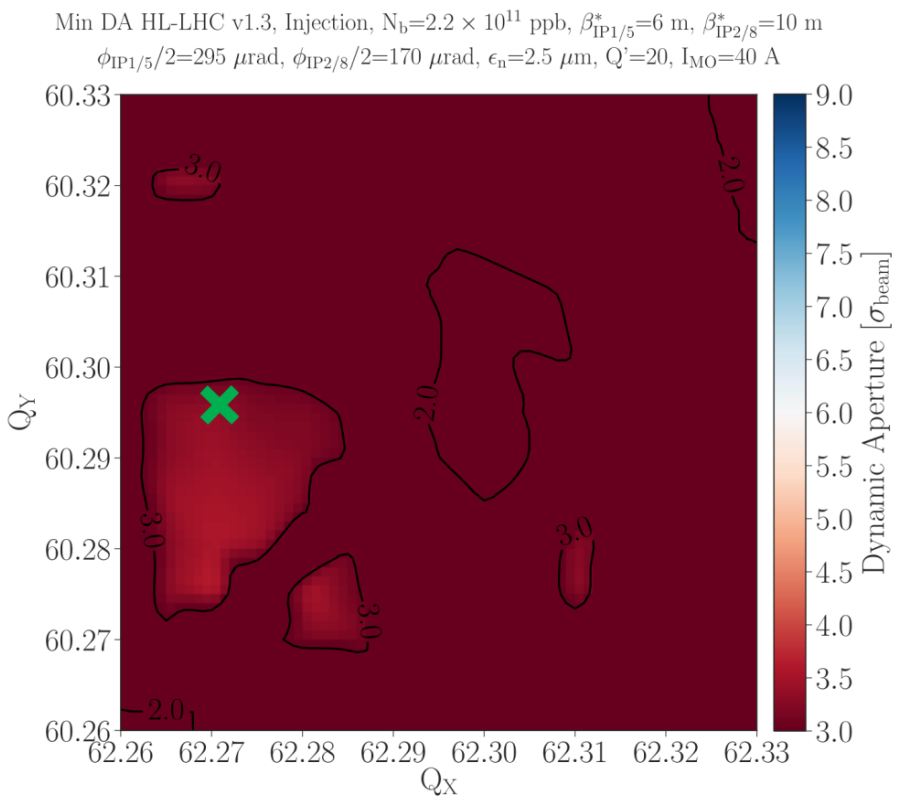
Recall of previous simulations and observations

- Previous simulations presented in WP2 28/05/2019 (“HL-LHC Dynamic Aperture at Injection”) have shown an **important reduction of DA** with beam-beam between ***LHC run III*** and ***HL-LHC*** (v1.3) at **injection and with high octupole current** (I_MO = 40 A)

- The goal of the study is to understand the large difference observed

Courtesy of N. Karastathis



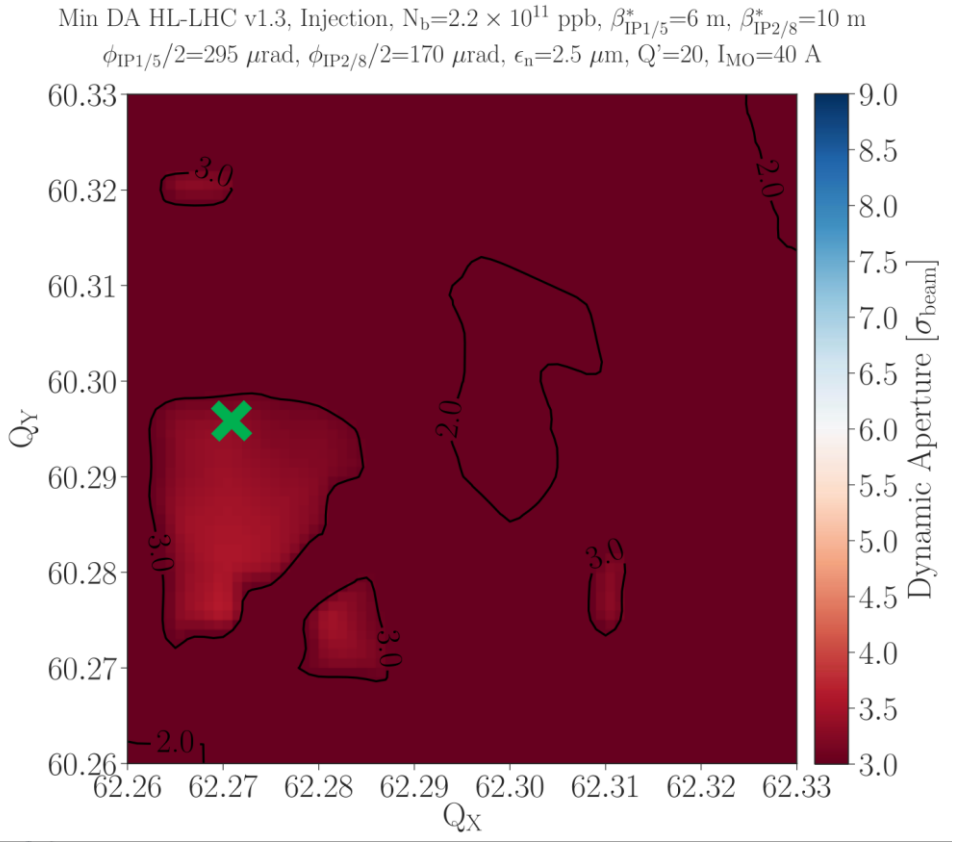


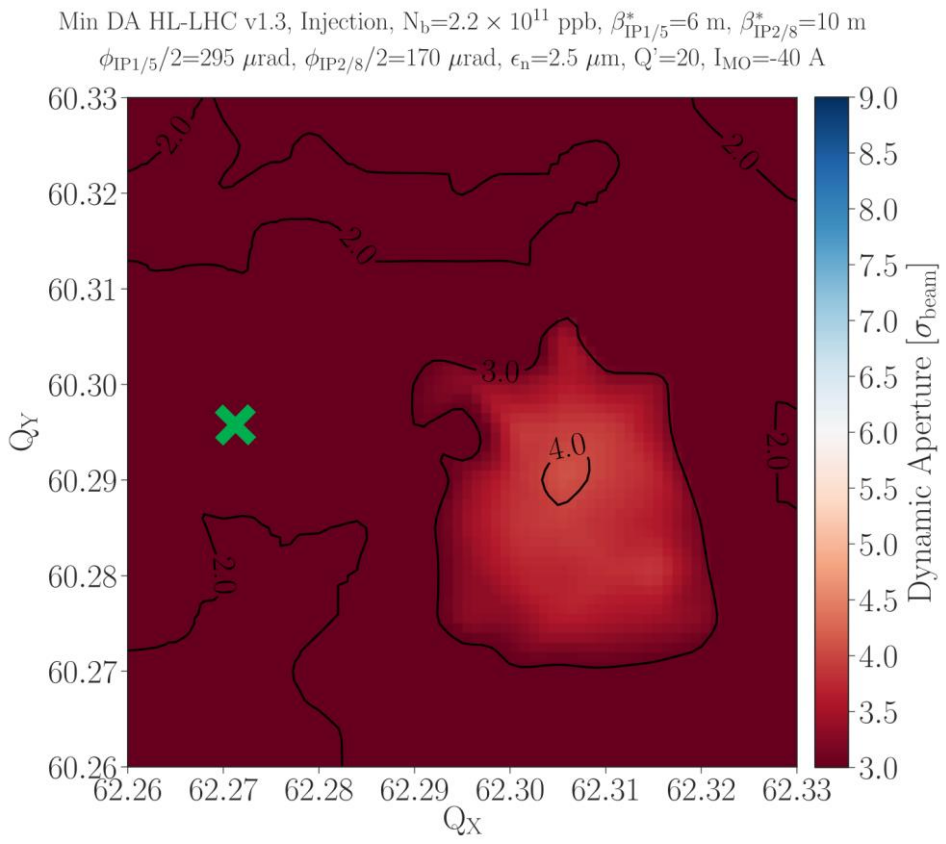
Recall of previous simulations and observations

- It was also shown that the **polarity of the octupoles change the location of the 'good DA' area**
- **Negative polarity gives better DA** but **move the good tune area further from the optimal WP** that was optimized for electron cloud

What makes the DA with octupoles much worst than LHC case?

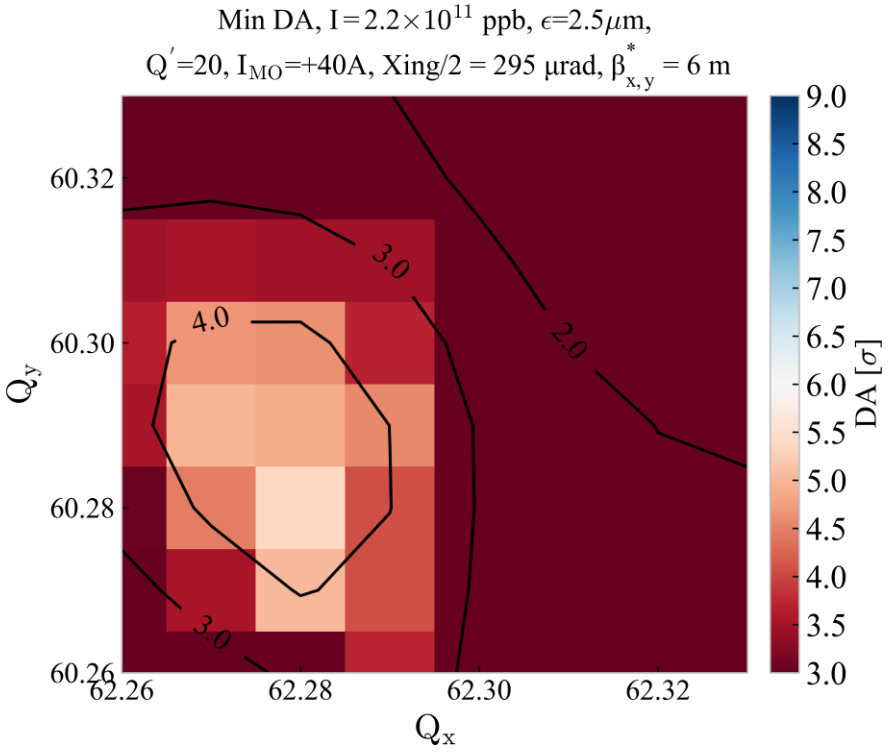
Courtesy of N. Karastathis

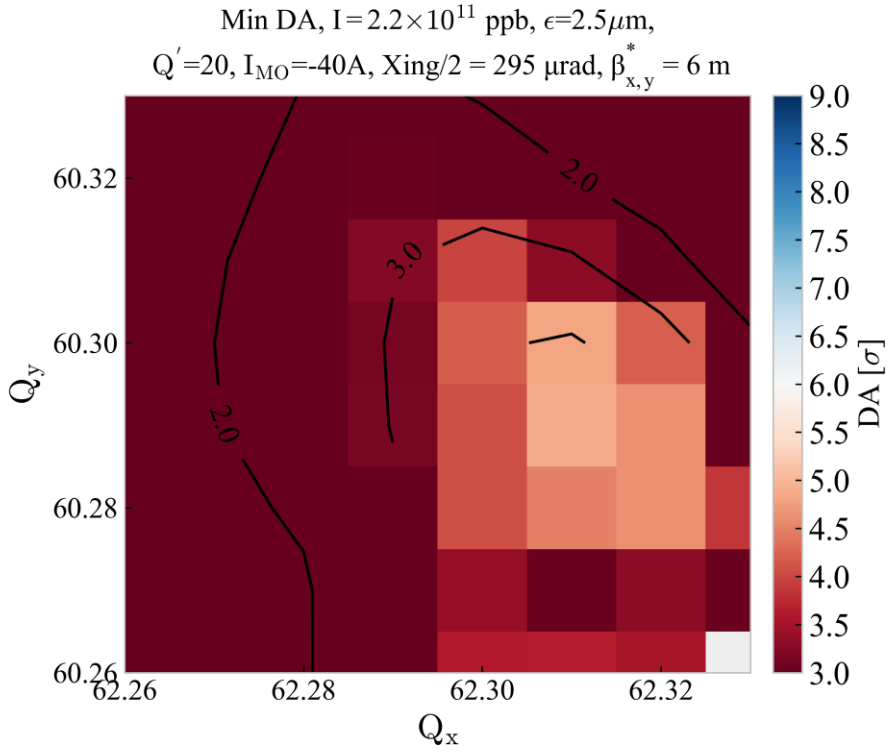




Update on DA at injection for HL-LHC

- The **simulation for HL-LHC at injection has been repeated** including beam-beam and for positive/ negative polarities (at 40 A) for HL-LHC v1.4
- However the **results show larger DA**, more similar to the LHC case.
- Also in the new simulation the **positive polarity of the octupole gives a better DA than the negative** case.

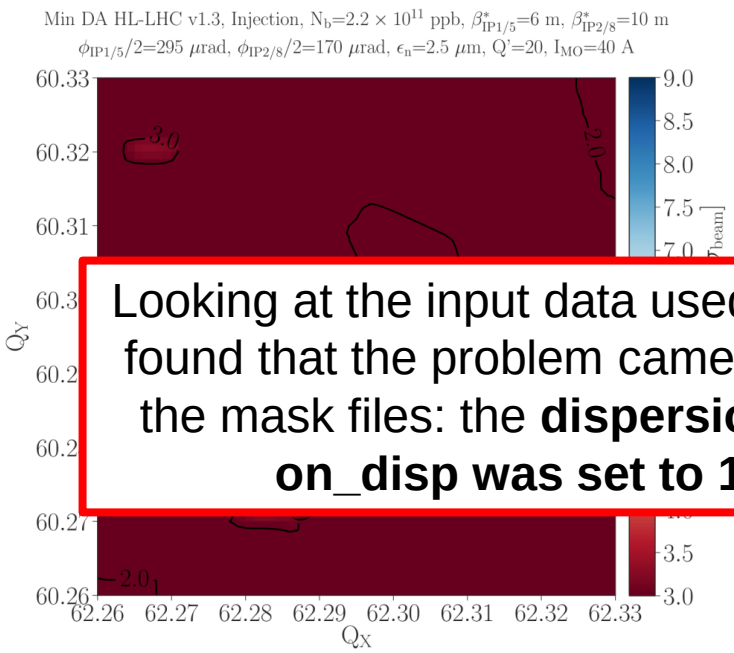


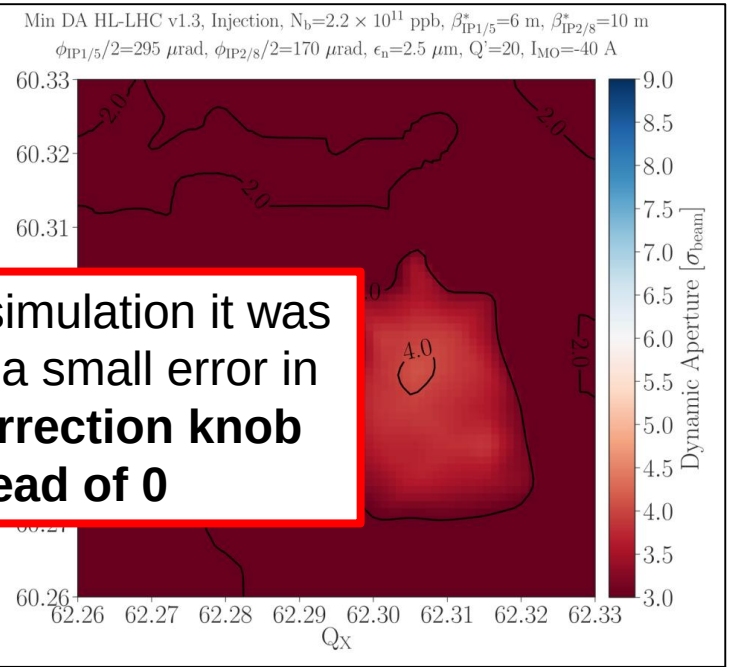


Update on DA at injection for HL-LHC

HL-LHC v1.3
Injection
I_{MO}=±40 A

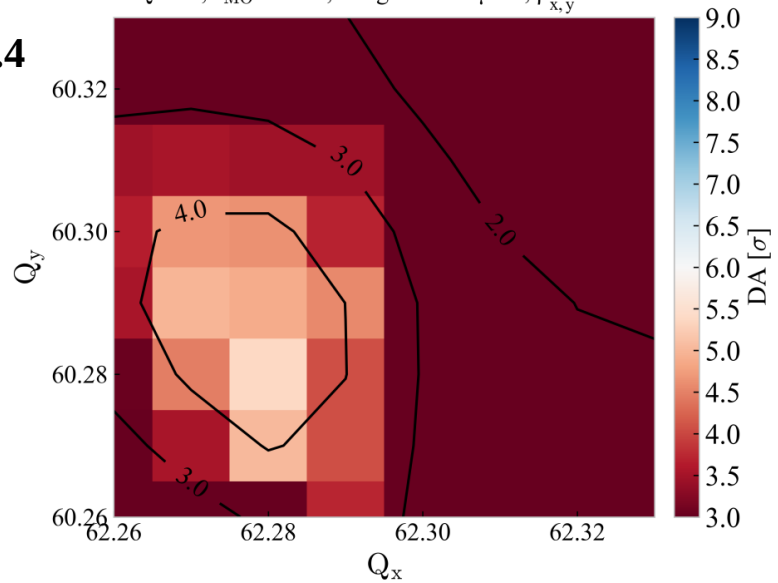
Presented in WP2 149th

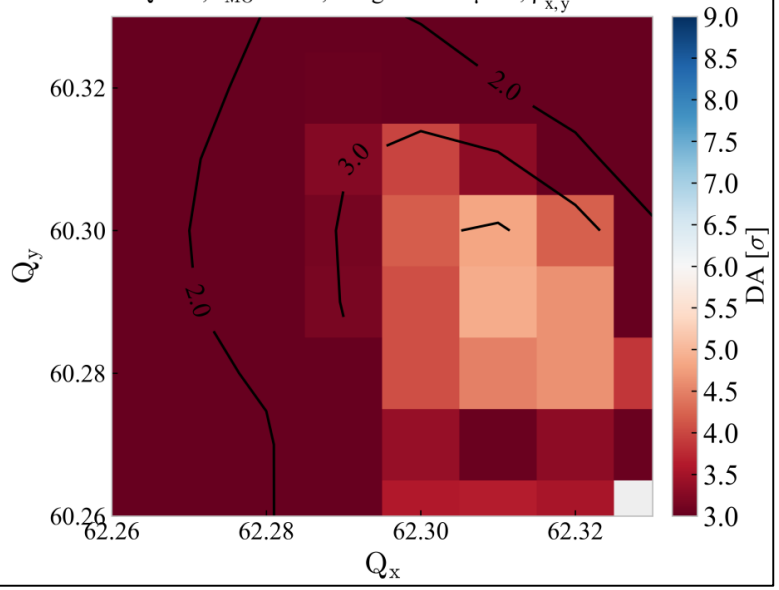




Looking at the input data used for simulation it was found that the problem came from a small error in the mask files: the **dispersion correction knob on_disp was set to 1 instead of 0**

HL-LHC v1.4
Injection
I_{MO}=±40 A

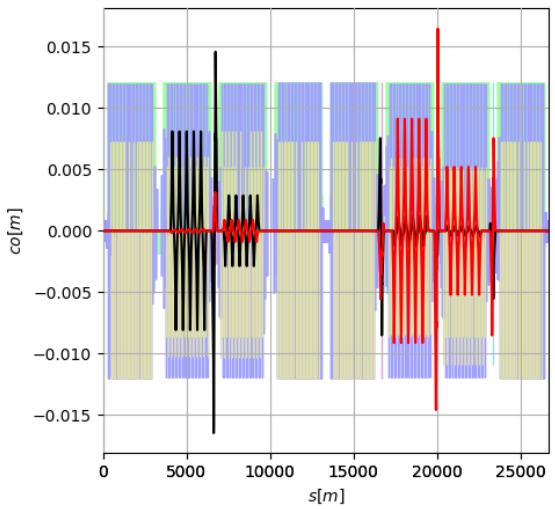


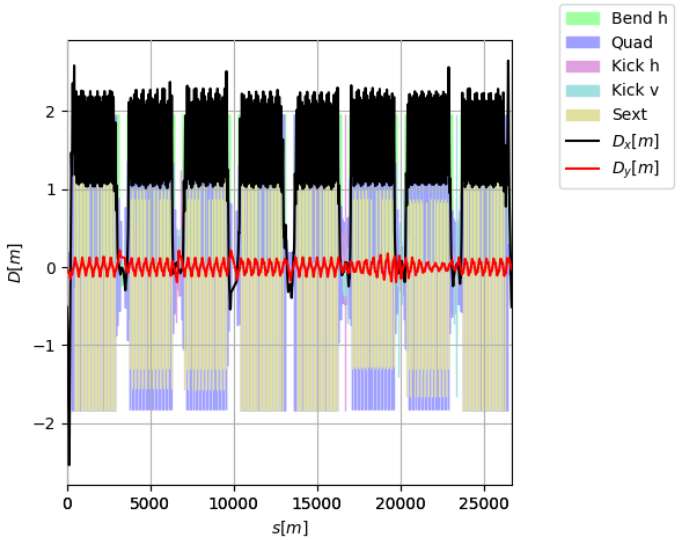


Update on DA at injection for HL-LHC

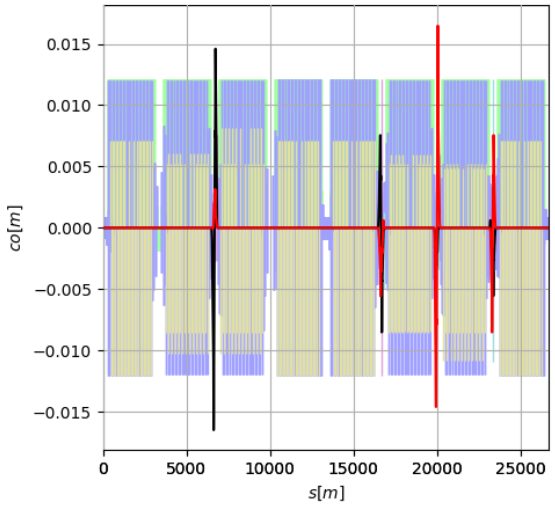
- The dispersion correction knob should not be used at injection due to the large orbit bumps required for small dispersion correction

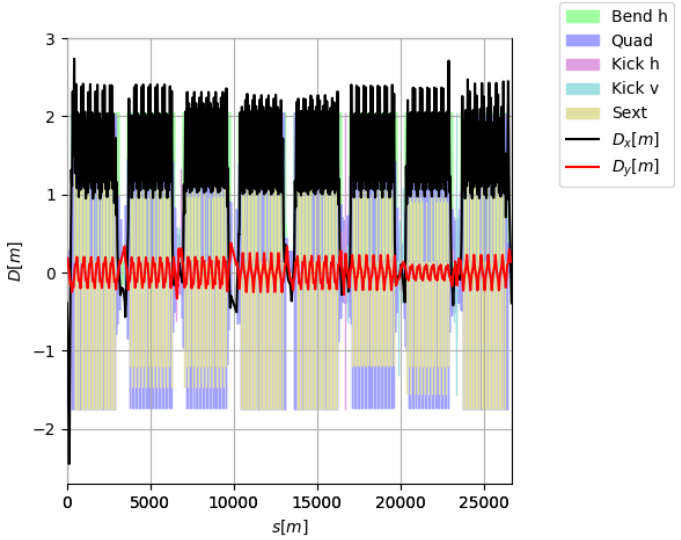
on_disp = 1 ;





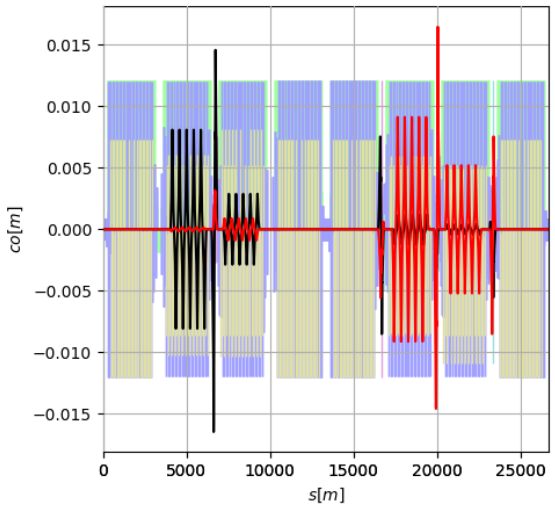
on_disp = 0 ;



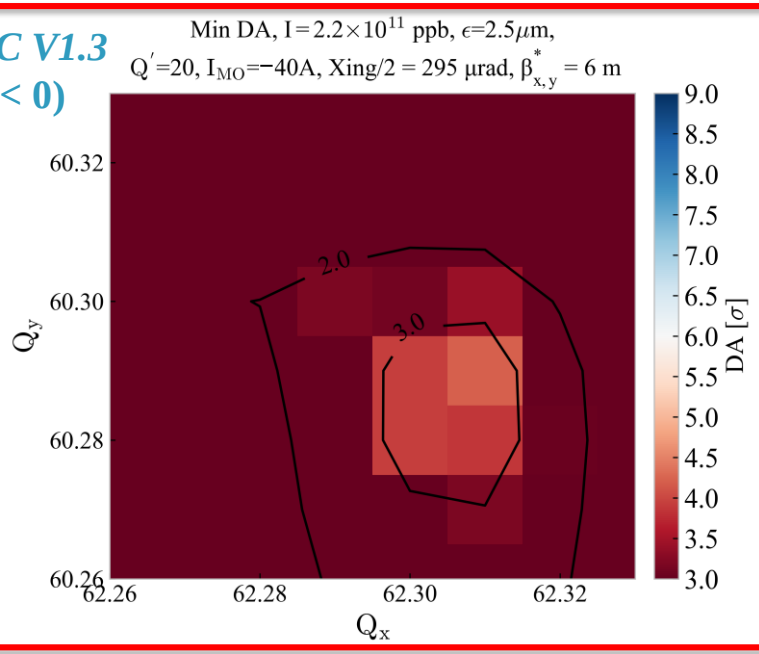


Update on DA at injection for HL-LHC

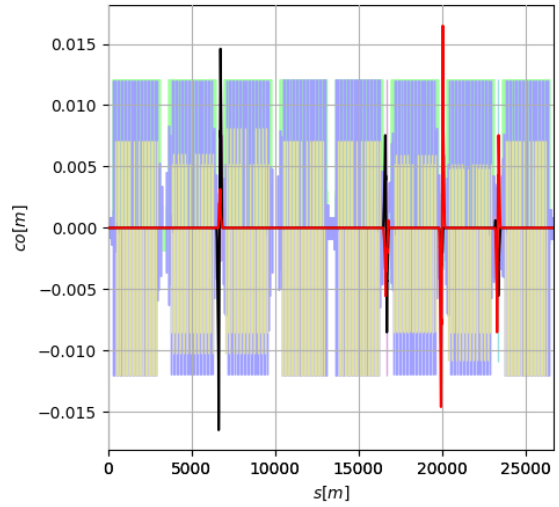
on_disp = 1 ;



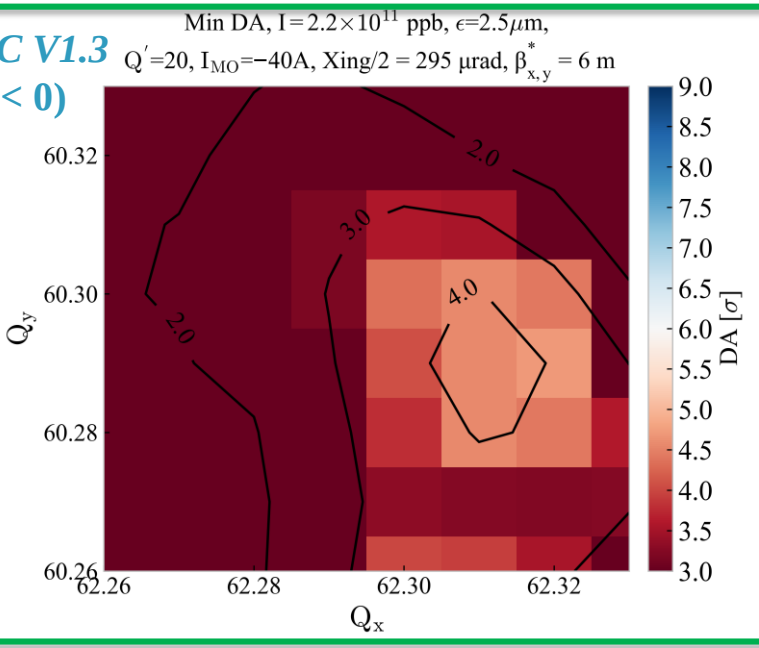
HL-LHC V1.3
(I_{MO}< 0)



on_disp = 0 ;

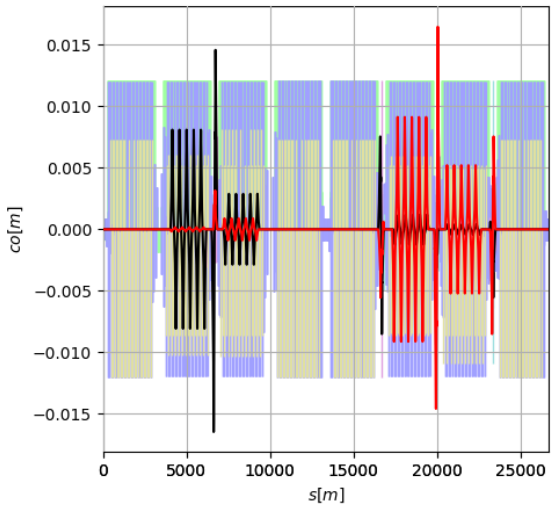


HL-LHC V1.3
(I_{MO}< 0)

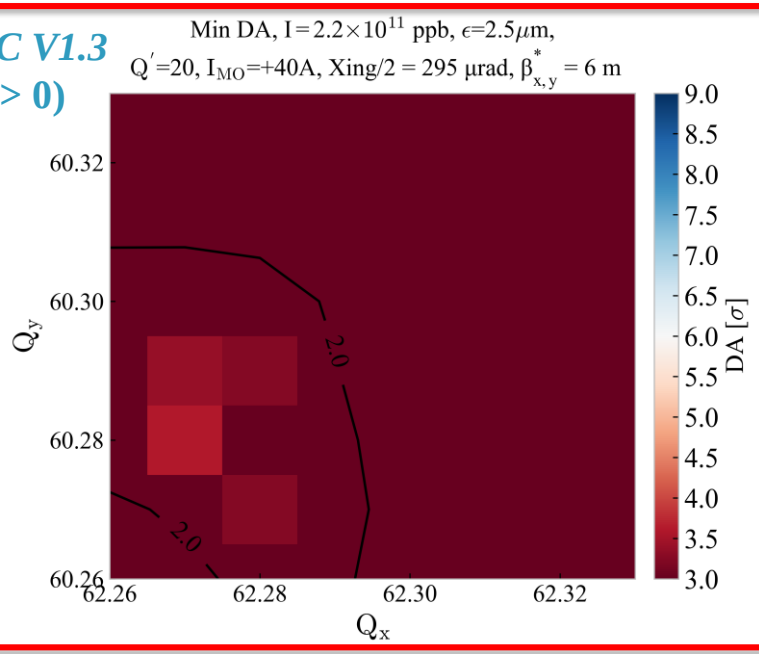


Update on DA at injection for HL-LHC

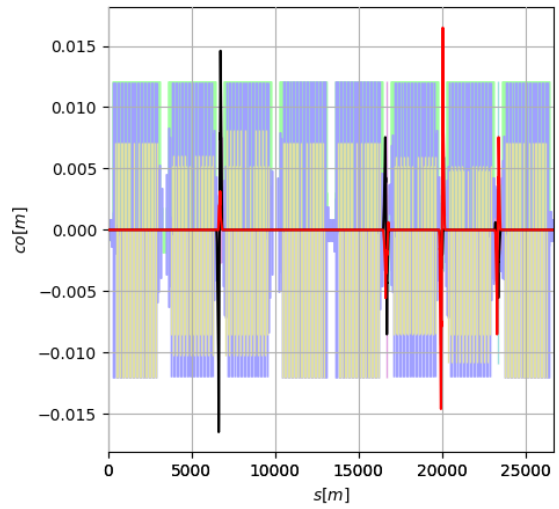
on_disp = 1 ;



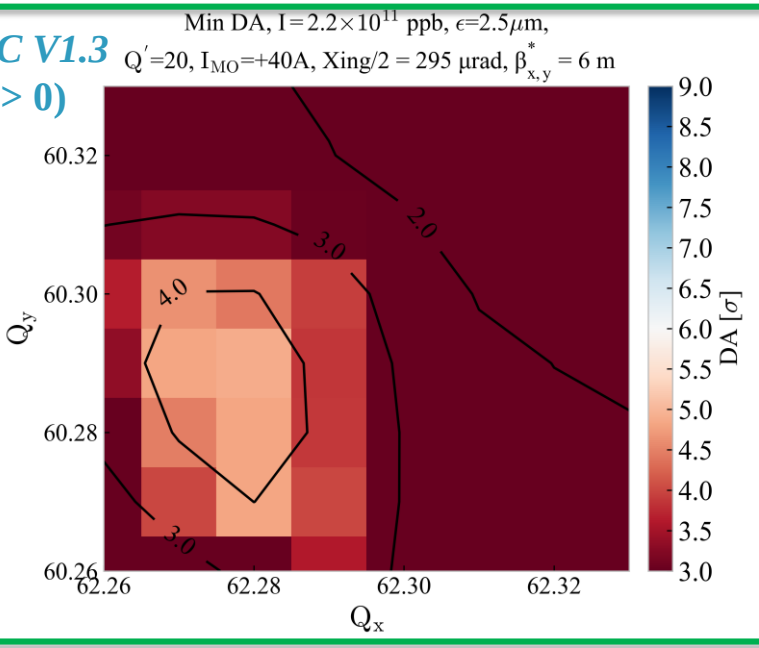
HL-LHC V1.3
(I_{MO}> 0)



on_disp = 0 ;

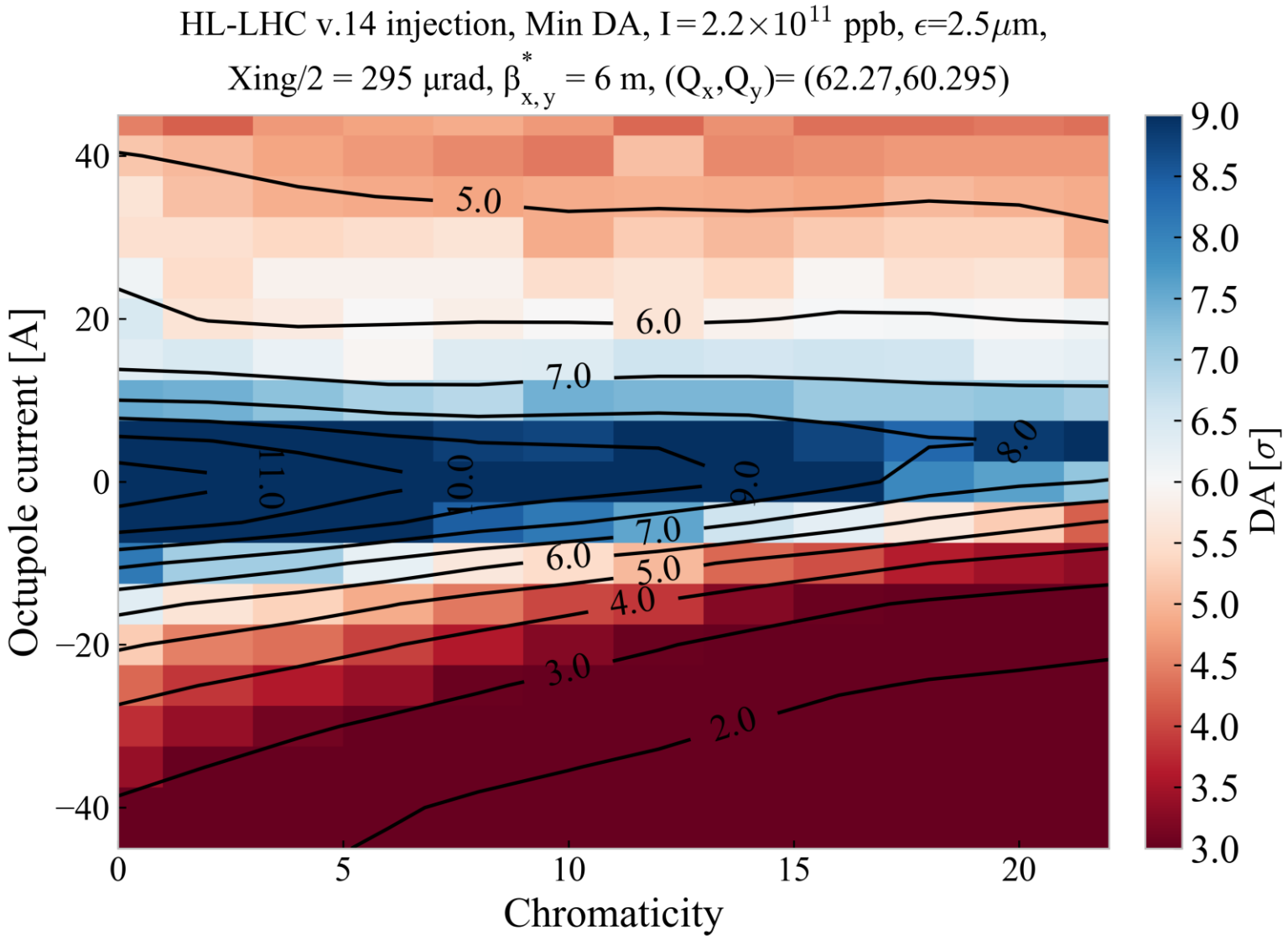


HL-LHC V1.3
(I_{MO}> 0)



Update on DA at injection for HL-LHC

- The **octupole vs chromaticity scan** has been repeated and shows a clear asymmetry between positive and negative current for the **WP (62.27,60,295)**
- **DA in this case is much better for positive** octupole current



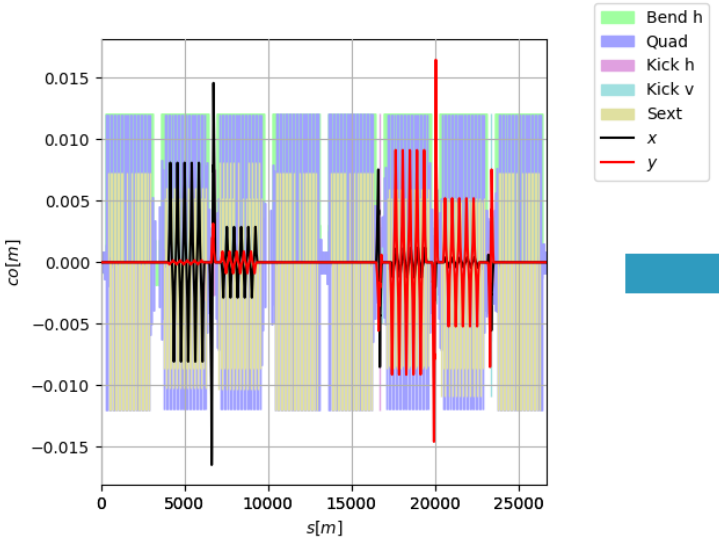
Conclusions

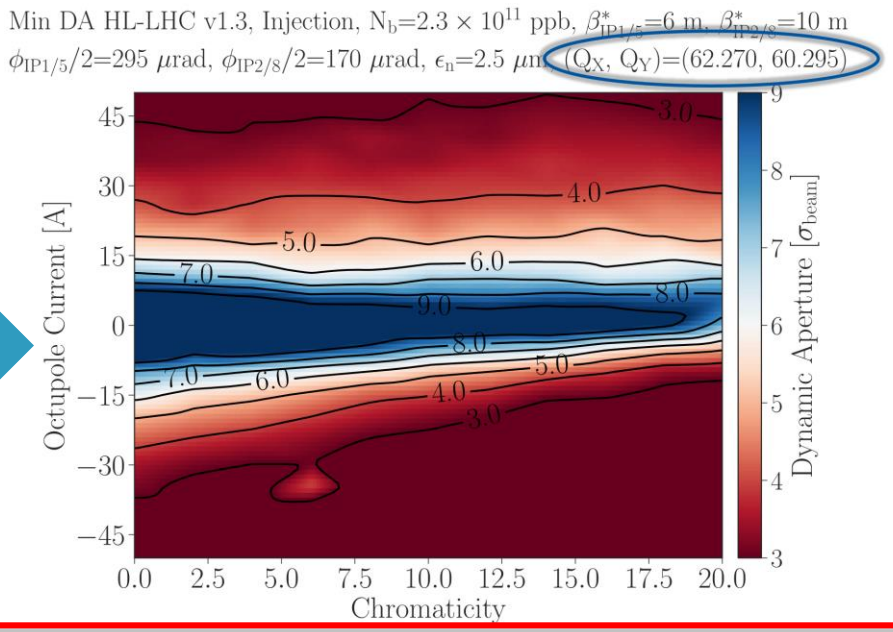
- The **DA at injection of the HL-LHC at high octupole current** (±40 A) is **comparable to the LHC case**
- For the chosen WP (62.27,60.295), **positive current gives much better DA**
- The **change of location of the 'good' tune area** resulting from the change of octupole polarity is **observed also for the LHC** case (see Backup slides)

BACKUP

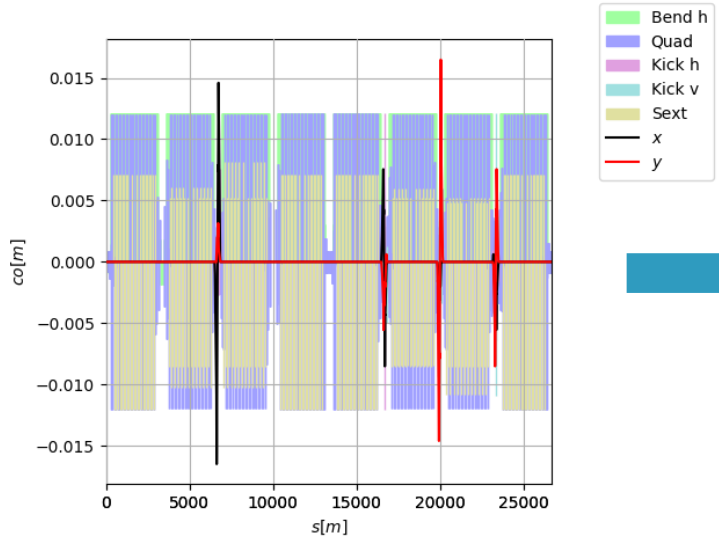
Comparison with/without disp. correction

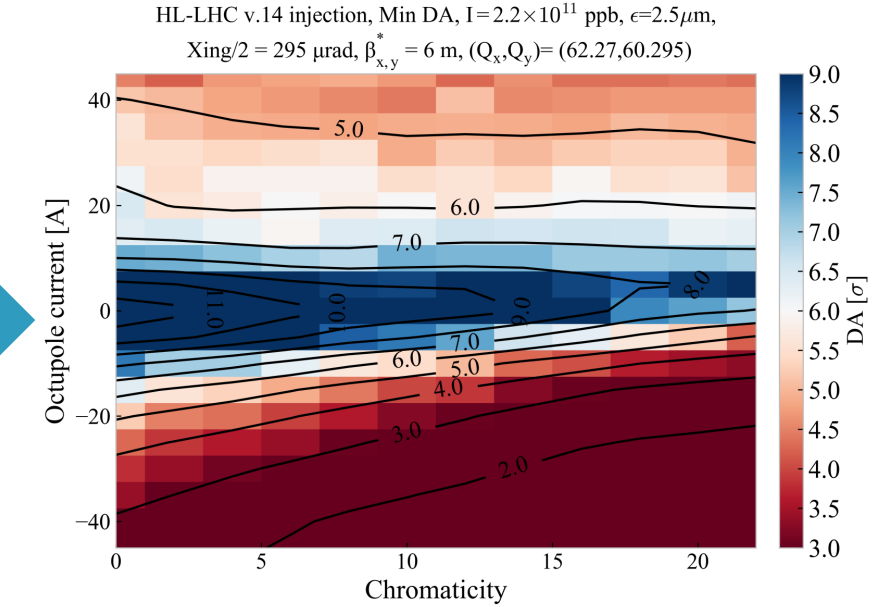
on_disp = 1 ;





on_disp = 0 ;

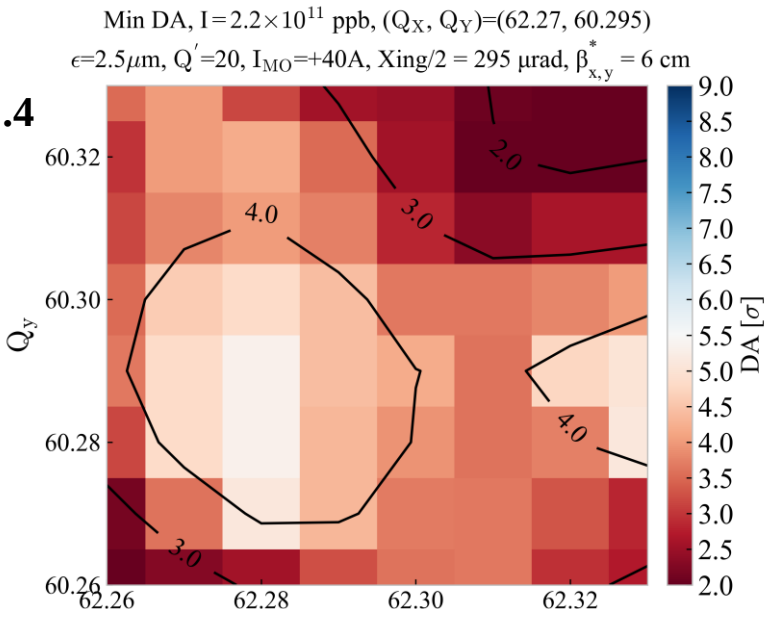


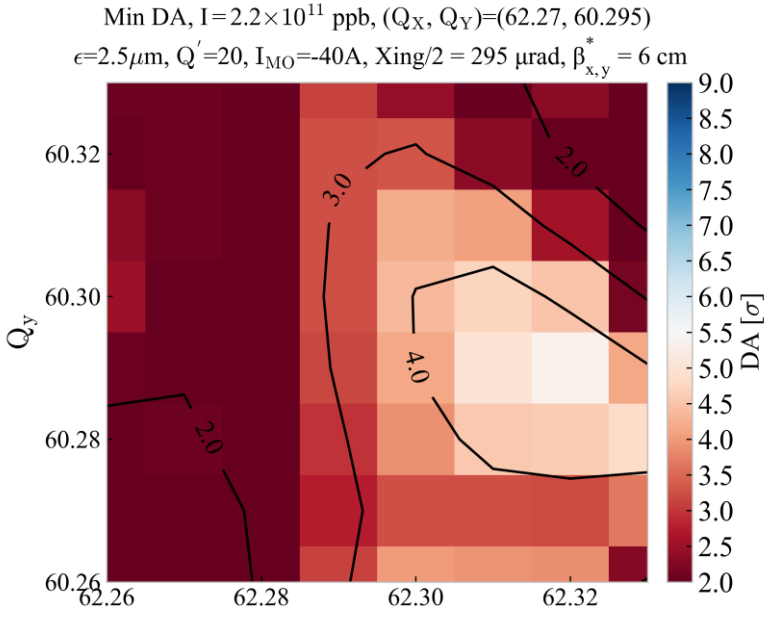


Comparison with/without Beam-Beam

HL-LHC v1.4
Injection
I_{MO}=±40 A

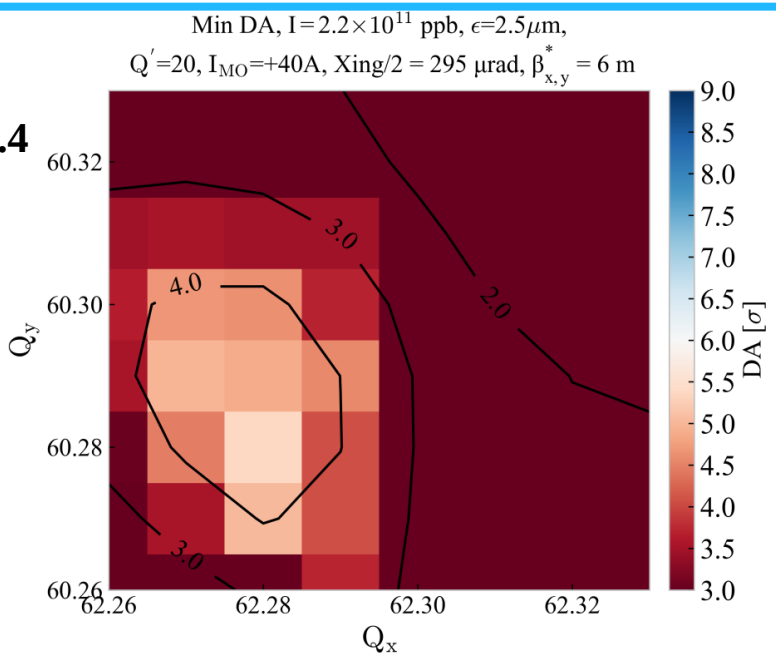
No Beam-Beam

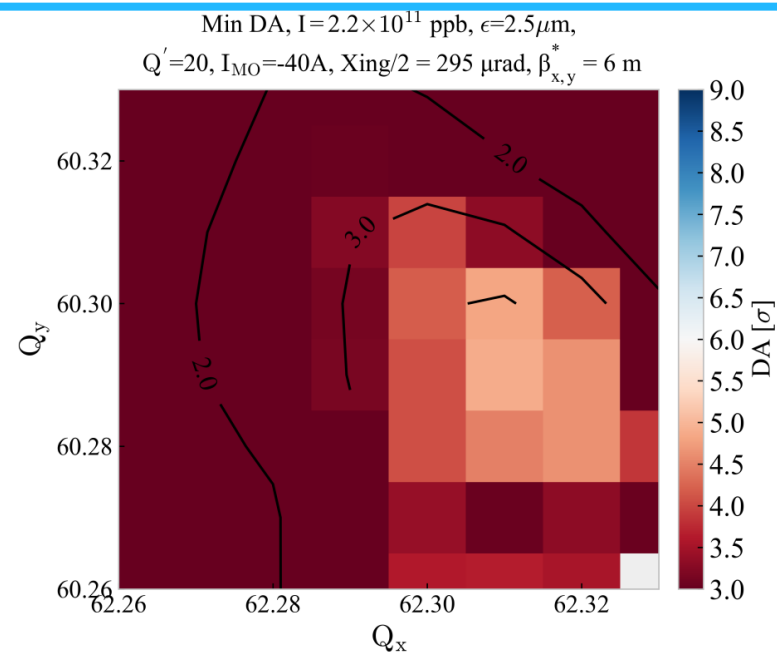




HL-LHC v1.4
Injection
I_{MO}=±40 A

With Beam-Beam

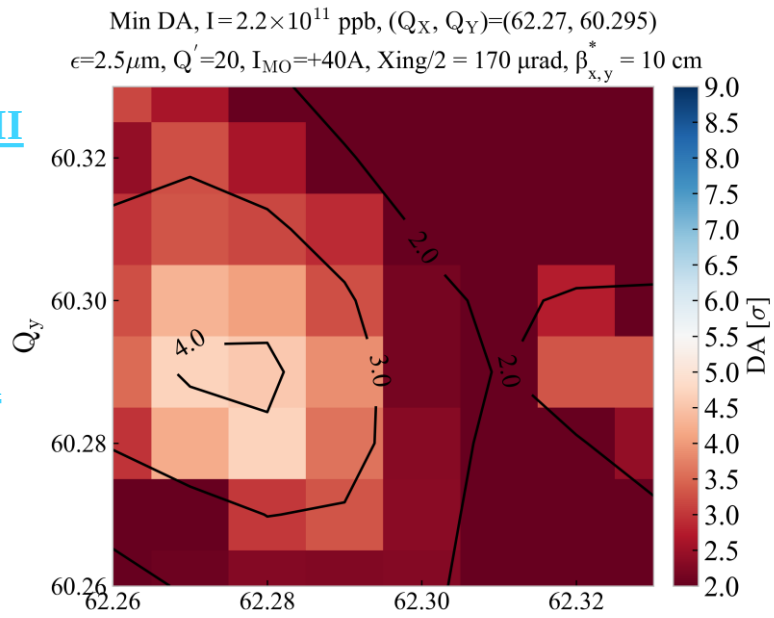


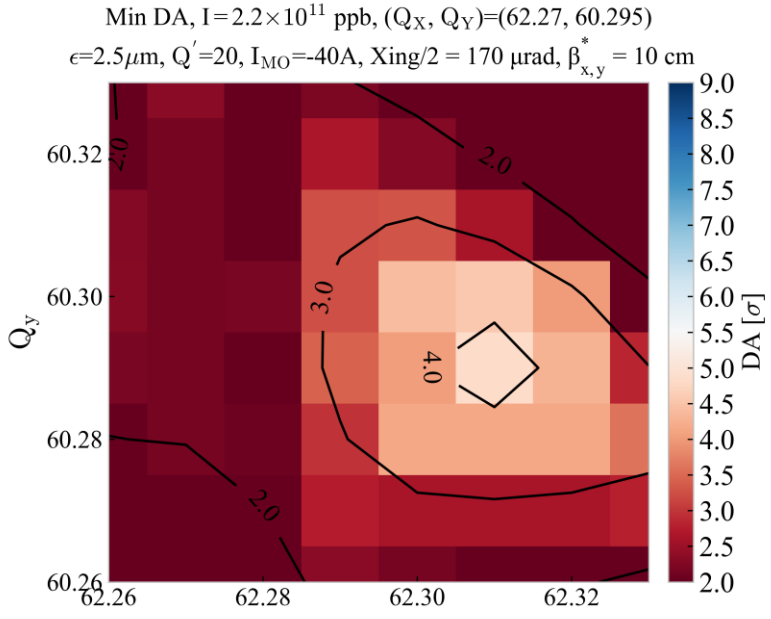


Comparison LHC vs HL-LHC (no beam-beam)

LHC run III
Injection
I_{MO}=±40 A

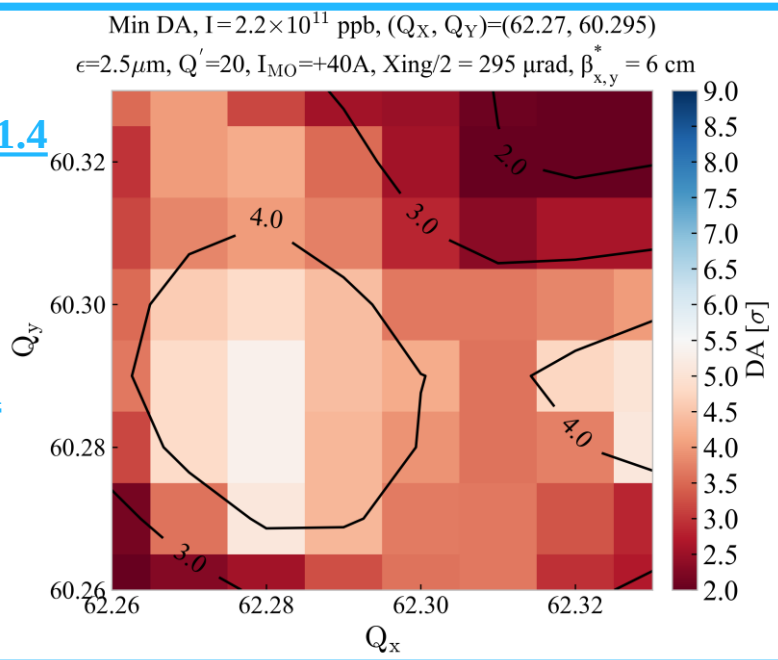
No BeamBeam

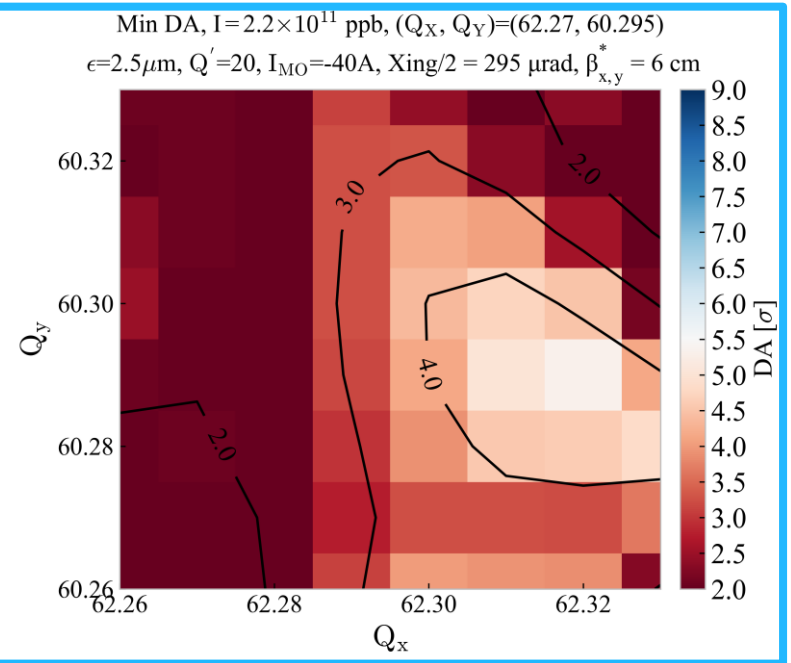




HL-LHC v1.4
Injection
I_{MO}=±40 A

No BeamBeam

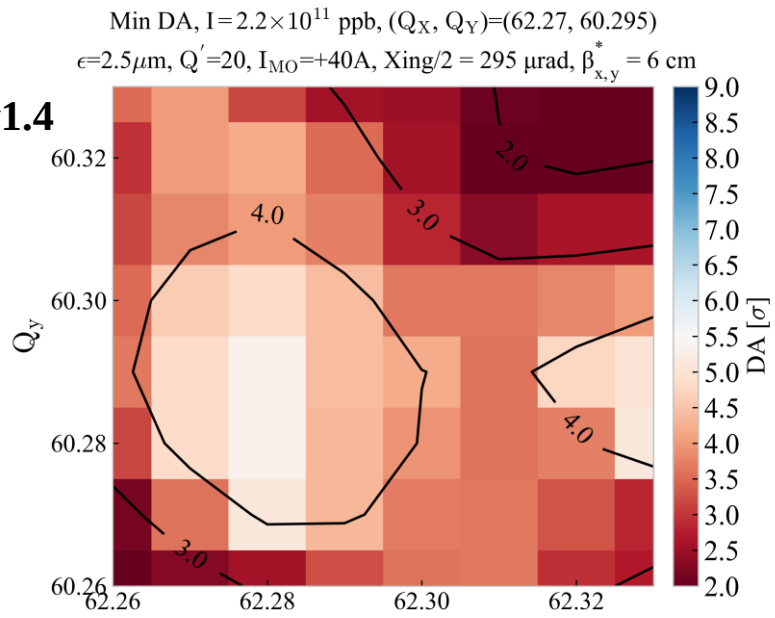


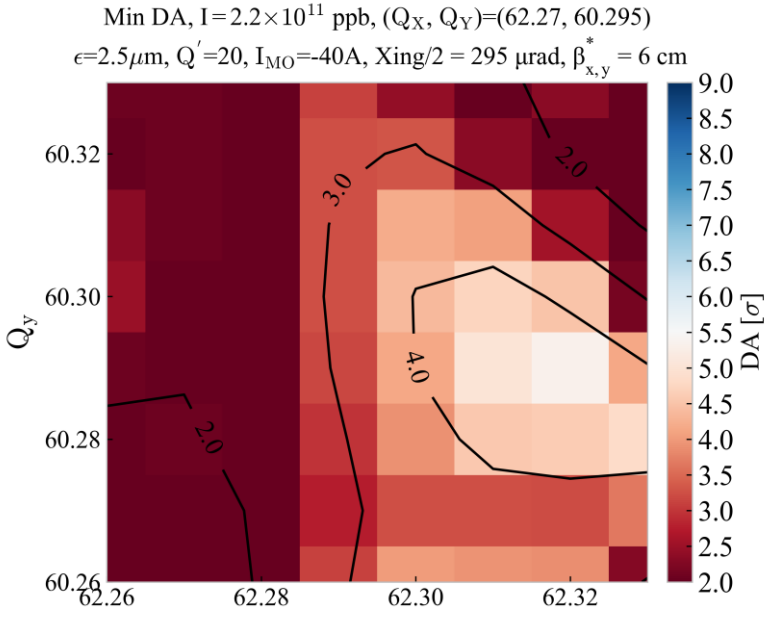


Comparison Q'=20 & Q'=15

HL-LHC v1.4
Injection
I_{MO}=±40 A

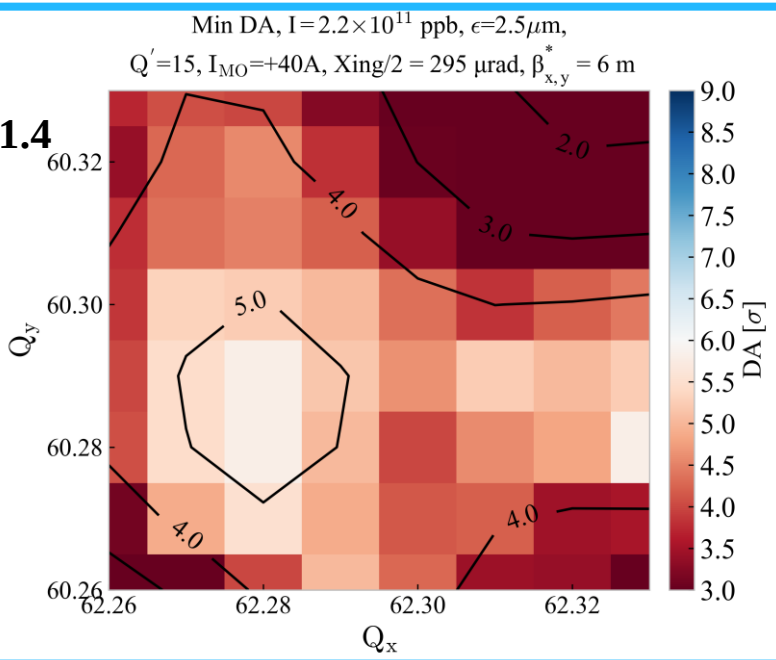
Q' = 20

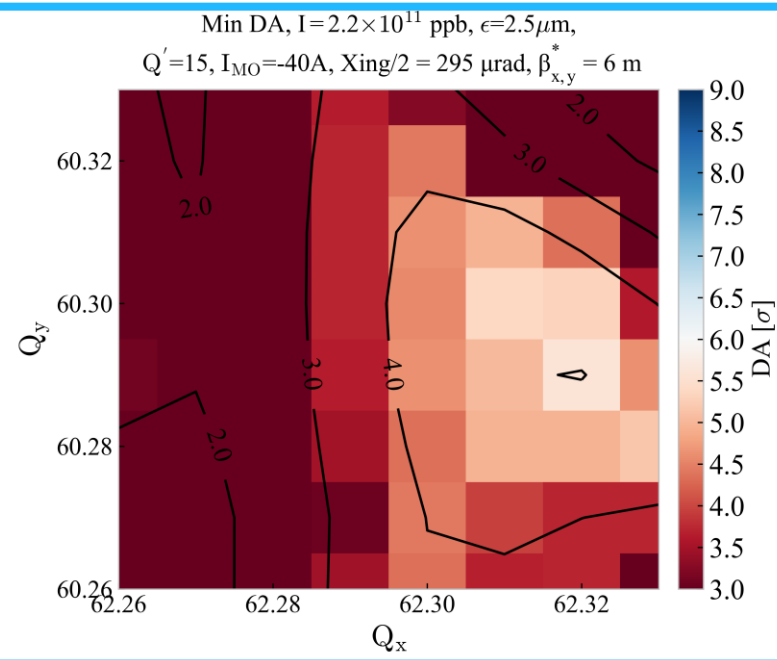




HL-LHC v1.4
Injection
I_{MO}=±40 A

Q'=15

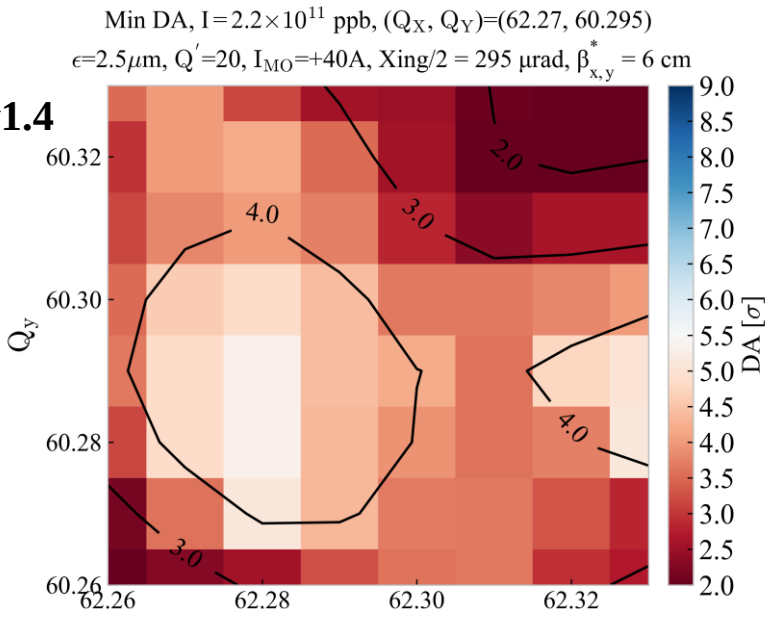


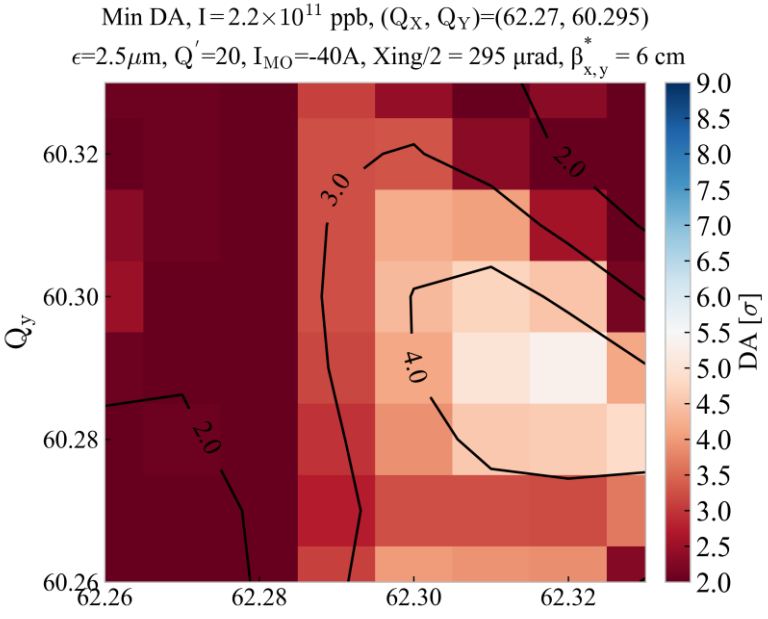


Comparison of sextupole powering

HL-LHC v1.4
Injection
I_{MO}=±40 A

Baseline HL-LHC sextupole powering





HL-LHC v1.4
Injection
I_{MO}=±40 A

Equal sextupole powering (LHC-like)