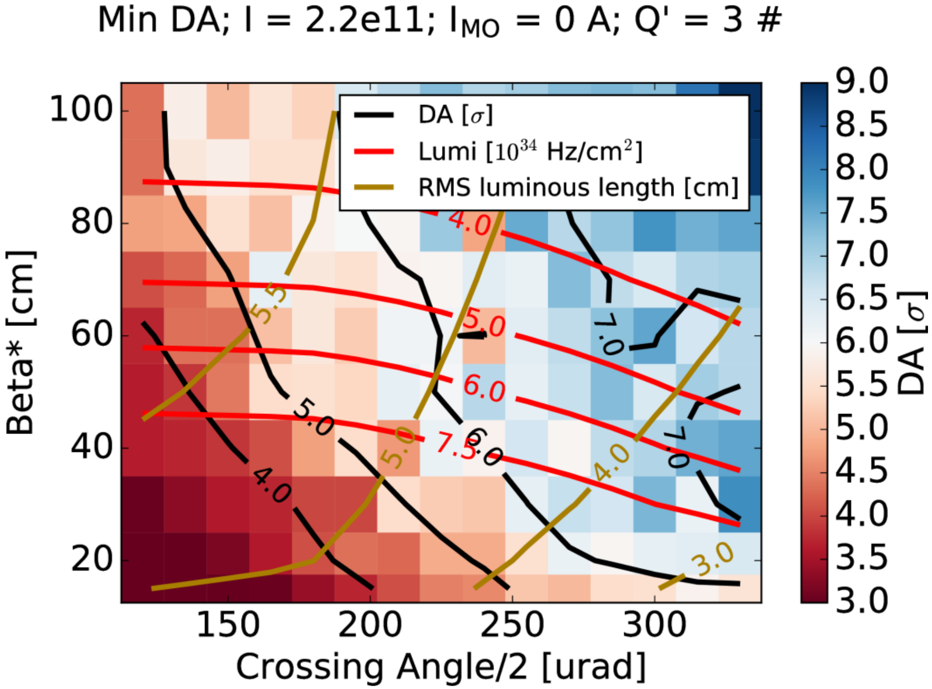
DA at the beginning of the fill with high octupoles and chromaticity.

N. Karastathis, Y. Papaphilippou, D. Pellegrini

94th HiLumi WP2 – 23/05/2017

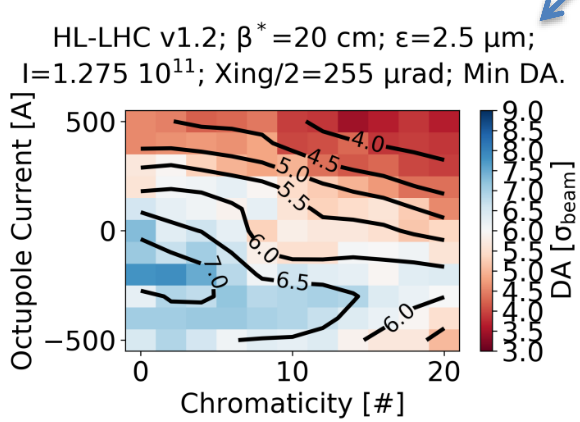
Where we did stand?



- Levelling strategy fully assessed for a low chroma and octupoles scenario (Y. Papaphilippou, Chamonix 2017).

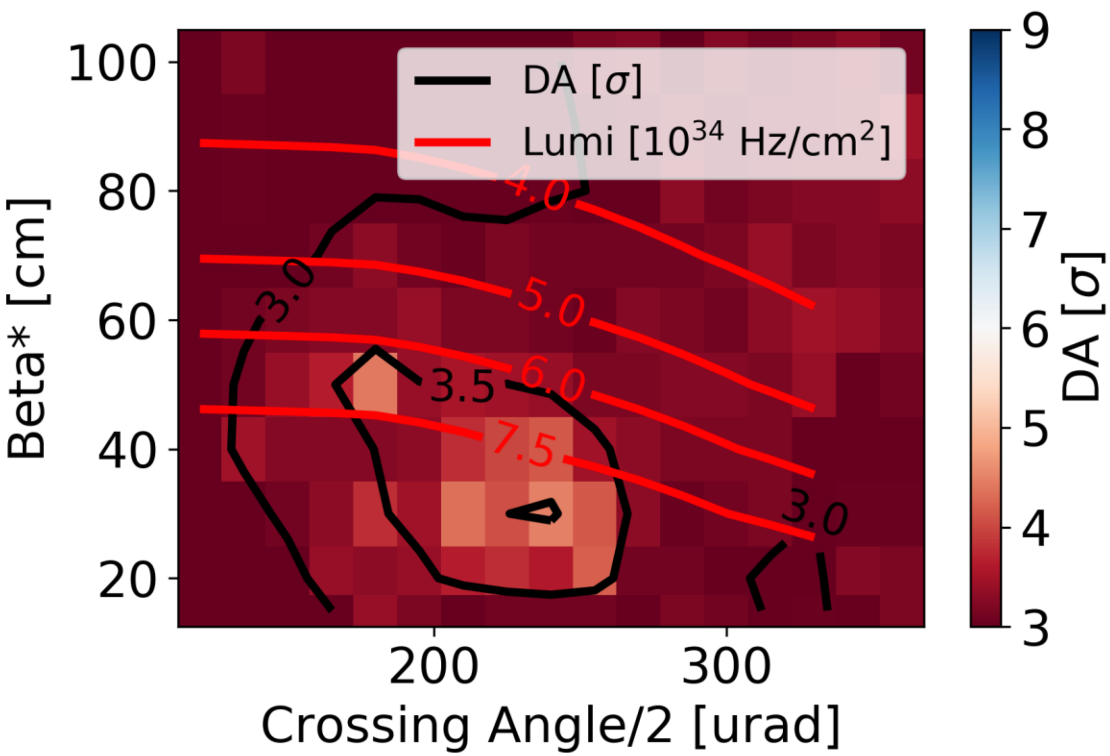
E. Metral, 88th WP2:

- Chromaticity changed: 3 --> 15 #
- Octupoles changed: 0 --> -570 A



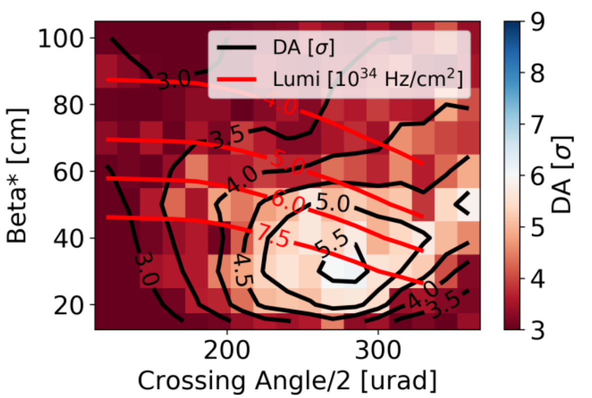
- Previous studies (D. Pellegrini 79th WP2) suggested that this could be accomplished at the end of levelling.
- **No previous indications regarding this change w.r.t. the start of the fill.**

Min DA; I = 2.2e11; I_{MO} = -570 A; Q' = 15

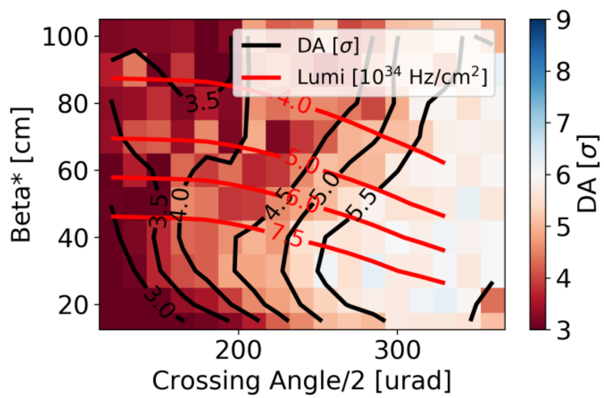


High octupoles and Chroma at the beginning of the fill. Increasing the crossing angle does not help…

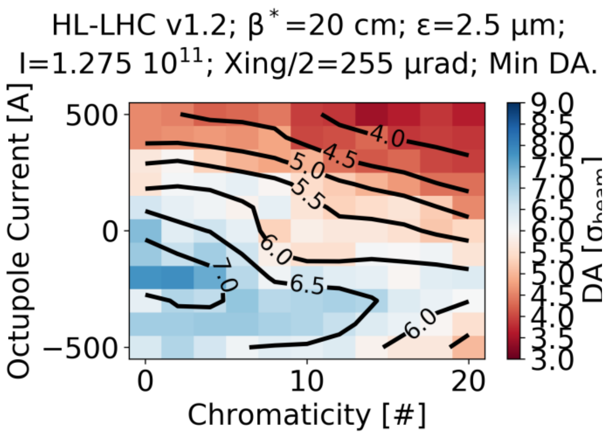
Min DA; I = 2.2e11; I_{MO} = -400 A; Q' = 15 #

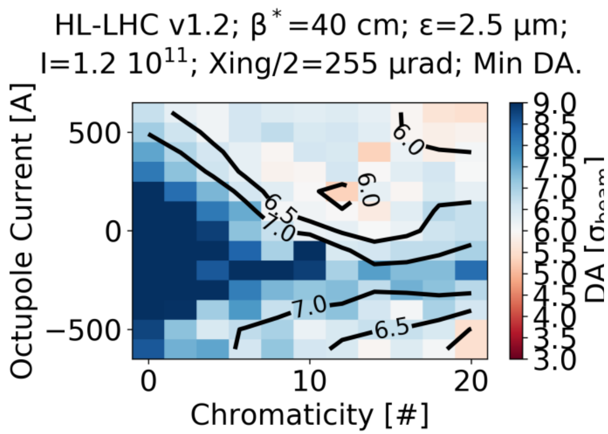


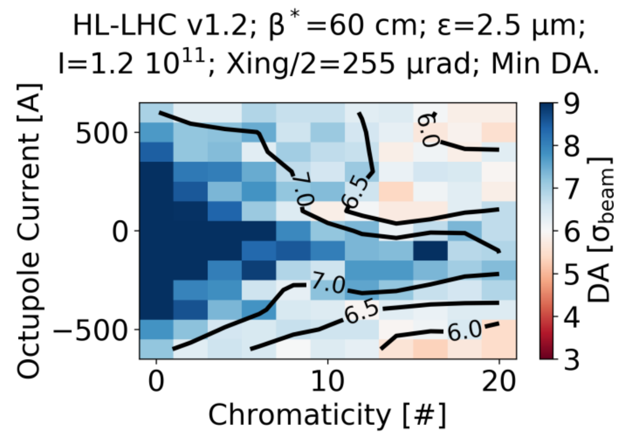
Min DA; I = 2.2e11; I_{MO} = -250 A; Q' = 15 #

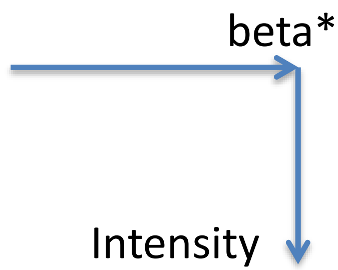


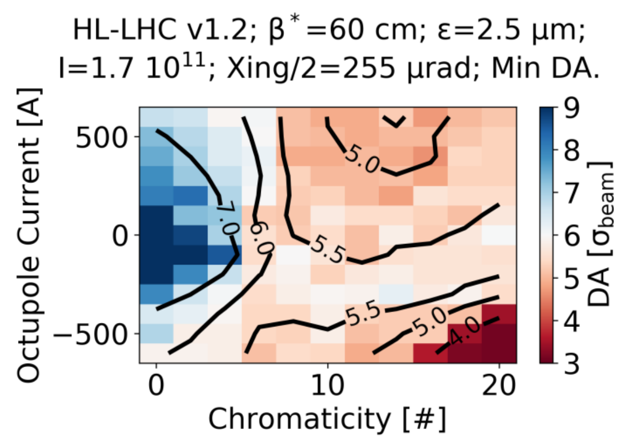
Moderate settings of the octupoles are somewhat helpful, but not sufficient.



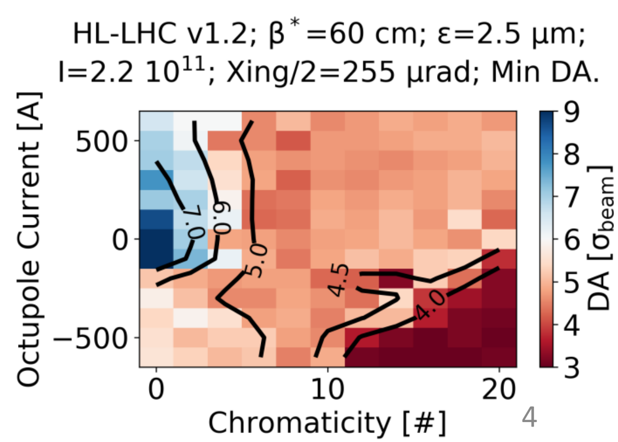




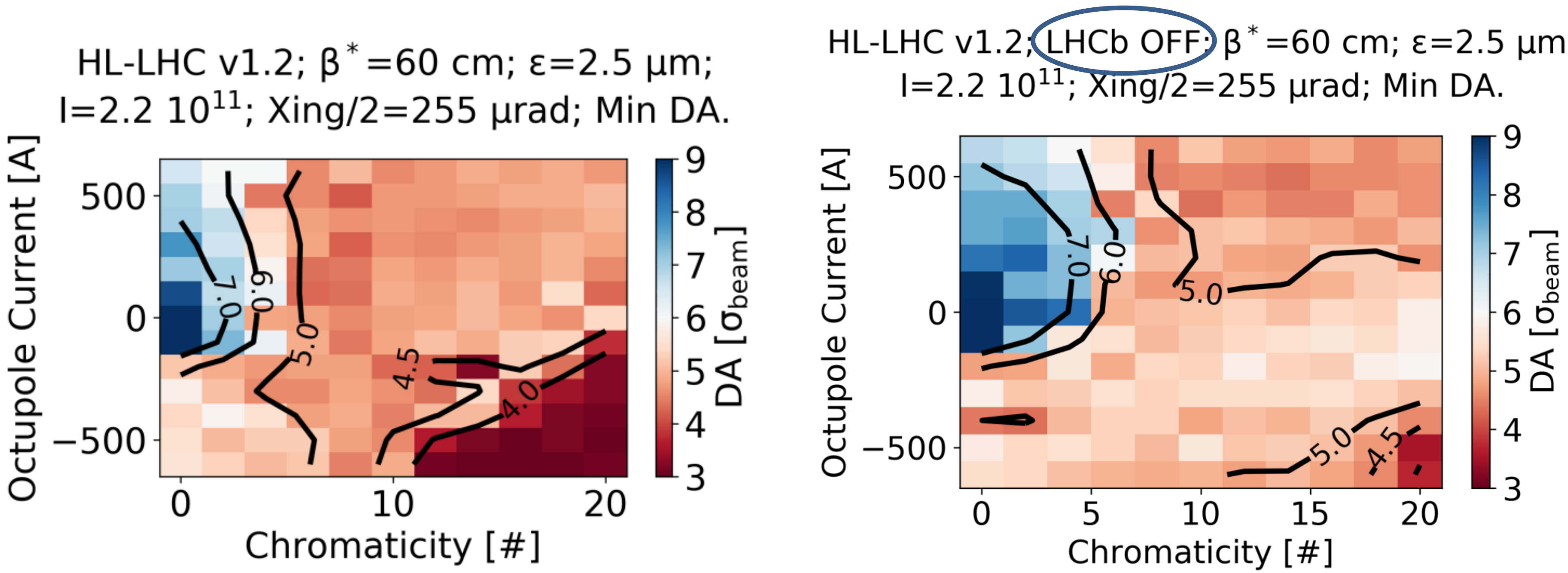




- From end of levelling to beginning of the fill by adjusting first beta* and then intensity.
- The beneficial effect of octupoles is lost with high intensity.
- Limited impact from crossing angle (previous slide).
- LRs do not seem to be the limiting factor, **are we HO dominated?**

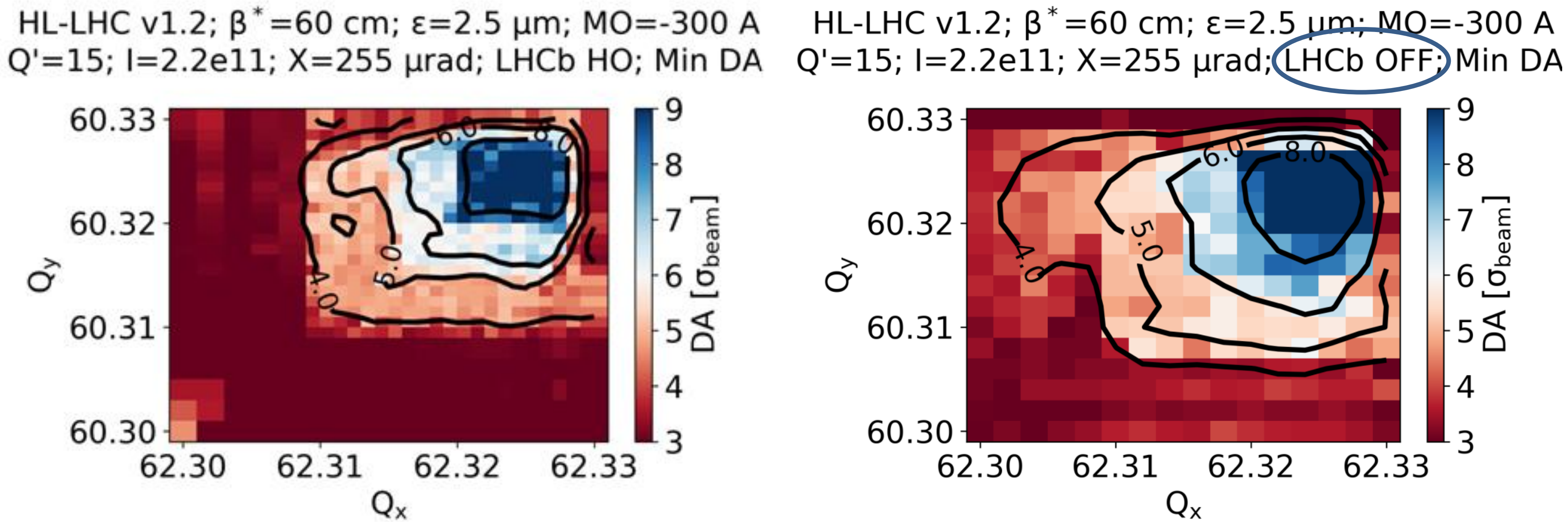


Reduced HO with LHCb OFF



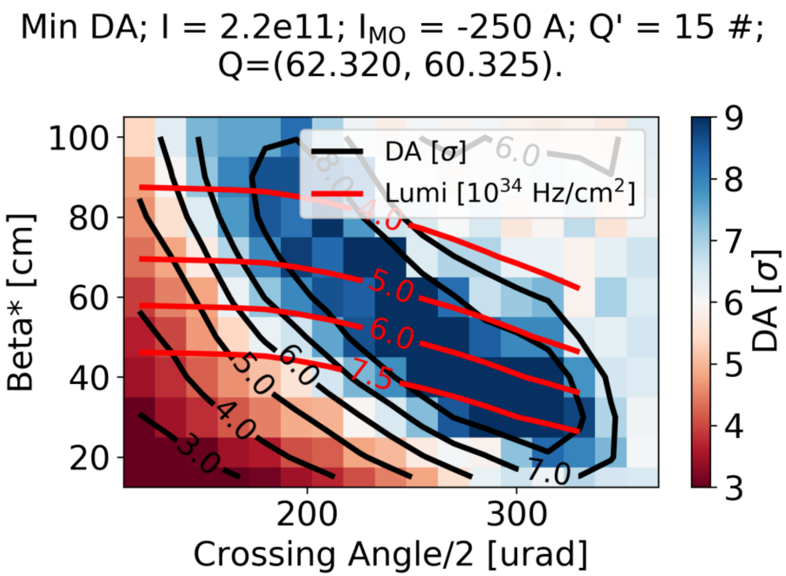
- Some octupole compensation is recovered.
- Confirmation of the too strong HO combined with the high chroma.
- The footprint elongation and the excursion along the diagonal is too large.

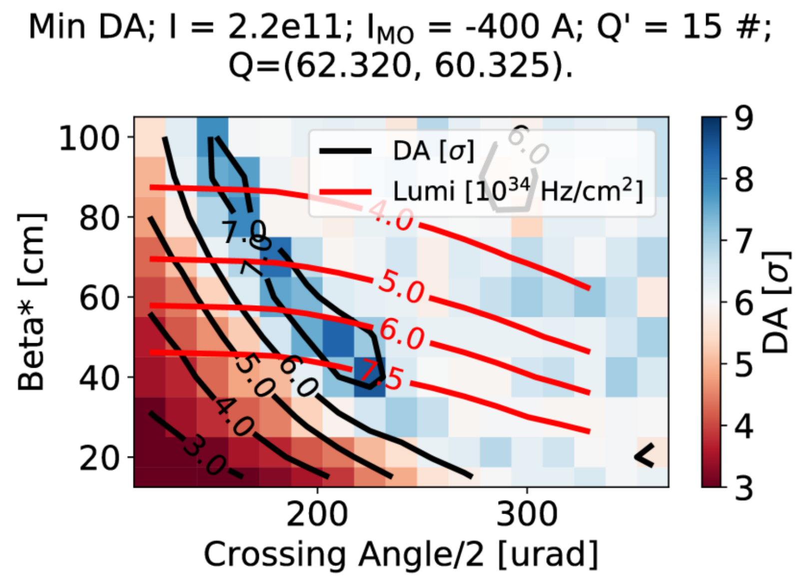
Tune scans with high Q’ and optimised MO (-300A)



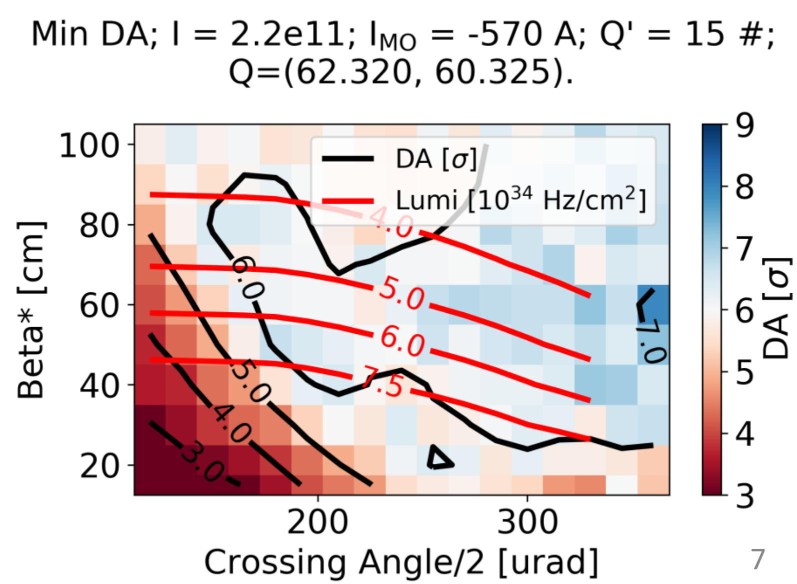
- Clear impact of LHCb at full luminosity and bad polarity…
- but switching it OFF is not sufficient.
- Small area with very good DA close to the third order resonances: optimised Q = (62.320, 60.325) – Same tune split value already tested in the LHC.

Testing the optimised tune





- The optimised tune gives substantial margin allowing to run with full-current octupoles.
- For moderate octupoles settings the long range compensation appears also in the Beta*-Crossing plane.
- Open questions:
  - Why the LHC does not like these tunes even in simulation?
  - Will these tunes be ok with errors, possibly giving large stop bands?



Conclusions and Outlook

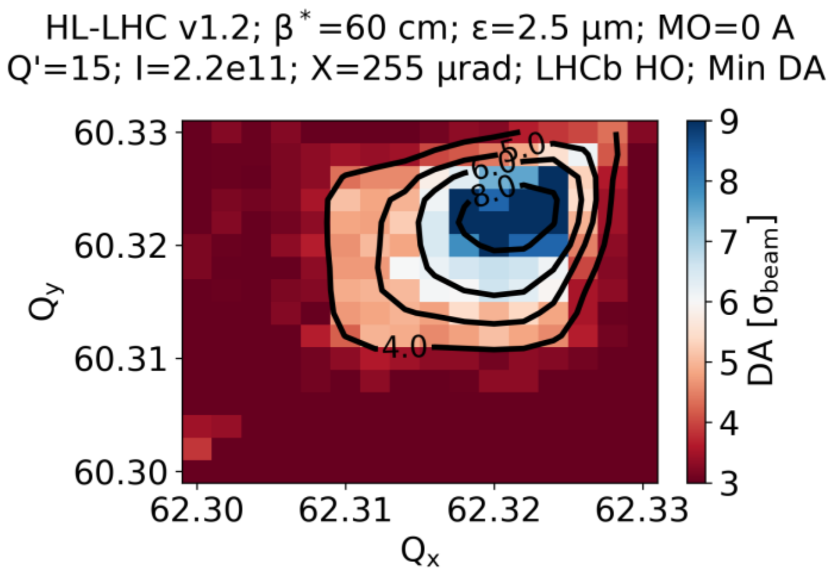
- The tune footprint is **elongated** along the diagonal due to the combined HO effects. The high chromaticity gives wide **excursions** along the diagonal together with the synchrotron motion. Also more excited resonances.
- The new baseline appears dramatic for DA. It seems recoverable with the tunes **(62.320, 60.325)**, but why these tunes do not work for LHC?
- Need to check the third order stop bands with **errors**.
- Should we reconsider **levelling by separation** (giving much less tuneshift)? DA investigations with high octupoles and chroma in the levelling by separation scenario are pending.
- Investigations of the **details** of the DA space (islands) may give some additional insight.
- Potential interest for an HO dominated **MD** with high brightness and chroma, eg 50 ns, and single bunches (Xavier).

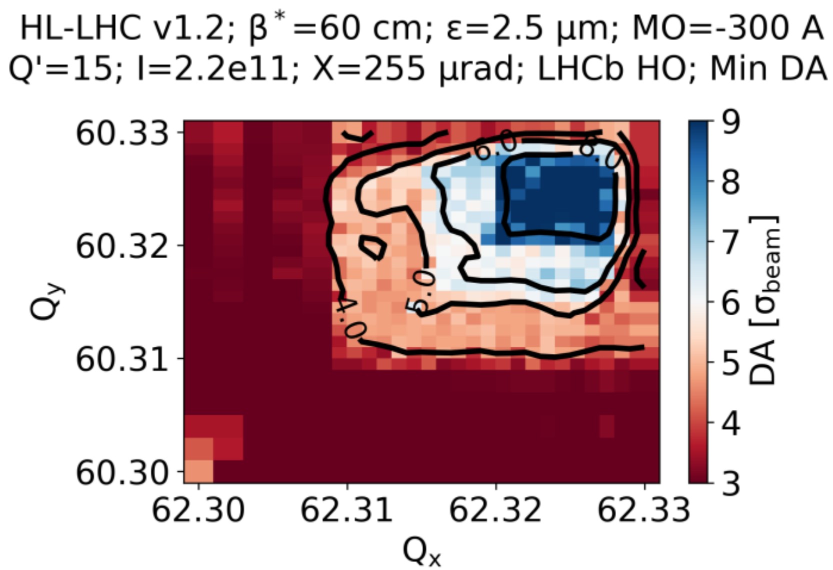
Other References

- LHCb at high luminosity: Beam-beam aspects (impact 3 HO), minimum crossing angle vs beta* (Y. Papaphilippou, 65th HiLumi WP2) – Low chroma case.
- Work in progress also from Dobrin Kaltchev (Triumph) – Tune scans, evaluation of resonant driving terms…

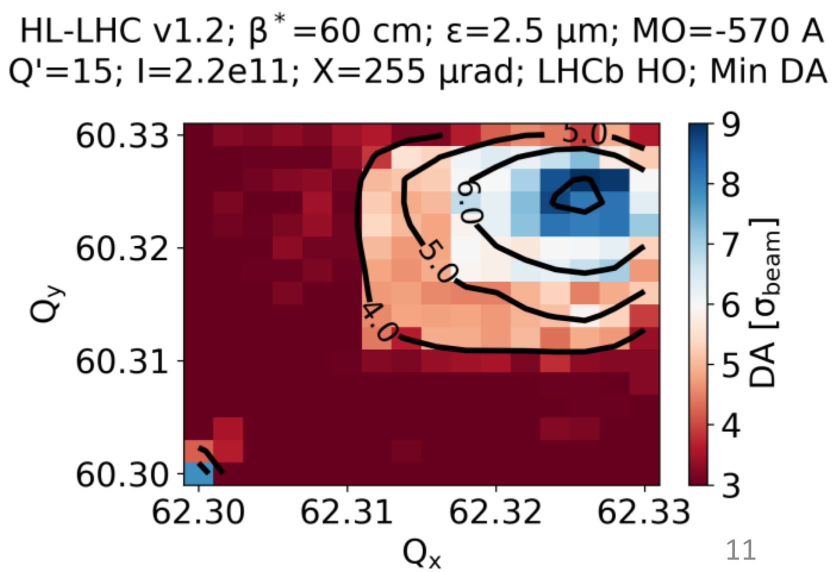
Back up

Tune scan for various Octupoles



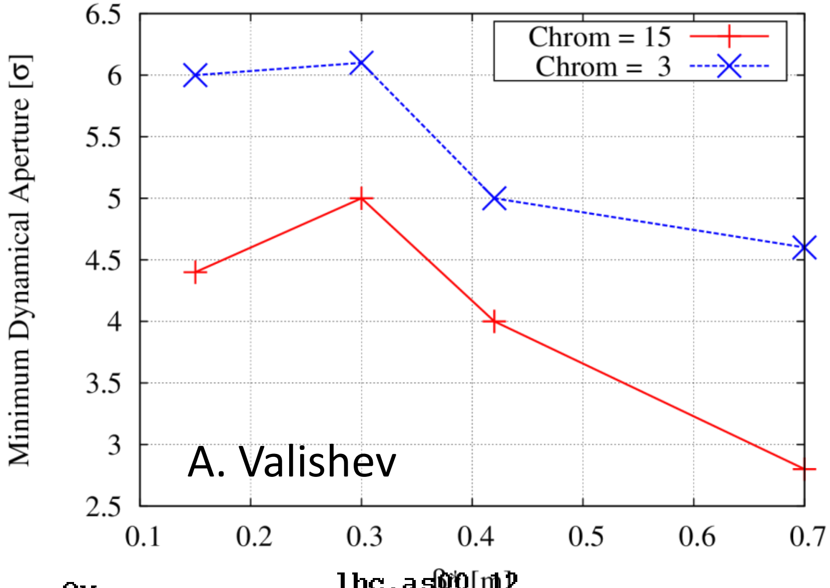


- Octupoles have some impact in the area close to the optimised tune.
- They drag the spot of good DA closer to the diagonal



Other Studies

10th order resonance affects particles between 3-4 σ



M. Fitterer