

Preliminary comparison of HL-LHC v1.3 with v1.2

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*With many thanks to **R. de Maria!***

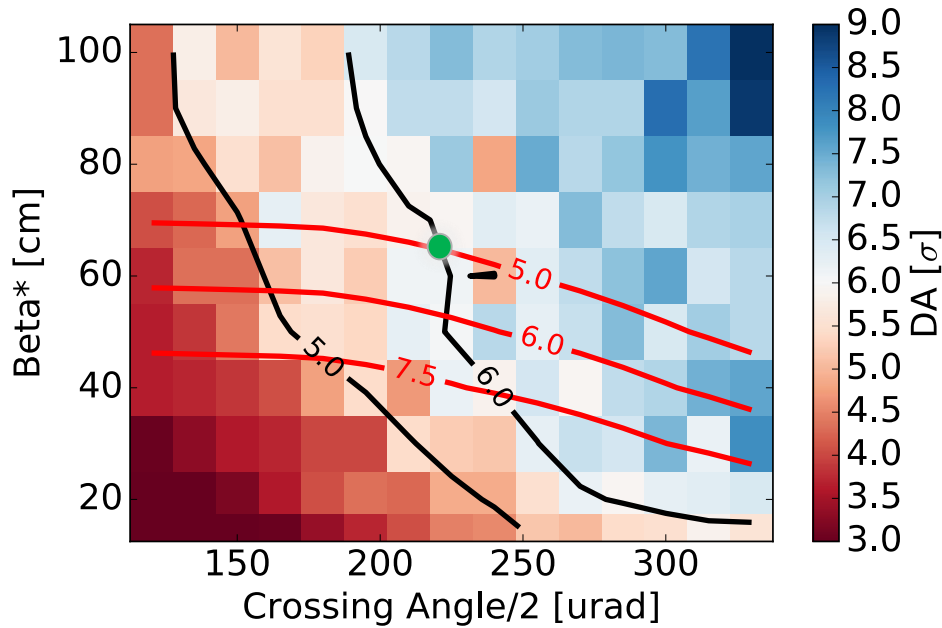
Introduction

- Preliminary checks comparing v1.2 multi-parametric scans with the v1.3 ones

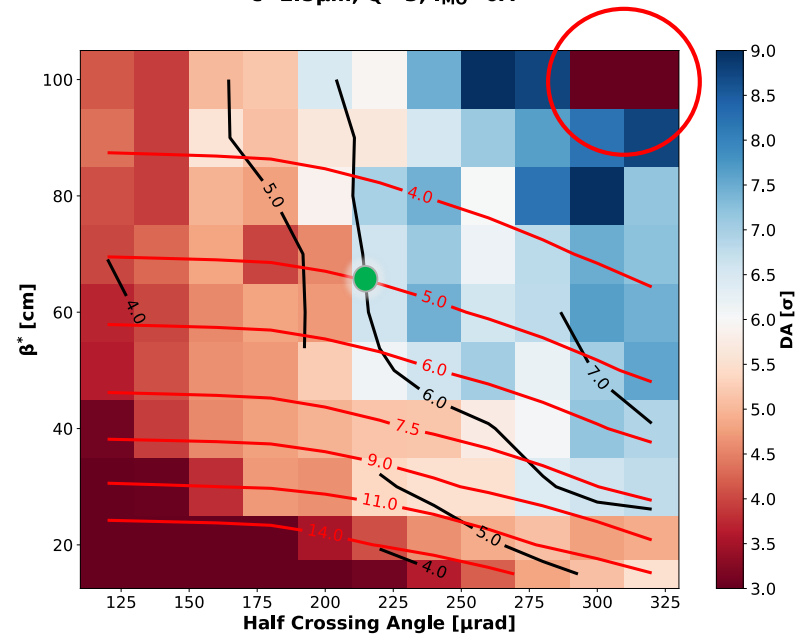
- What has changed?
 - Optics update
 - IR6 phase advances
 - IR1/5 new phase and MS in Q10
 - New BB element

Start of levelling – Low Chroma/Octupoles

Min DA; $I = 2.2 \times 10^{11}$; $I_{MO} = 0$ A; $Q' = 3$ #

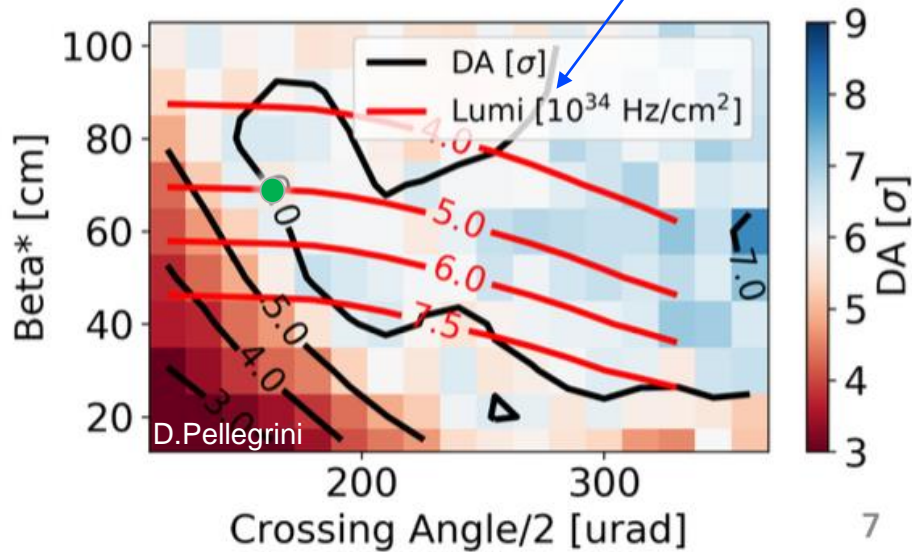


Min DA HL-LHC v1.3, $I = 2.2 \times 10^{11}$ ppb, $(Q_X, Q_Y) = (62.31, 60.32)$
 $\epsilon = 2.5 \mu\text{m}$, $Q' = 3$, $I_{MO} = 0$ A

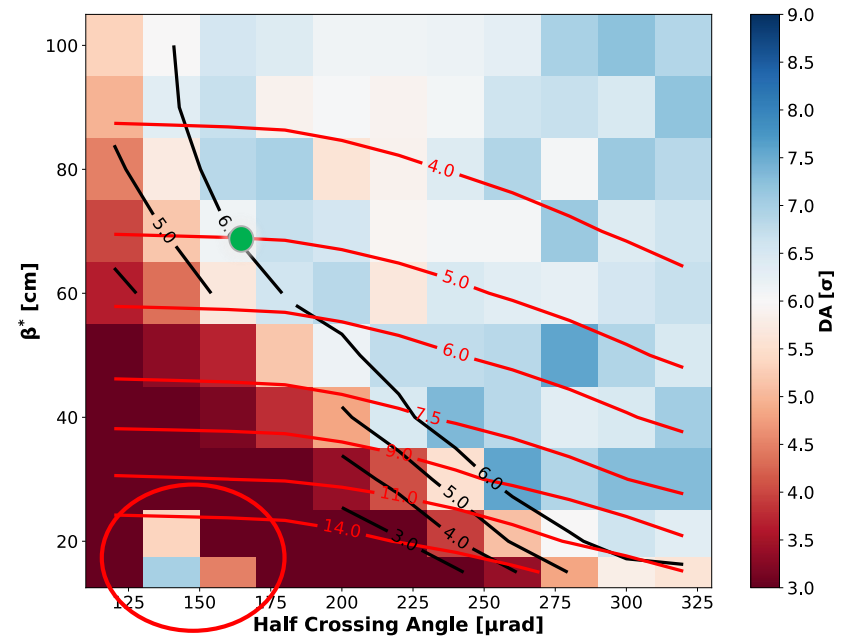


Start of levelling – High Chroma/Octupoles – Opt. Tune

Min DA; $I = 2.2 \times 10^{11}$; $I_{MO} = -570$ A; $Q' = 15$ #;
 $Q = (62.320, 60.325)$.

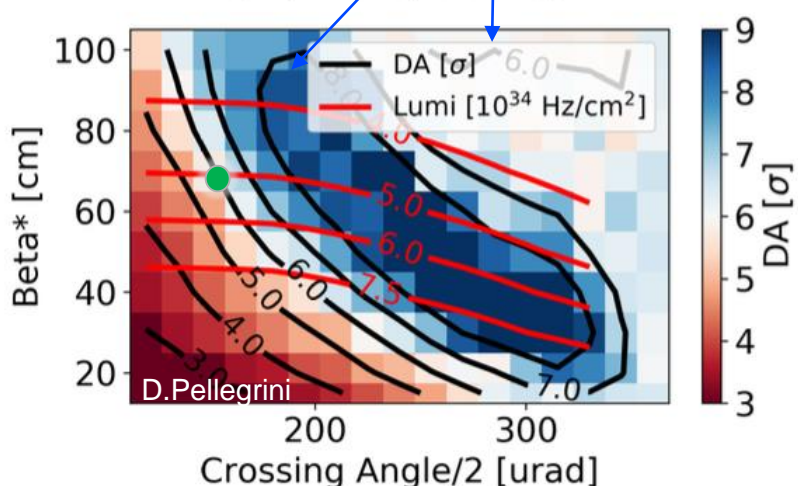


Min DA HL-LHC v1.3, $I = 2.2 \times 10^{11}$ ppb, $(Q_x, Q_y) = (62.320, 60.325)$
 $\epsilon = 2.5 \mu\text{m}$, $Q' = 15$, $I_{MO} = -570$ A

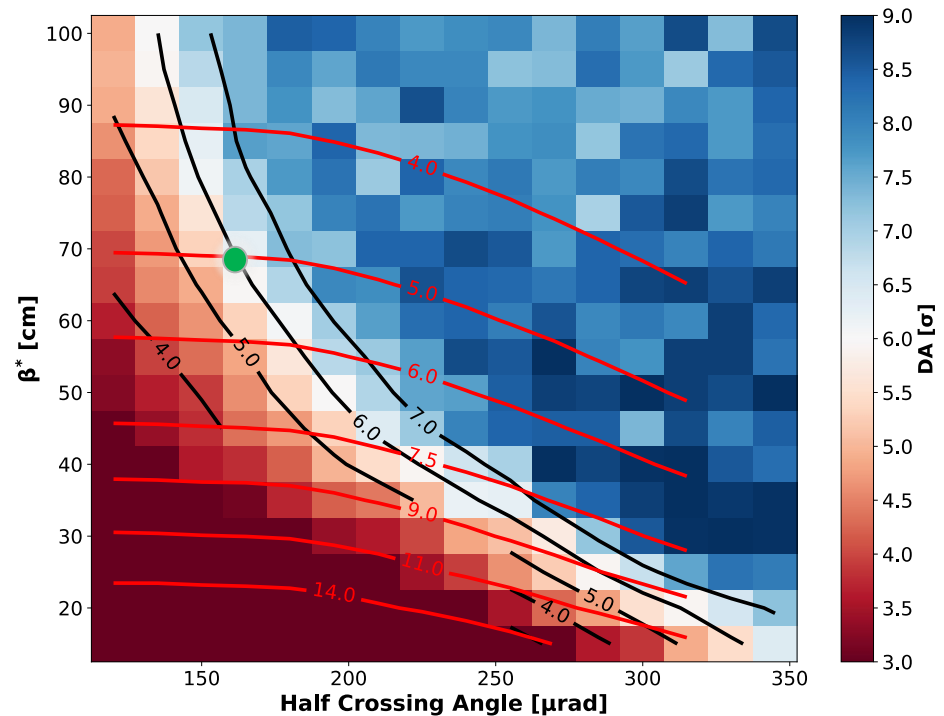


Start of levelling – High Chroma/Octupoles – Opt. Tune

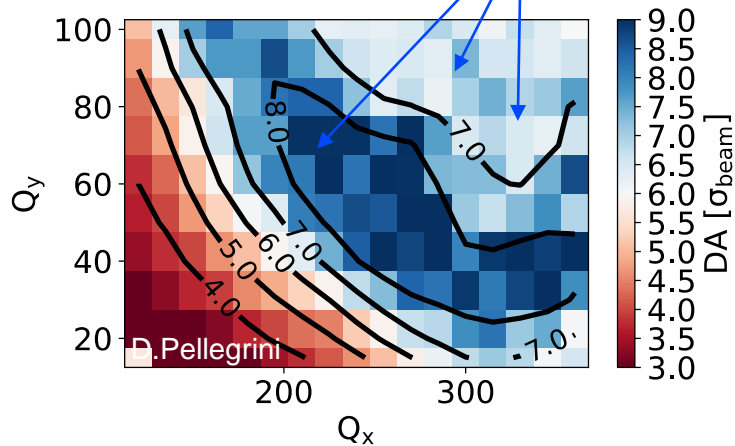
Min DA; $I = 2.2 \times 10^{11}$; $I_{M0} = -250$ A; $Q' = 15$ #;
 $Q = (62.320, 60.325)$.



Min DA HL-LHC v1.3, $I = 2.2 \times 10^{11}$ ppb, $(Q_x, Q_y) = (62.320, 60.325)$
 $\epsilon = 2.5 \mu\text{m}$, $Q' = 15$, $I_{M0} = -250$ A

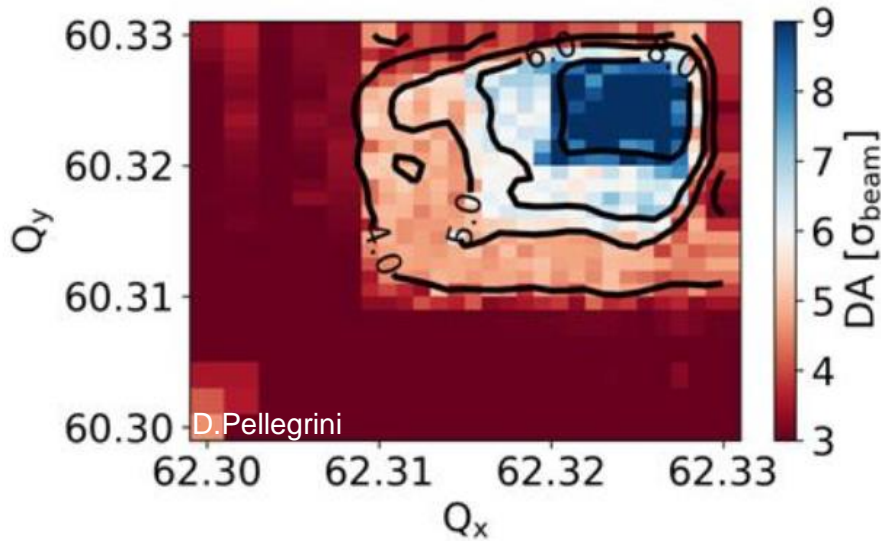


HL1.2 (New BB); $I = 2.2 \times 10^{11}$; $I_{M0} = -250$;
 $Q' = 15$; $Q = (62.320, 60.325)$; Min DA.

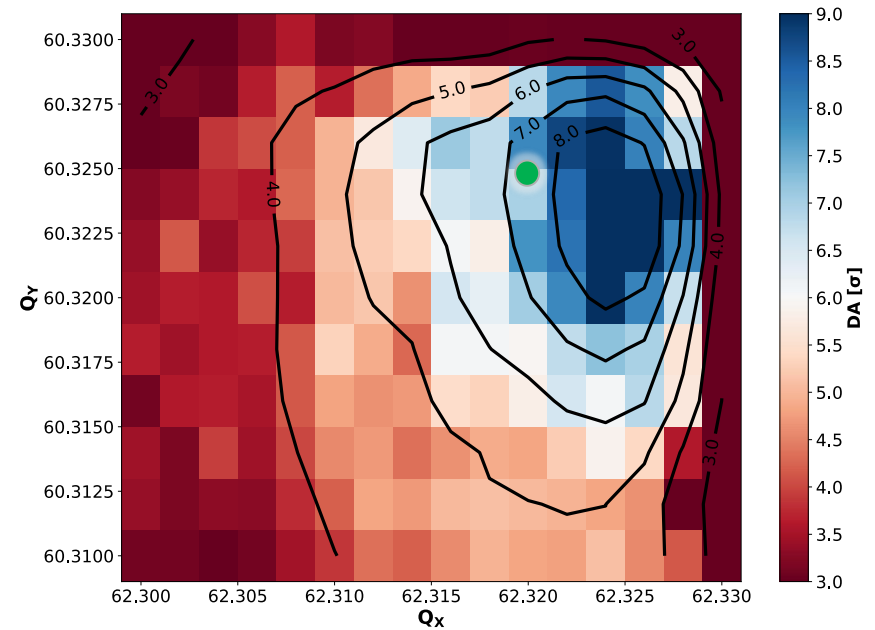


Start of levelling – High Chroma/Octupoles – Opt. Tune

HL-LHC v1.2; $\beta^* = 60$ cm; $\epsilon = 2.5$ μm ; $M_0 = -300$ A
 $Q' = 15$; $I = 2.2 \times 10^{11}$; $X = 255$ μrad ; LHCb HO; Min DA



Min DA HL-LHC v1.3, $I = 2.2 \times 10^{11}$ ppb, $\beta^* = 60$ cm, $\phi = 510$ μrad
 $\epsilon = 2.5$ μm , $Q' = 15$, $I_{M_0} = -300$ A

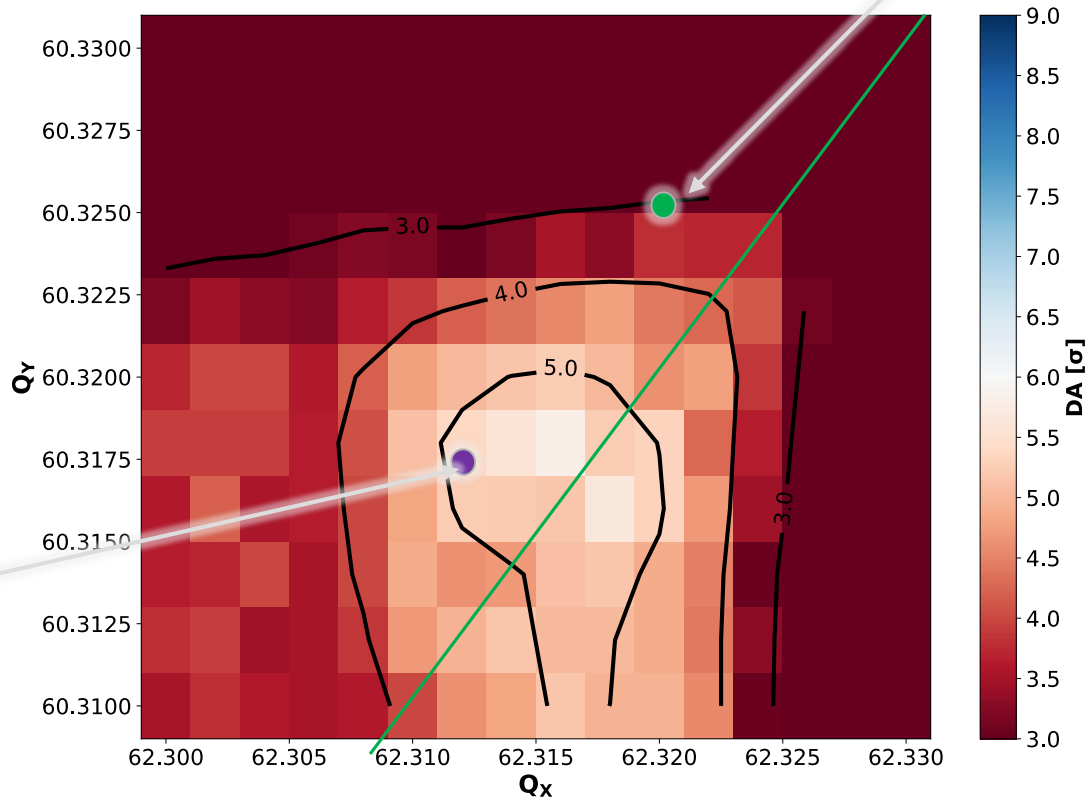


~ End of levelling – High Chroma/Octupoles – Opt. Tune

Preliminary

Min DA HL-LHC v1.3, $I=1.3 \times 10^{11}$ ppb, $\phi=380\mu\text{rad}$
 $\epsilon=2.5\mu\text{m}$, $Q'=15$, $I_{M0}=-570\text{A}$

(.320, .325)
at start of levelling



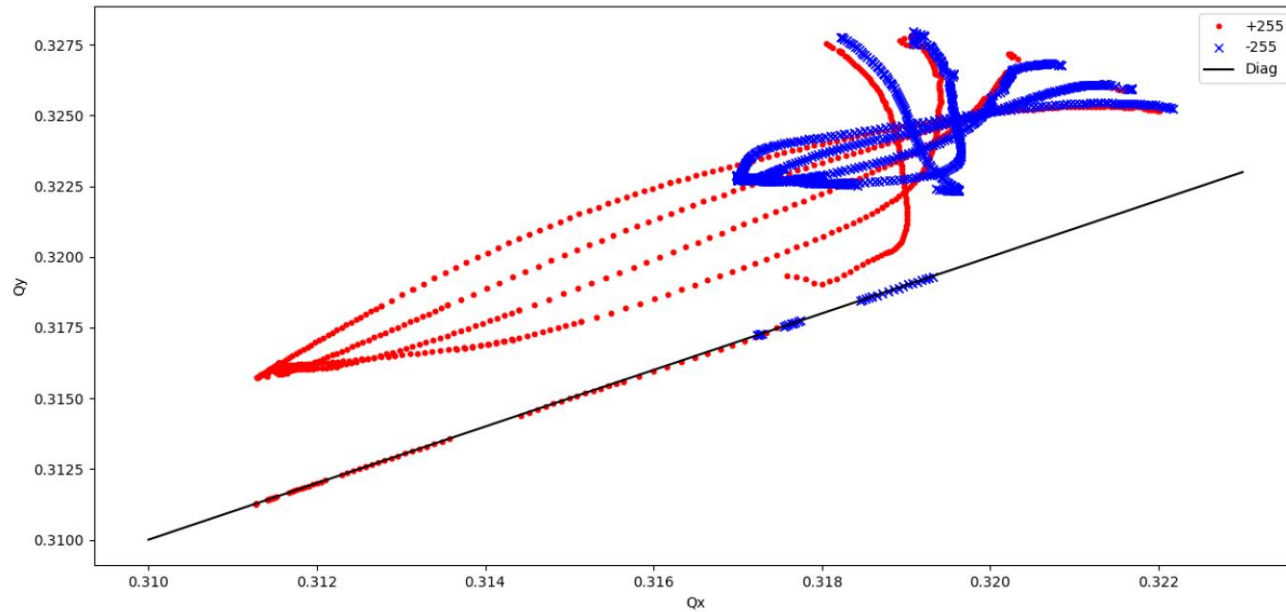
(.313, .317)
LHC FT optimal

Summary & [Not-so-future] Plans

- So far versions 1.2 and 1.3 seem comparable.
 - Together with the inclusion of the updated bb element v1.3 yields smoother contours
 - For the β^* -xing path during levelling the two versions are fully compatible (high/low chroma/octupoles)
- More checks to be done
 - **Done** OK Verify the crabbing of the weak beam → footprint from SixTrack
 - **Almost Done** Small tune optimizations seems to be necessary during the levelling → find a simple “optimal tune path” during levelling
- Plan : *Production, Production, Production*
 - Fix the $Q'=15$, $IMO=-570A$ repeat the adaptive-crossing levelling exercise with tune optimization per levelling step
 - Estimate the impact of field errors (full and individual multipoles)



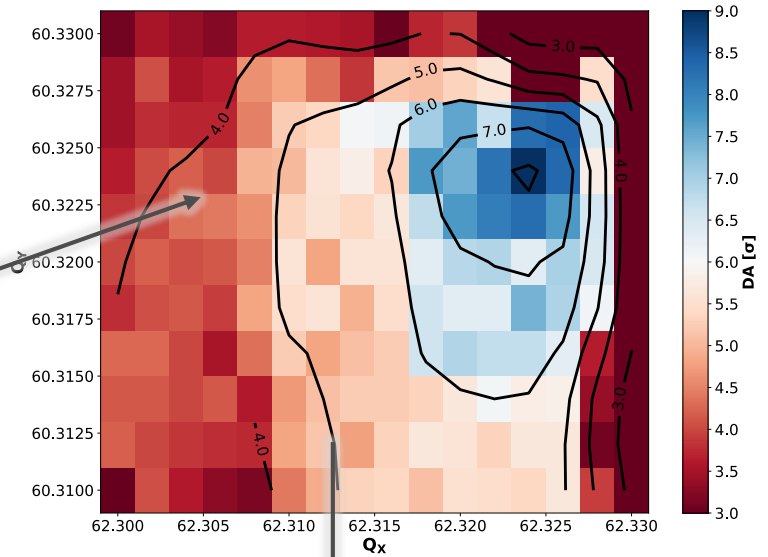
Footprint



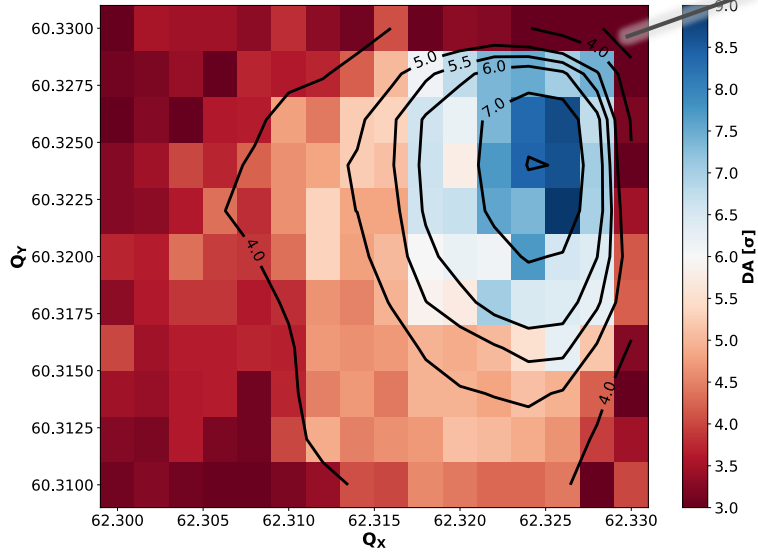
*TbT data dumped by SixTrack
NAFF to compute tunes*

→ Positive sign shows the proper footprint shape – ok in our mask!

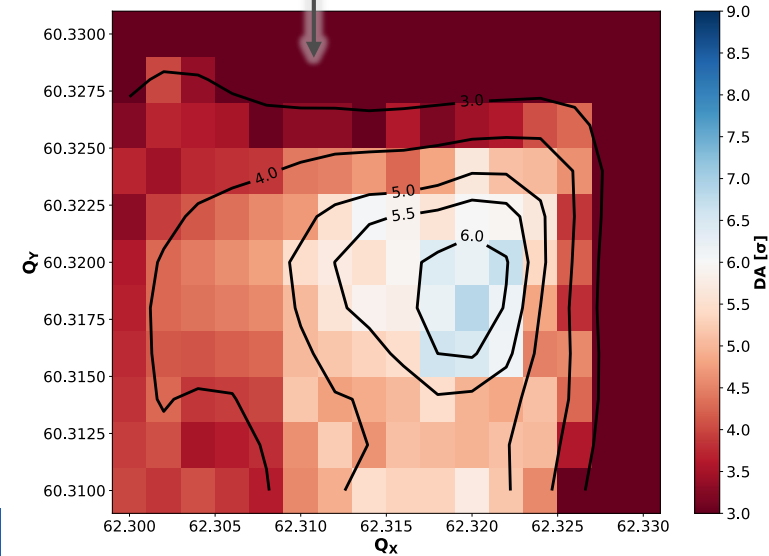
Min DA HL-LHC v1.3, $I=1.6 \times 10^{11}$ ppb, $\beta^*=28\text{cm}$, $\phi=510\mu\text{rad}$
 $\epsilon=2.5\mu\text{m}$, $Q=15$, $I_{M0}=-570\text{A}$



Min DA HL-LHC v1.3, $I=2.2 \times 10^{11}$ ppb, $\beta^*=60\text{cm}$, $\phi=510\mu\text{rad}$
 $\epsilon=2.5\mu\text{m}$, $Q=15$, $I_{M0}=-570\text{A}$

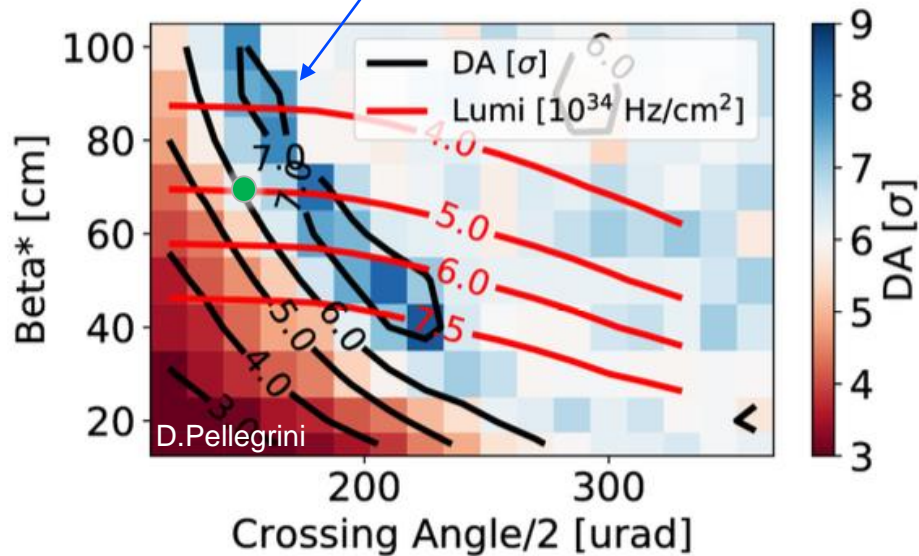


Min DA HL-LHC v1.3, $I=1.3 \times 10^{11}$ ppb, $\beta^*=20\text{cm}$, $\phi=430\mu\text{rad}$
 $\epsilon=2.5\mu\text{m}$, $Q=15$, $I_{M0}=-570\text{A}$



Start of levelling – High Chroma/Octupoles – Opt. Tune

Min DA; $I = 2.2 \times 10^{11}$; $I_{MO} = -400$ A; $Q' = 15$ #;
 $Q = (62.320, 60.325)$.



Min DA HL-LHC v1.3, $I = 2.2 \times 10^{11}$ ppb, $(Q_X, Q_Y) = (62.320, 60.325)$
 $\epsilon = 2.5 \mu\text{m}$, $Q' = 15$, $I_{MO} = -400$ A

