



## DA for the stability scenarios

X. Buffat, R. De Maria, N. Karastathis, Y. Papaphilippou



WP2 Meeting - 31.07.2018

# Outline

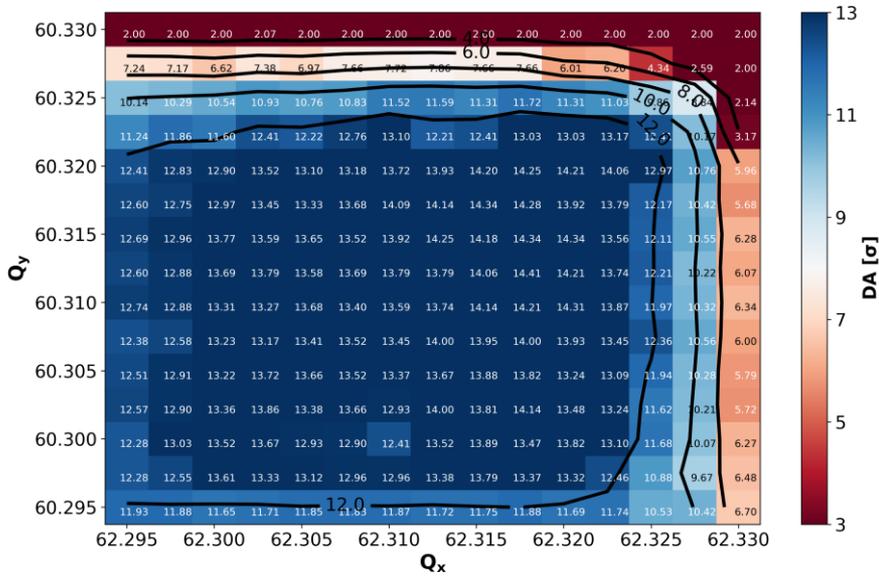
- Investigating the available dynamic aperture right before the collapse of the separation bumps.
- The beam/machine parameter are taken from
  - E. Metral *et al.* “Update of the HL-LHC operational scenarios for proton operation”, CERN-ACC-NOTE-2018-0002
- In this brief presentation we show the available tune space for
  - (almost) the **nominal** ( $\beta^*=60\text{cm}$ ) and
  - the **ultimate** ( $\beta^*=41\text{cm}$ ) scenario,
    - For nominal tele-index ( **$r=1$** )
    - and high tele-index ( **$r=3.33$** ).

# Nominal Tele-Index

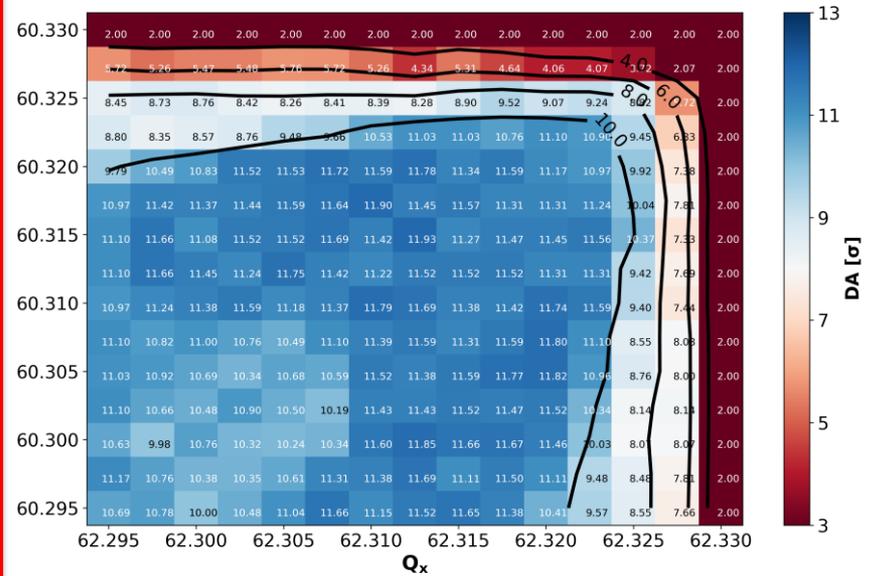
Nominal

Ultimate

Min DA HL-LHC v1.3, Pre-Squeeze,  $N_b = 2.2 \times 10^{11}$  ppb  
 $\beta_{IP1}^* = 0.60\text{m}$ ,  $\phi/2 = 250\mu\text{rad}$ ,  $\epsilon = 2.5\mu\text{m}$ ,  $Q' = 15$ ,  $I_{MO} = -570\text{A}$



Min DA HL-LHC v1.3, Pre-Squeeze,  $N_b = 2.2 \times 10^{11}$  ppb  
 $\beta_{IP1}^* = 0.41\text{m}$ ,  $\phi/2 = 250\mu\text{rad}$ ,  $\epsilon = 2.5\mu\text{m}$ ,  $Q' = 15$ ,  $I_{MO} = -570\text{A}$



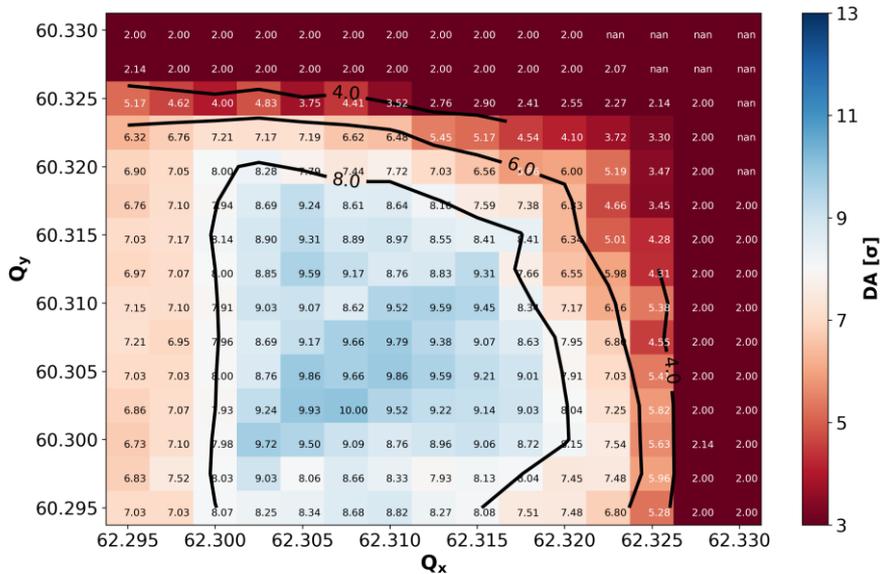
Difference of about  $2\sigma$  DA between the two scenarios  $\rightarrow$  Effect of the BB

# High Tele-Index ( $r=3.33$ )

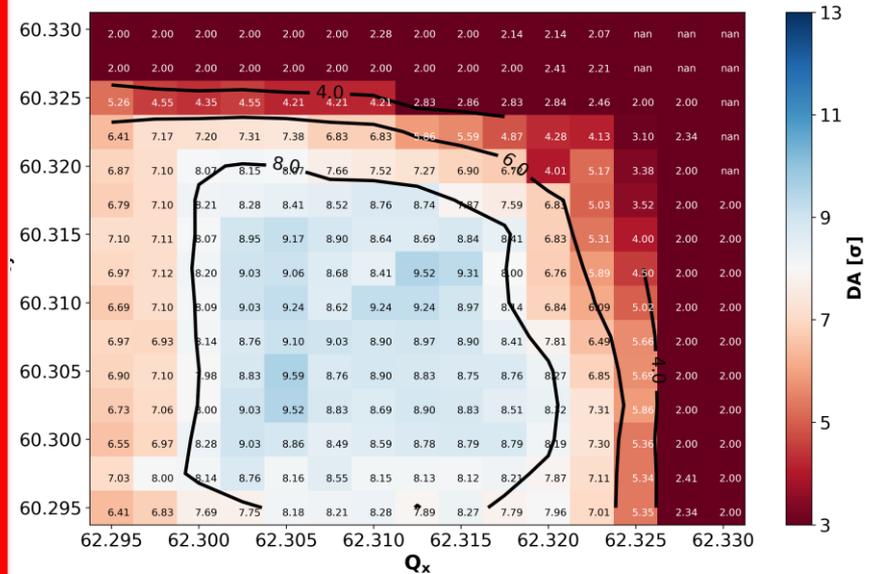
Nominal

Ultimate

Min DA HL-LHC v1.3, Pre-Squeeze,  $r_{ATS}=3.3$ ,  $N_b = 2.2 \times 10^{11}$  ppb  
 $\beta_{IP1}^*=0.60m$ ,  $\phi/2=250\mu rad$ ,  $\epsilon=2.5\mu m$ ,  $Q'=15$ ,  $I_{MO}=-570A$

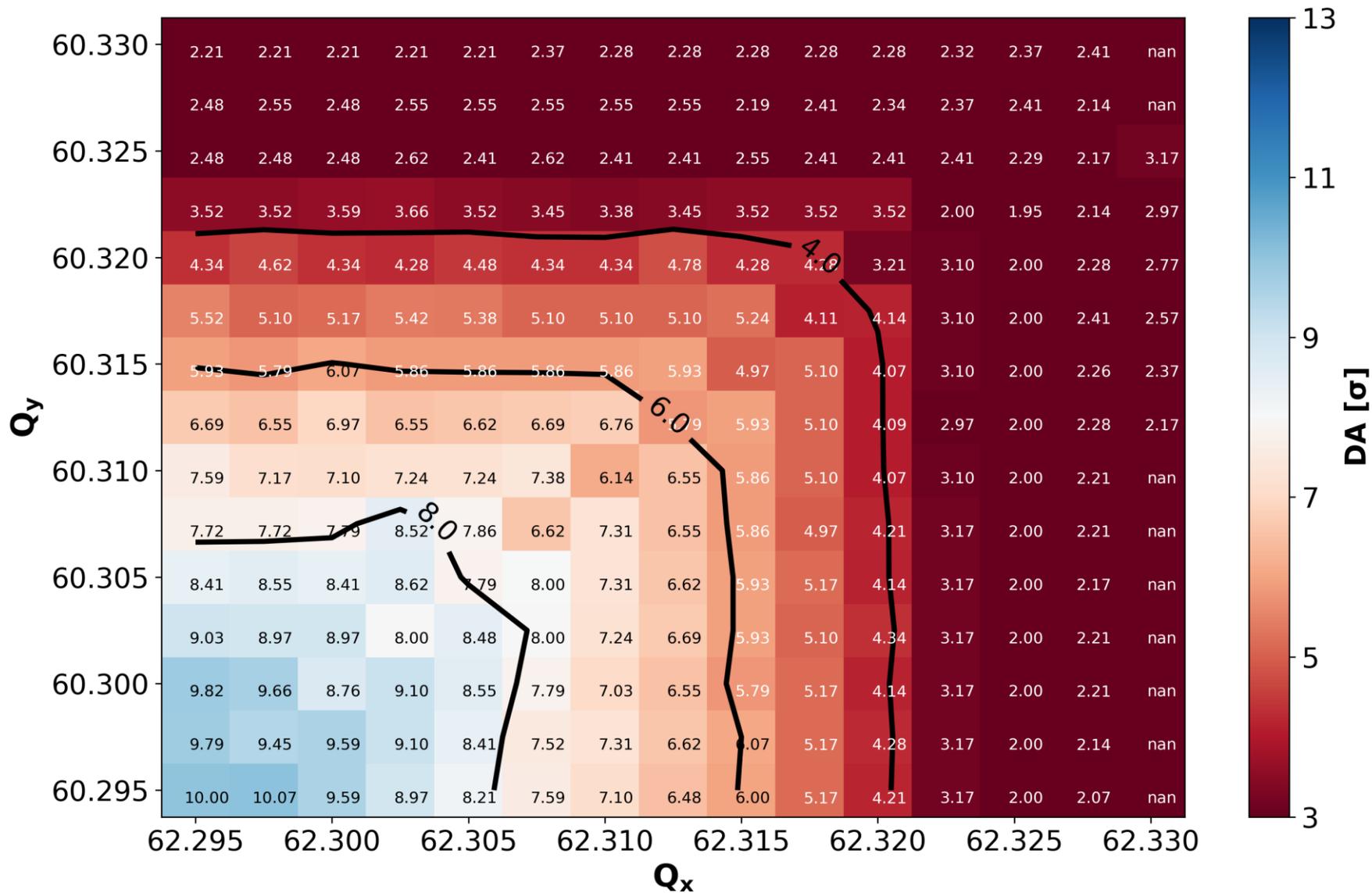


Min DA HL-LHC v1.3, Pre-Squeeze,  $r_{ATS}=3.3$ ,  $N_b = 2.2 \times 10^{11}$  ppb  
 $\beta_{IP1}^*=0.41m$ ,  $\phi/2=250\mu rad$ ,  $\epsilon=2.5\mu m$ ,  $Q'=15$ ,  $I_{MO}=-570A$



Small impact  $\rightarrow$  dominated by octupoles

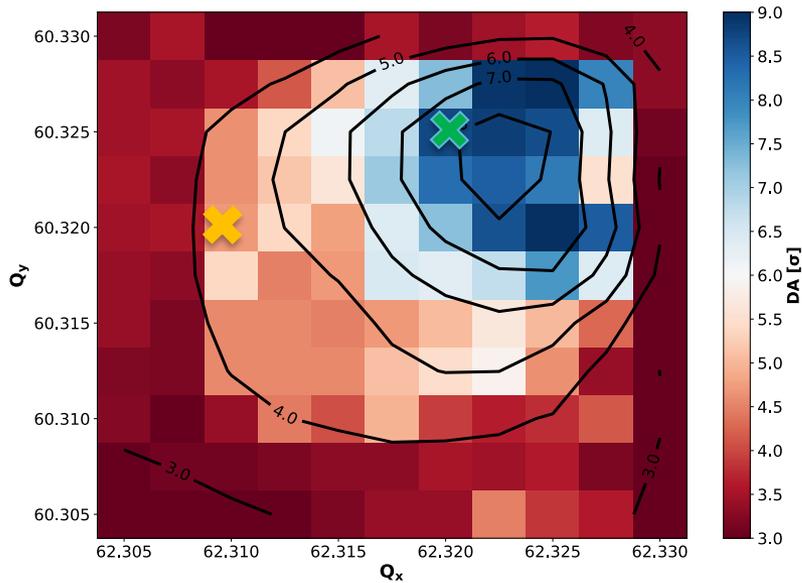
**Min DA HL-LHC v1.3, Pre-Squeeze,  $r_{\text{ATS}}=3.3$ ,  $N_b = 2.2 \times 10^{11}$  ppb**  
 $\beta_{\text{IP1}}^* = 0.60\text{m}$ ,  $\phi/2 = 250\mu\text{rad}$ ,  $\varepsilon = 2.5\mu\text{m}$ ,  $Q' = 15$ ,  $I_{\text{MO}} = 300\text{A}$



# Collision ( $\beta^*=60\text{cm}$ )

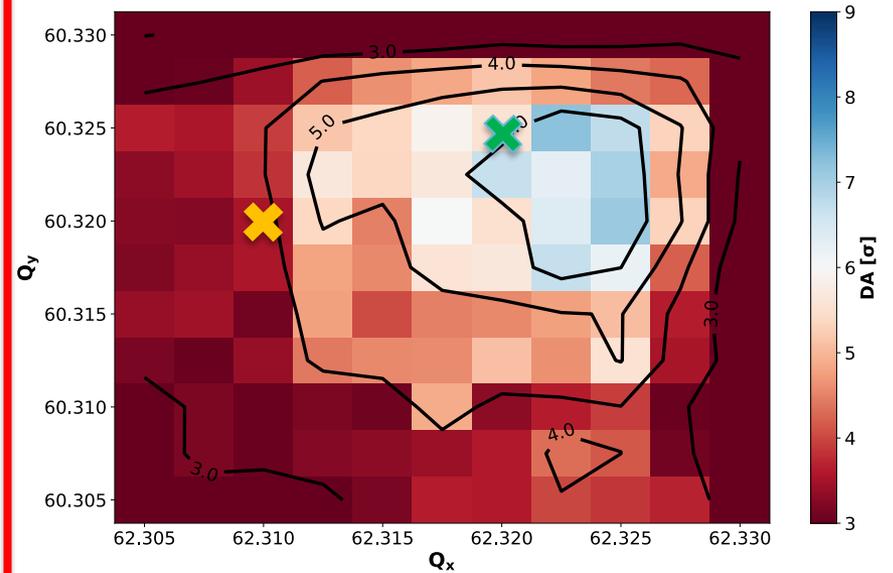
$r = 1$

Min DA HL-LHC v1.3,  $I = 2.2 \times 10^{11}$  ppb,  $\beta_{IP1}^* = 0.60\text{m}$   
 $\phi/2 = 250\mu\text{rad}$ ,  $\epsilon = 2.5\mu\text{m}$ ,  $Q' = 15$ ,  $I_{MO} = -300\text{A}$



$r = 3.33$

Min DA HL-LHC v1.3,  $r_{ATS} = 3.3$ ,  $N_b = 2.2 \times 10^{11}$  ppb  
 $\beta_{IP1}^* = 0.60\text{m}$ ,  $\phi/2 = 250\mu\text{rad}$ ,  $\epsilon = 2.5\mu\text{m}$ ,  $Q' = 15$ ,  $I_{MO} = -300\text{A}$



Dominated by octupoles

# Overview

- In the nominal scenario (60cm,  $r=1$ ) with -570A :  $14\sigma$ , wide
- In the ultimate scenario (41cm,  $r=1$ ) with -570A :  $12\sigma$ , wide
  
- In the nominal high-r scenario (60cm,  $r=3.33$ ) with -570A:  $10\sigma$ , smaller
- In the ultimate high-r scenario (41cm,  $r=3.33$ ) with -570A:  $9\sigma$ , smaller
  
- For the **nominal high-r** scenario, scan of the octupoles behaved as expected:
  - For negative polarity going towards 0A increases DA
  - For positive polarity going towards 0A significantly increases DA
  - From the simulations maximum min DA at +40A ( $\sim 14.6\sigma$ )
  
- At **collisions** nominal high-r scenario significantly reduces DA due to the **overcompensation of the BB** interaction (therefore a twisted footprint).