



Long-range compensation: PACMAN and HO impact in HL-LHC dynamic aperture

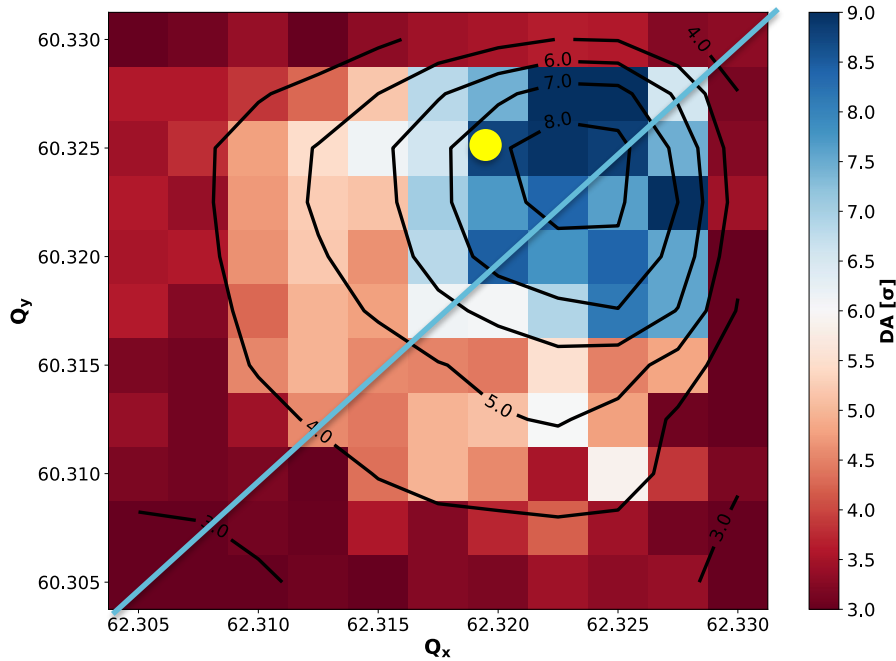
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K. Skoufaris, G. Sterbini,**



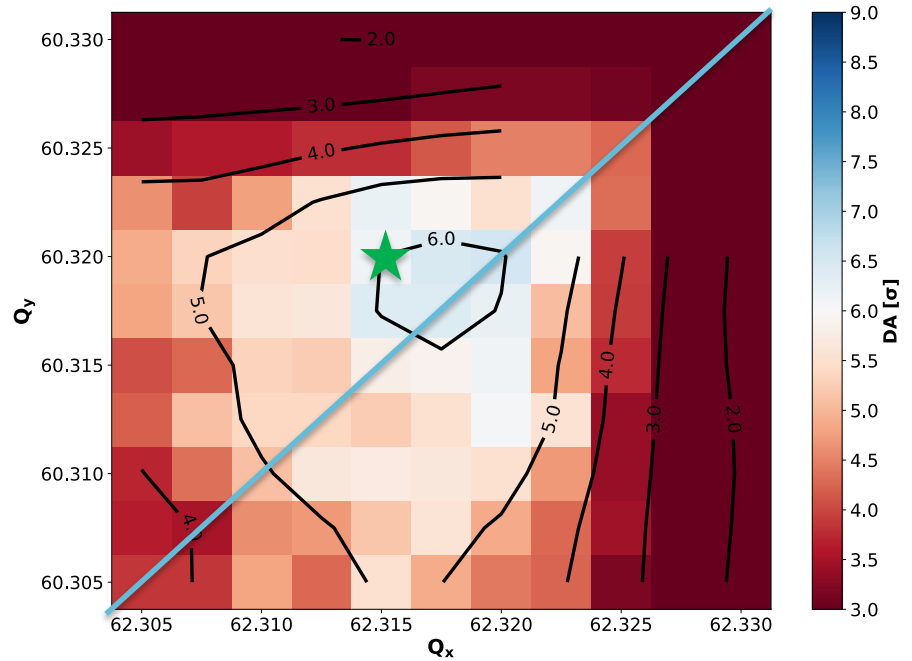
Nominal HO+LR

Updated for the latest optics version
(after the bug in generation of optics)
to be consistent → No surprises

Min DA HL-LHC v1.3, $I = 2.2 \times 10^{11}$ ppb, $\beta_{IP1}^* = 0.64\text{m}$
 $\phi/2 = 250\mu\text{rad}$, $\epsilon = 2.5\mu\text{m}$, $Q' = 15$, $I_{MO} = -300\text{A}$



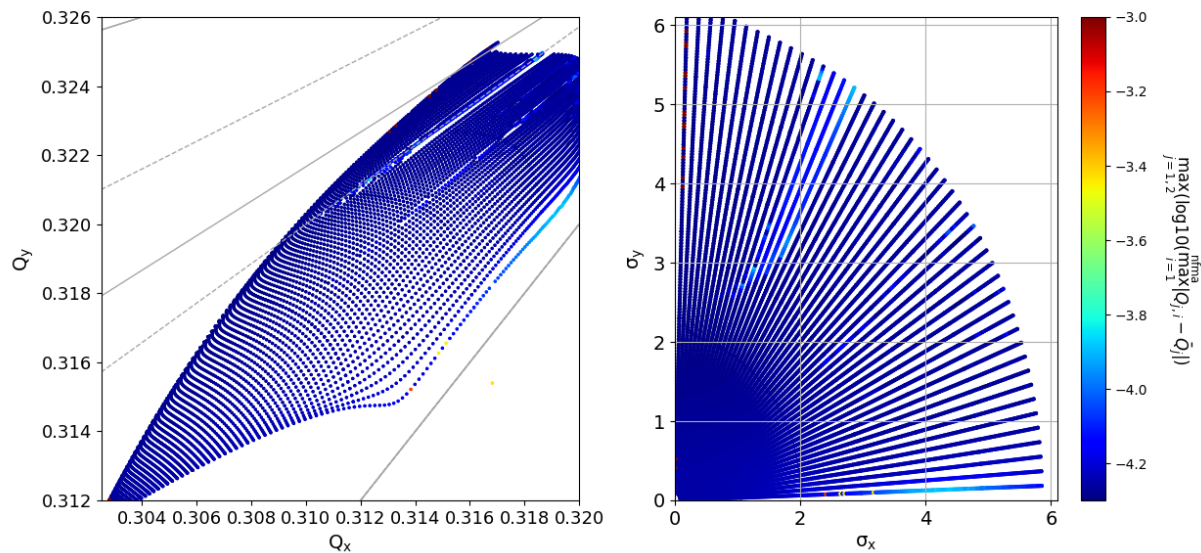
Min DA HL-LHC v1.3, $I = 1.2 \times 10^{11}$ ppb, $\beta_{IP1}^* = 0.15\text{m}$
 $\phi/2 = 250\mu\text{rad}$, $\epsilon = 2.5\mu\text{m}$, $Q' = 15$, $I_{MO} = -300\text{A}$



FMA Nominal HO+LR

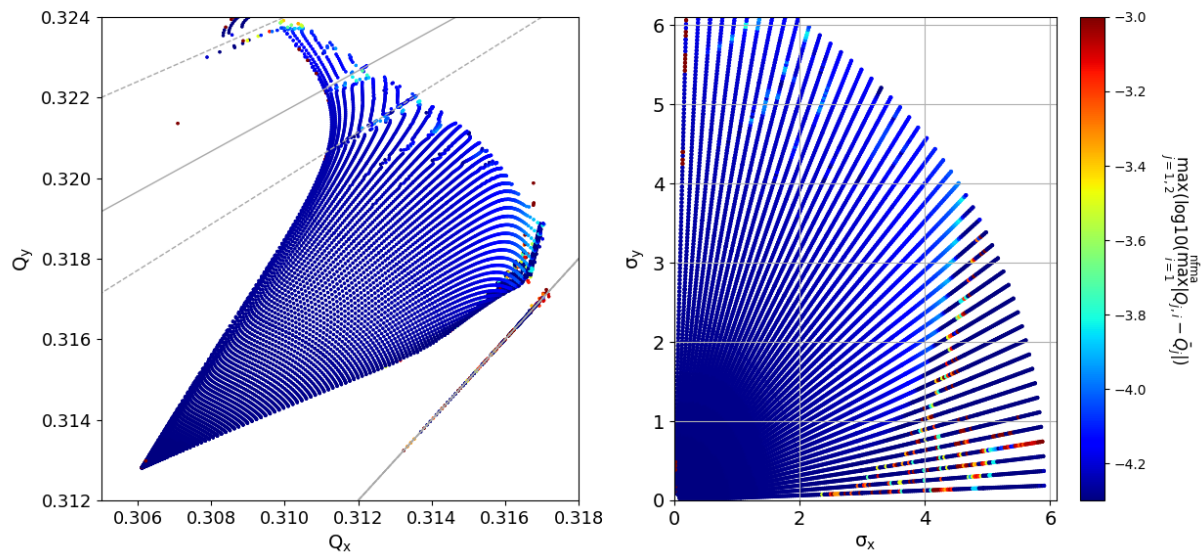
5D, $E = 7.0\text{TeV}$, $I_{\text{oct}} = 300\text{A}$, Beam - beam (lr - ho) ON, $\epsilon_n = 2.5$, $N_{b0} = 2.2e11$, $\beta^* = 64\text{cm}$, $x_{\text{ing}} = 250\mu\text{rad}$, μm , $q = 15$
 $(Q_x, Q_y) = (62.32, 60.3250)$, V_{RF} OFF, $\delta p = 27e-5$, 49 angles, $0.1 - 6.1 \sigma$, sliding NAFF

$N_b = 2.2e11$ ppb:



5D, $E = 7.0\text{TeV}$, $I_{\text{oct}} = 300\text{A}$, Beam - beam (lr - ho) ON, $\epsilon_n = 2.5$, $N_{b0} = 1.2e11$, $\beta^* = 15\text{cm}$, $x_{\text{ing}} = 250\mu\text{rad}$, μm , $q = 15$
 $(Q_x, Q_y) = (62.315, 60.32)$, V_{RF} OFF, $\delta p = 27e-5$, 49 angles, $0.1 - 6.1 \sigma$, sliding NAFF

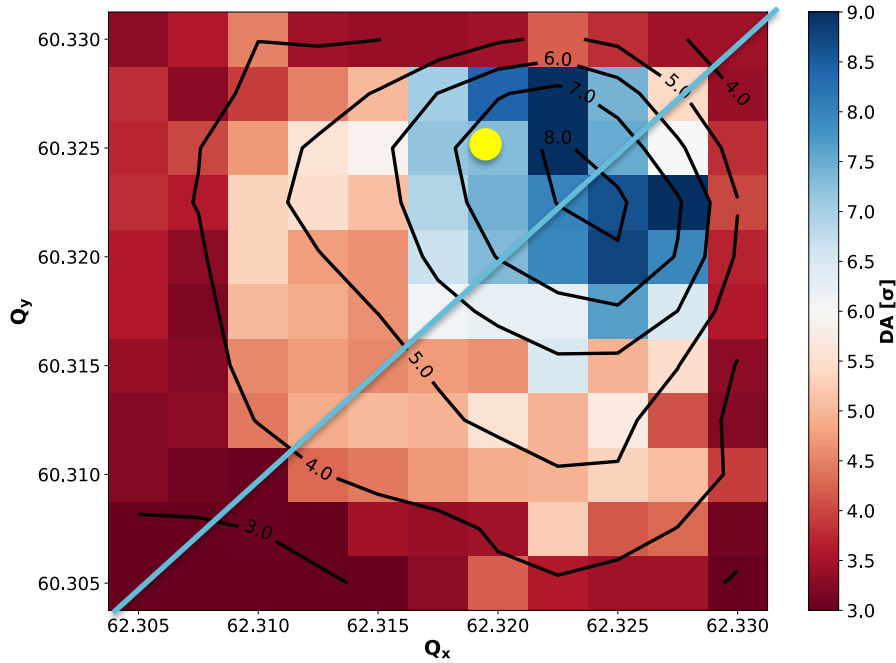
$N_b = 1.2e11$ ppb:



Nominal HO+LEFT PACMAN

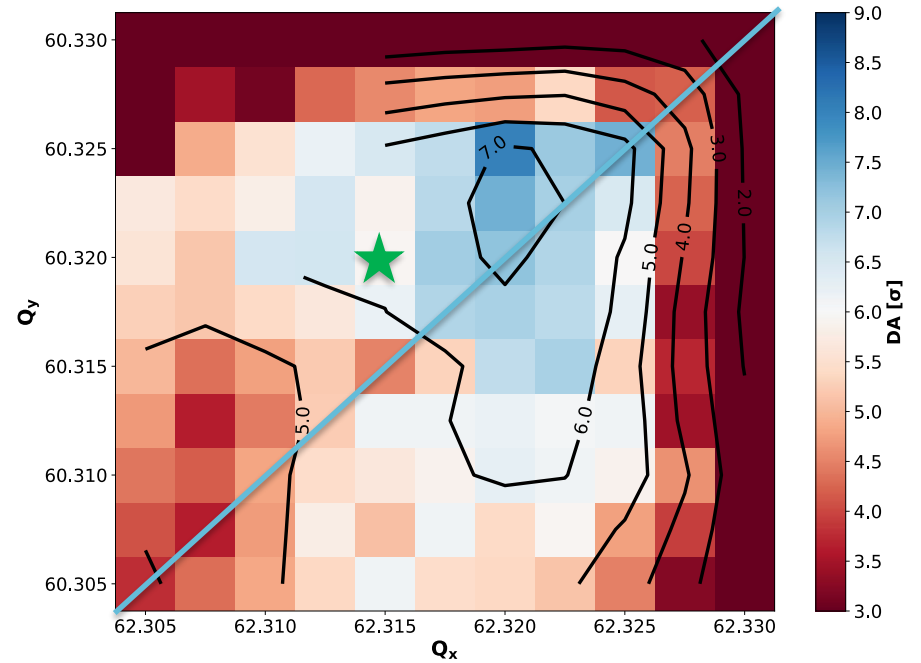
(21.8 σ d_{bb})

Min DA HL-LHC v1.3, Left PACMAN, $I = 2.2 \times 10^{11}$ ppb, $\beta^* = 0.64\text{m}$
 $\phi/2 = 250\mu\text{rad}$, $\epsilon = 2.5\mu\text{m}$, $Q' = 15$, $I_{MO} = -300\text{A}$



(10.5 σ d_{bb})

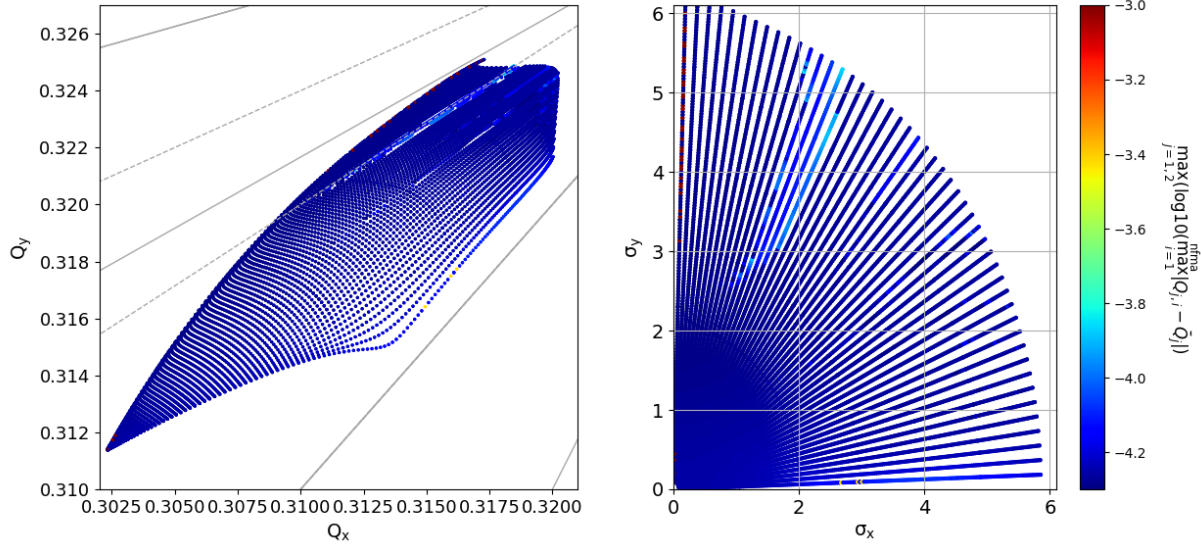
Min DA HL-LHC v1.3, Left PACMAN, $I = 1.2 \times 10^{11}$ ppb, $\beta^* = 0.15\text{m}$
 $\phi/2 = 250\mu\text{rad}$, $\epsilon = 2.5\mu\text{m}$, $Q' = 15$, $I_{MO} = -300\text{A}$



FMA HO+LEFT PACMAN

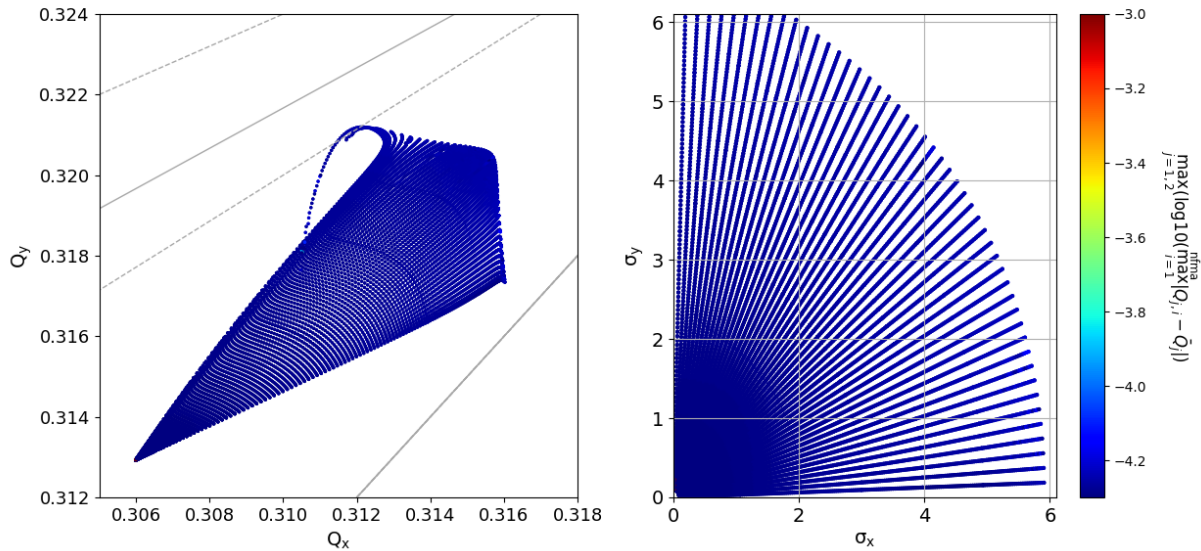
5D, E = 7.0TeV, $I_{\text{oct}} = -300\text{A}$, Beam - beam left lr & ho, $\epsilon_n = 2.5$, $N_{b0} = 2.2\text{e}11$, $\beta^* = 64\text{cm}$, $x_{\text{ing}} = 250\mu\text{rad}$, $q = 15$
 $(Q_x, Q_y) = (62.32, 60.3250)$, $V_{\text{RF}} \text{ OFF}$, $\delta p = 27\text{e} - 5$, 49 angles, 0.1 - 6.1 σ , sliding NAFF

Nb=2.2e11ppb:



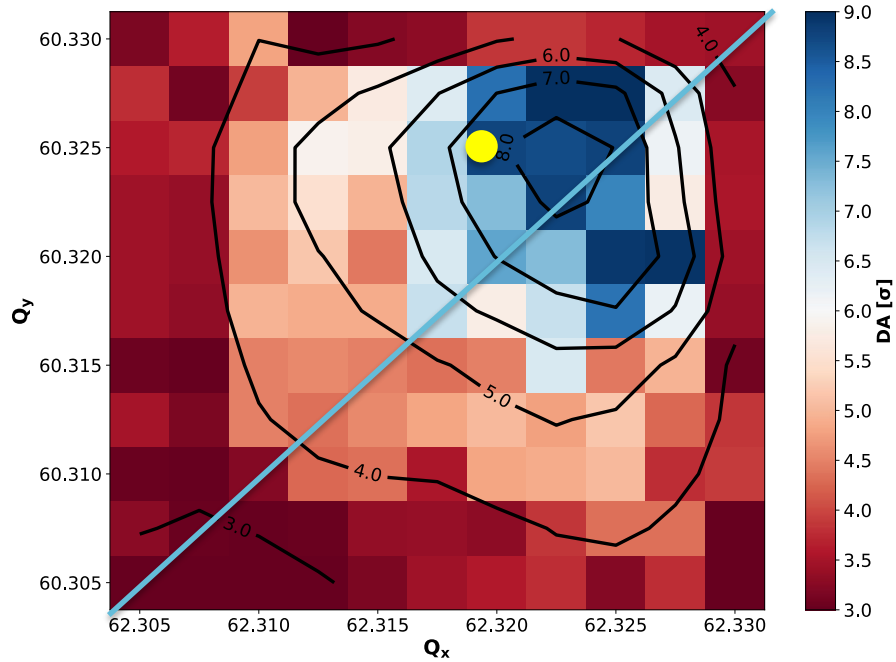
5D, E = 7.0TeV, $I_{\text{oct}} = -300\text{A}$, Beam - beam left lr & ho, $\epsilon_n = 2.5$, $N_{b0} = 1.2\text{e}11$, $\beta^* = 15\text{cm}$, $x_{\text{ing}} = 250\mu\text{rad}$, $q = 15$
 $(Q_x, Q_y) = (62.315, 60.32)$, $V_{\text{RF}} \text{ OFF}$, $\delta p = 27\text{e} - 5$, 49 angles, 0.1 - 6.1 σ , sliding NAFF

Nb=1.2e11ppb:

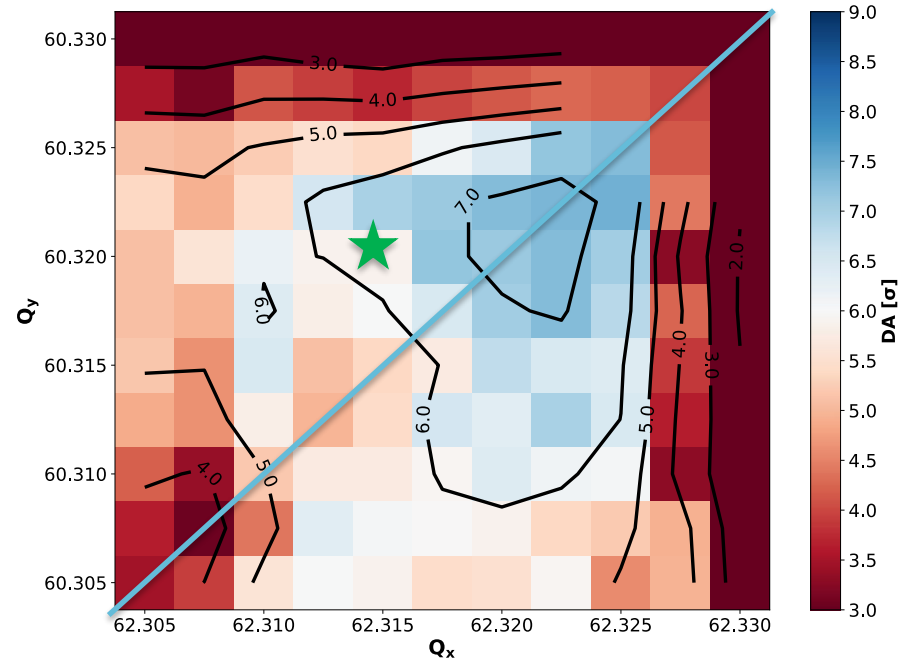


Nominal HO+RIGHT PACMAN

Min DA HL-LHC v1.3, Right PACMAN, $I = 2.2 \times 10^{11}$ ppb, $\beta^* = 0.64$ m
 $\phi/2 = 250 \mu\text{rad}$, $\epsilon = 2.5 \mu\text{m}$, $Q' = 15$, $I_{M0} = -300$ A



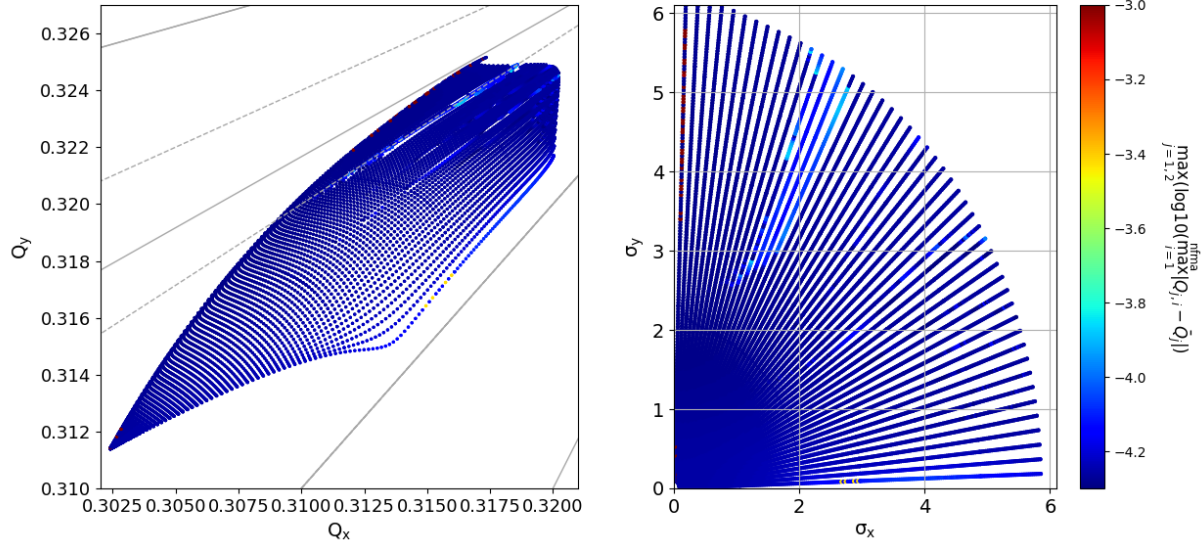
Min DA HL-LHC v1.3, Right PACMAN, $I = 1.2 \times 10^{11}$ ppb, $\beta^* = 0.15$ m
 $\phi/2 = 250 \mu\text{rad}$, $\epsilon = 2.5 \mu\text{m}$, $Q' = 15$, $I_{M0} = -300$ A



FMA HO+RIGHT PACMAN

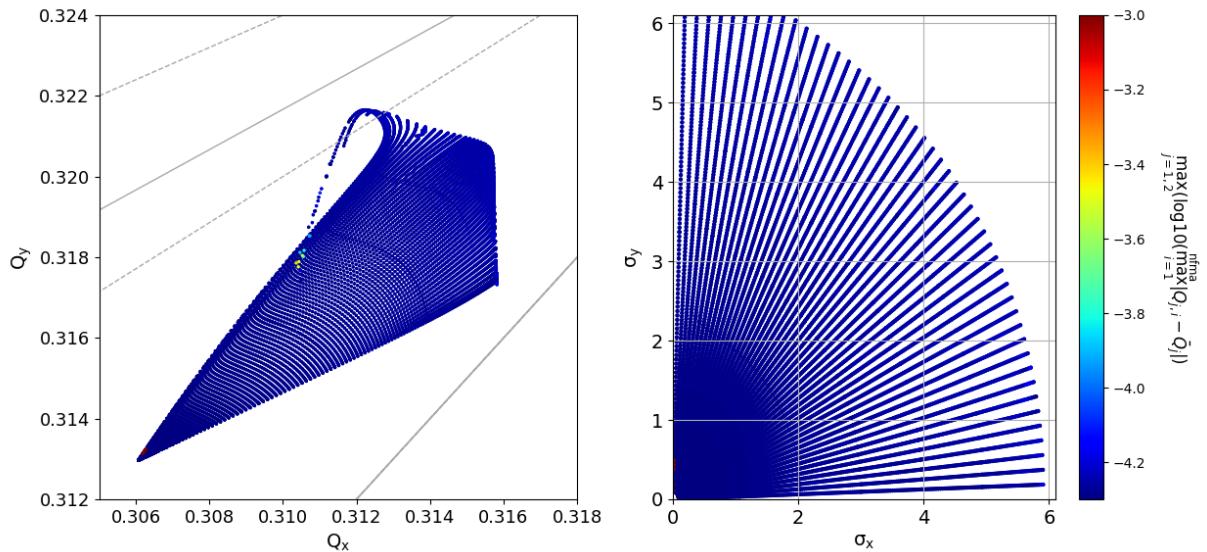
5D, $E = 7.0\text{TeV}$, $I_{\text{oct}} = -300\text{A}$, Beam – beam right lr & ho, $\epsilon_n = 2.5$, $N_{b0} = 2.2\text{e}11$, $\beta^* = 64\text{cm}$, $x_{\text{ing}} = 250\mu\text{rad}$, $q = 15$
 $(Q_x, Q_y) = (62.32, 60.3250)$, $V_{\text{RF}} \text{ OFF}$, $\delta p = 27e-5$, 49 angles, 0.1 – 6.1 σ , sliding NAFF

$N_b = 2.2\text{e}11\text{ppb}$:



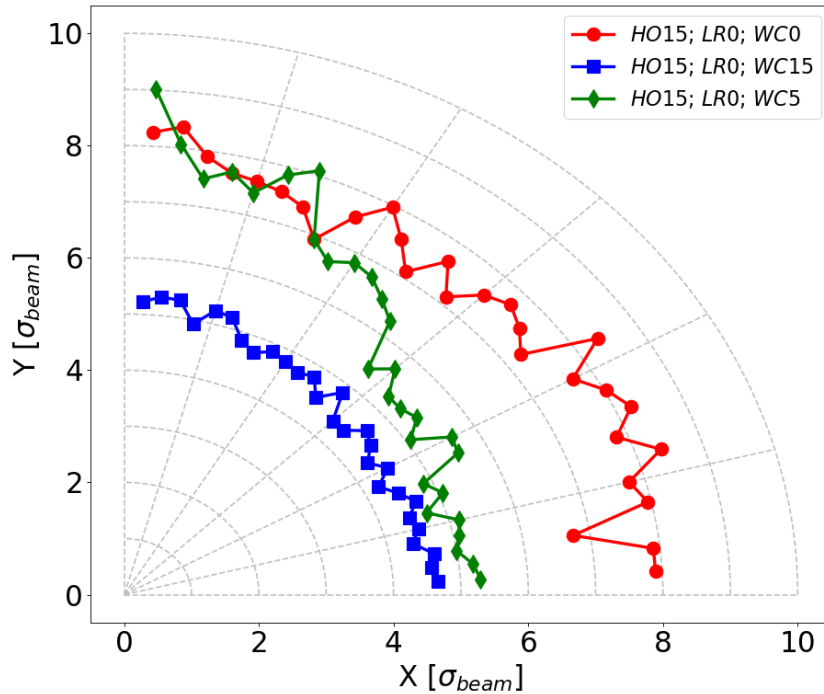
5D, $E = 7.0\text{TeV}$, $I_{\text{oct}} = -300\text{A}$, Beam – beam right lr & ho, $\epsilon_n = 2.5$, $N_{b0} = 1.2\text{e}11$, $\beta^* = 15\text{cm}$, $x_{\text{ing}} = 250\mu\text{rad}$, $q = 15$
 $(Q_x, Q_y) = (62.315, 60.32)$, $V_{\text{RF}} \text{ OFF}$, $\delta p = 27e-5$, 49 angles, 0.1 – 6.1 σ , sliding NAFF

$N_b = 1.2\text{e}11\text{ppb}$:

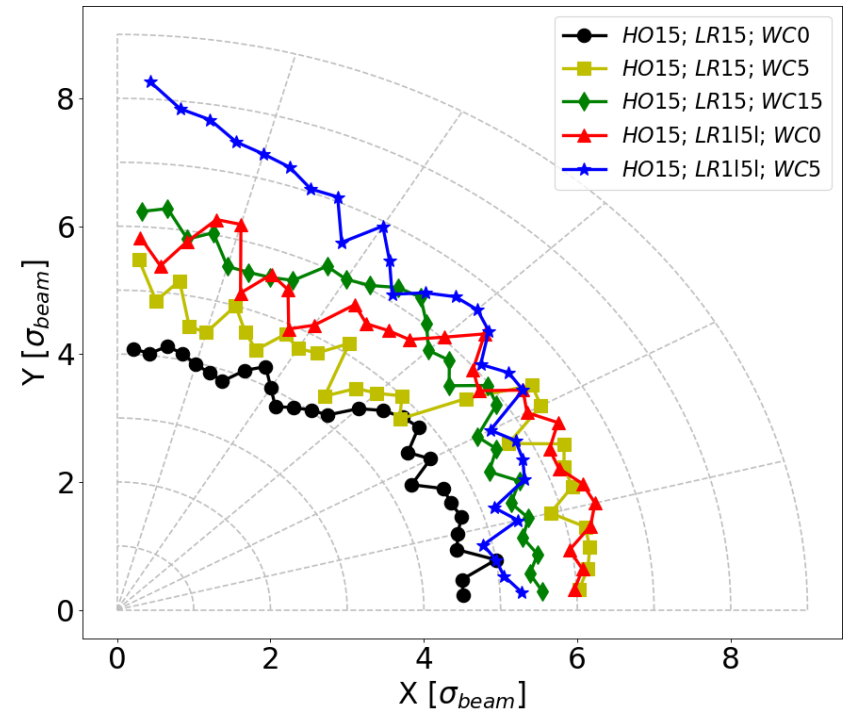


Wire compensation in LHC

LHC ATS18; $Q' = (15, 15)$; $Q = (62.31, 60.32)$; $I_0 = 550$ A;
 $\beta^* = 30$ cm; $Xing15 = 150\mu\text{rad}$; $N_p = 1.25 \times 10^{11}$

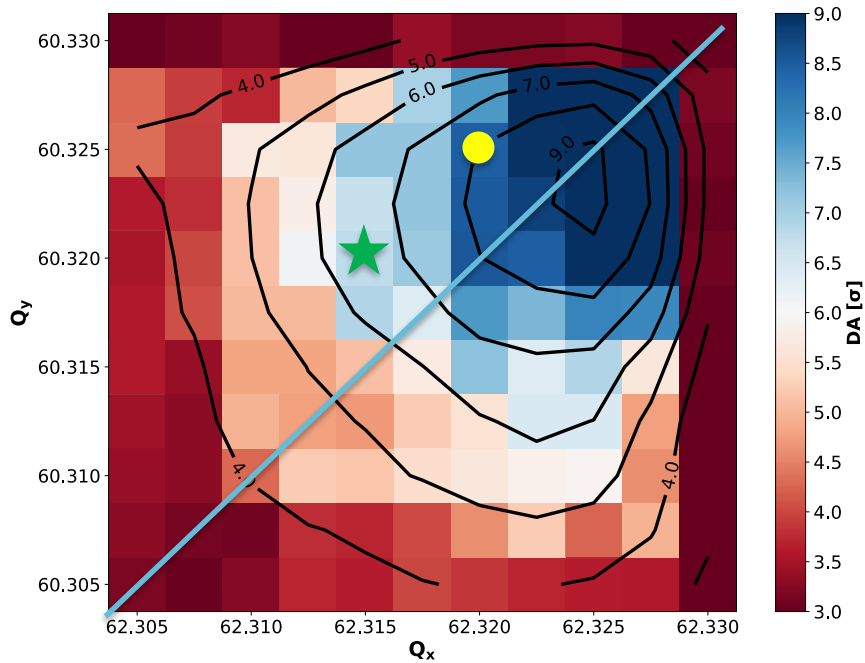


LHC ATS18; $Q' = (15, 15)$; $Q = (62.31, 60.32)$; $I_0 = 550$ A;
 $\beta^* = 30$ cm; $Xing15 = 150\mu\text{rad}$; $N_p = 1.25 \times 10^{11}$



Nominal HO+LR | HO Charge = 80%

Min DA HL-LHC v1.3, BBHO Charge 80%, $I = 2.2 \times 10^{11}$ ppb, $\beta_{IP1} = 0.64\text{m}$
 $\phi/2 = 250\mu\text{rad}$, $\varepsilon = 2.5\mu\text{m}$, $Q' = 15$, $I_{MO} = -300\text{A}$



Min DA HL-LHC v1.3, BBHO Charge 80%, $I = 1.2 \times 10^{11}$ ppb, $\beta_{IP1} = 0.15\text{m}$
 $\phi/2 = 250\mu\text{rad}$, $\varepsilon = 2.5\mu\text{m}$, $Q' = 15$, $I_{MO} = -300\text{A}$

