



MD4224 High Brightness: Simulations

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11.04.19

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MD4224 Parameters

Parameter	MD	Simulation
Intensity $N_p [10^{10}]$	≈ 72.5	72.5
Normalised horizontal RMS emittance $\epsilon_x^n [\text{mm mrad}]$	1.2	1.2
Normalised vertical RMS emittance $\epsilon_y^n [\text{mm mrad}]$	1	1
Bunch length $\sigma_t [\text{ns}]$	140	140
Momentum spread $\frac{\Delta p}{p} [10^{-3}]$	0.87	0.87
Horizontal maximum tune spread $\Delta Q_{x,\max}$	0.2	0.16
Vertical maximum tune spread $\Delta Q_{y,\max}$	0.24	0.24
Harmonic number h	9	9
RF voltage $V_{rf} [\text{kV}]$	21.2	21.2
Horizontal chromaticity Q'_x	0.77	0.80
Vertical chromaticity Q'_y	-2.85	-3.05
Kinetic energy of the stored beam [GeV]	1.4	1.4
Relativistic β	0.916	0.916
Relativistic γ	2.4921	2.4921
Synchrotron Frequency [Hz]	634	634



Simulation Parameters

Parameter	Simulation
SC Grid x	64
SC Grid y	64
SC Grid z	32
N_{mp}	$1.5 \cdot 10^6$
Turns	2200

Table: Simulation parameters

Simulation Parameters

Tune Footprints

Apertures

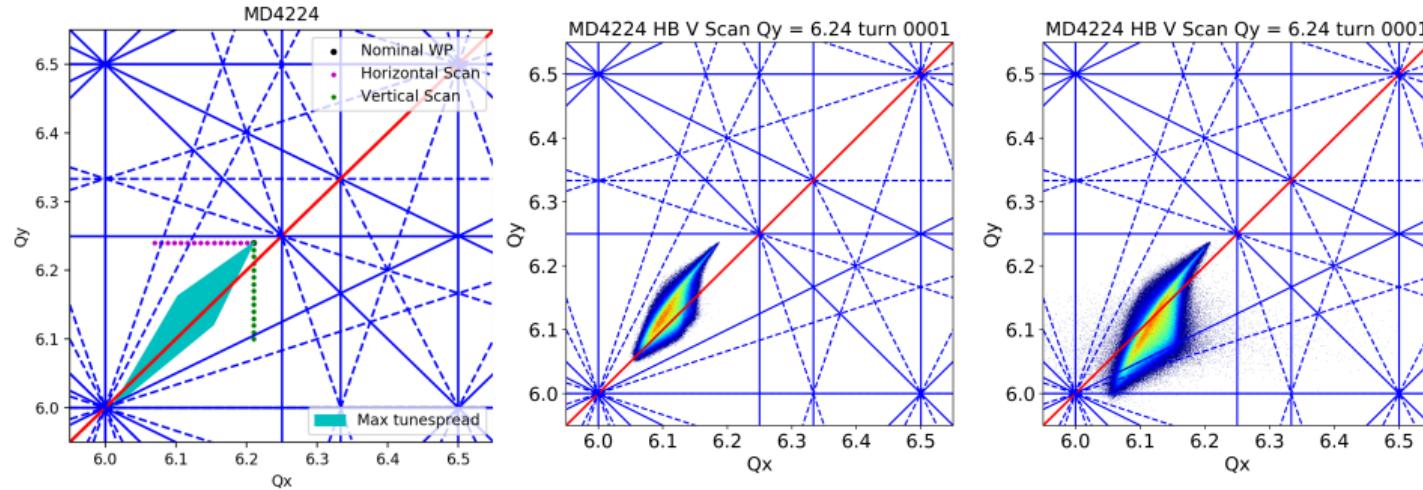
Results

Convergence Test

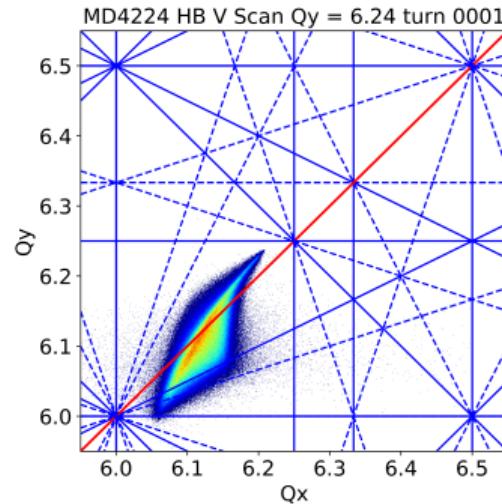
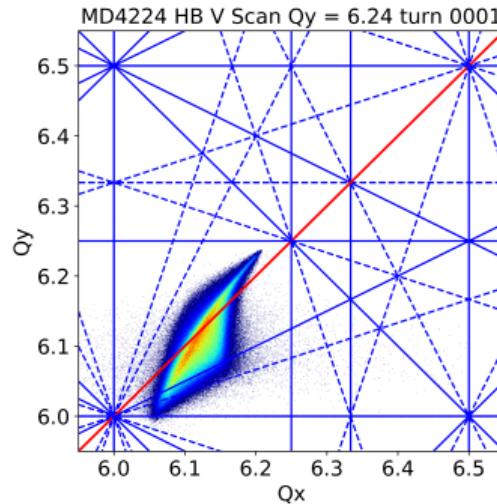
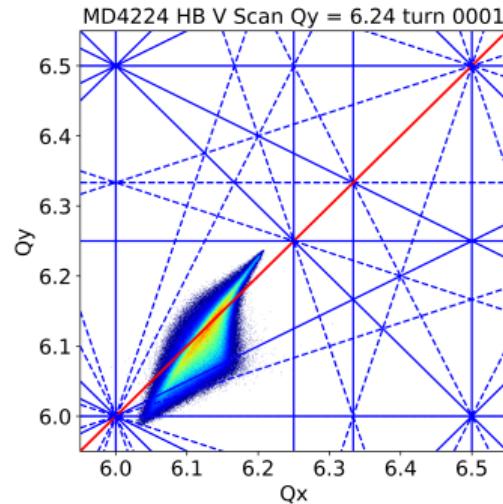


Tune Footprints: Predicted, Old, New

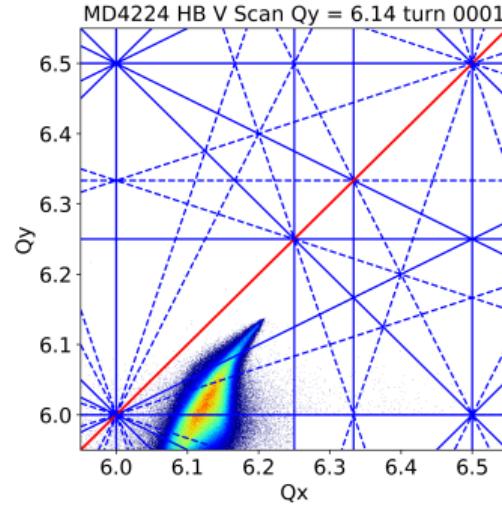
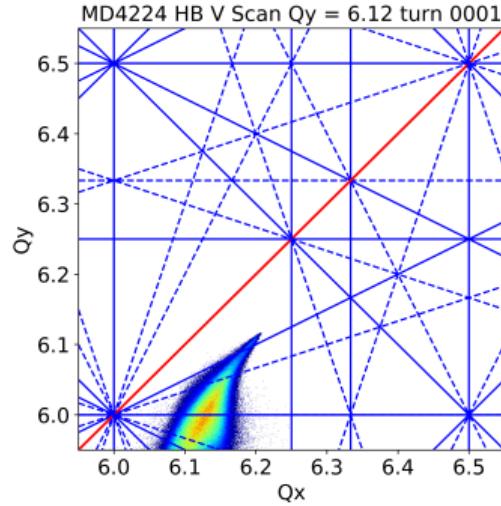
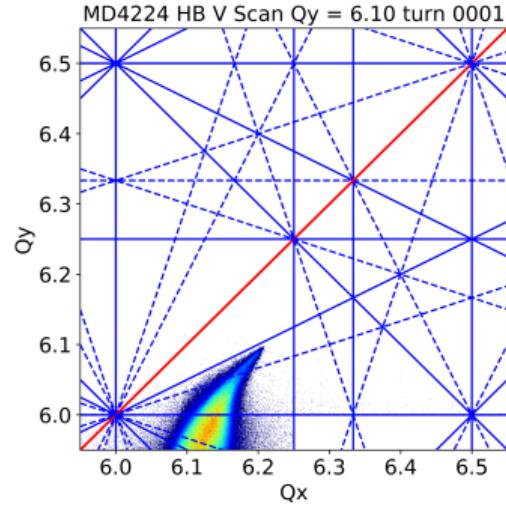
- ▶ Predicted (0.2, 0.24).
- ▶ Old WS 65H injection, 32^3 SC grid, natural chroma.
- ▶ New WS 64V injection, $64 \times 64 \times 32$ SC grid, low chroma. $\approx (0.16, 0.24)$



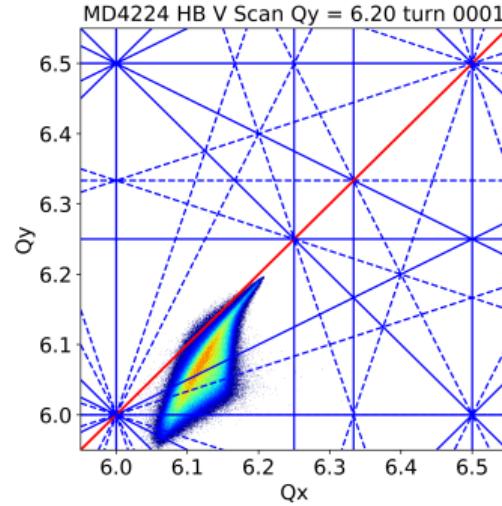
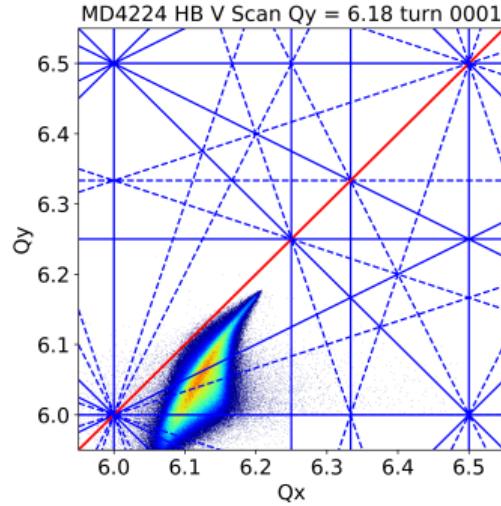
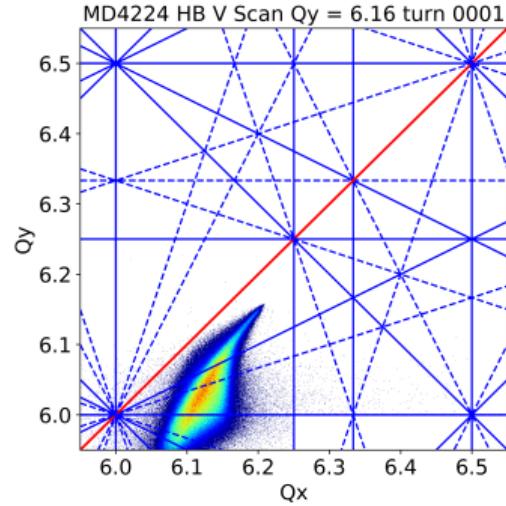
Tune Footprints: 2.5D, Slice-by-slice, Slice-by-slice with longitudinal kick



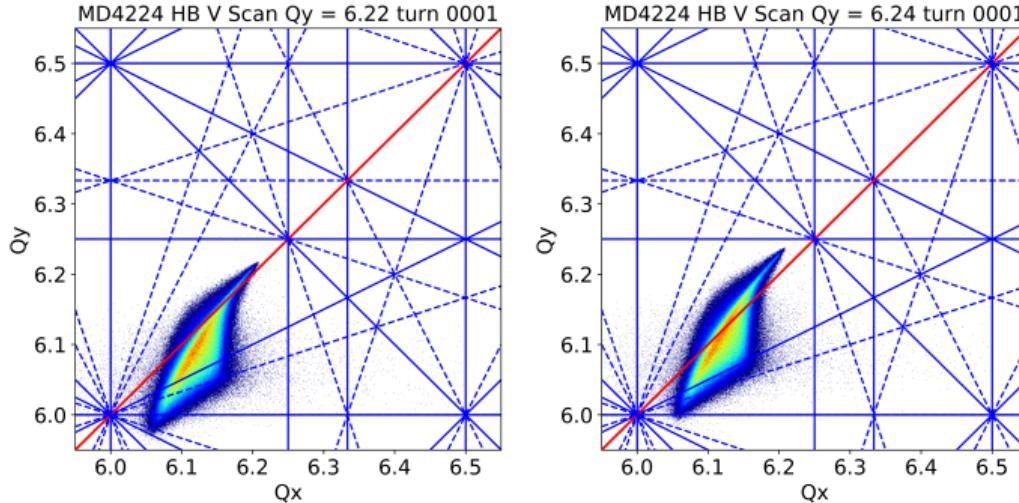
Tune Footprints: 6.10, 6.12, 6.14



Tune Footprints: 6.16, 6.18, 6.20



Tune Footprints: 6.22, 6.24



Simulation Parameters

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Apertures

PS_2013.aper - /home/HR/Documents/PyORBIT_Utils/MD4224/High_Brightness/Simulation/Lattice_LowChroma - Geany

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Flat_file.madx x copy_bunch_outputs.sh x plot_tunefootprint.py x Plot_All_Outputfile_Conv.py x PS_2013.aper x

```
1 !-----!  
2 ! Main magnets !  
3 !-----!  
4 ! We define the apertures for the blocks, not for the thin virtual elements  
5 APERTHAXIS = 0.073;  
6 APERTVAXIS = 0.035;  
7 !-----!  
8 ! MU1 !  
9 !-----!  
10 APERTHAXIS001 := APERTHAXIS;  
11 APERTVAXIS001 := APERTVAXIS;  
12 PR.BHT000001.FINFF1, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS001,APERTVAXIS001};  
13 PR.BHT000001.FINFF2, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS001,APERTVAXIS001};  
14 PR.BHT000001.DINDD1, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS001,APERTVAXIS001};  
15 PR.BHT000001.DINDD2, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS001,APERTVAXIS001};  
16 !-----!  
17 ! MU2 !  
18 !-----!  
19 APERTHAXIS002 := APERTHAXIS;  
20 APERTVAXIS002 := APERTVAXIS;  
21 PR.BHU000002.FINFF1, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS002,APERTVAXIS002};  
22 PR.BHU000002.FINFF2, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS002,APERTVAXIS002};  
23 PR.BHU000002.DINDD1, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS002,APERTVAXIS002};  
24 PR.BHU000002.DINDD2, APERTYPE=ELLIPSE, APERTURE={APERTHAXIS002,APERTVAXIS002};  
25 !-----!  
26 !-----!  
27
```



Simulation Parameters

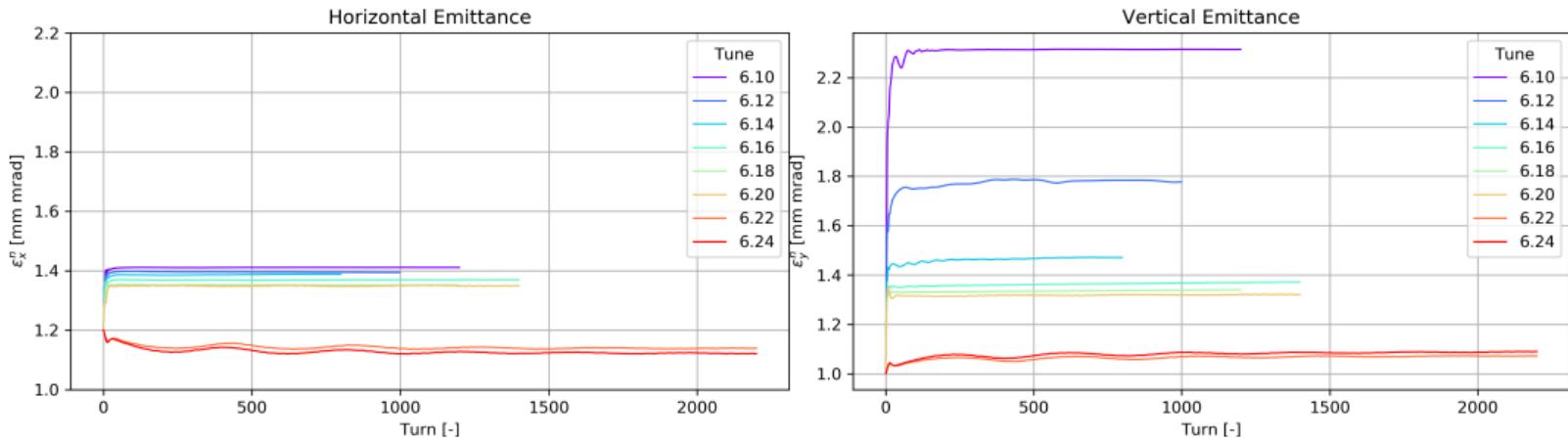
Tune Footprints

Apertures

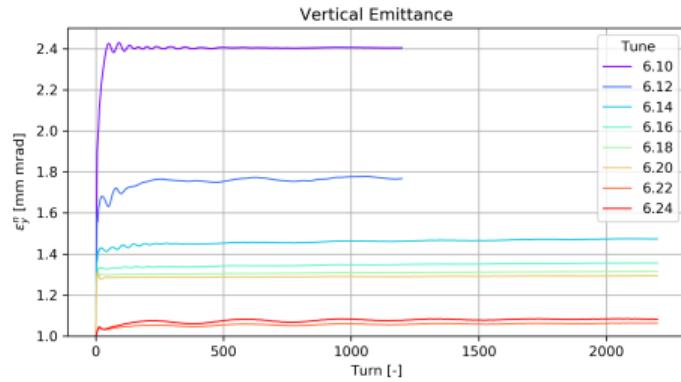
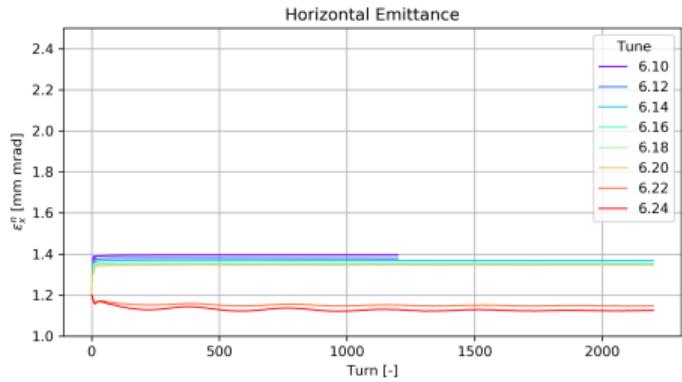
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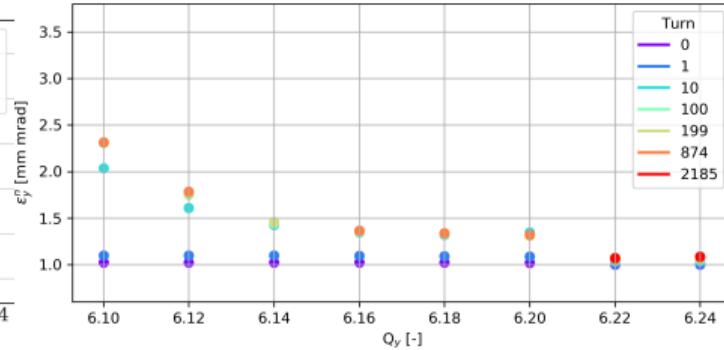
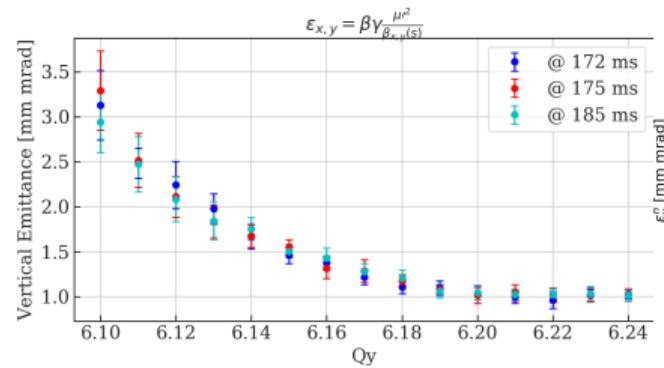
Vertical Scan Emittance Slice-by-slice (lk)



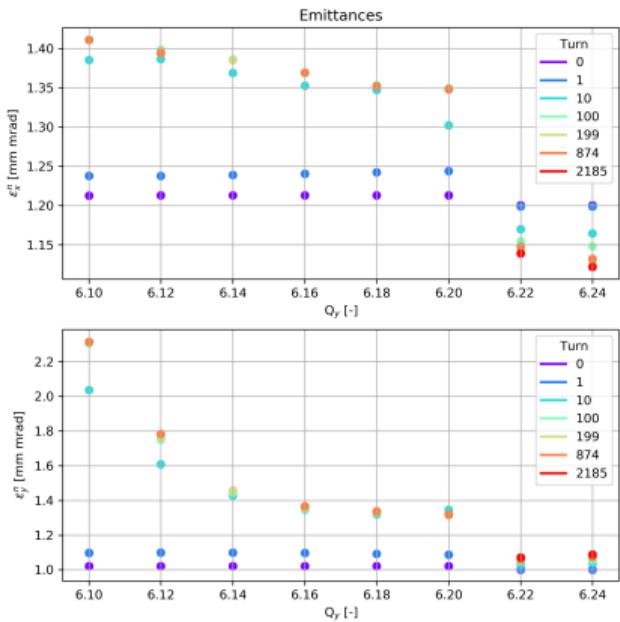
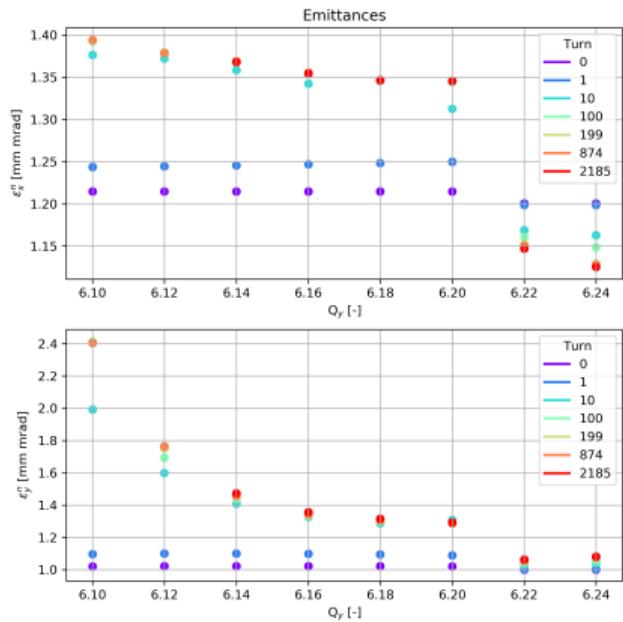
Vertical Scan Emittance 2.5D



Vertical Scan Emittance



Vertical Scan Emittance: 2.5D vs Slice-by-slice



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Vertical Scan Emittance: 2.5D vs Slice-by-slice

