

# Possible layout for arc cells of HE-LHC

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## Acknowledgements:

M. Benedikt, M. Crouch, R. De Maria, S. Fartoukh, M. Giovannozzi, M. Hofer, K. Oide, T. Risselada, L. Riesen-Haupt, D. Sagan, D. Schoerling, R. Tomas, P. Thrane, E. Todesco, D. Tommasini, F. Zimmermann

1st HE-LHC optics meeting, CERN, Jul. 25, 2017

# 1. Possible layouts for the arcs of HE-LHC

## ➤ Arcs designed by Y. Nosochkov

- 18x 60-deg (helhc\_v102)
- 20x 90-deg (helhc\_v201)

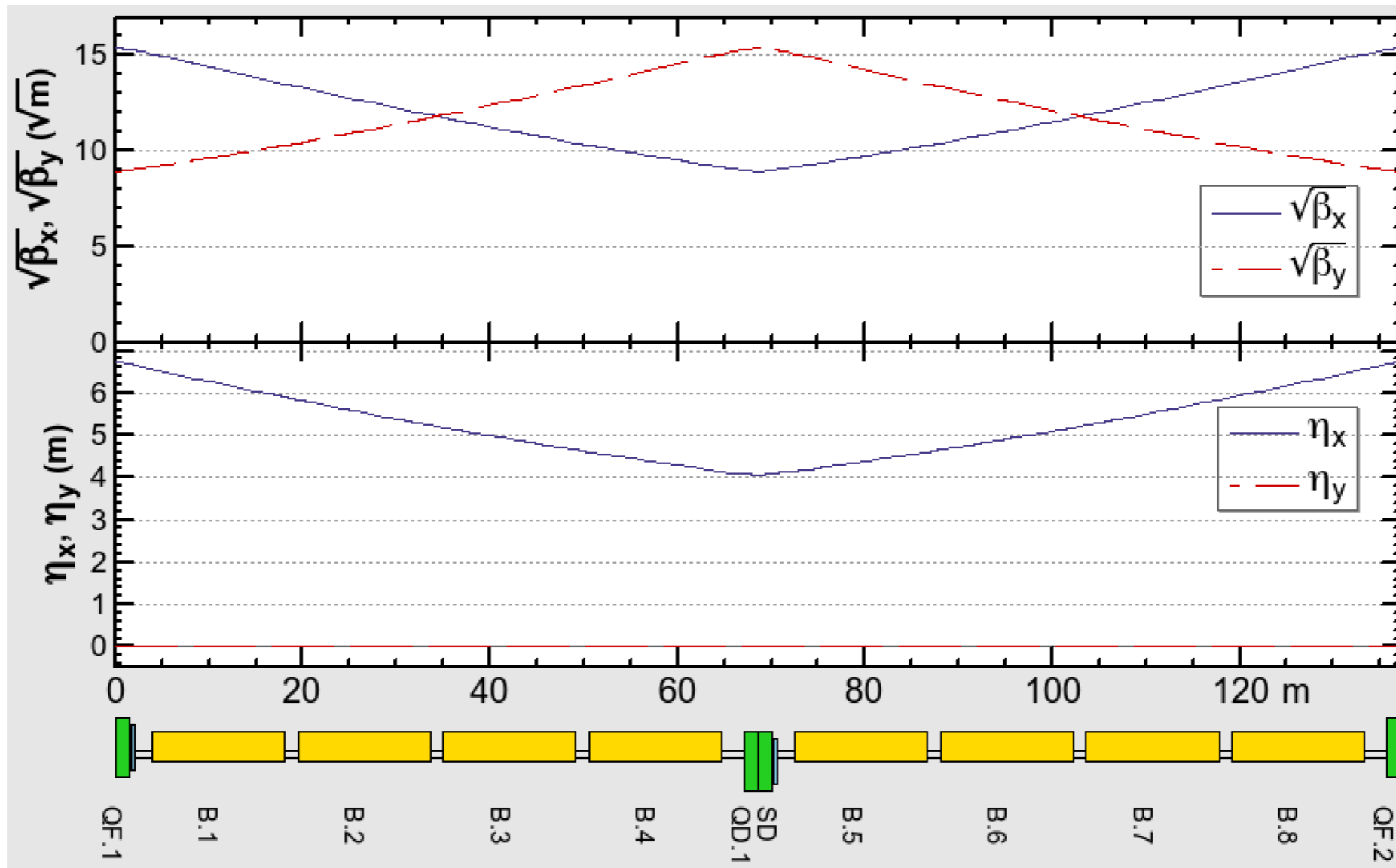
## ➤ Possible modifications using the same layout of helhc\_v102

- 18x 80-deg [Preserve resonance cancelation condition:  $4 \times 2\pi$ ]
- 18x 90-deg [Preserve resonance cancelation condition if considering DS as a 90-deg cell:  $4 \times 2\pi \Rightarrow$  Add sextuples to DSs, similar as LHC]

# 1. Possible layouts for the arcs of HE-LHC

## ➤ 18x 60-deg (helhc\_v102 by Y.N.)

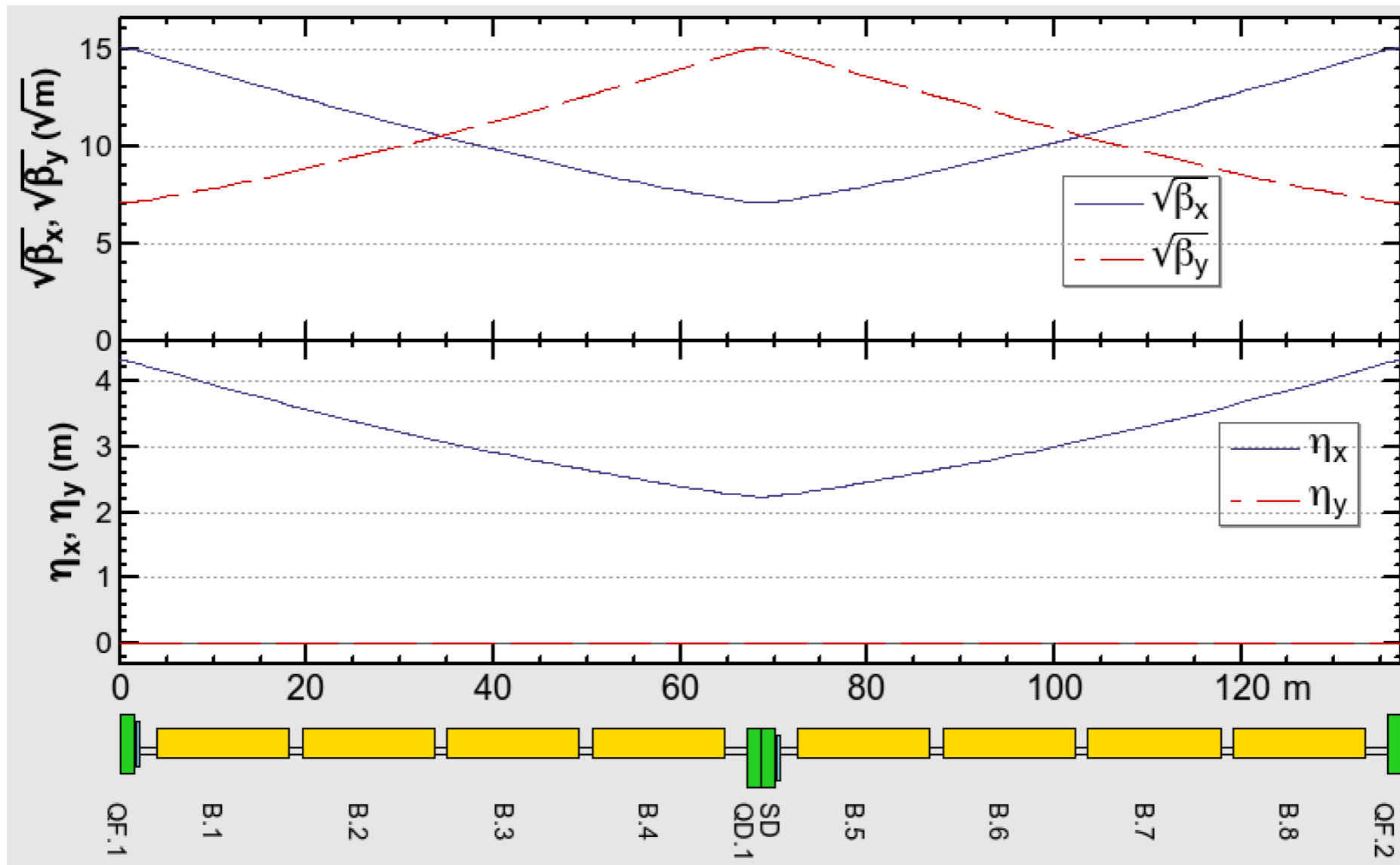
- LB=14.18m, LQ=3.1m, LS=0.369m
- LBQ=2.358m, LSB=1.829m, LQS=0.16m, LBB=1.36m



# 1. Possible layouts for the arcs of HE-LHC

## ➤ 18x 80-deg (Same geometry of helhc\_v102 by Y.N.)

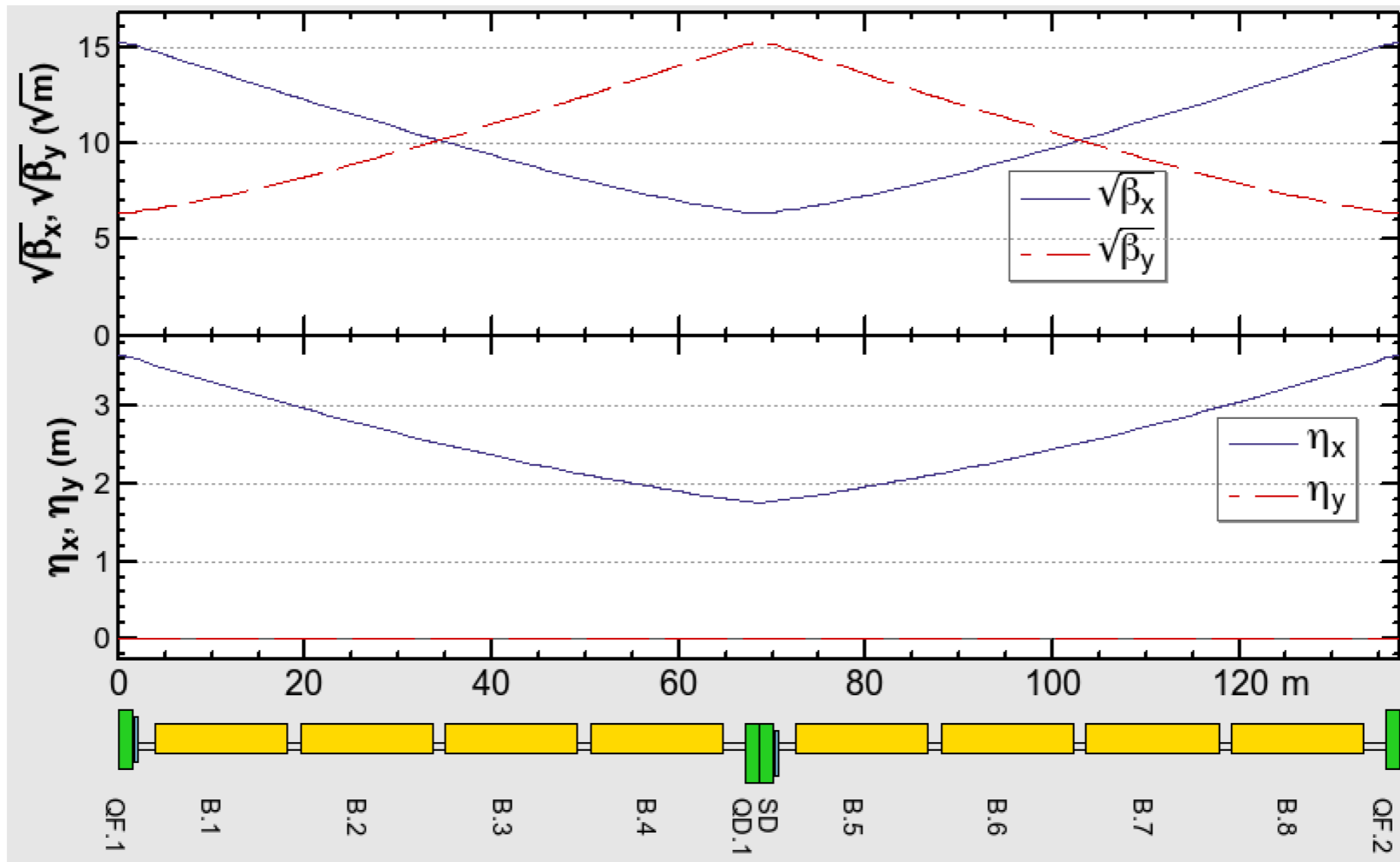
- $LB=14.18\text{m}$ ,  $LQ=3.1\text{m}$ ,  $LS=0.369\text{m}$
- $LBQ=2.358\text{m}$ ,  $LSB=1.829\text{m}$ ,  $LQS=0.16\text{m}$ ,  $LBB=1.36\text{m}$



# 1. Possible layouts for the arcs of HE-LHC

## ➤ 18x 90-deg (Same geometry of helhc\_v102 by Y.N.)

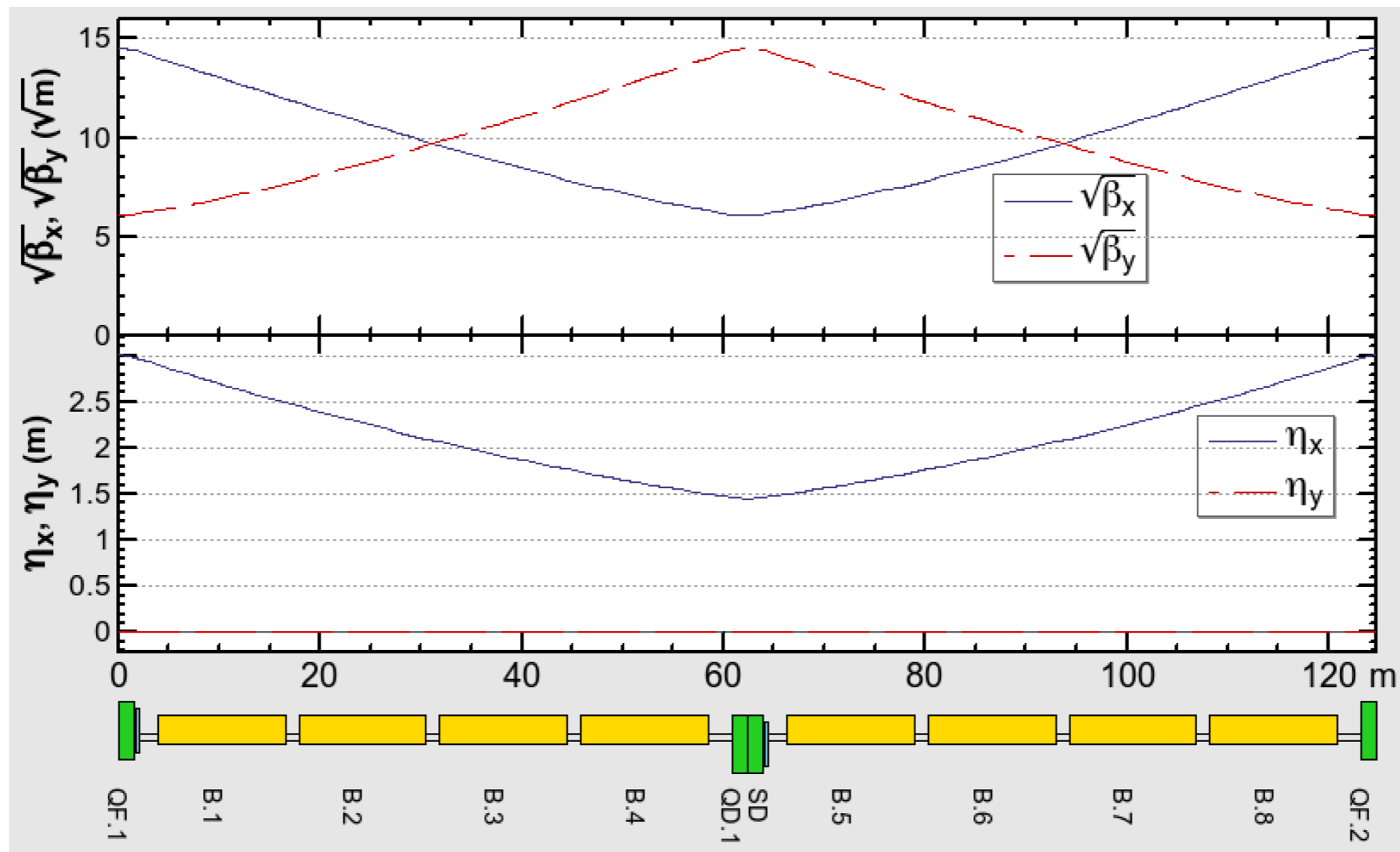
- LB=14.18m, LQ=3.1m, LS=0.369m
- LBQ=2.358m, LSB=1.829m, LQS=0.16m, LBB=1.36m



# 1. Possible layouts for the arcs of HE-LHC

## ➤ 20x 90-deg (Same geometry of helhc\_v102 by Y.N.)

- $LB=12.625\text{m}$ ,  $LQ=3.1\text{m}$ ,  $LS=0.369\text{m}$
- $LBQ=2.36\text{m}$ ,  $LSB=1.831\text{m}$ ,  $LQS=0.16\text{m}$ ,  $LBB=1.36\text{m}$



# 1. Possible layouts for the arcs of HE-LHC

➤ FCC tech: **16 T@B, 400 T/m@Q, 7800 T/m<sup>2</sup>@S**

	LHC-like	18x60 <sup>0</sup>	18x80 <sup>0</sup>	18x90 <sup>0</sup>	20x90 <sup>0</sup>
Arc cell phase advance [deg]	90/90	60/60	80/80	90/90	90/90
Arc cell length [m]	106.958	137.233			124.8
K1 [m <sup>-1</sup> ]	0.027	0.0148	0.019	0.021	0.023
$\beta_{\max/\min}$ [m]	181.3/31.5	236.7/79.5	227.7/50.0	233.0/40.4	211.7/36.8
$\eta_{\max/\min}$ [m]	2.2/1.1	6.7/4.1	4.3/2.2	3.6/1.8	3.0/1.5
Dipole length [m]	14.3 [x6]	14.18 [x8]			12.625 [x8]
Dipole field [T] @13.5TeV	16.06	15.59			15.92
Quad. gradient [T/m] @13.5TeV	391.7	214.8	276.2	303.9	334.7
Sext. gradient [T/m <sup>2</sup> ] @13.5TeV	4883	866	?	?	2940
Filling factor	0.802	0.827			0.809

## 2. Strategy for HE-LHC design

### ➤ Task distribution

- Arc cells and DSs
- IR1 and IR5: Main experiment IRs
- IR3 and IR7: collimation
- IR4 and IR6: RF and beam dump
- Full lattice: Global matching&optimization/chromaticity

### correction/toolkits

- Beam-beam issues
- Collective effects



## 2. Strategy for HE-LHC design

### ➤ Iterative design process

- Step 1: Create arc cells, adjust DSs, matching to SLHC IRs [respect to LHC geometry]
- Step 2: IR design/update, repeat Step 1
- Step 3: Global matching&optimization/chromaticity correction
- Step 4: DA calculations with errors
- Step 5: Check challenges (technical and beam physics), if hit show-stopper, restart from Step 1
- Step 6: Collimation and other sub-system design/update (electron lens, crab cavity, etc.)