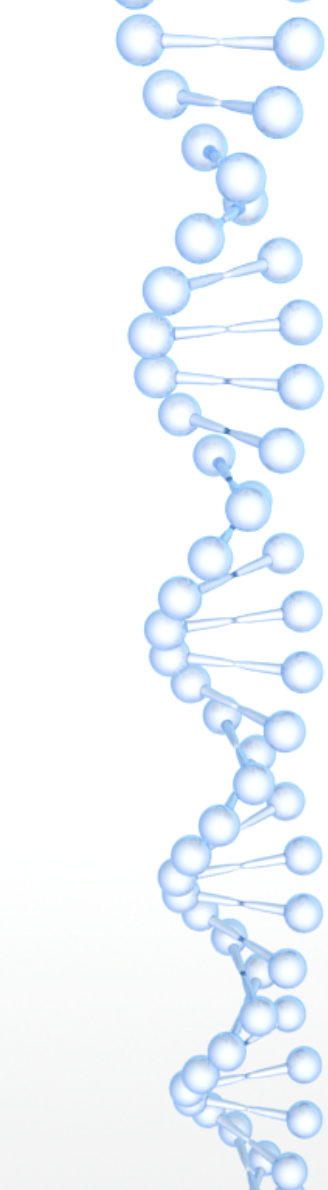
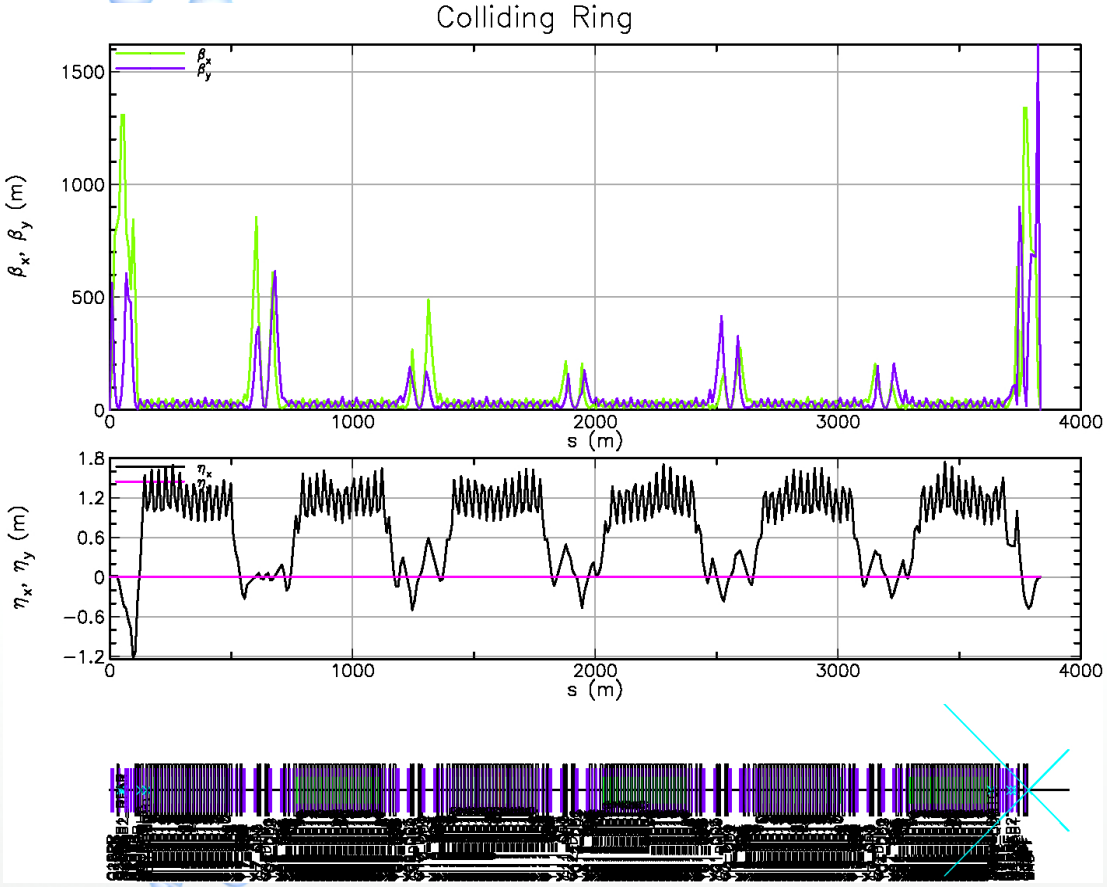


Collider Ring (CR)

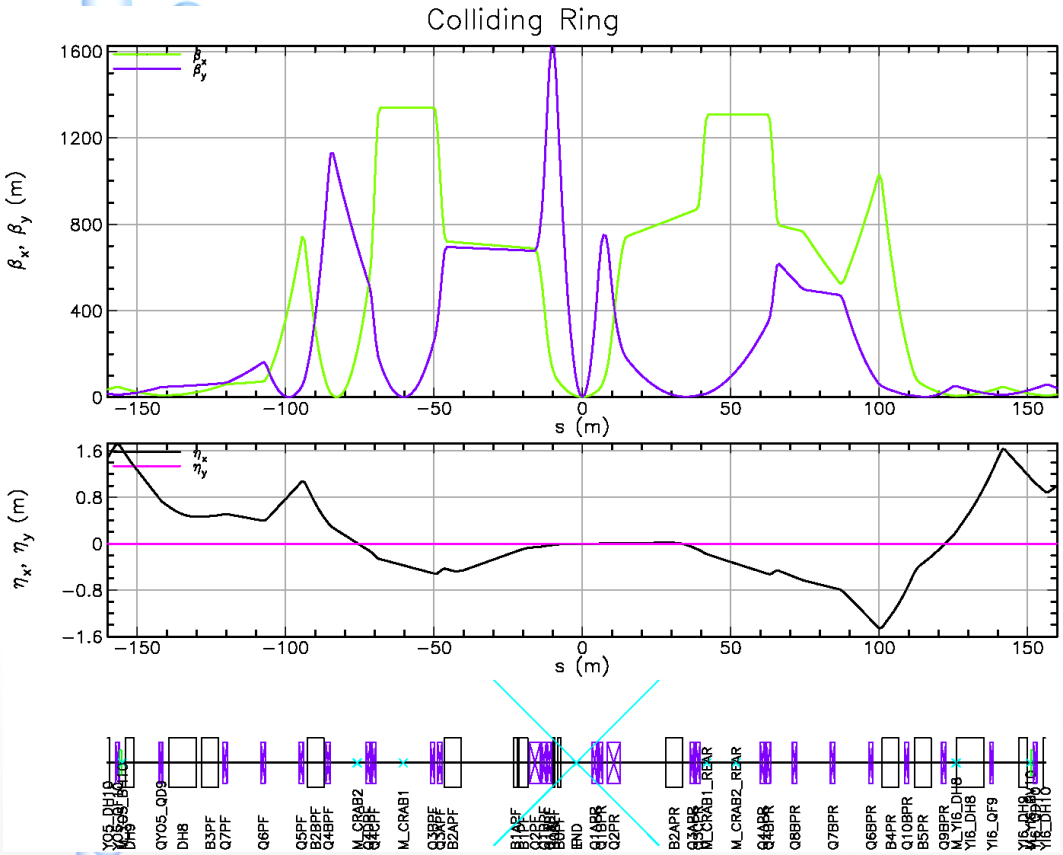
IR Meeting
11/15/19
Henry Lovelace III

Yellow Ring Design



- Yellow ring elements only
- Length 3833.85293 m
- $\beta_{\text{a-mode max}}$ = 1338.8824 m
  - At 3765.514 m
  - Element Q4CPF
- $\beta_{\text{b-mode max}}$ = 1632.2312 m
  - At 3823.893 m
  - Element D_IR#4
- $\eta_{\text{a-mode max}}$ = 1.766 m
  - At 3440.524 m
  - Element YO4_QF16
- $\eta_{\text{a-mode min}}$ = -1.44359 m
  - At 99.698 m
  - Element D_B4PR#9

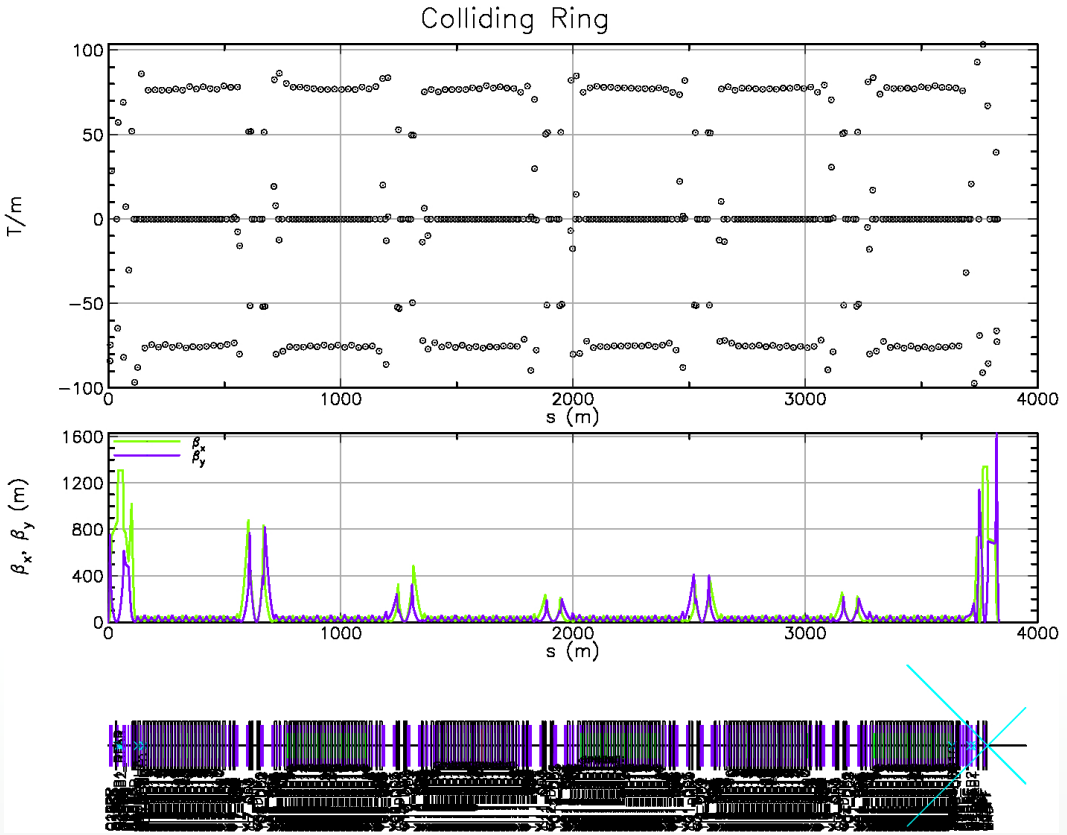
IR of Yellow Ring Design



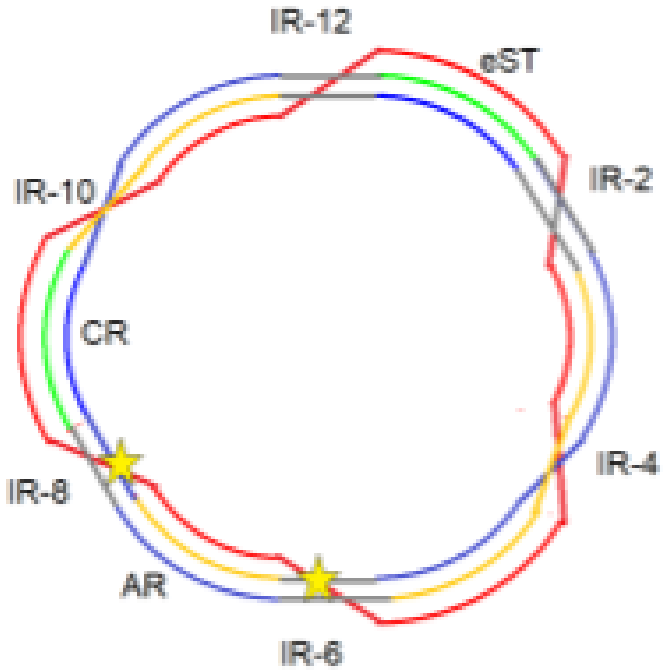
- Tune for ring
  - ν_x=28.691
  - ν_x=28.688
- Chromaticity
  - In both planes 2
- Initial Coordinates
  - x = 31694.295 m
  - z = 30209.628 m
  - θ = 3.1067 rad
  - 81 cm offset 1.7 mrad rotation
- IR $\beta_{x,y}$
  - 0.8953 m
  - 0.0520 m

Gradient Quench Levels

- For top energy (100 GeV Au) 2006
  - Gradient 71 T/m
  - Gradient quench level 107 T/m
- Yellow Ring Design (275 GeV proton)
  - Average gradient all current quadrupoles ~ 77 T/m | -75 T/m
  - Max gradient ~86.29 T/m
    - YI6_QF9
    - YO8_QF6
  - Min gradient ~ -89.6016 T/m
    - YI11_QD6
    - YI3_QD6



New Design
Collider Ring(CR) Accelerator Ring (AR)

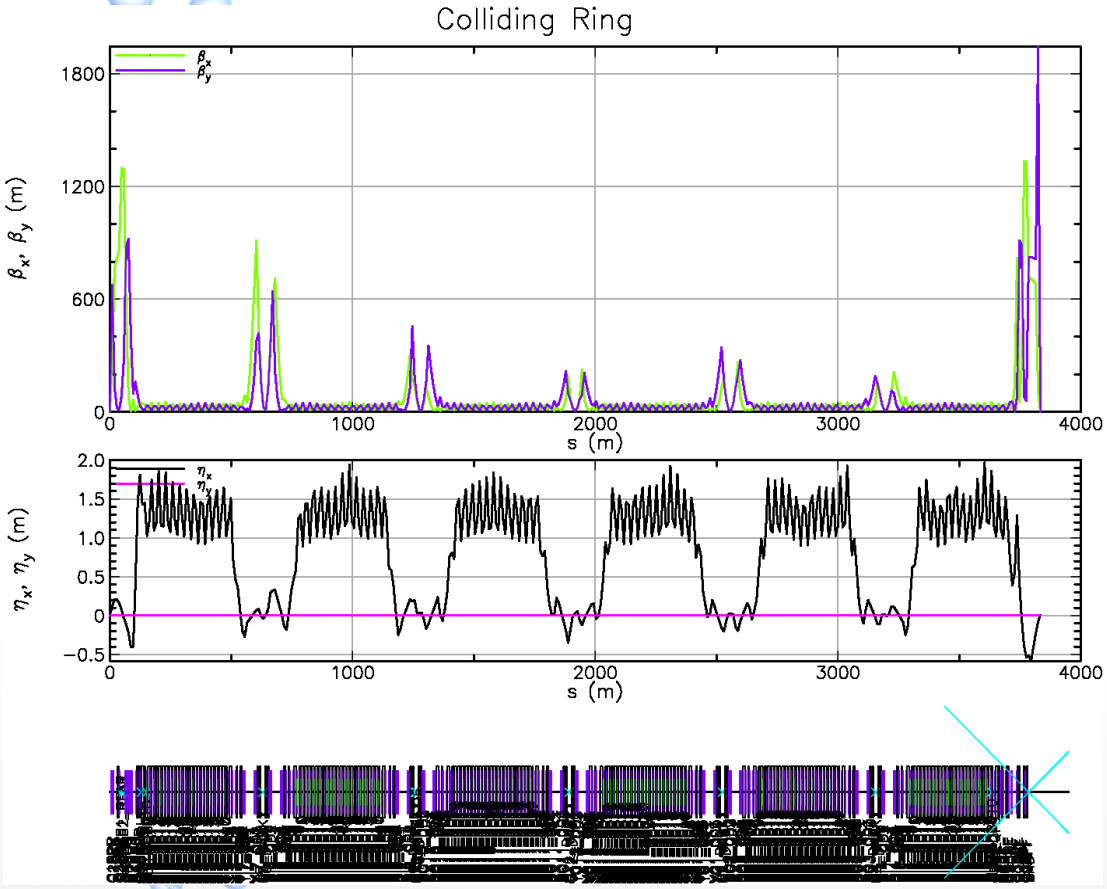


- Sextant 6-8
  - CR: Yellow Ring (inside)
  - AR: Blue Ring (outside)
- Sextant 8-10
  - CR : Blue Ring (inside)
  - AR: Yellow Ring (outside)
- Sextant 10-12
  - CR : Blue Ring (outside)
  - AR: Yellow Ring (inside)
- Sextant 12-2
  - CR : Yellow Ring (outside)
  - AR: Blue Ring (inside)
- Sextant 2-4
  - CR : Blue Ring (outside)
  - AR: Blue Ring (inside)
- Sextant 4-6
  - CR : Blue Ring (inside)
  - AR: Yellow Ring (outer)

Collider Ring

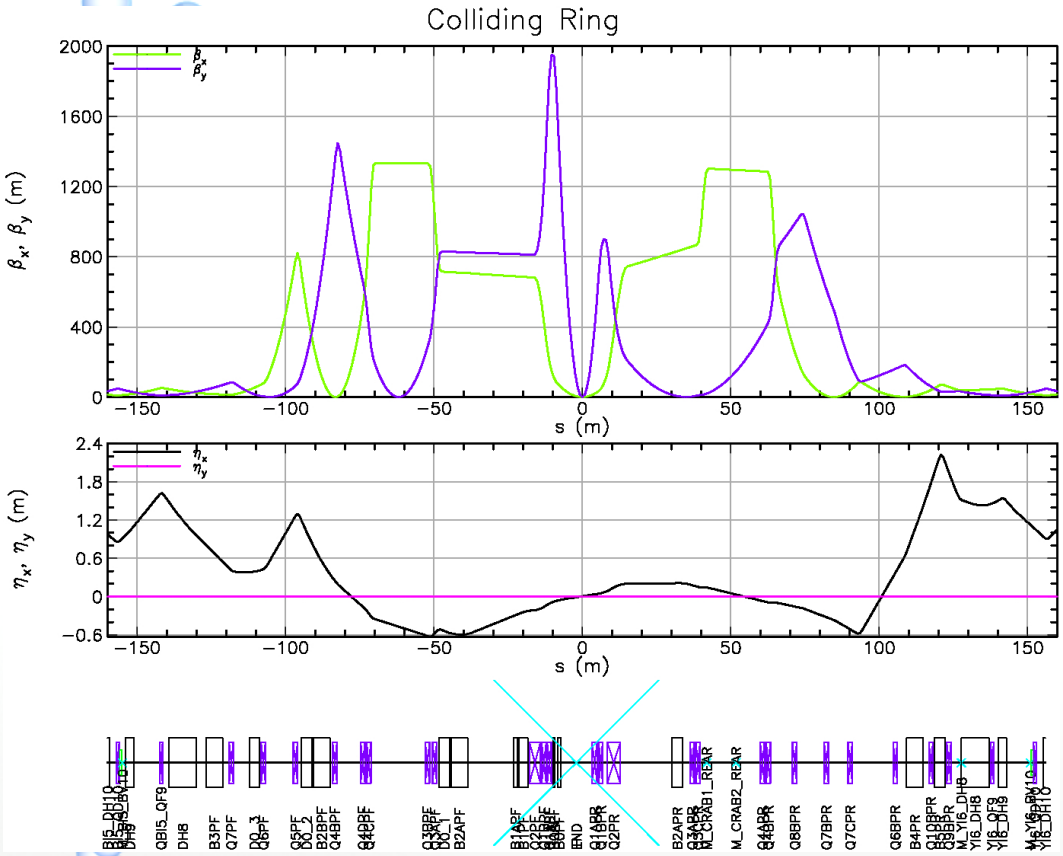
https://brookhavenlab.sharepoint.com/:f:/s/eRHIC/R&D/Ekf59aH7HHhDswxQ-4CLX7wB50wiu1l2Uq62fKu974KrAA?e=mBai3A

SharePoint:eRHIC R&D Lattice Files > Hadron Lattices > Collider Ring



- Yellow and Blue Ring combination
- Length 3833.85523 m
- $\beta_{\text{a-mode max}}$ = 1334.01329m
  - At 3763.735 m
  - Element Q4CPF
- $\beta_{\text{b-mode max}}$ = 1958.2359 m
  - At 3823.895 m
  - Element D_IR#4
- $\eta_{\text{a-mode max}}$ = 2.177 m
  - At 121.698 m
  - Element Q10BPR
- $\eta_{\text{a-mode min}}$ = -0.6242 m
  - At 3782.235 m
  - Element D_Q4BPF#1
  -
- Tuned lattice results

IR of Collider Ring Design



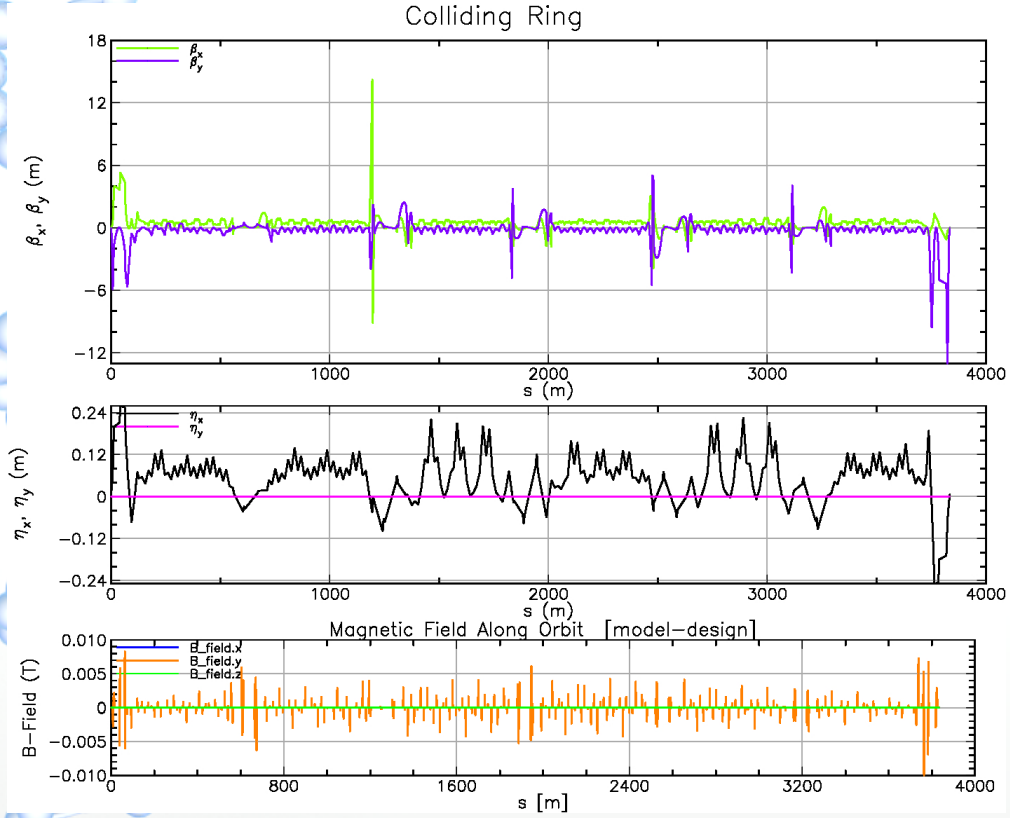
- Tune for ring
  - ν_x=28.690
  - ν_x=29.680
- Chromaticity
  - In both planes 2
- Initial Coordinates
  - x = 31694.295 m
  - z = 30209.628 m
  - θ = 3.1067 rad
  - 81 cm offset 1.7 mrad rotation
- IR $\beta_{x,y}$
  - 0.900m
  - 0.043 m

Matching Points

- M_YI6_BV10
  - Floor Coordinates (RHIC)
    - x-coordinate=31703.624 m
    - z-coordinate=30055.108 m
    - θ-coordinate=3.01125 mrad
  - Twiss
    - β_a=12.42667 m
    - β_b=42.36983 m
    - η_a=0.96141 m
    - η'=-0.04253 m
- M_BI5_BV10
  - Floor Coordinates (RHIC)
    - x-coordinate=31692.808m
    - z-coordinate=30364.398 m
    - θ-coordinate=-3.08107 mrad
  - Twiss
    - β_a=12.42497 m
    - β_b=42.75126 m
    - η_a=0.91890 m
    - η'=0.04513 m

After retuning

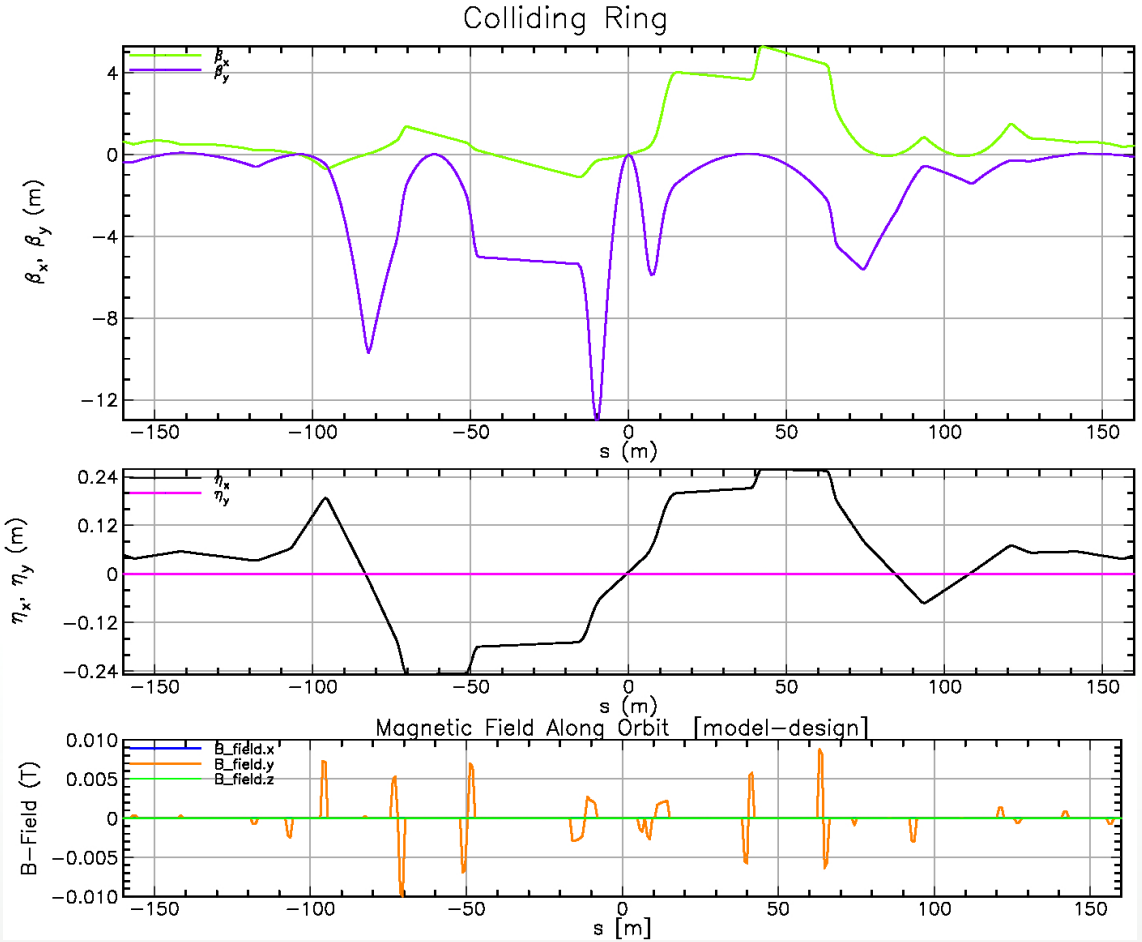
(no-constraints on quadrupole normalized strengths)



- Before retune:
  - No phase adjustments
  - Only IR segments placed
  - Base 275 GeV proton lattice used to match IR
  - Working points of 29.465 horizontally, 29.571 vertically
- After retune:
  - Working points of 28.69 horizontally, 29.68 vertically

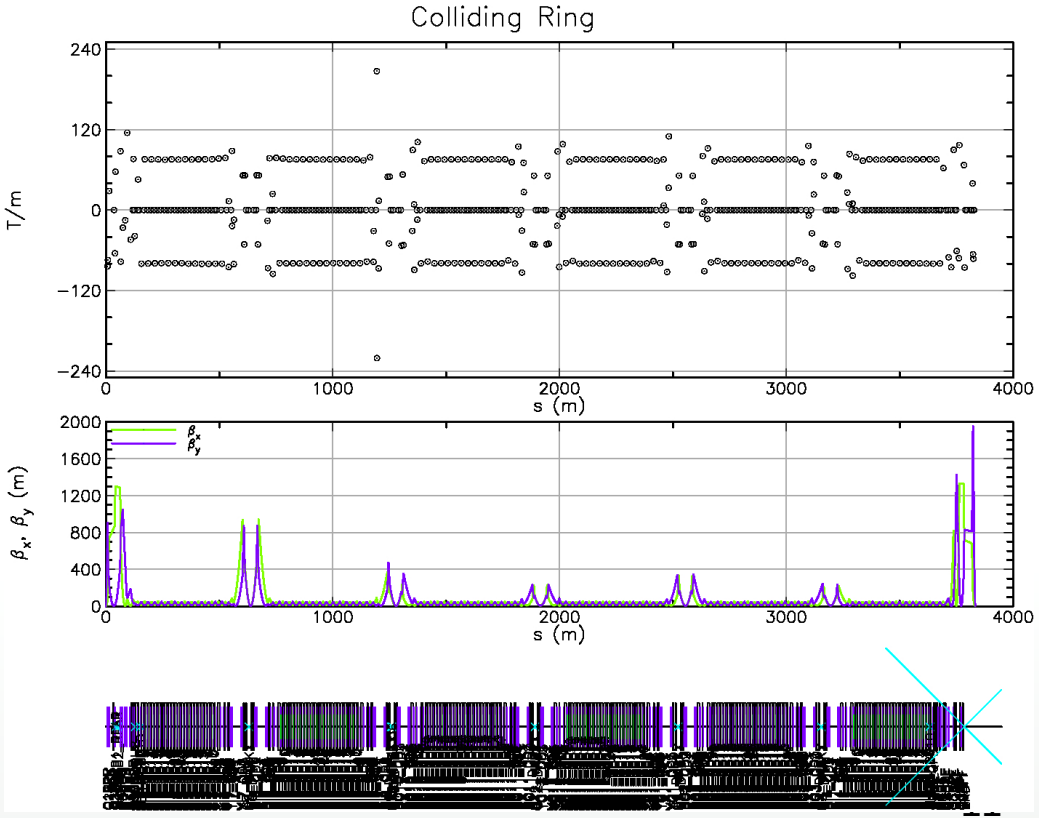
Model -Design in IR

(No magnet strengths adjusted)



Gradient Quench Levels

- Rough draft of lattice shows a few field gradients for the quadrupoles may be to great for the current RHIC quadrupoles
  - BI9_QF5 gradient of 206.923956 T/m
    - L = 1.11 m
  - BI9_TQ5 gradient of -220.765655 T/m
    - ~Gradient at 100 A = 29.4 T/m
    - L= 0.75 m



Conclusion

- Previous Yellow ring version is functional with the given gradient constraints.
  - Can be considered a secondary solution to EIC hadron ring
- CR design may also be feasible within RHIC current magnet configuration gradient constraints
  - Changes to correct for tune and chromaticity have minor effects to the IR Twiss parameters.