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WE4P18

PRELIMINARY DESIGN OF HIGHER-ORDER ACHROMAT LATTICE FOR THE UPGRADE OF TAIWAN PHOTON SOURCE

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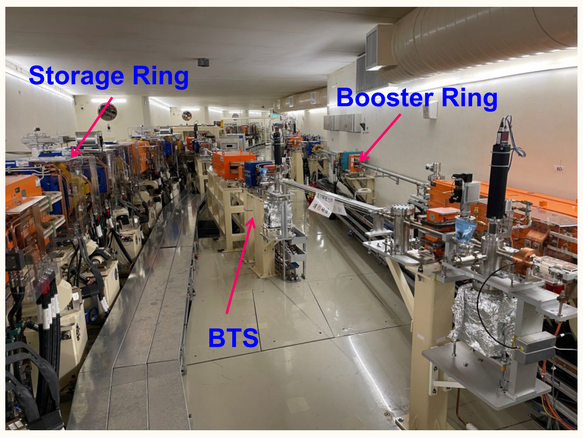
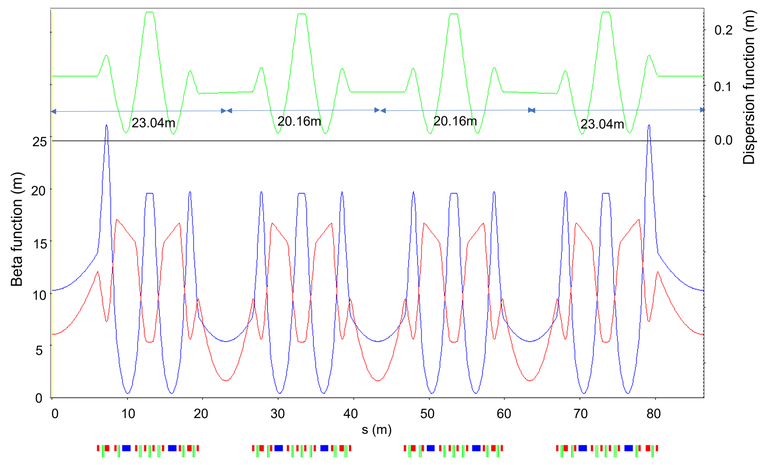


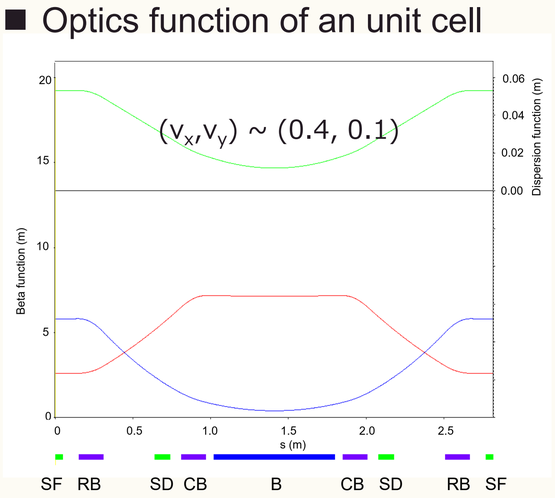
■ TPS tunnel



■ TPS Lattice

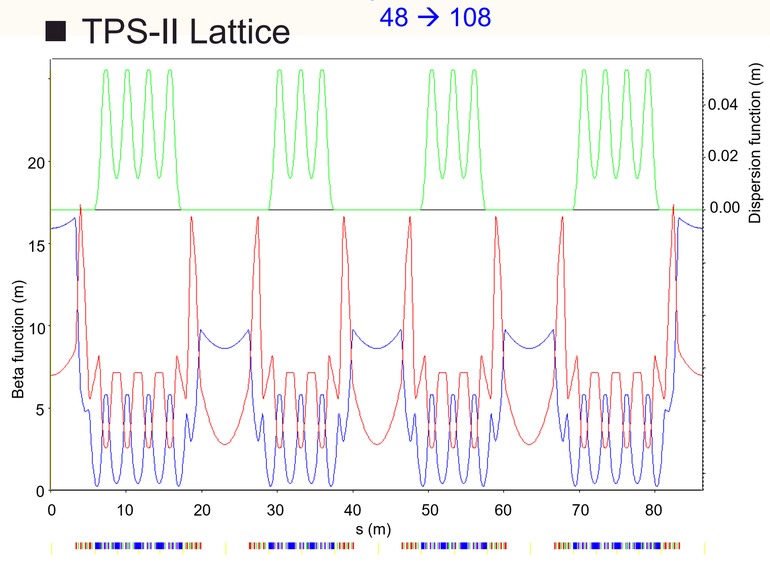
Dipole numbers
48 → 108

■ Optics function of an unit cell



✓ Fine tune the phase advance in the unit cell (for 5BA cancellation).
Proper phase condition for 4BA and 5-4-4-5BA?!

■ TPS-II Lattice



✓ TPS insertion devices could be adopted without the concerns of length shortening

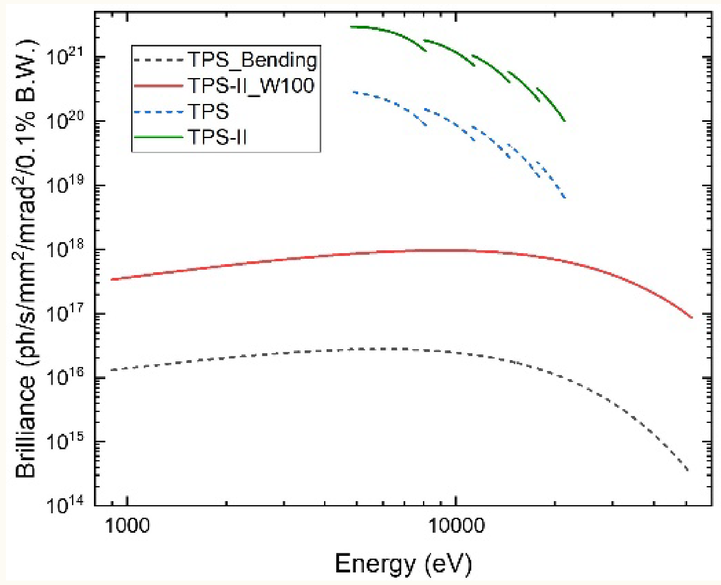
Parameters	TPS	TPS-II (TBD)
Circumference	518.4 m	
Energy	3 GeV	
Lattice	4 DB~A	HOA
LSS	12 m × 6	6.43 m × 6
SSS	7 m × 18	6.31 m × 18
η_x @ SS center	0.088 m	0 m
Natural Emittance	1.6 nm-rad	131 pm-rad
Energy spread	0.886×10^{-3}	1.043×10^{-3}
Tune (ν_x, ν_y)	(26.19, 13.25)	(49.23, 16.32)
Natural chromaticity (ξ_x, ξ_y)	(-75, -27)	(-92, -59)
Momentum compaction factor (α_1, α_2)	$(2.4\times10^{-4}, 2.1\times10^{-3})$	$(1.2\times10^{-4}, 4.0\times10^{-4})$
Radiation damping time	(12.2, 12.2, 6.1) ms	(9.2, 20.3, 25.6) ms

■ Challenges

1. Non-ideal symmetric
2. large difference between SS length (12:7)
3. challenging to keep the same source ID points、keep sufficient SSS length

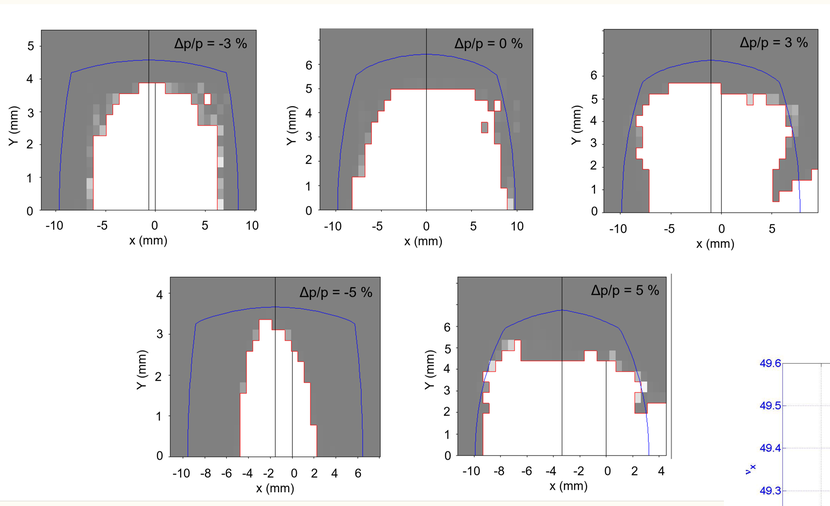
➢ The adopt of HOA scheme (5-4-4-5BA). (challenge on nonlinear dynamics)

■ Improved spectrum from TPS to TPS-II

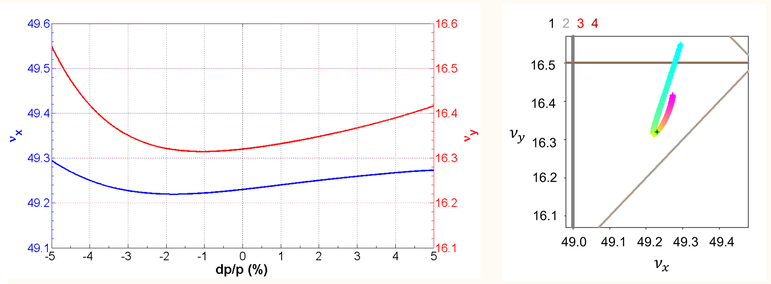


TPS bending: B~ 1.2 T,
W100: λ_u =100 mm, N_u=4, B_{max} ~1.8 T,
IU22: λ_u =22 mm, N_u=140, B_{max} ~0.76 T

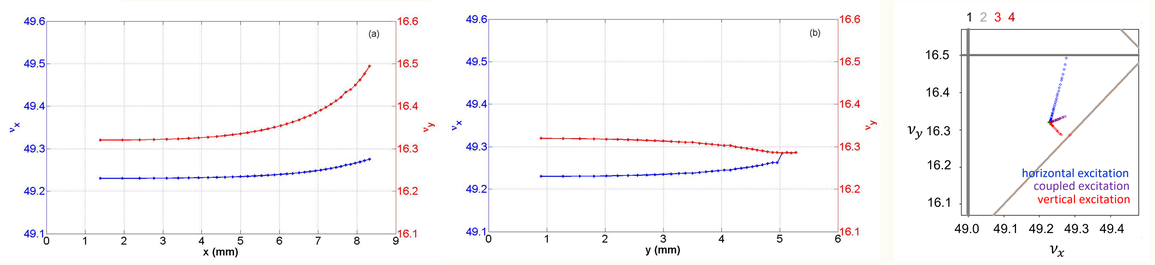
■ Tracking Dynamic Aperture $(\xi_{x,ope}, \xi_{y,ope})$=(0.94, 0.93)



■ Off-momentum Tune Shift



■ Amplitude Dependent Tune Shift



■ Evaluation of longitudinal dynamics E= 3 GeV; h = 864; V_{rf} = 3.0 MV; U0 = 497.8 keV ; Φ_s =170.45°

■ TPS-II RF Bucket

(a) 2.5 MV, 499.654 MHz
(b) With a 3rd harmonic cavity

■ Tracking Momentum Acceptance

Brown: Linear acceptance from beam pipe width
Green: RF momentum acceptance
Red: Tracking result

2.5 MV, 500 mA, 1% coupling
δ = -6.4 x10^{-2} % ~ + 5.6 x10^{-2} %
$\sigma_{z,rms}$ = 2.84 mm

■ Future Works

- ➢ The bare lattice of HOA scheme for TPS-II is proposed
  - Emittance、brightness、CF > 10**x** is possible from TPS to TPS-II upgrade
  - ID magnets、Multipole error、intra-beam stability (IBS) are not considered yet
- ➢ **nonlinear kicker** to relive the DA issues
- ➢ **HOC** to reduce the heat load and improve the life time (~ 2 x)
- ➢ **an well-balanced systematic design is on-going**

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