IPAC21

WEPAB089

THAI SYNCHROTRON NATIONAL LAB

Conceptual design of Booster synchrotron for Siam Photon Source II

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Siam Photon

MHESI
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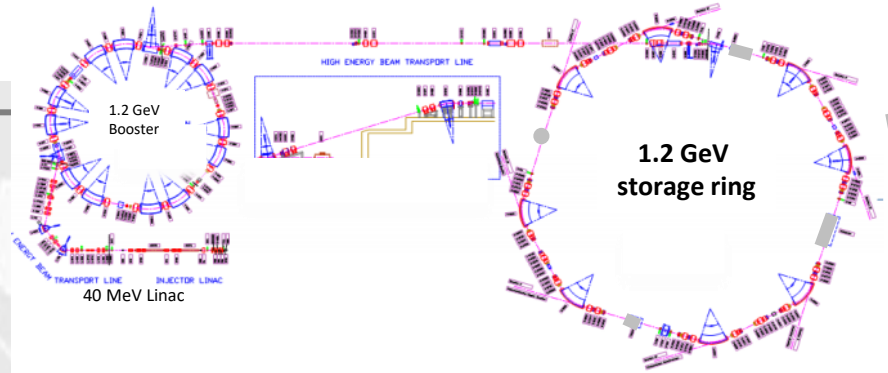
Ministry of Higher Education, Science, Research and Innovation

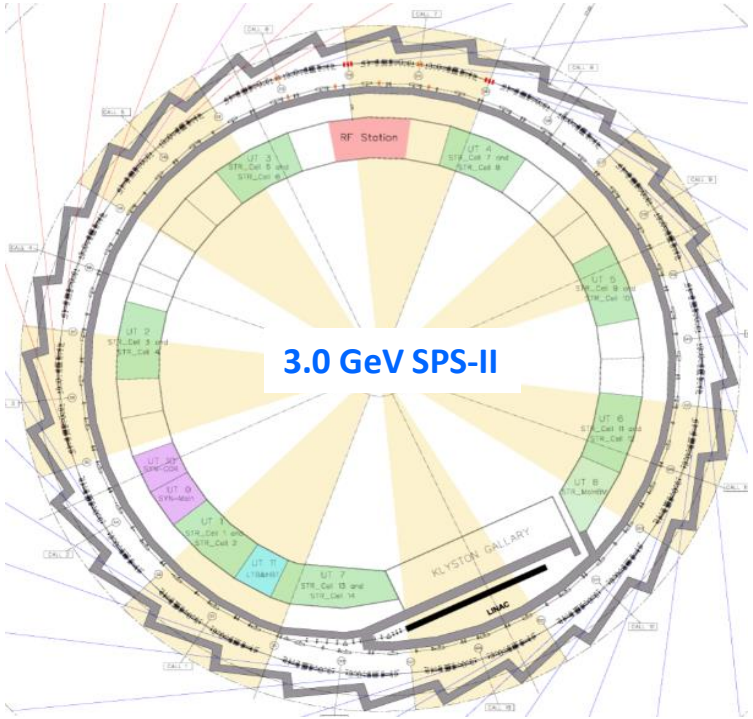
Synchrotron Light Research Institute (Public organization)
Nakhon Ratchasima, Thailand

Synchrotron Light Source in Thailand



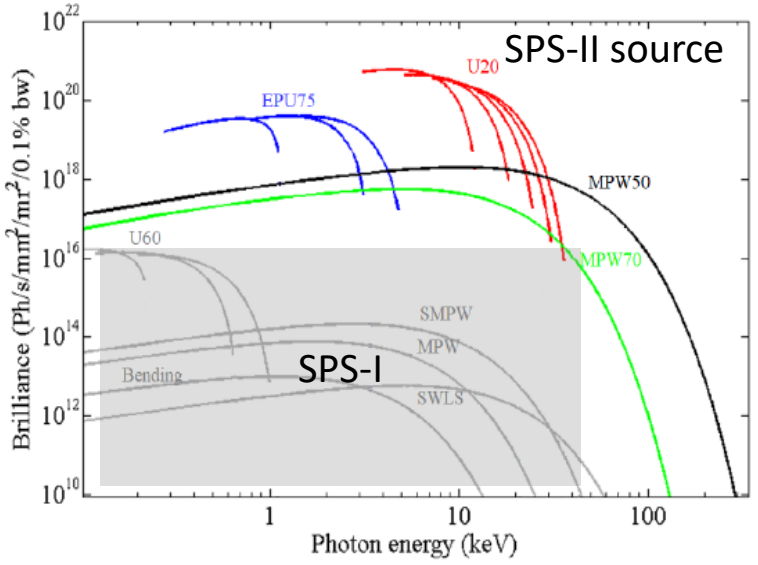
Storage ring for SPS-I

- Circumference: 81.3 m
- Beam energy: 1.2 GeV
- Beam current: 150 mA



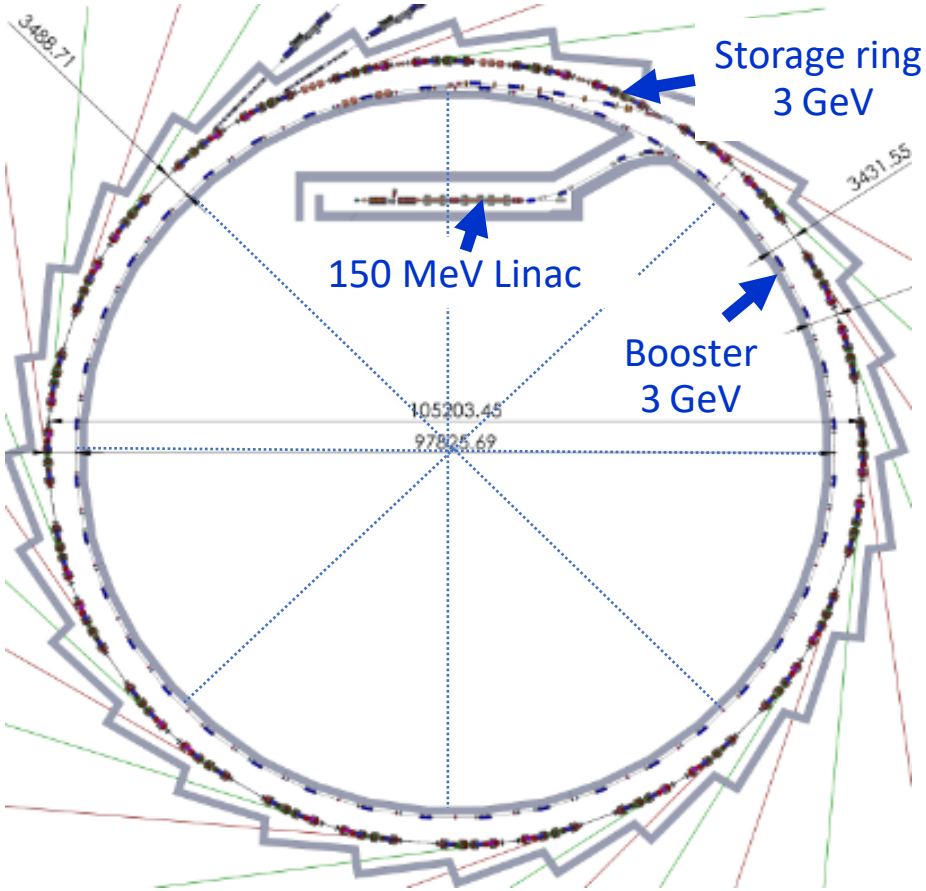
Storage ring for SPS-II

- Circumference: 327.502 m
- Beam energy: 3.0 GeV
- Beam current: 300 mA

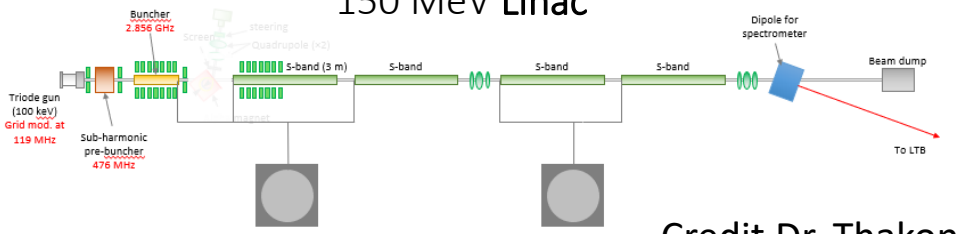


Brilliance of the exiting (grey) and SPS-II sources

3.0 GeV SPS-II

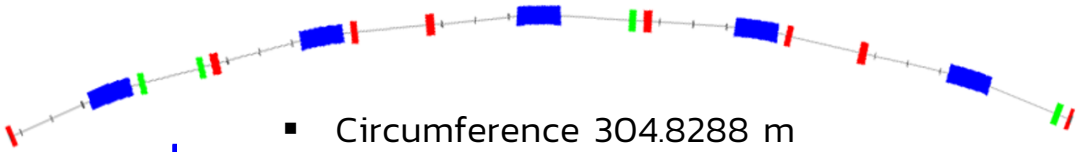


150 MeV **Linac**



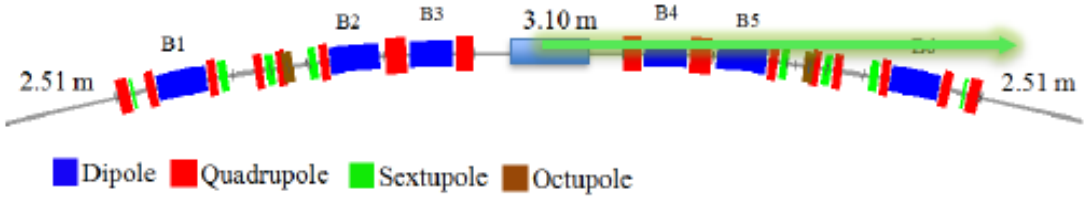
Credit Dr. Thakonwat

1 FODO cell of **booster synchrotron**



- Circumference 304.8288 m
- FODO cell with 8-fold symmetric
- Emittance < 10 nm-rad

1 DTBA cell of **storage ring**



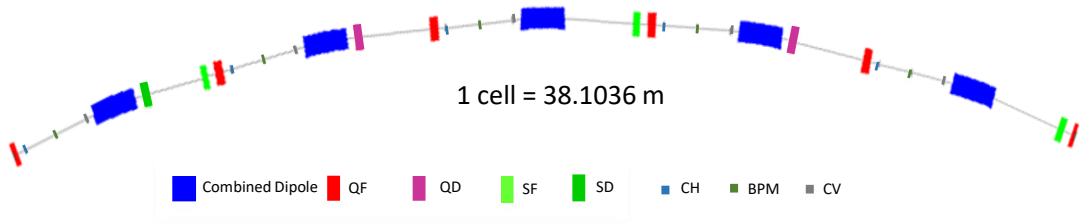
- Circumference 327.26 m
- DTBA (Double triple bend achromat)
- Emittance < 1 nm-rad

Credit Dr. Thapakorn

SPS-II Booster parameters

Parameters	SPS-II: Booster Synchrotron
Circumference (m)	304.8288
Energy (GeV)	3
Relativistic factor γ	5870.85
Emittance (nm-rad)	**5.87**
Nat. energy spread (%)	0.091
Nat. chromaticity ξx/ξy	-23.63/ -10.31
Tune (Qx/Qy)	14.71/5.61
Momentum compaction	1.674e-3
Straight/circumference	38.1036
Energy loss per turn U_0 (MeV)	0.750
RF frequency (MHz)	119.0008537
Harmonic number	121
Dispersion at straight section, m	0.377
Beam current, mA	2
Repetition rate, Hz	2

SPS-II Booster Synchrotron

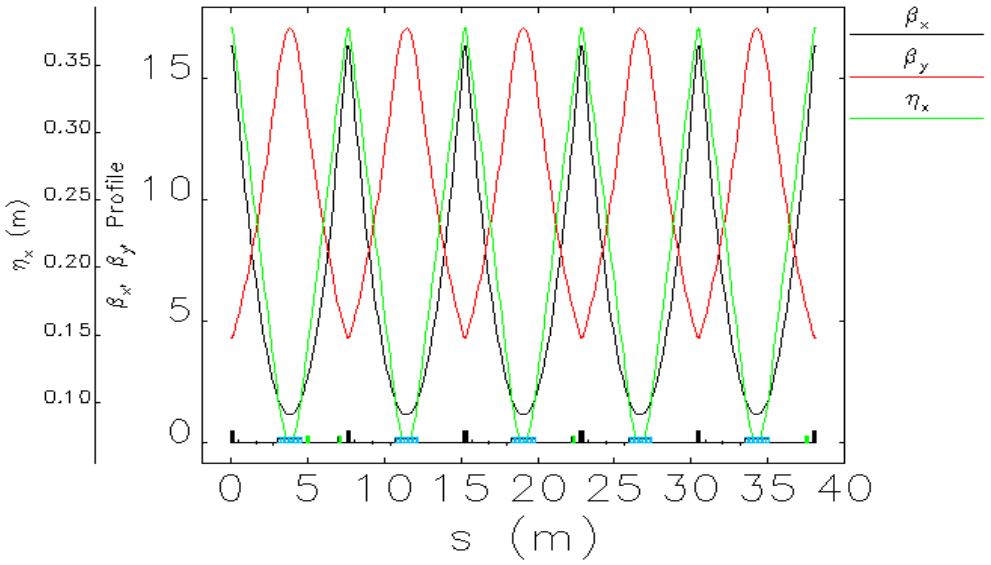


SPS-II Booster Synchrotron

8-fold symmetric, FODO with combined function magnets

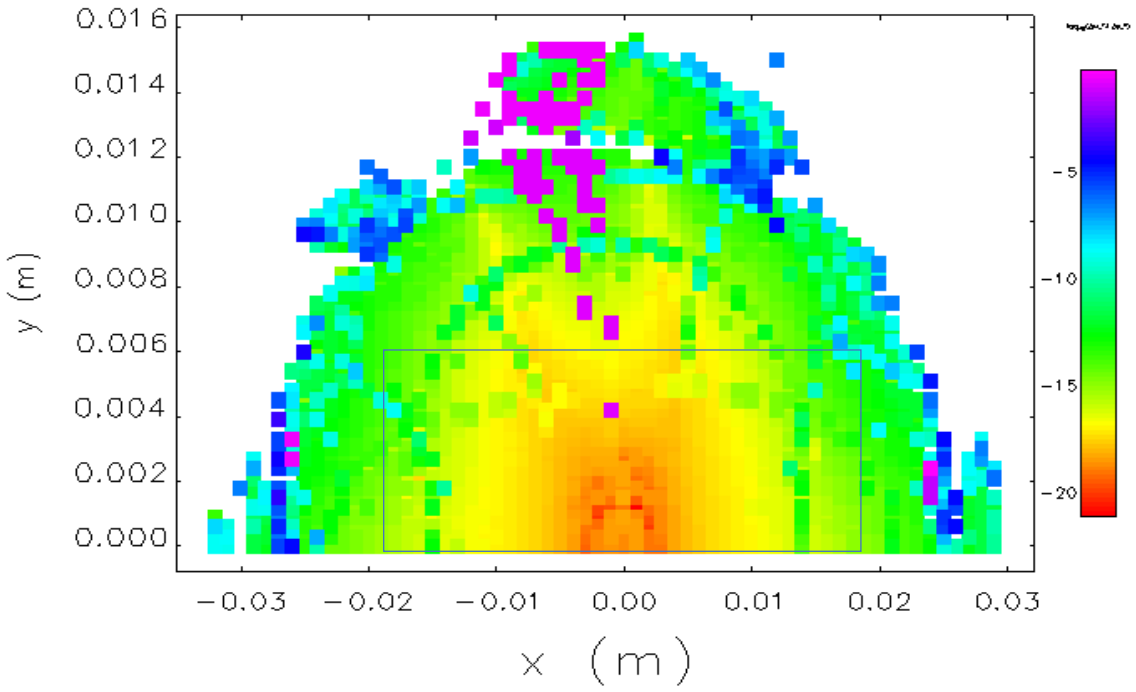
Circumference: **304.8288 m**

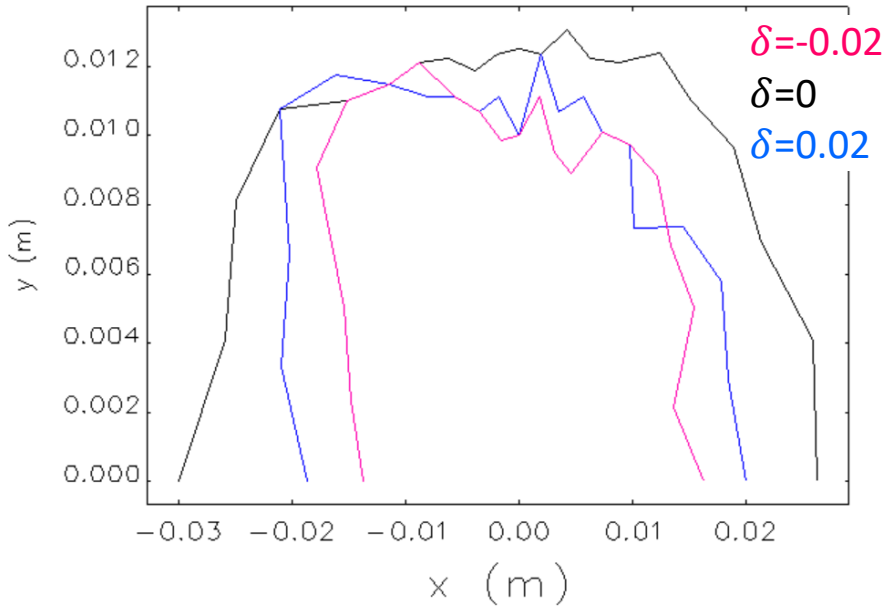
Distance between BS and STR: **3.61 m**

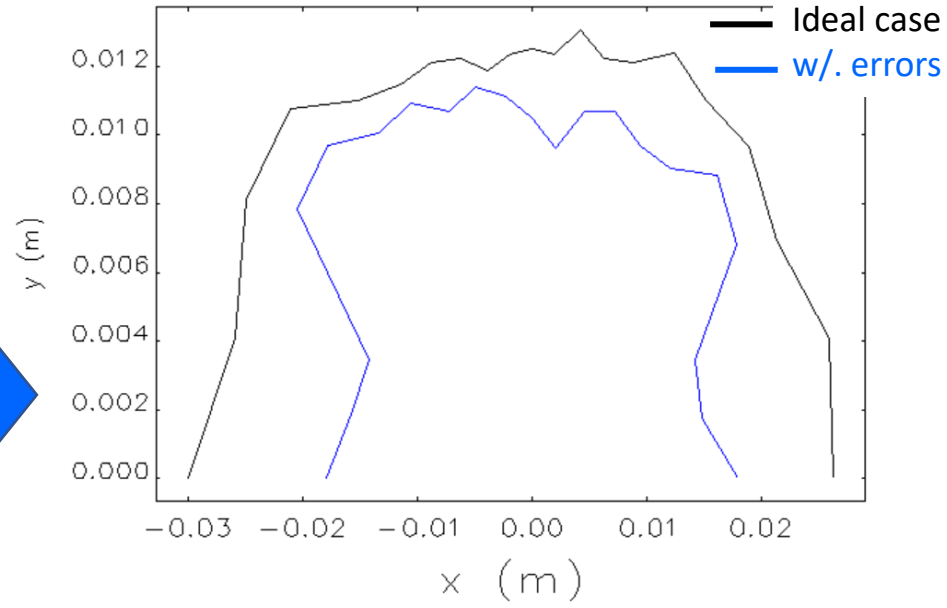


Dynamic aperture & imperfections

- The dynamic aperture for the ideal machine is about ±30 mm in the horizontal and ±12 mm in the vertical plane, which is larger than that of the physical aperture.







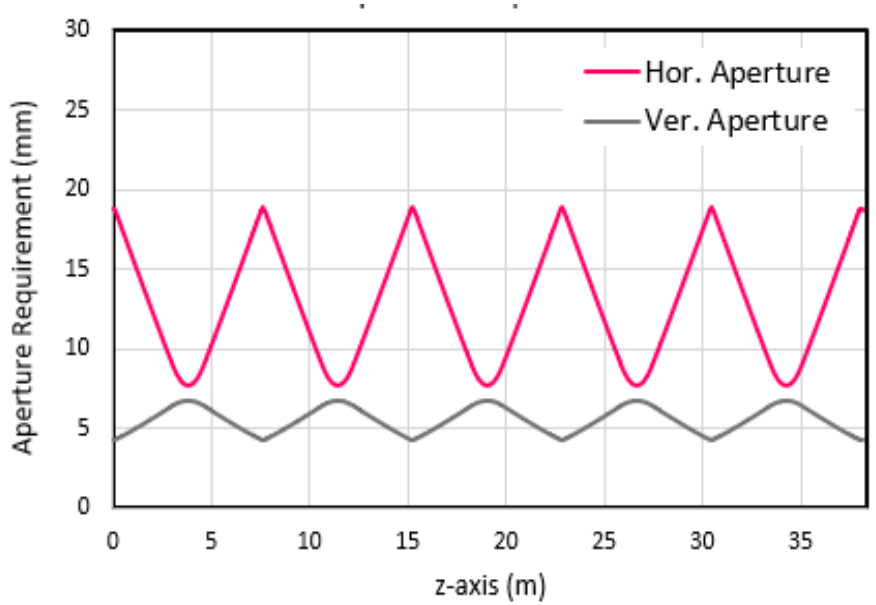
- This shows the effects in the dynamic aperture due to multipole errors, misalignment, excitation errors and higher-order multipole field errors in the dipole and quadrupole magnets.

Aperture requirement for SPS-II booster synchrotron

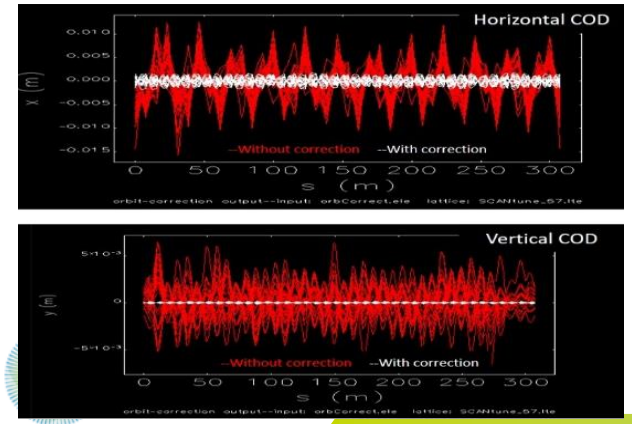
Beam stay clear (BSC) or Half-aperture

$$A_x = 3\sqrt{\beta_x \varepsilon_x (170\ \text{nm.rad}) + \left(\eta_x \sigma_x (0.5\%)\right)^2} + x_{COD}(1.8\text{mm}) + \eta_x \delta_{osc}(2\%) + x_{osc}(3\text{mm})$$

$$A_y = 3\sqrt{\beta_x \varepsilon_x (170\ \text{nm.rad})} + y_{COD}(0.2\text{mm}) + y_{osc}(1.5\text{mm})$$



	Dipole	Quad.	Sext.	BPMs
Misalignments, um	160	160	160	300
Rotation error, mrad	0.8	0.8	0.8	-
Excitation errors, %	0.15	0.3	0.3	
Dipole field error, %	2.4			



xCOD = 1.8 mm
yCOD = 0.2 mm

Beam stay clear (Half-aperture)	Horizontal (mm)	Vertical (mm)
at Quadrupoles	18.783	4.265
at Dipoles	7.680	6.808

Proposed vacuum chamber for booster synchrotron:

- A round stainless steel with a thickness of 0.7 – 1 mm will be obtained
  - at Quadrupole QF, Round chamber with **38 mm** inner diameter.
  - at Dipoles, Round chamber with **16 mm** inner diameter.

Siam Photon

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วิทยาศาสตร์ วิจัยและนวัตกรรม
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Thank you

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