

A compact ring for ThomX-ray Source

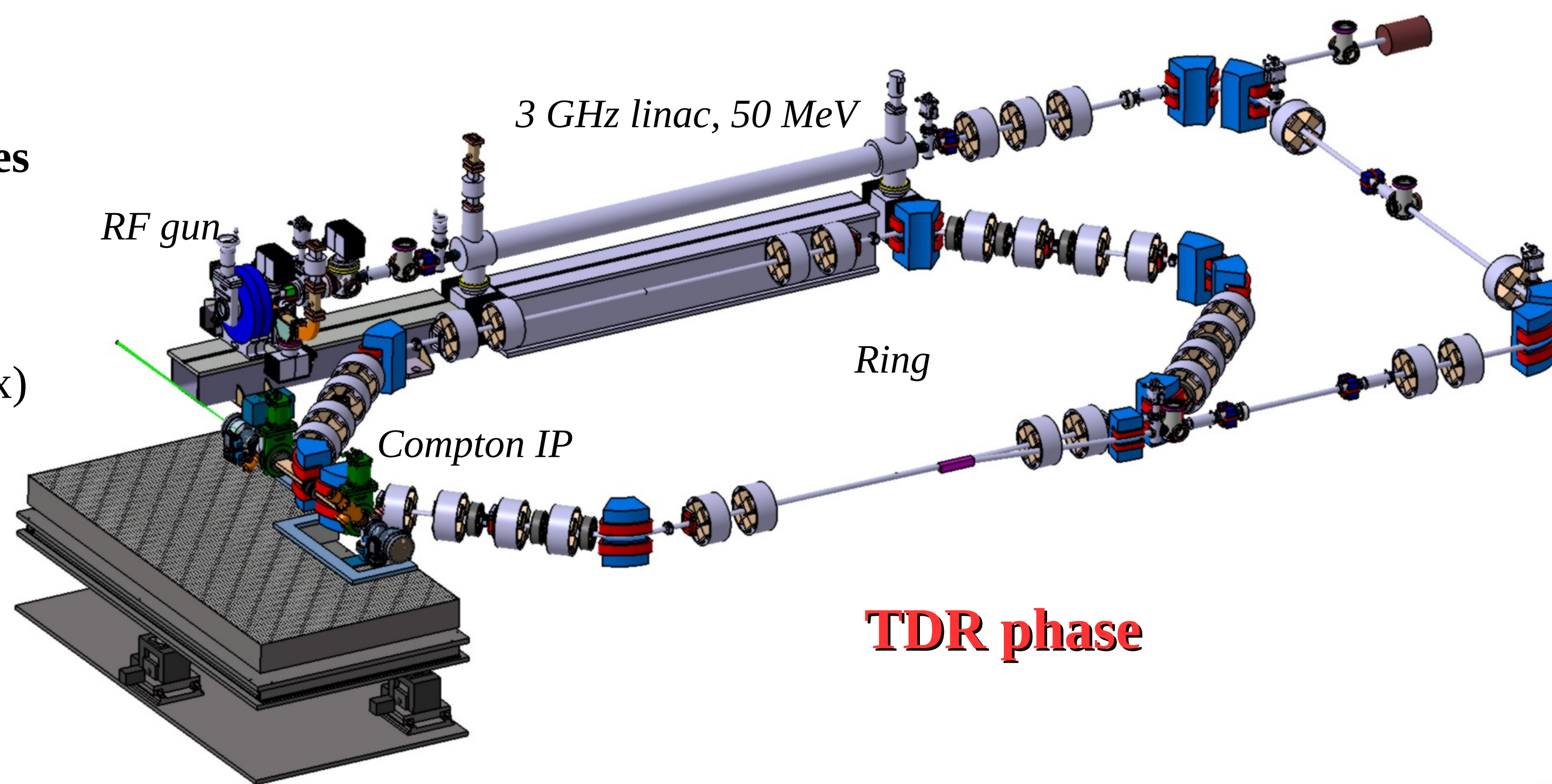
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Fabry-Pérot laser cavity between dipoles

Offers the advantages :

- Free the two long straights (Space)
- Mirrors located out of the ring (Access)
- Compton extraction cone close to IP (Flux)
- Accommodate a 2D planar optical cavity



Goal

Produce $\sim 10^{13}$ ph/s in the 10-50 keV range by Compton back scattering

With

50 MeV Electron bunches @ 50 Hz :

$Q=1$ nC, $\sigma_t=20$ ps, $\epsilon_{x,z}=5 \cdot 10^{-8}$ nm

at IP, $\sigma_{x,z}=70$ μ m rms

1.23 eV Laser pulse @ 40 MHz:

$E=25$ mJ, $\sigma_t=5$ ps

at IP, $\sigma_{x,z}=40$ μ m rms

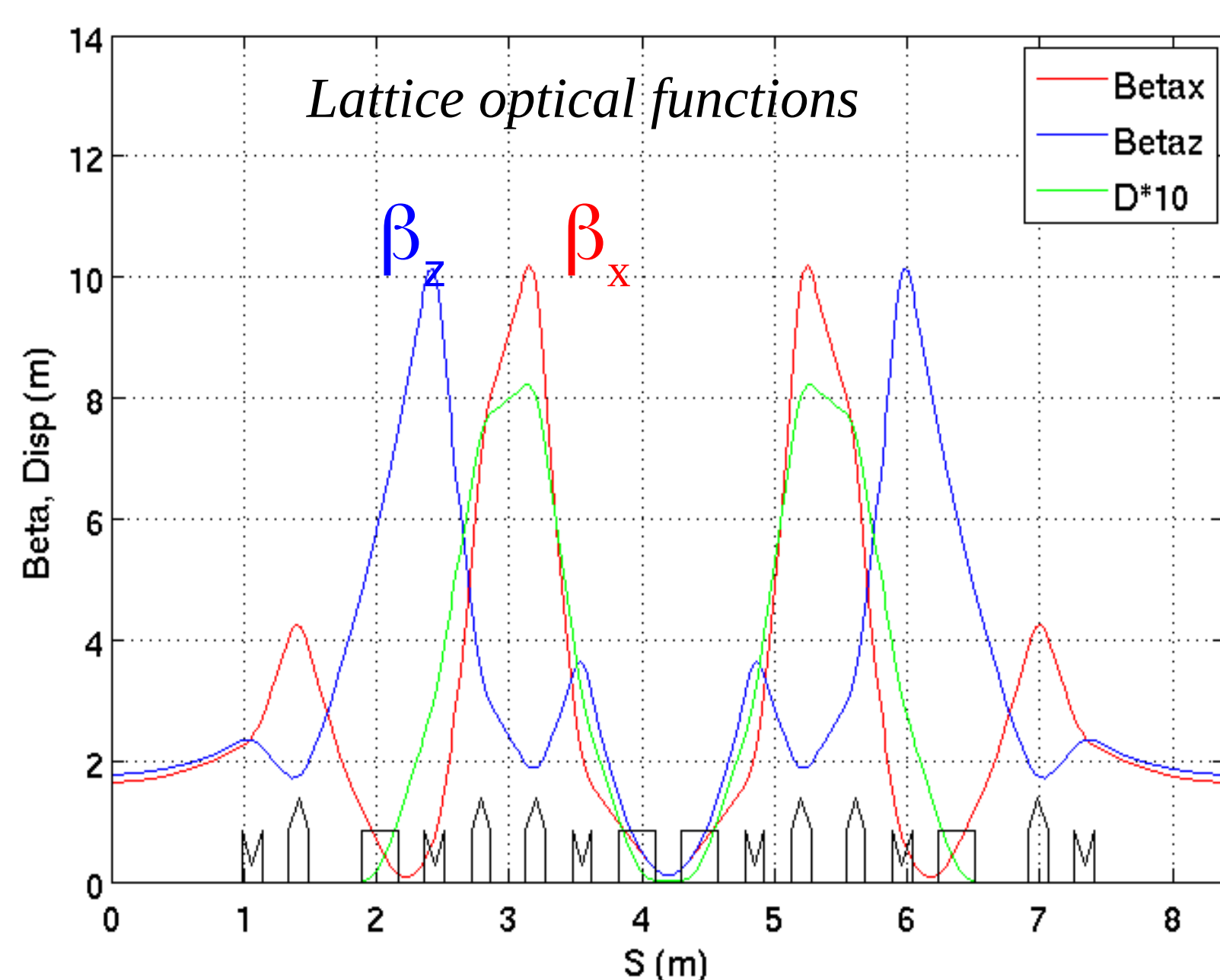
Crossing angle : 2 deg.

Machine

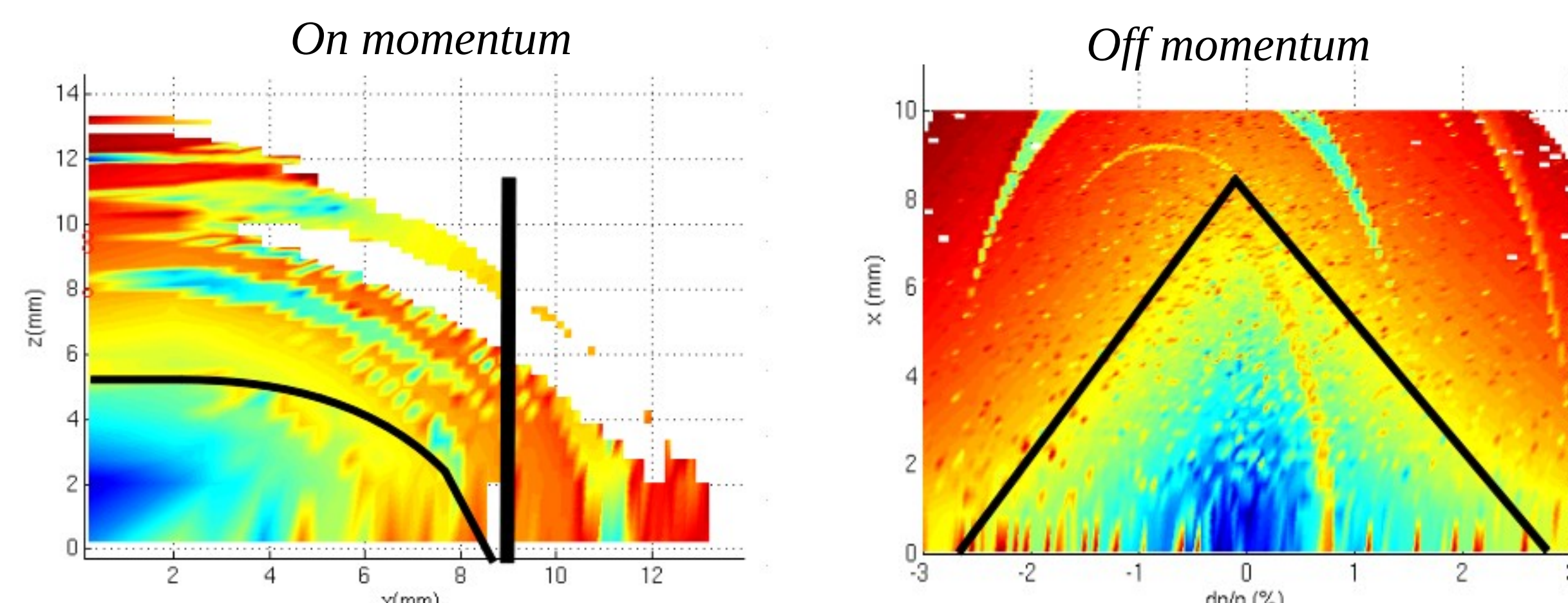
Linac + Compact Ring+ Optical FP cavity

Ring lattice parameter

Nominal energy (Max)	50 MeV (70)
RF Frequency / Harm	500 MHz / 28
Circumference / Rev. Freq.	16.80 m / 17.8 MHz
Betatron tunes (ν_x, ν_z)	3.4, 1.74
Momentum compaction	$1.48 \cdot 10^{-2}$
Natural chromaticities (ξ_x, ξ_z)	-3.2, -8.2
Beta, Disp @ IP	0.1, 0.1, 0 m
Nbr of dipoles / Families / Field	8 / 1 / 0.5 T
Nbr of Quad / Families / Grad	24 / 6 / 3 T/m
Nbr of Sext / Families / Grad	12 / 2 / 30 T/m ²

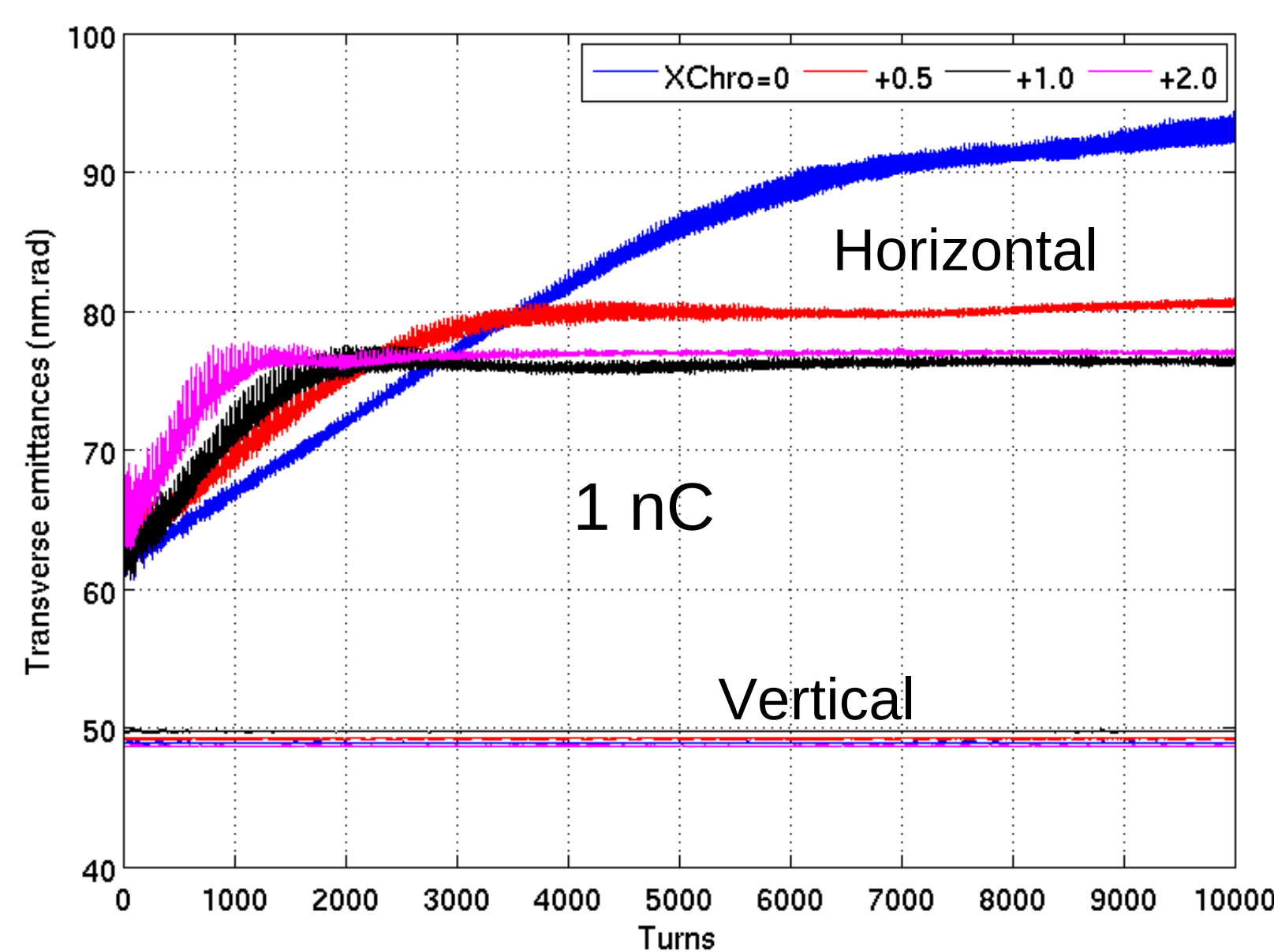


Non-linear Dynamics



Dynamic Aperture at injection point including sextupoles and quadrupoles fringe field effects. Black line are the scaled pipe limit and the injection septum.

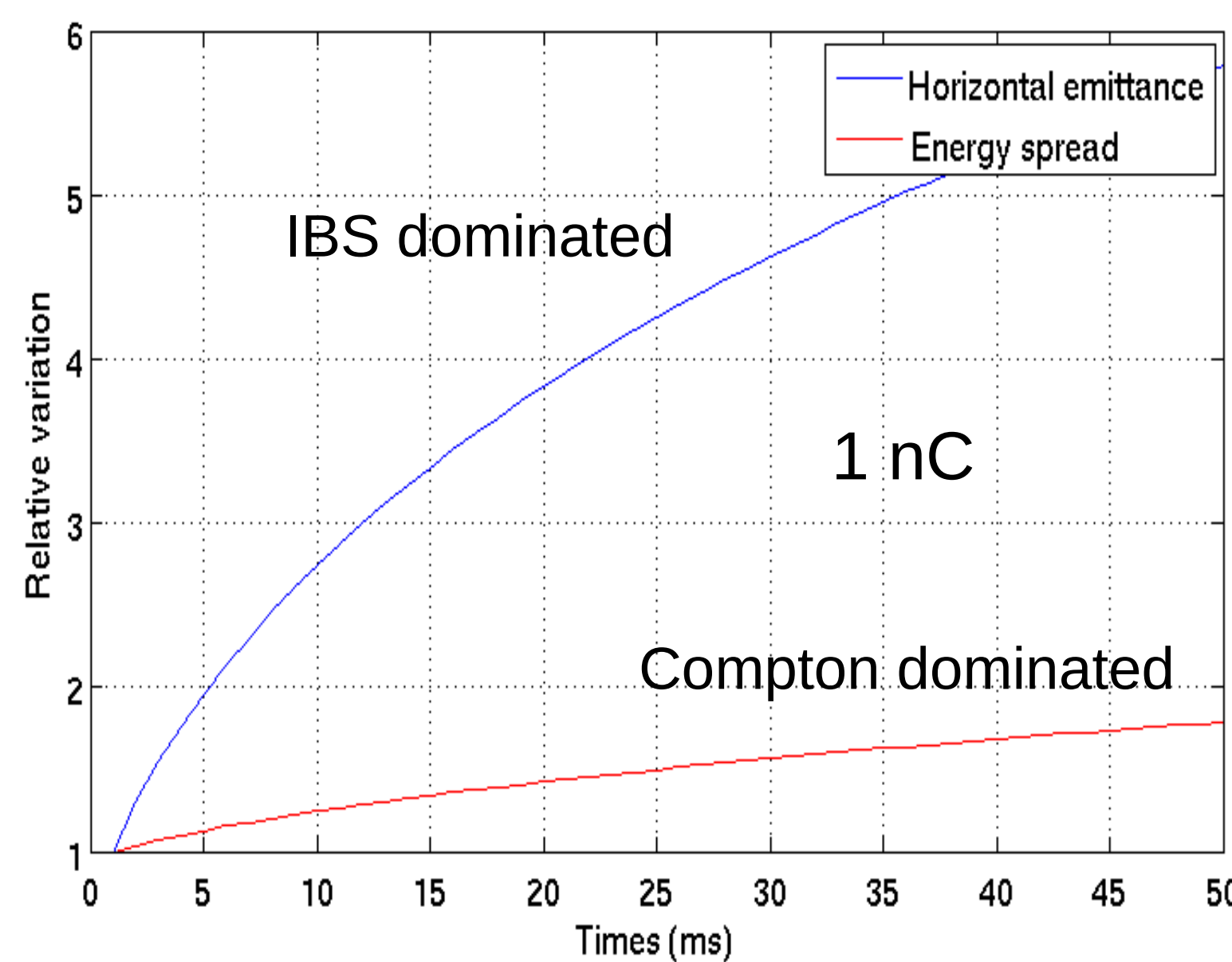
CSR, RW, LSC & Pipe Collective effects



Emittance variation versus time including collective effect over the first 0.5 ms storage time for different chromaticities

Minimum bunch length : 20 ps
Needs positive Chromaticities
==> Due to collective effect
CSR dominated ..

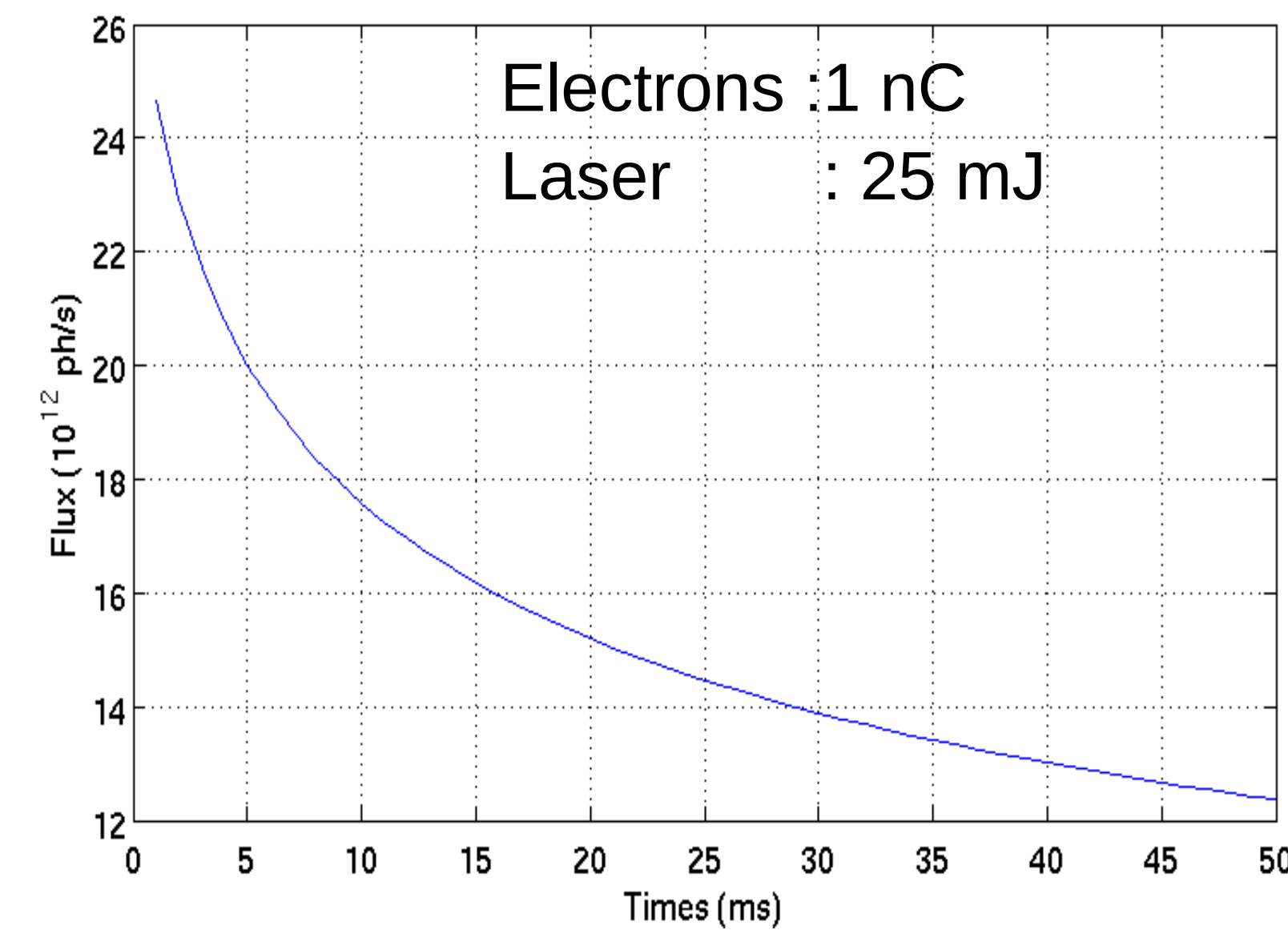
IBS & Compton effects



Relative variation of energy spread and emittance versus time including Compton interaction and IBS effect

==> Bunch length x 2 over 50 ms
==> H emittance x 6 over 50 ms

X-ray flux



Estimated flux reduction versus time by IBS and Compton effects

$\sim 10^{13}$ ph/s

References

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