

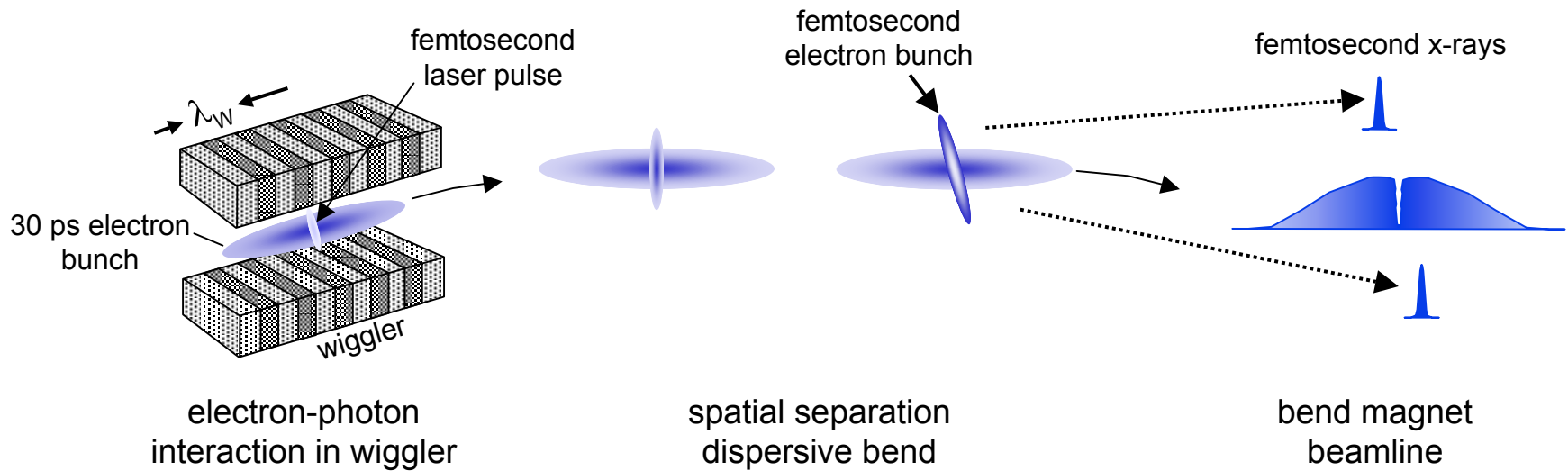
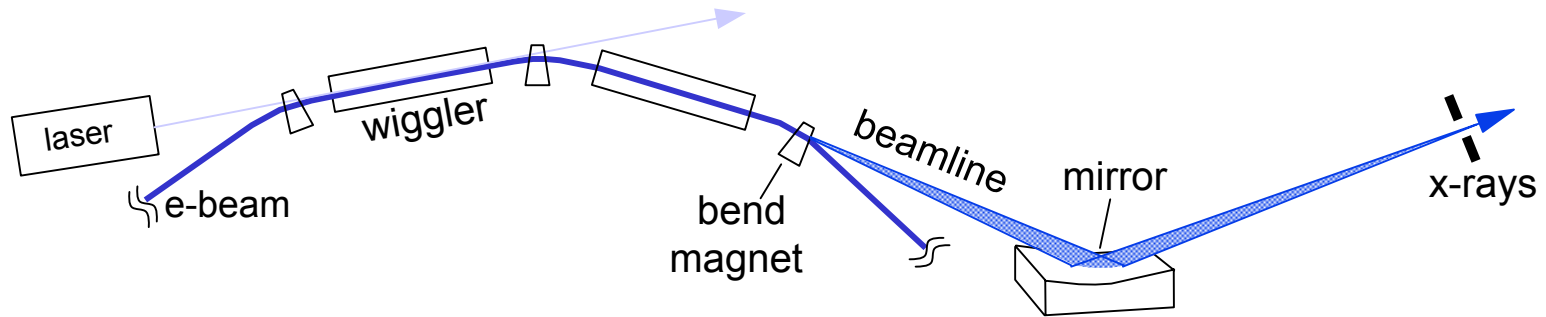
---

# Sliced electron beam dynamics at SOLEIL

A. Loulergue, A. Nadji, L. Nadolski

Synchrotron SOLEIL

# Generation of FEMTO-second X-rays from the ALS



Zholents and Zolotarev, *Phys. Rev. Lett.*, **76**, 916, 1996.

# Beam-laser interaction / Slicing efficiency

## Energy modulation :

- Possible energy modulation :  $\Delta E \sim \pm 14 \text{ MeV}$  (laser : 50 fs / 5 mJ / 800 nm)
- SOLEIL 2.75 GeV :  $\Delta E/E_0 = \pm 5 \cdot 10^{-3} \Rightarrow 5$  Energy standard deviations

## Slicing efficiency estimation (10 kHz laser) :

- Estimated multibunch (500 mA, 12ps) flux  $\sim 10^7 \text{ photons/s/0.1\%b.p.}$
- Estimated singlebunch (10 mA, 24 ps) flux  $\sim 4 \cdot 10^7 \text{ photons/s/0.1\%b.p.}$

---

## SOLEIL requirements

⇒ **Radiators** : Hard X-rays : U20  
Soft X-rays : HU80

⇒ **Modulator** : High field Wiggler : (W100?)

## Location :

SOLEIL lattice is not suitable for having the Modulator and the Radiator in the same long straight section as SLS scheme.

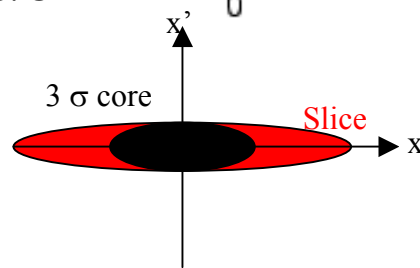
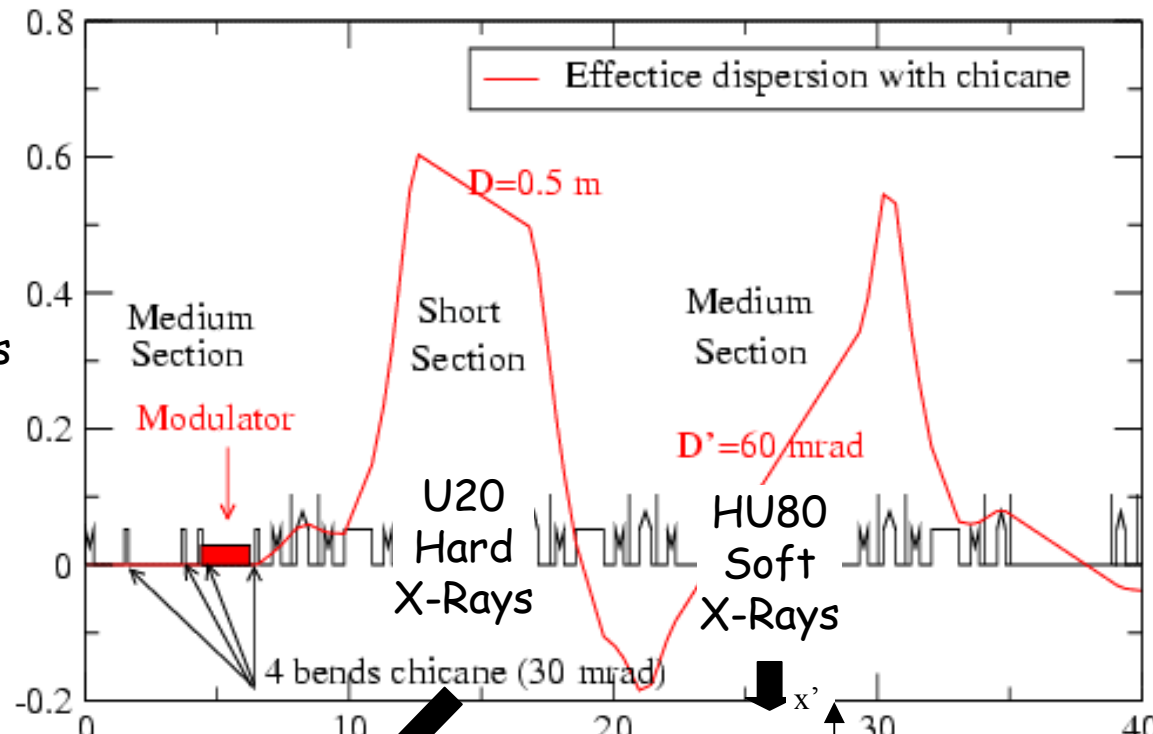
In counter part, the natural SOLEIL optics enables us to set the Modulator and radiators on several consecutive straight sections

# Modulator in Medium Section + chicane

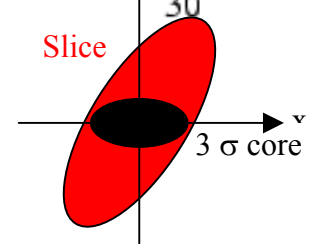
## Spatial separation for Hard X-Rays

## Angular separation for Soft X-Rays

- Main separation is done by the dipoles of the machine
- Weak stretching of the slice (50 fs < slice < 70 fs)
- Angular separation for Soft X-rays further increased by a magnetic chicane :
  - Machine optics weakly perturbed
  - Emittance increased by 10 %
- Possible alignment of sliced electrons by dedicated steerers



Spatial Separation  $\Delta x = 7\sigma$   
for 14 MeV modulated electrons



Angular Separation  $\Delta x' = 10\sigma$   
for 14 MeV modulated electrons

# Turn-by-turn behaviour and bunch energy equilibrium

---

## Turn by turn behaviour:

Sliced particles will come back at the same position every 3 turns with a fast lengthening ( $\sim 500$  fs per turn)

Need to wait few ms (thousand of turns) to damp the sliced particles

## Energy equilibrium :

At 10 kHz laser repetition rate with 14 MeV ( $5\sigma$ ) modulation over 50 fs rms, the equilibrium energy spread of the bunch is increased by  $\sim 10\%$

Cure : Use different bunches

# Conclusion

---

We have presented a layout with :

Both Hard and Soft X-Rays radiators

Weak impacts on machine optics

Need to finalized :

The magnetic chicane bracketing the modulator

Radiation absorbers / Vacuum chamber

Laser injection in the modulator