Design of a Fabry-Perot optical resonator for the storage of several hundreds kW and the interaction with particle beams : application to the PERLE ERL case

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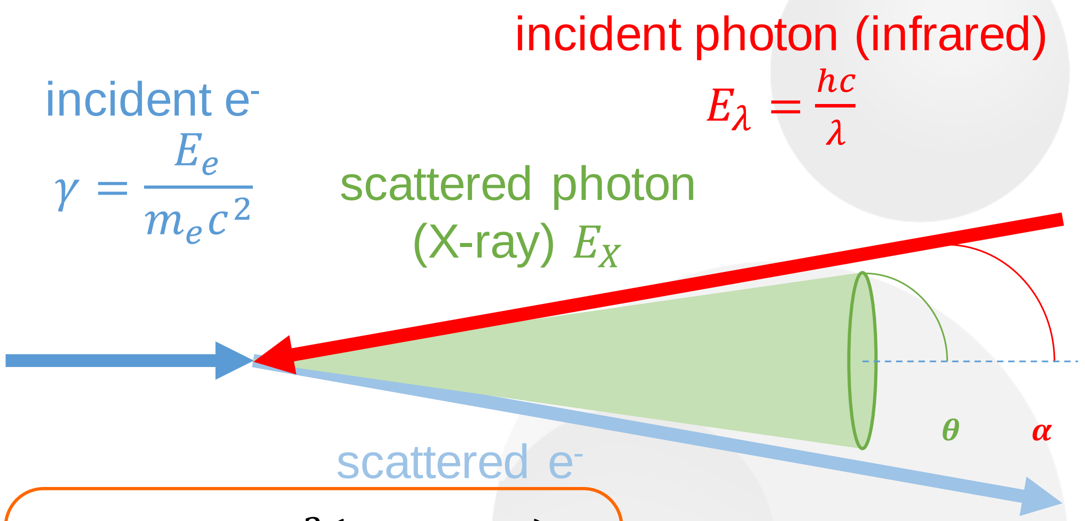
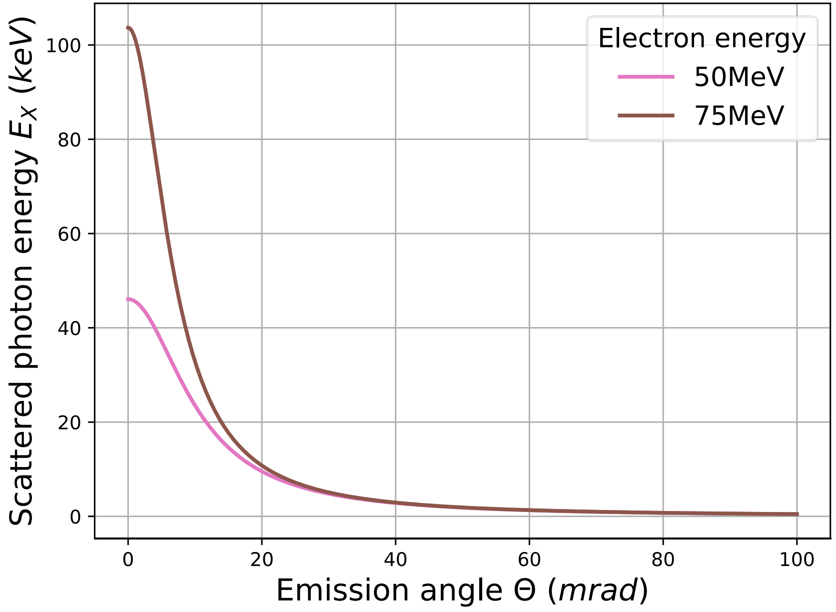


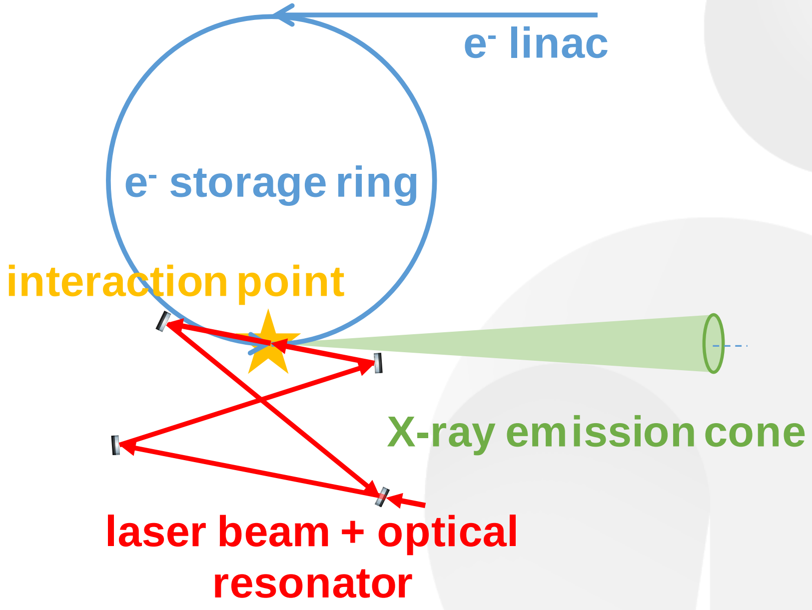
$$E_X \simeq E_\lambda \frac{2\gamma^2(1-\cos\alpha)}{1+\gamma^2\theta^2}$$

$$E_{X,max} \simeq E_\lambda \times 4\gamma^2$$



$$\lambda = 1030nm \rightarrow E_\lambda = 1.2eV$$

Inverse Compton sources



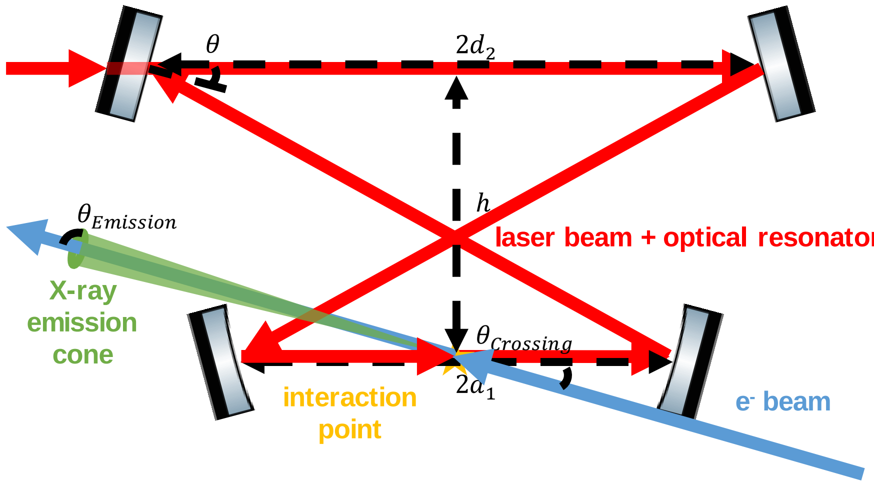
- Very small cross-section of the inverse Compton scattering process ($\simeq 0.6 barn$)
- Maximization of the X-ray flux
- Fixed e- beam parameters
- ➢ **Very high average laser power needed : $\geq 100kW$**

ThomX @ IJCLab
- X-ray energy : **45-90 keV**
- X-ray flux : **10^{11}-10^{13} ph.s^{-1}**

Design of a 515nm cavity for the PERLE ERL

- PERLE specifications :
  - Space requirements

  $\rightarrow$ Choice of $f_{rep} \rightarrow L_{cav}$, d_1, d_2, h, $\theta_{Crossing}$

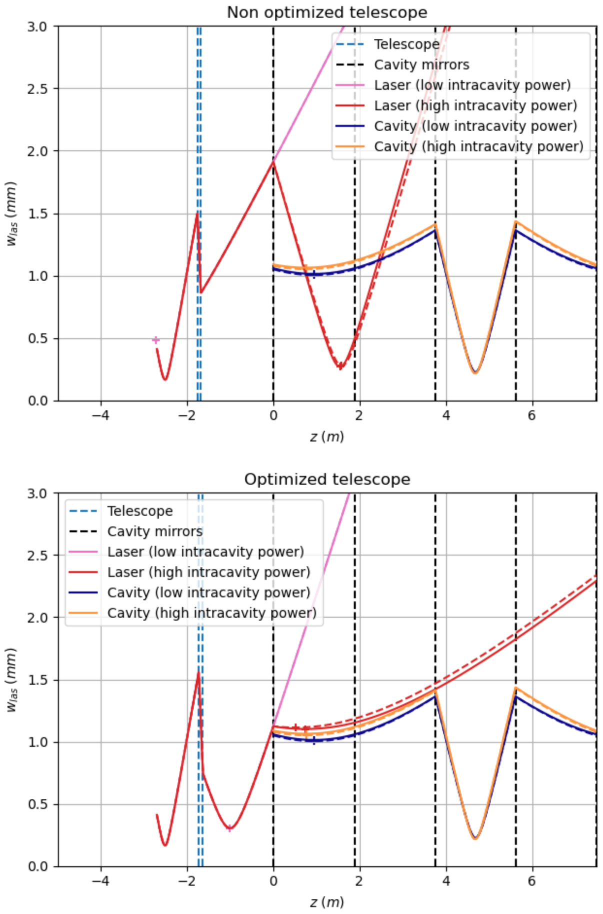


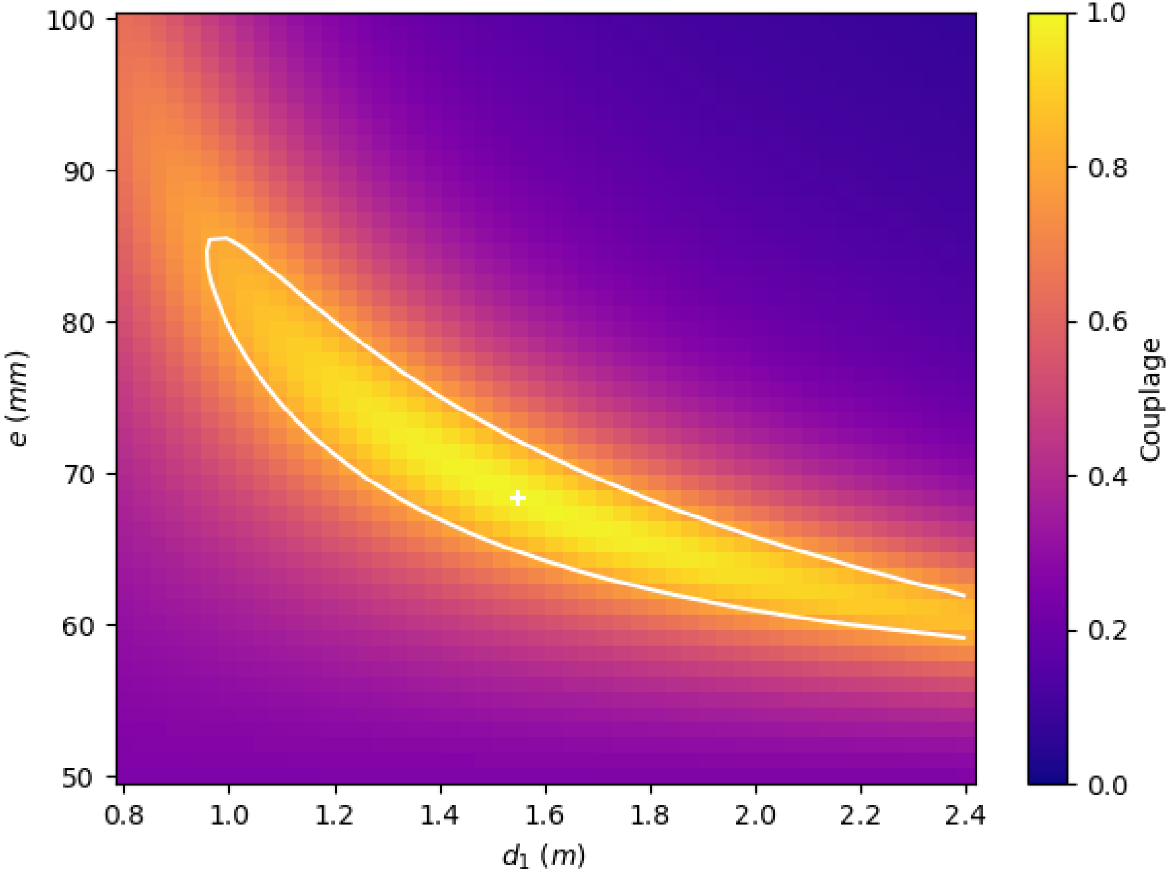
- X-ray flux maximization :
  - X-ray flux maximization without geometrical coupling
  - Geometrical maximization
  - Accounting for thermal effects $\rightarrow$ minimization of the flux and coupling losses due to changes in the fundamental transverse eigenmode of the cavity

  $\rightarrow$ Choice of R

  $\rightarrow$ Telescope design

- Design of a telescope :



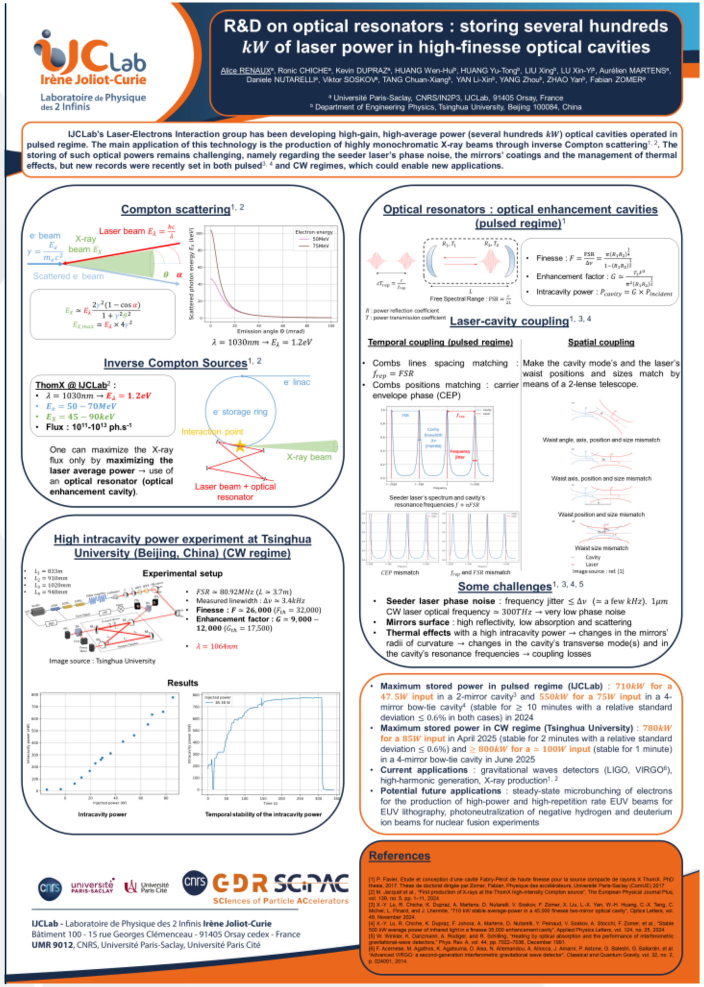


Conclusion

- Design of a cavity for X-rays production with the PERLE ERL :
  - Design of a cavity
  - Design of a telescope
  - Accounting for thermal effects occuring at a high intracavity power

→ Contribution to the Technical Design Report

→ Experimental R&D with these cavities



Thank you for your attention

Any questions ?