The RadiothomX project

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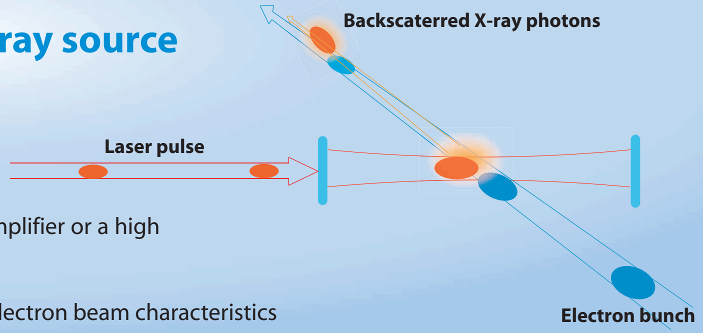
A compact medical high flux monochromatic X-ray source

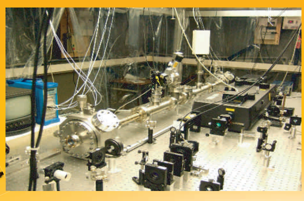


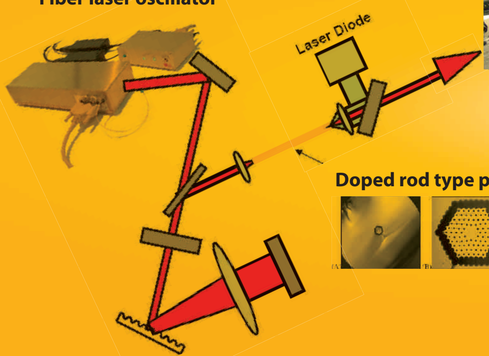
X rays: 10^{12} photons/s within 2-3% of spectral bandwidth
Compton back-scattering
Collision between an intense laser beam and an electron beam

Laser beam :
A high gain Fabry-Perot cavity coupled with either a high average power fiber amplifier or a high average power conventional bulk amplifier.

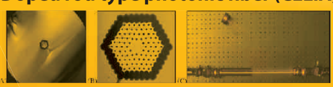
Electron beam :
A storage ring operating at an injection frequency high enough to preserve the electron beam characteristics
A high average current ERL

High gain Fabry-Perot cavity





Doped rod type photonic fiber (CELIA)



Laser Beam

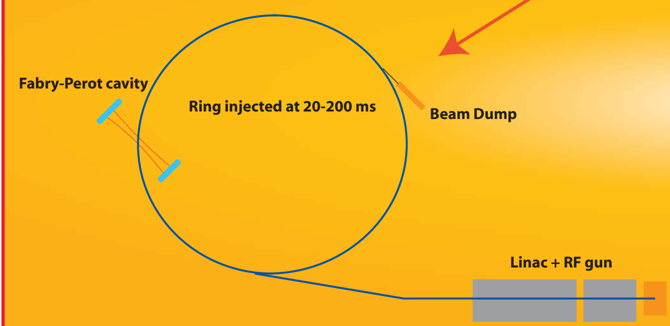
High average power fiber amplifier or a high average power conventional bulk amplifier.
Wavelength : 1.03-1.064 µm

High gain Fabry-Perot cavity

High repetition rate ~50 MHz
Energy : 10-30 mJ per pulse
Transverse size : 15-250 µm rms

Electron Beam

Small transverse beam sizes at the interaction point : ~70 µm
Energy : 50 -60 MeV

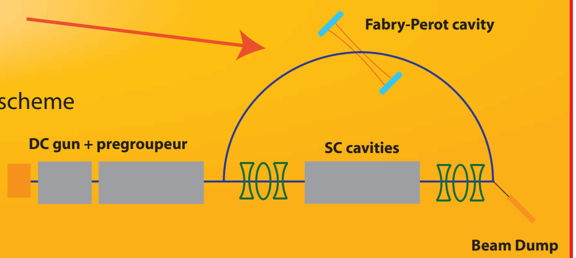


Ring

Injection each 20-200 ms to avoid beam degradation
Energy spread : 0.6 %
Normalized transverse emittance : 4 p mm mrad
Bunch charge 0.5-1 nC
Ring circonference : 7-14 m

ERL

DC JLab type photoinjector
ELBE type cryomodules
Constant gradient focusng scheme
BBU threshold ~100 mA



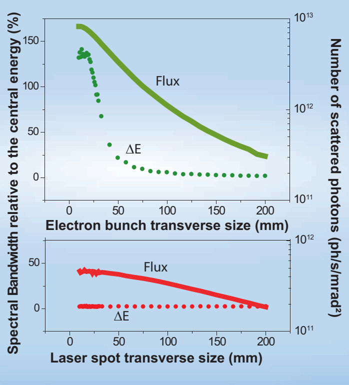
ERL versus ring

The flux is almost the same for both configuration dépending on the deveopment of the high average current ERL

Ring :
- Well known technology
- Flux degradation due to bunch caracteristics degradation
- Difficulty to place a 4 mirors low waist optical cavity

ERL :
- High average current technology under development
- Place of the cryogeny
- Electron bunch renewed at each interaction
- Easy to place a 4 mirors low waist optical cavity in the loop

Beam sizes and source brilliance



- Change of the laser transverse dimensions practically does not influence the spectral bandwidth

- Changing only the electron transverse sizes leads to an enhancement on the flux in spite of an enlargement of the spectral width

- With a 70 µm (RMS) electron beam transverse size and a 15 µm (RMS) transverse laser spot size, an X-ray flux of 5 1011 ph/s/mrad² can be obtained with a quasi mono-energetic spectral bandwidth of 2-3 %.