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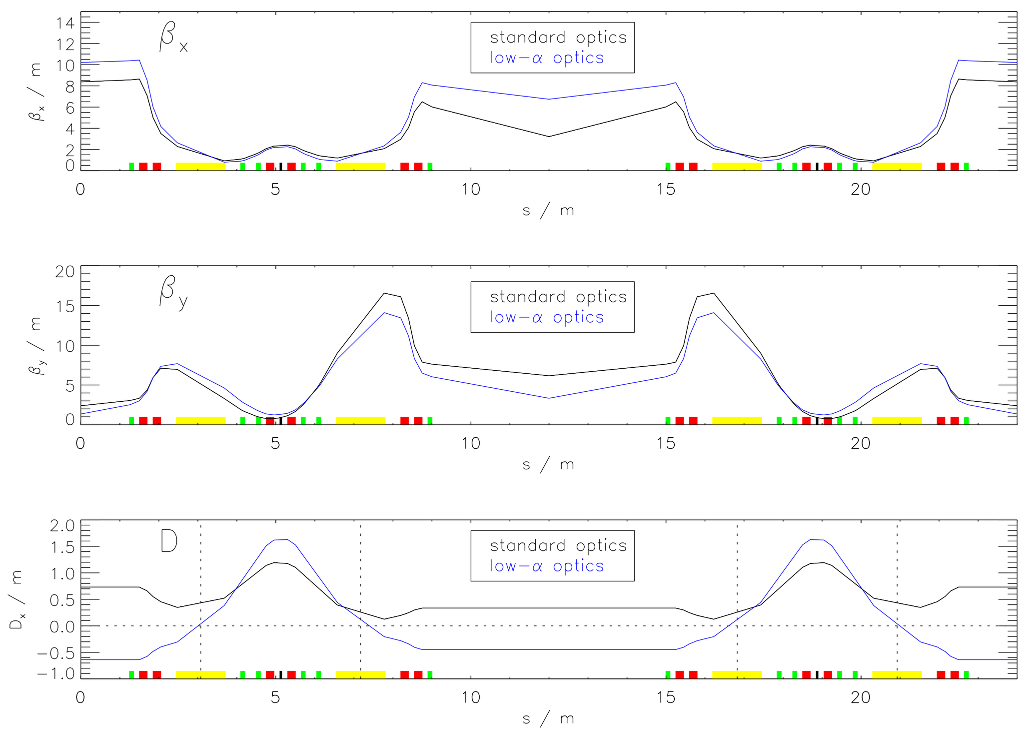
The MLS - an optimized source for coherent THz synchrotron radiation

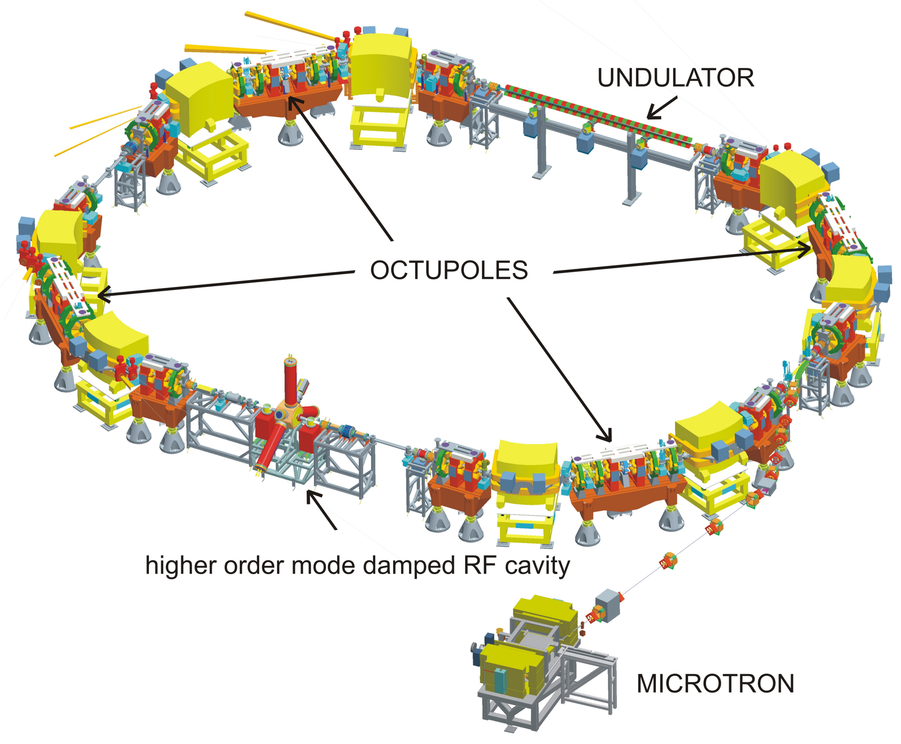
Picosecond bunches at the Metrology Light Source (MLS)

The MLS is an electron storage ring optimized to generate EUV-/ VUV-radiation. In addition, dedicated sextupole and octupole magnets allow exceptional control of the non-linear momentum compaction factor $\alpha = \alpha_0 + \alpha_1\delta + \alpha_2\delta^2$. Therefore, in a low-$\alpha$ optics mode it is possible to create sub-ps electron bunches of good lifetime.

lattice functions



MLS scheme



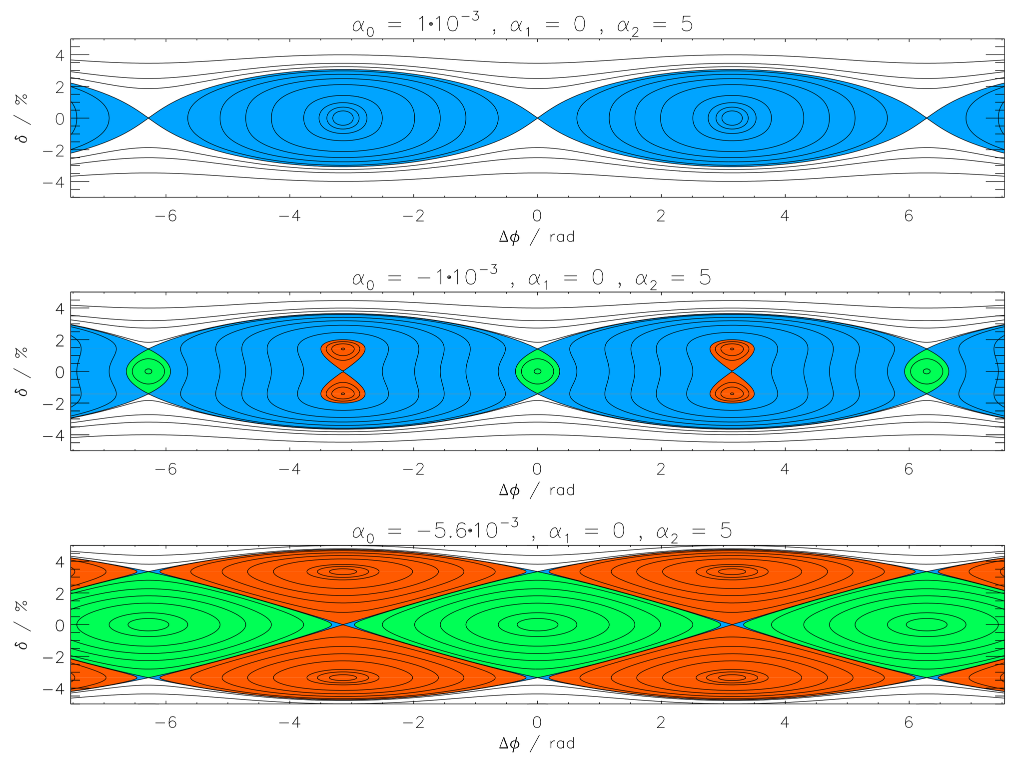
storage ring parameters

parameter	value
structure	double bend acromat
circumference	48 m
R_{bend}	1.528 m
E_e	105 . . . 629 MeV
ΔE_e / turn	7 . . . 9060 eV
$\frac{\Delta p}{p}$	$0.7 \cdot 10^{-4} \ldots 4.2 \cdot 10^{-4}$
I_e	1 pA ($1e^-$) . . . 200 mA
α	$1 \cdot 10^{-5} \ldots 7 \cdot 10^{-2}$
$V_{RF\text{-}max}$	450 kV
Q_x / Q_y	3.18 / 2.23

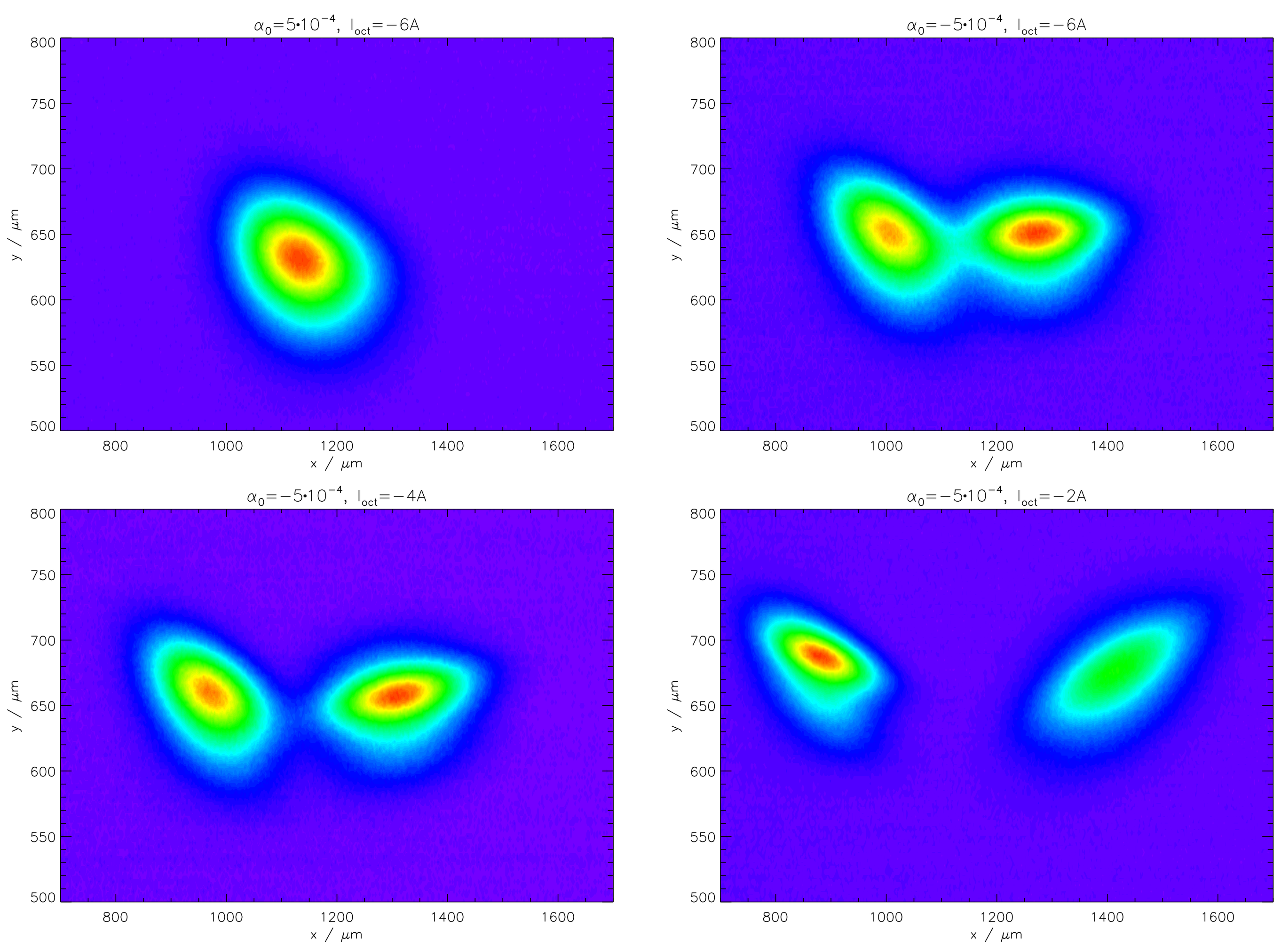
Low-α buckets and generation of double beams

RF bucket dynamics

$$\mathcal{H} = \pi f_{rf}\left(\alpha_0\delta^2 + \alpha_2\frac{\delta^4}{2}\right) + \frac{f_{rev}eU_0}{E}\cos(\Delta\Phi)$$

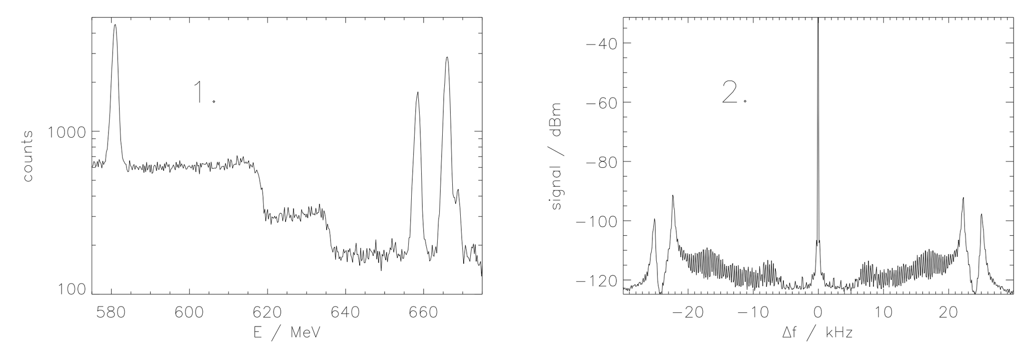


observation of double beams



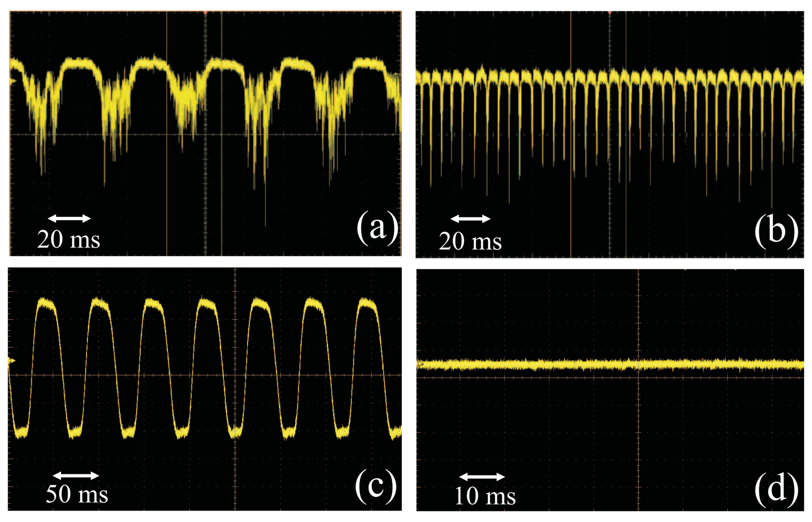
double beam diagnostics

1. Energy difference of the double beam, measured with Compton backscattering $\Delta E = 3.3\%E_0 = 21$ MeV
2. longitudinal tune measurement shows different tunes for each bunch



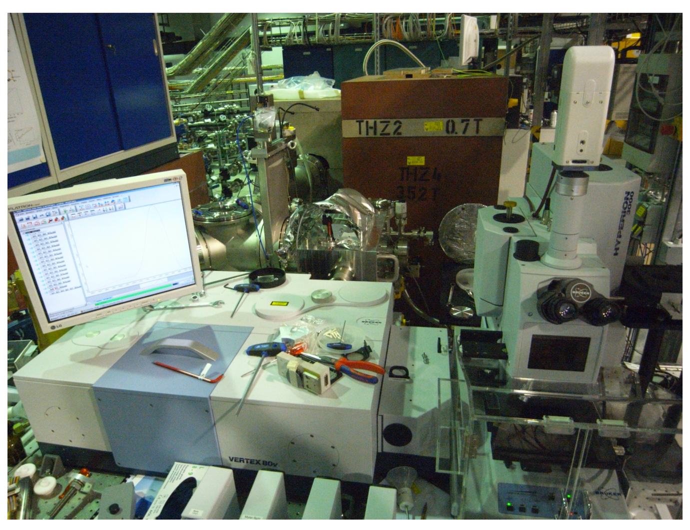
Coherent synchrotron radiation: detection and application

THz time domain



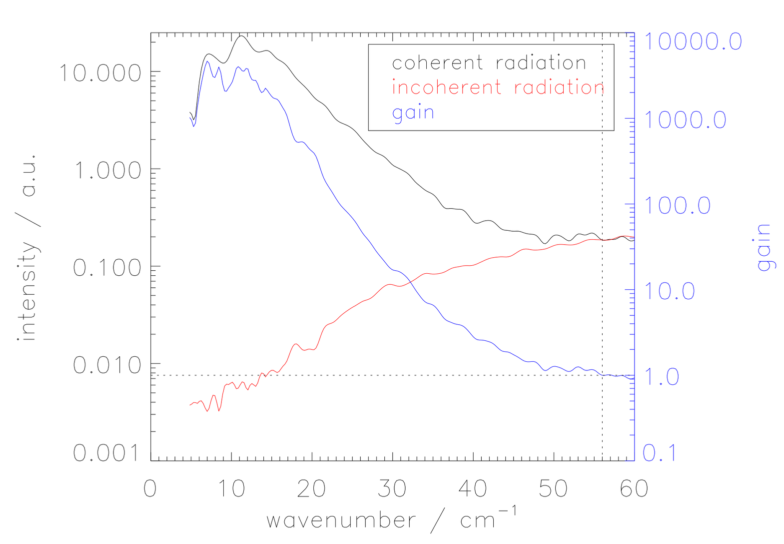
oscilloscope records

FTIR spectrometer



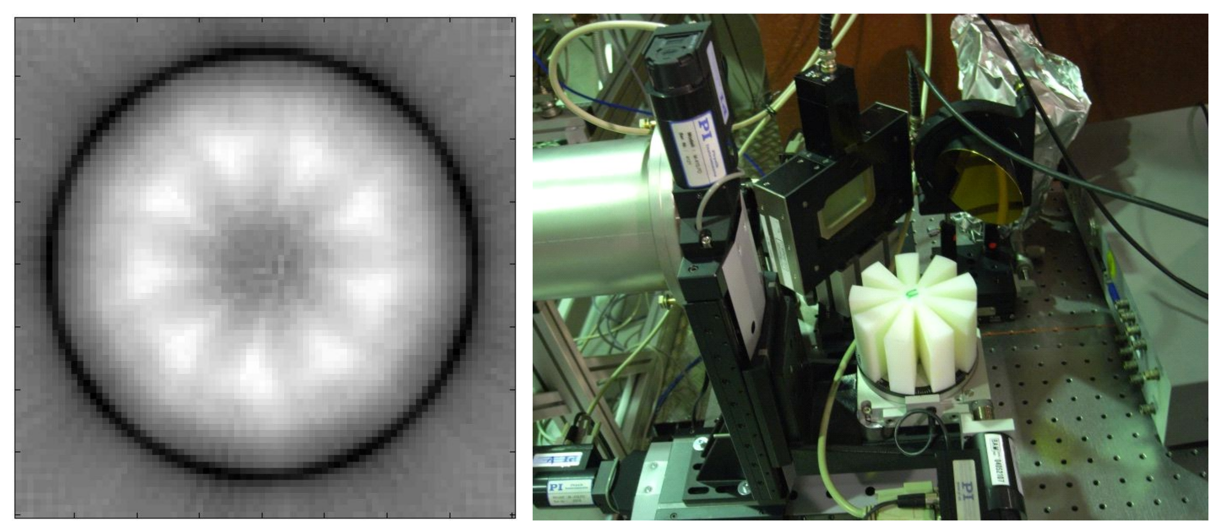
THz beam port

THz frequency domain



coherent frequency range

THz - computed tomography



THz CT works similar as the well known X-ray CT.
High brilliance THz CSR from the MLS is applied.
measurements in cooperation with BAM, Berlin

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