Commissioning off the test FEL at MAX-lab

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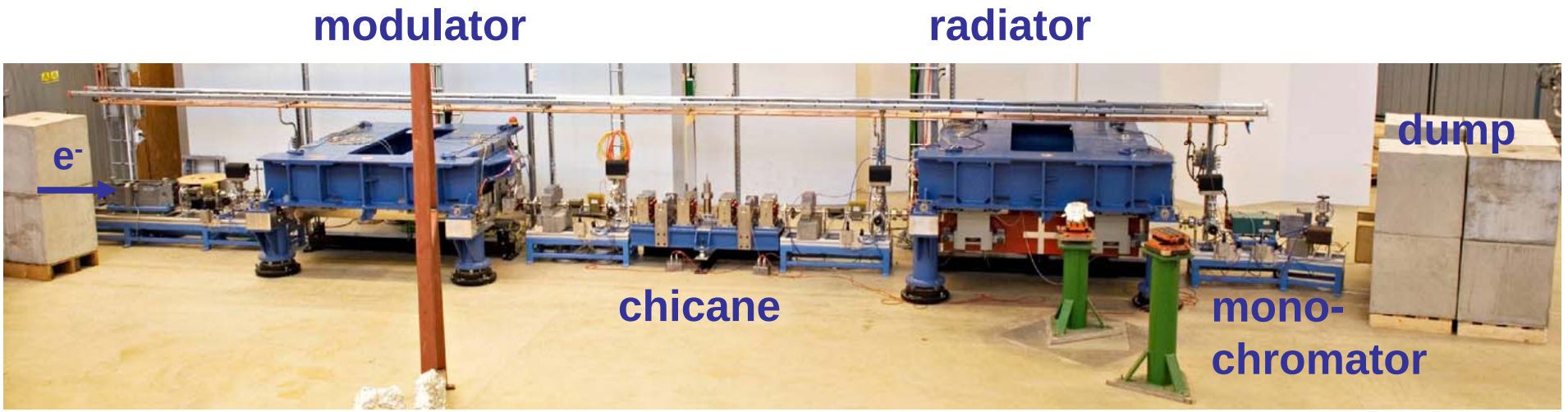
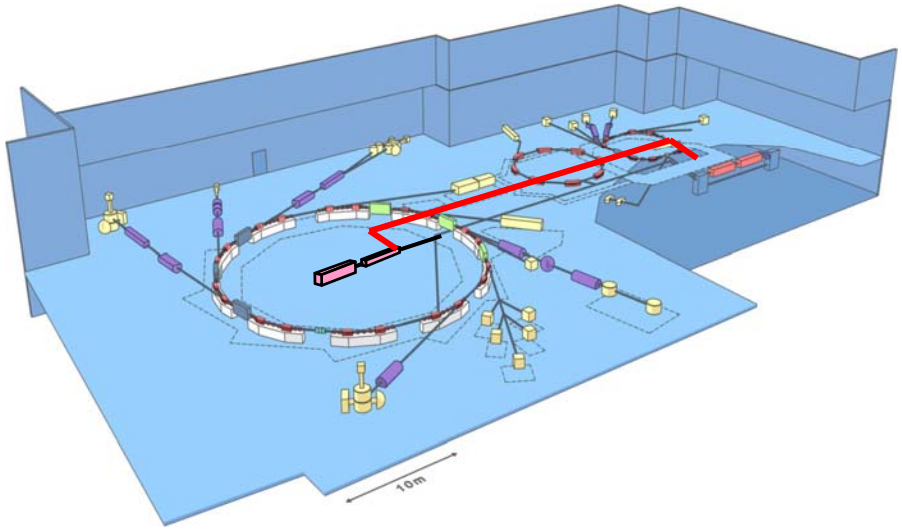
Layout of the FEL

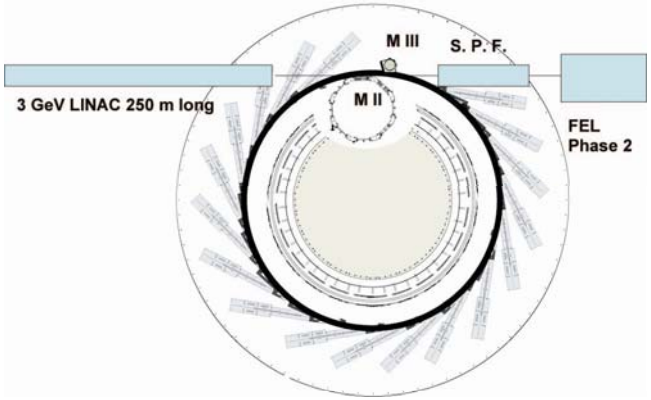


Layout of the FEL

- 500 MeV injector
- Transport with compression
- **Laser for gun and seeding**
- **FEL undulators and a chicane**
- **Diagnostics**



The motivation for this project is to ”examine” technologies and learn for MAX IV, as well as to educate PhD student FORMULERING??



Layout of the FEL

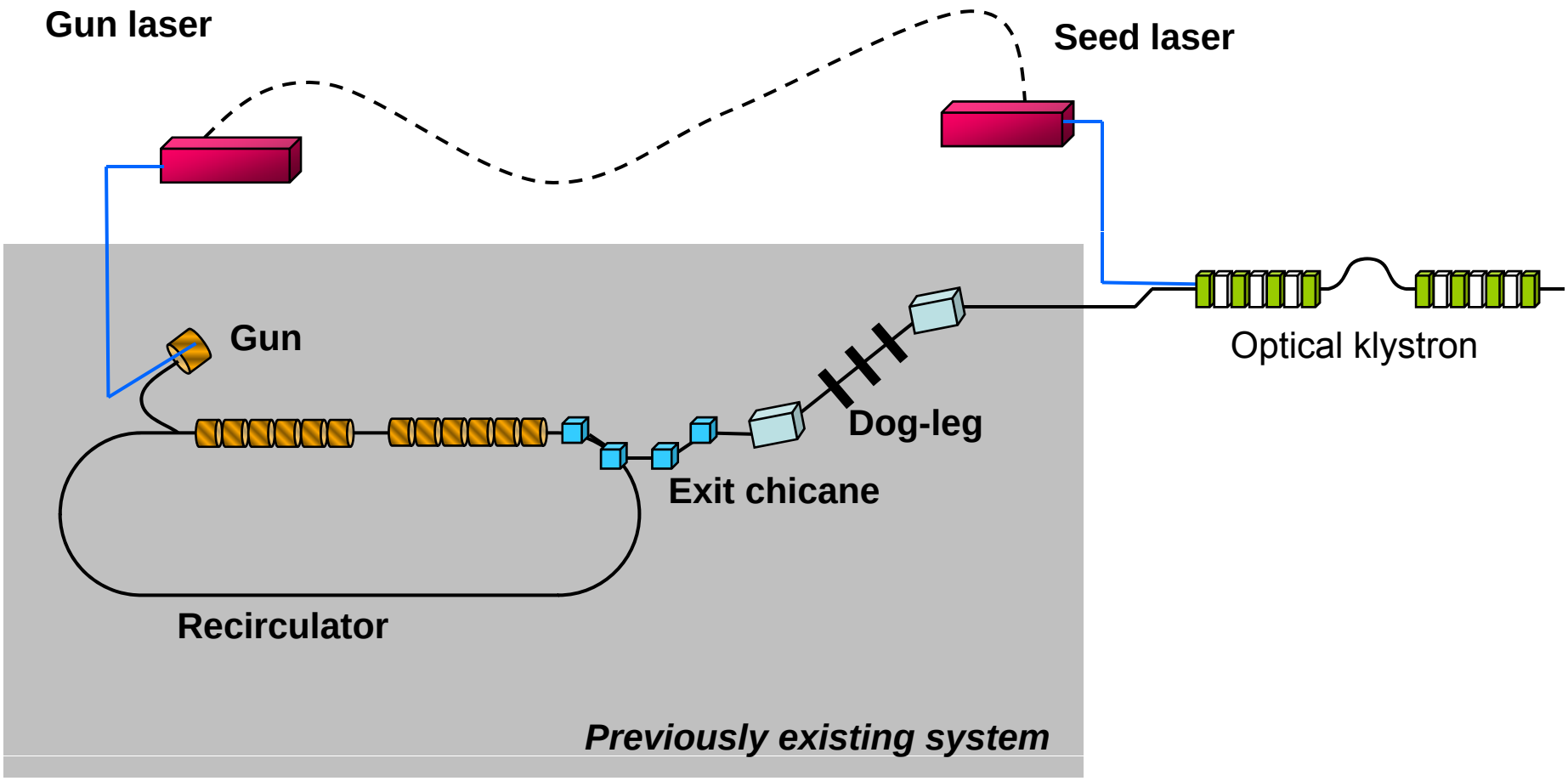
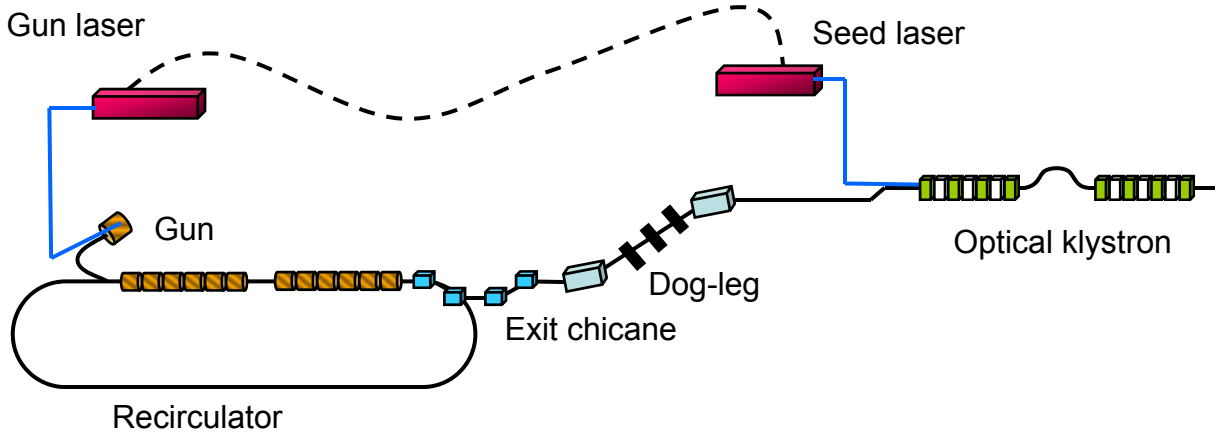
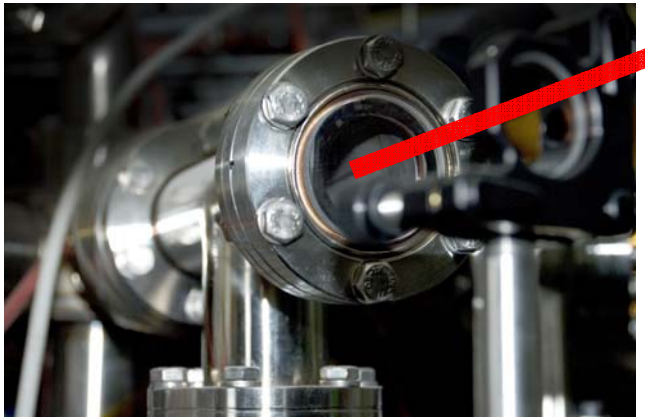


Photo cathode gun

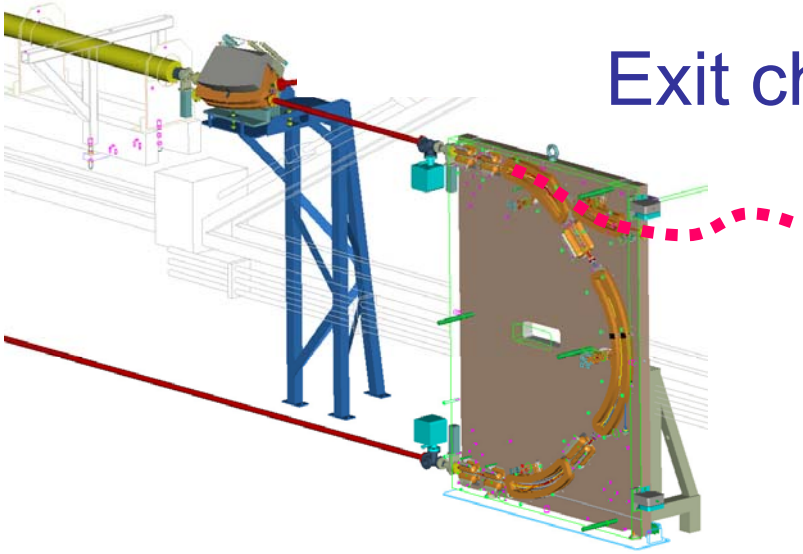


RF gun
≈ 1.8 MeV
Thermionic ++

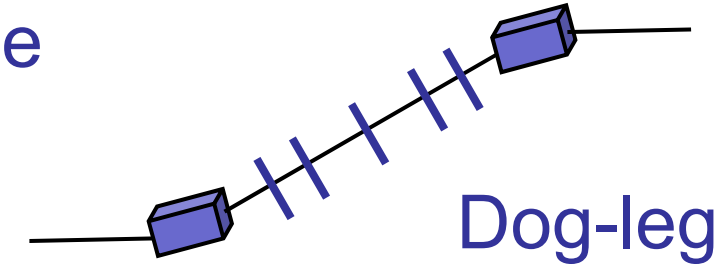


10 ps
263 nm

Acceleration and compression



Exit chicane

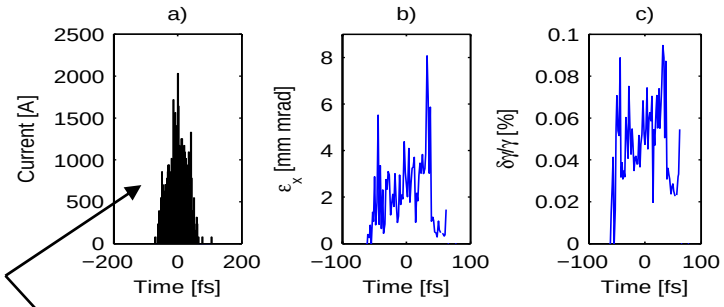


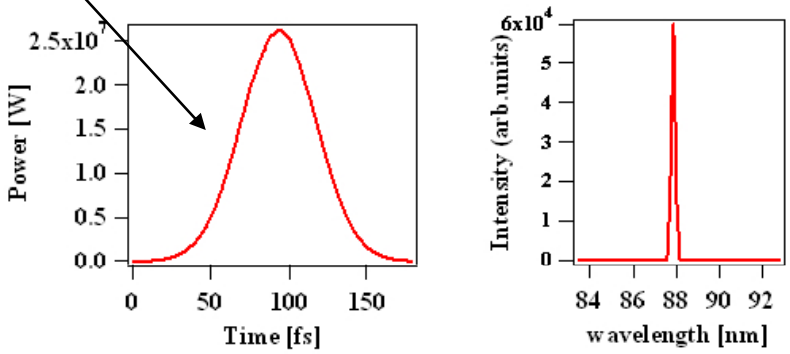
Dog-leg

Linac
(100 + 100) x 2 = 400 MeV
[500 MeV]

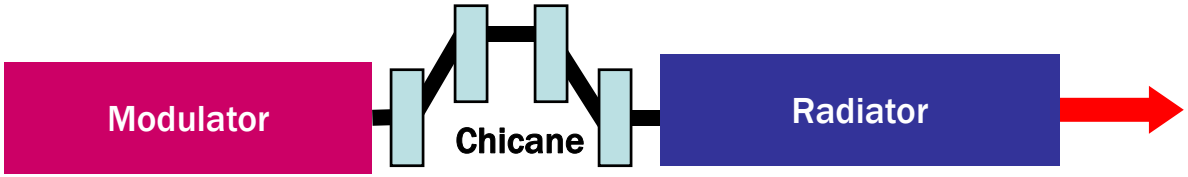
Ideal phase for compression ≈ 30°
Compression after full acceleration =>
Optimized acceleration phase ≈ 8°

fwhm≈100 fs





Optical klystron



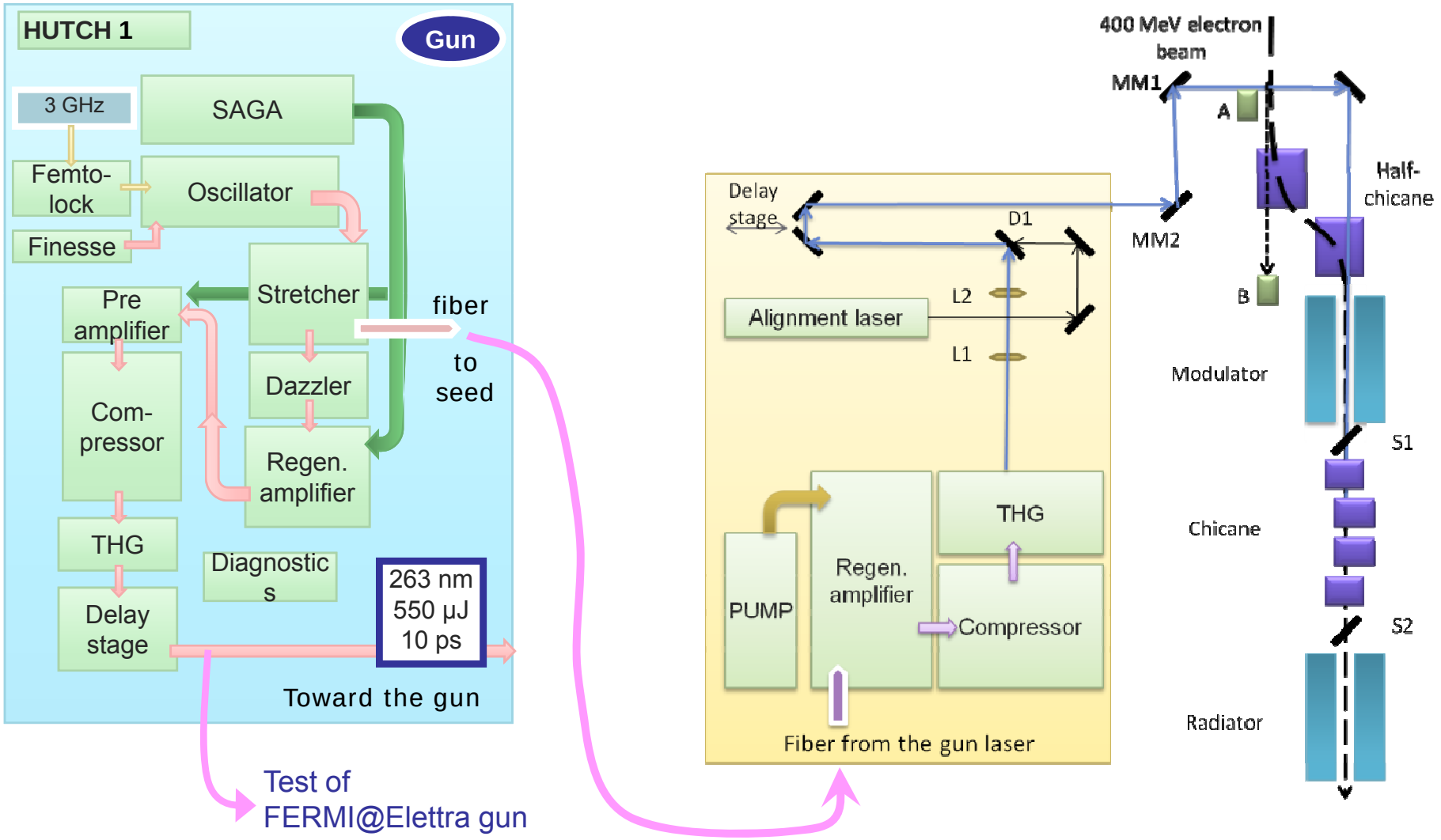
Modulator	Planar (ESRF)
Period	48 mm
# of periods	30
Min. gap	10 mm
K max	4.3

Chicane	
# of magnets	4
Gap	15 mm
B max	0.2 T

Poster: TUPPH006

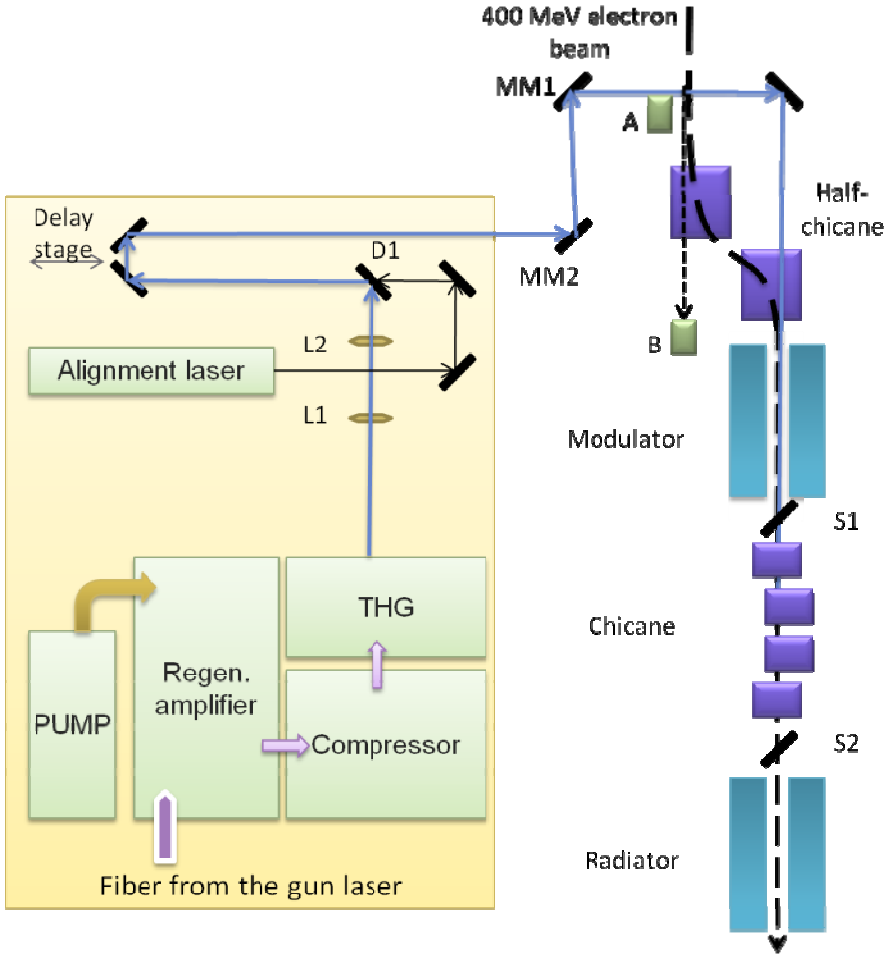
Radiator	Apple II (BESSY)
Period	56 mm
# of periods	30
Min. gap	12 mm
K max	4.3

Laser system and seeding



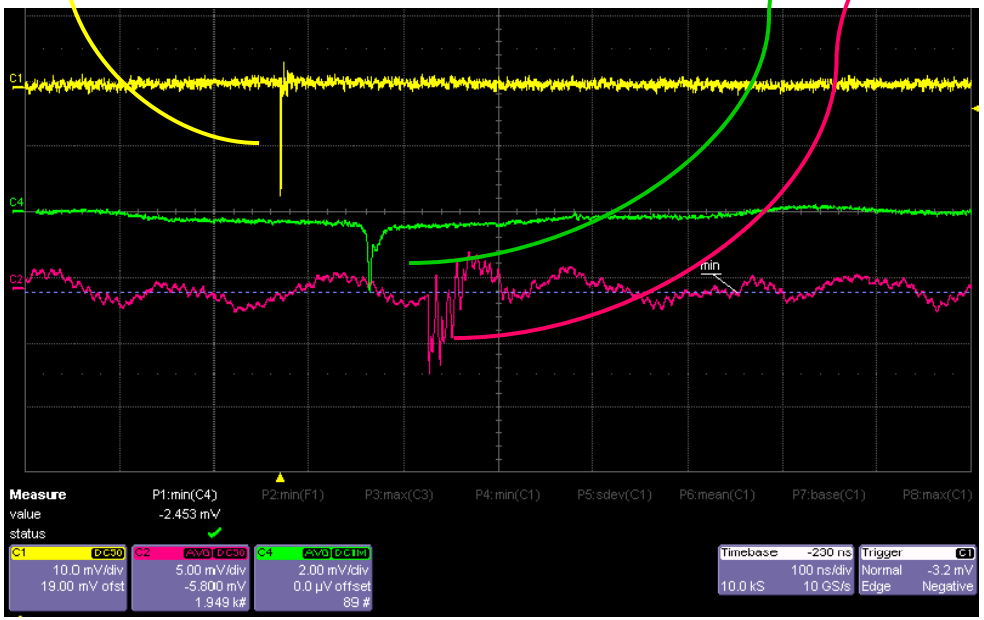
Laser system and seeding

Precision ≈ 200 ps



Progress of commissioning

Current transformer



Faraday cup at the dump

Monocromator looking at spontanius undulator radiation

Photo injector measuments

The phase of photo cathode emission was scanned within one RF cycle to determine the ideal emission phase

Measurements corresponds well to simulations

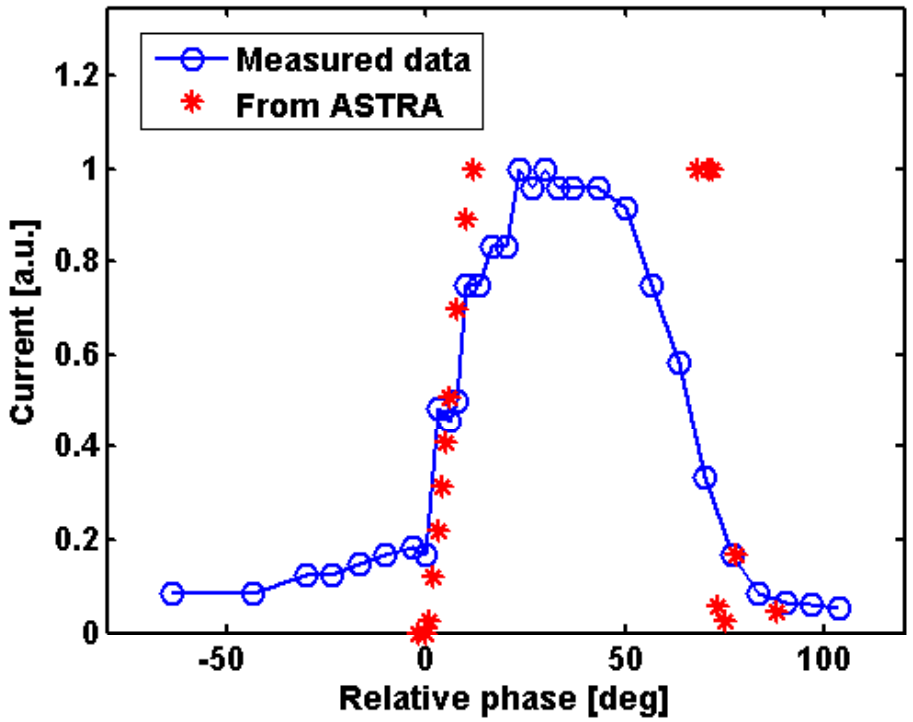
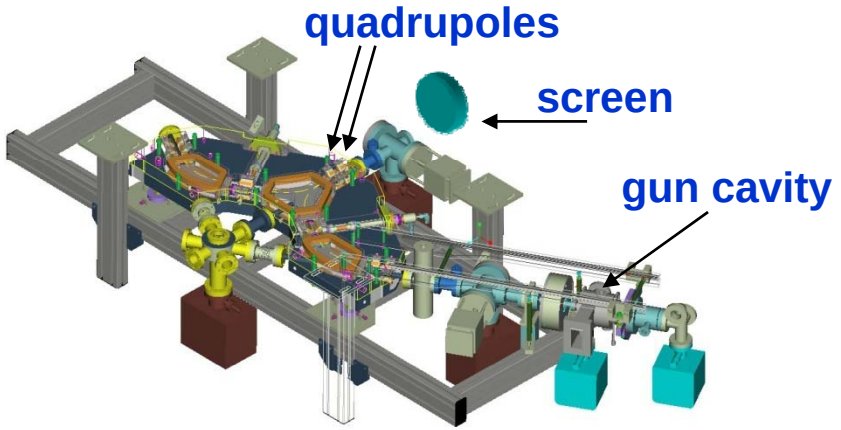
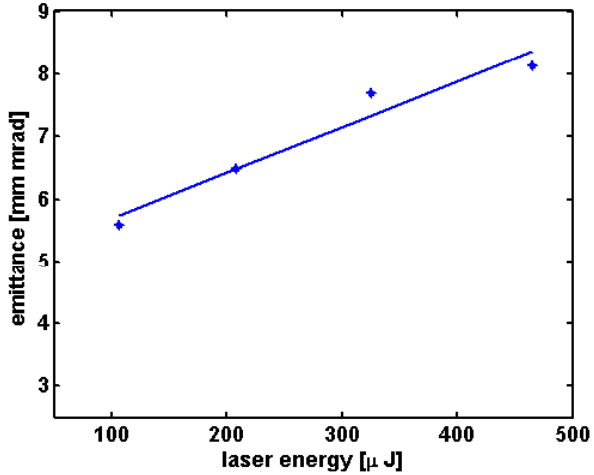


Photo injector measuments

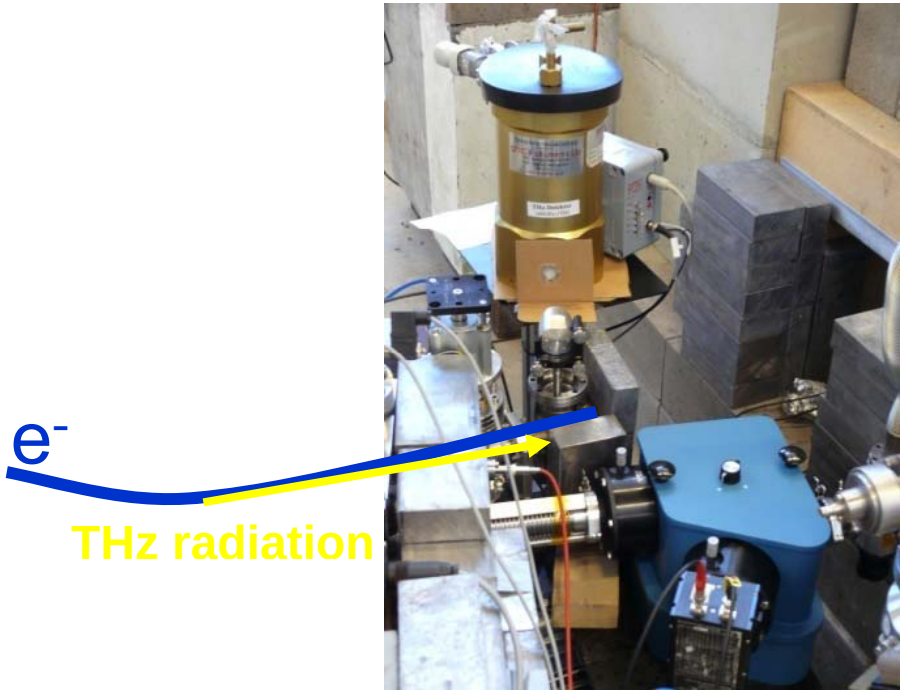
A quadacan was performed right after the gun energyfilter to determine the emittance for different currents.

Increasing the laser energy increases the extracted current. As much as 1 nC has been produced but in this case the emittance is too high for good FEL performance.





Compression measurements - THz

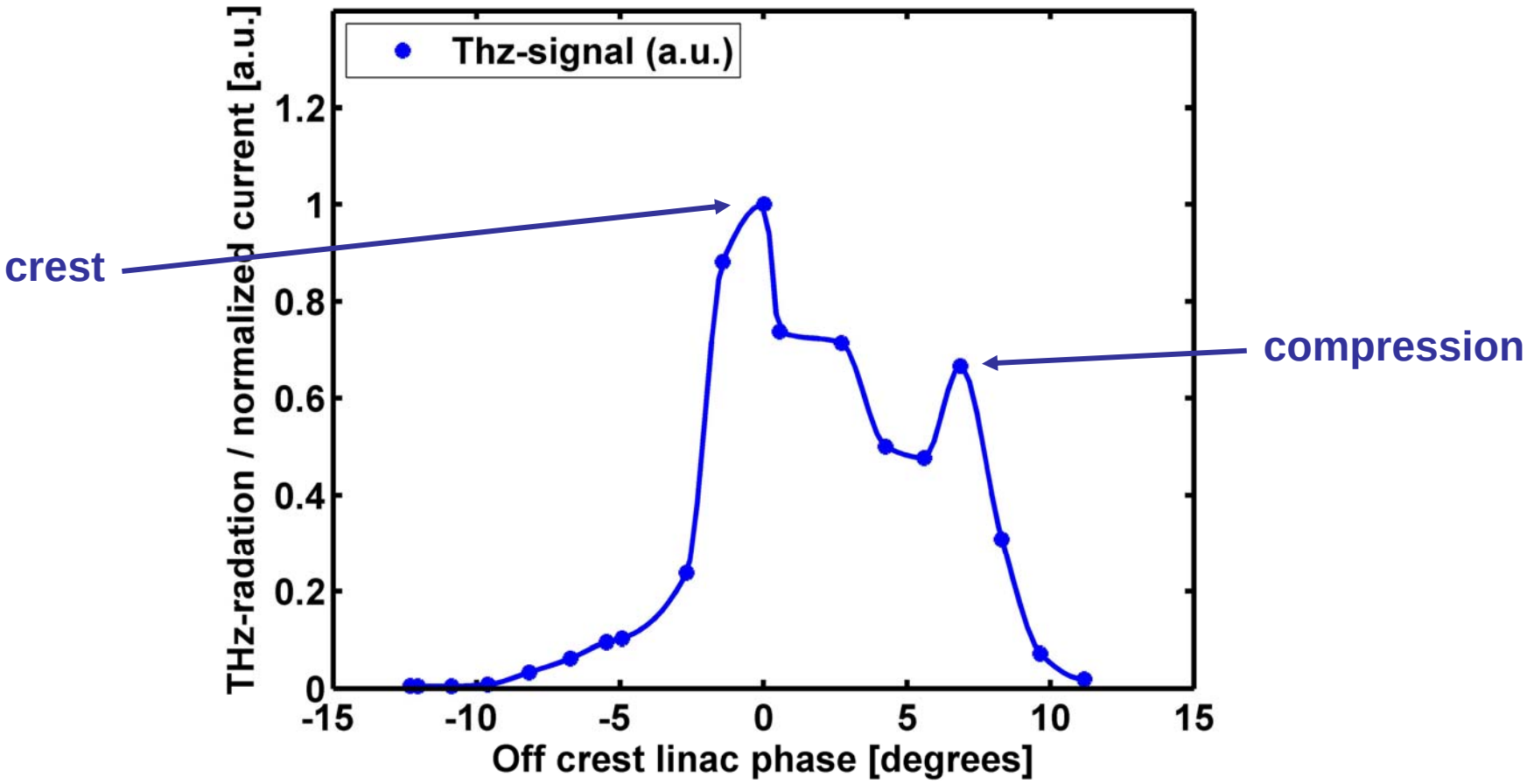


THz radiation from the dumpmagnet was measured

When the bunches become shorter, more THz radiation is produced

Poster: TUPPH006

Compression measurements - THz



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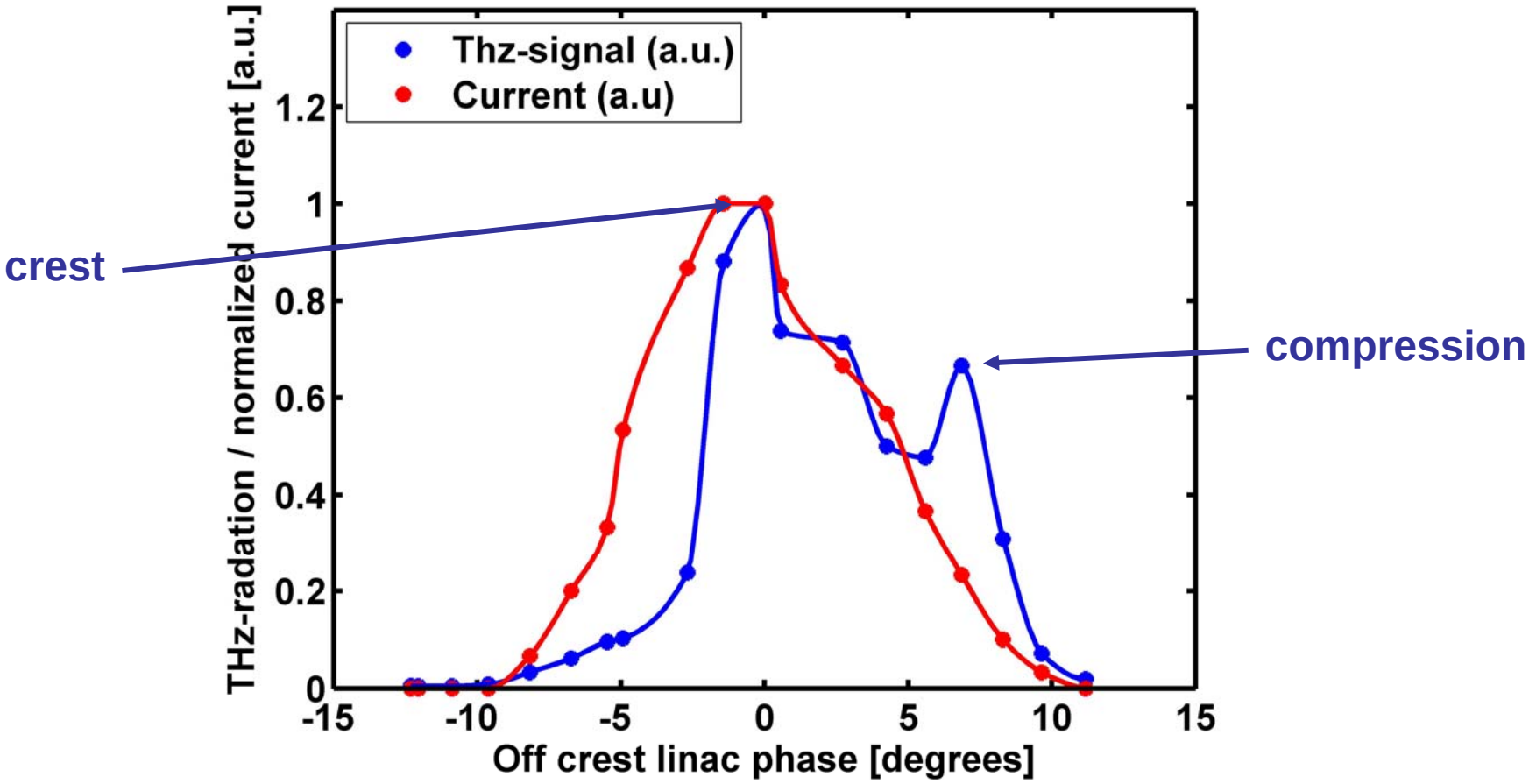

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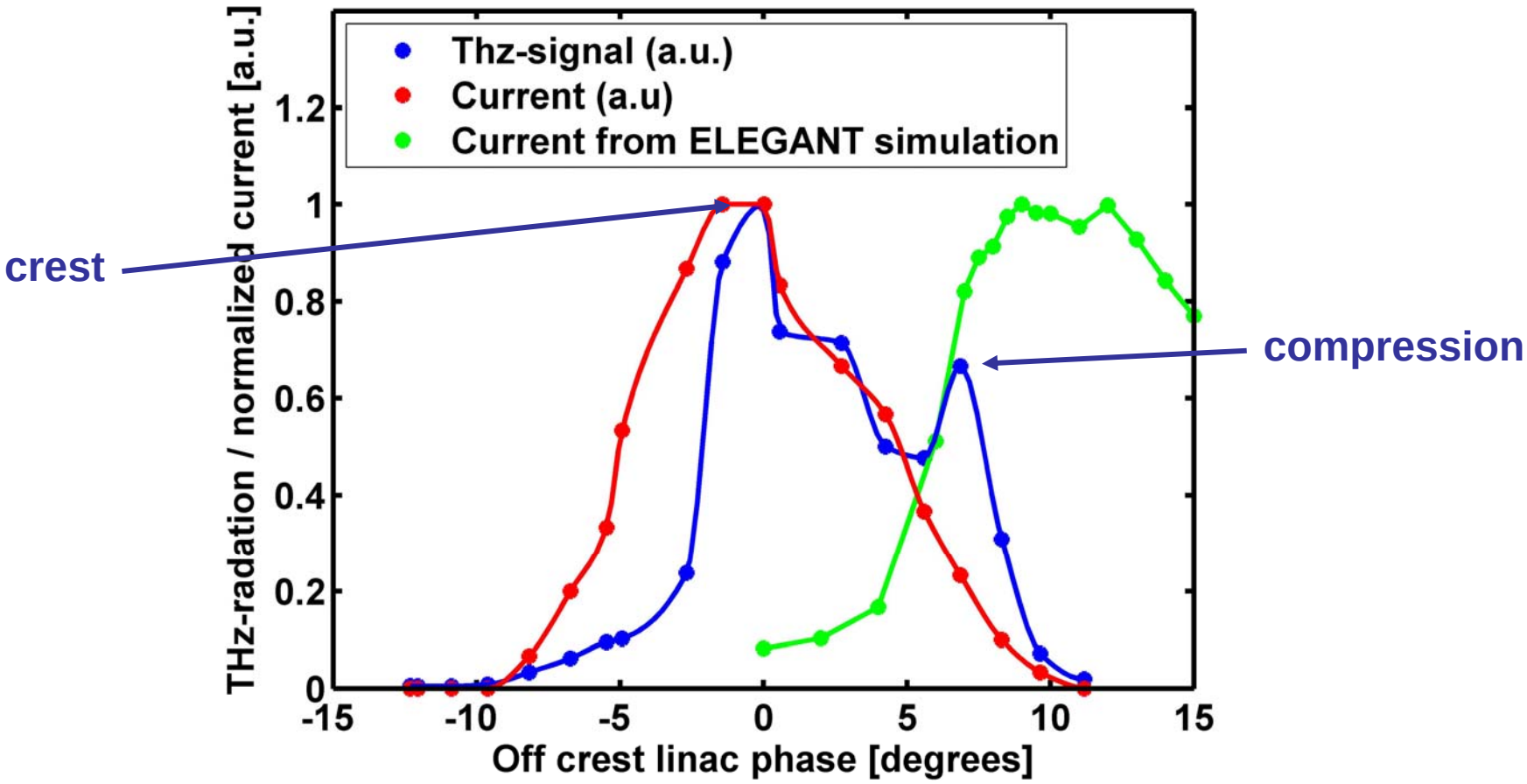

Summary and outlook

Progress

✓ **Gun: Successfully turned into a photo injector for the FEL**

✓ **Transport: The electron are transported all the way through the electron beam line and the optical klystron**

✓ **Compression: the compression scheme has been confirmed though THz radiation measurements**

✓ **Undulators: are operating and have been calibrated**

The next step

- **Achieve transversal and longitudinal overlap of electrons and laser**
- **Start seeding to produce coherent radiation at the second harmonic 132 nm**
- **Start producing even lower wavelengths, at the third and fifth harmonic (88 and 53 nm)**

...

- **Seed the FEL at shorter wavelength using HHG**