

Beschleunigerphysik am Institut für Experimentalphysik

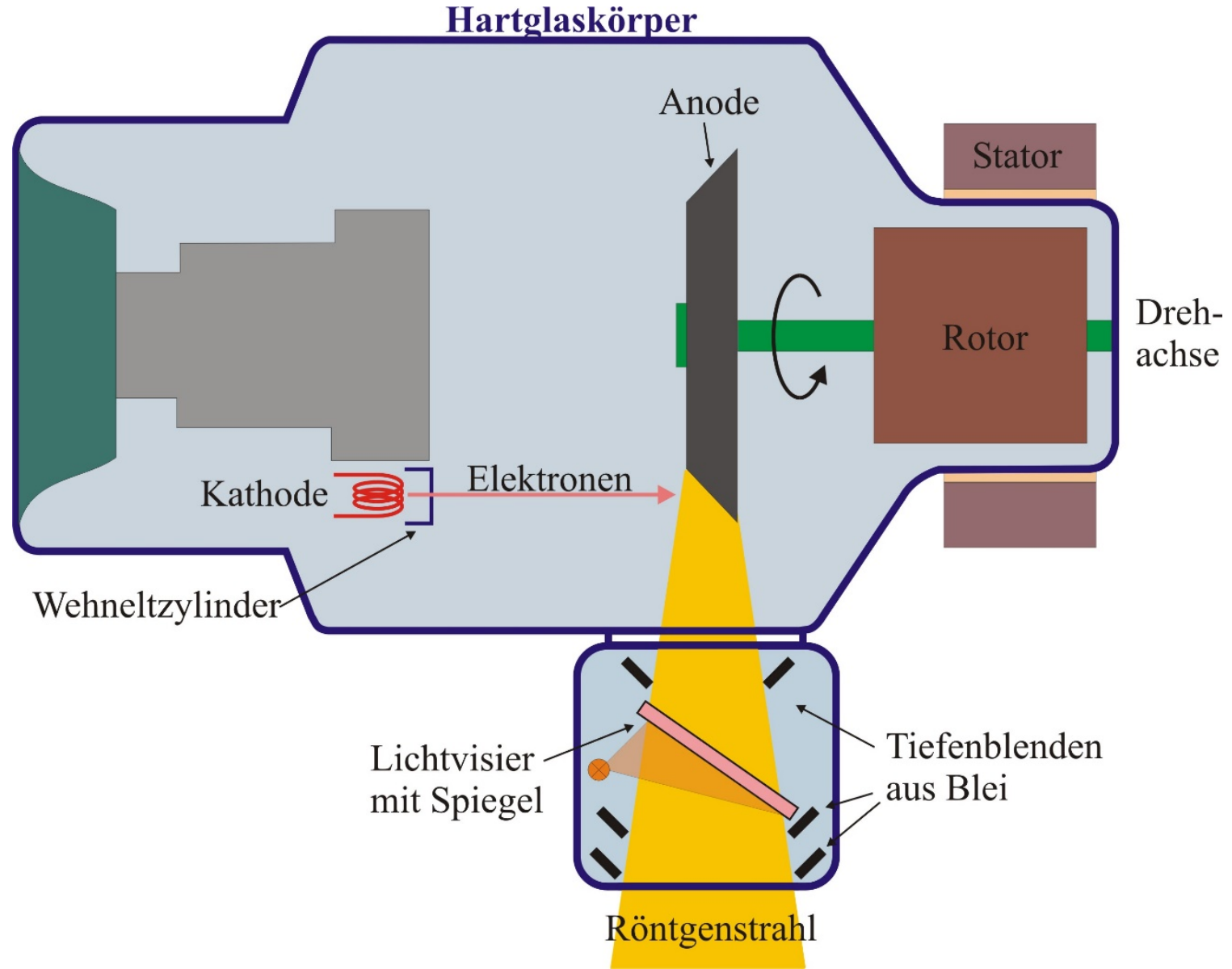
Wolfgang Hillert

für die AG's Beschleunigerphysik

IExpH Sommerseminar, 1. Juni 2017



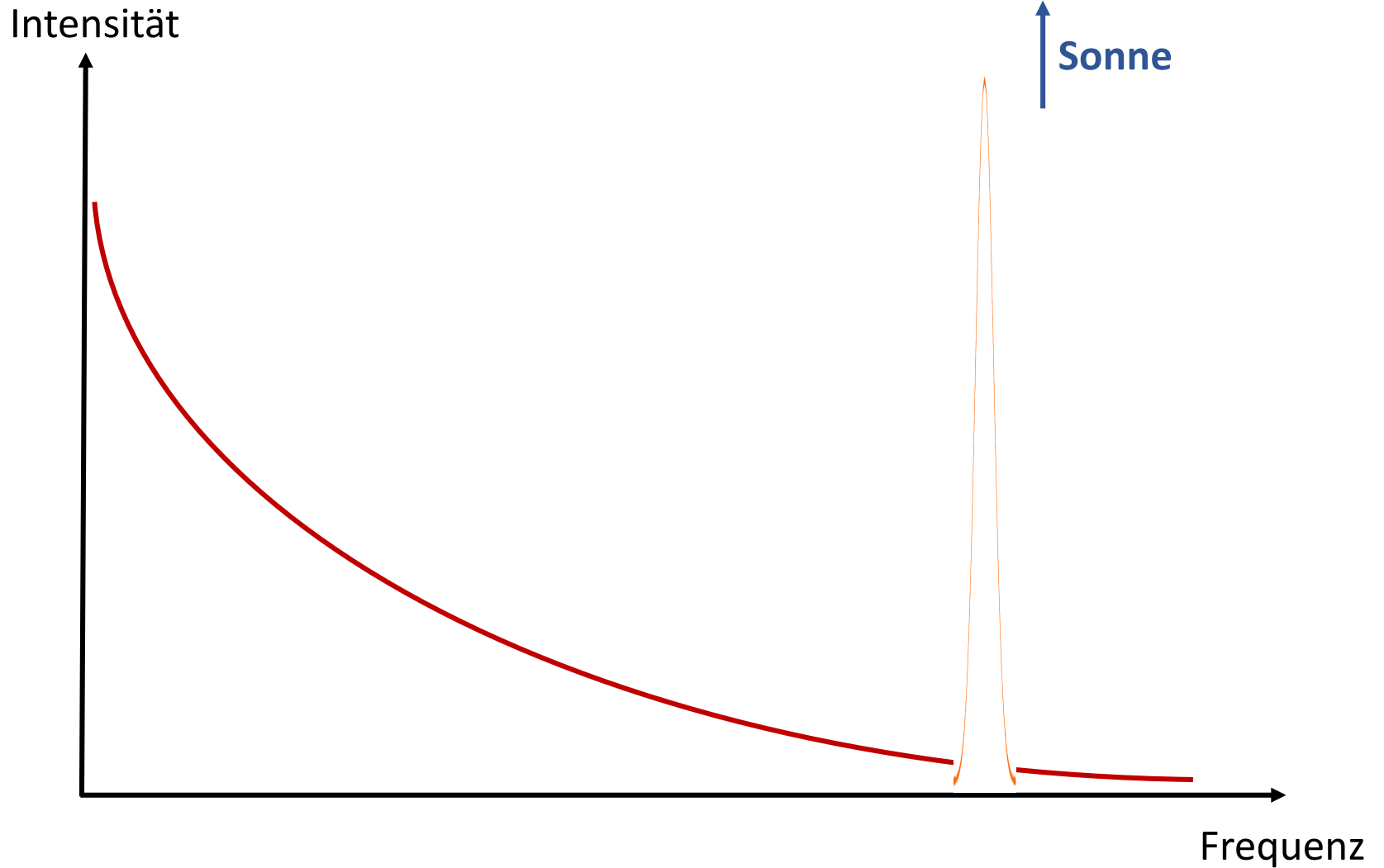
Erzeugung von Röntgenstrahlung



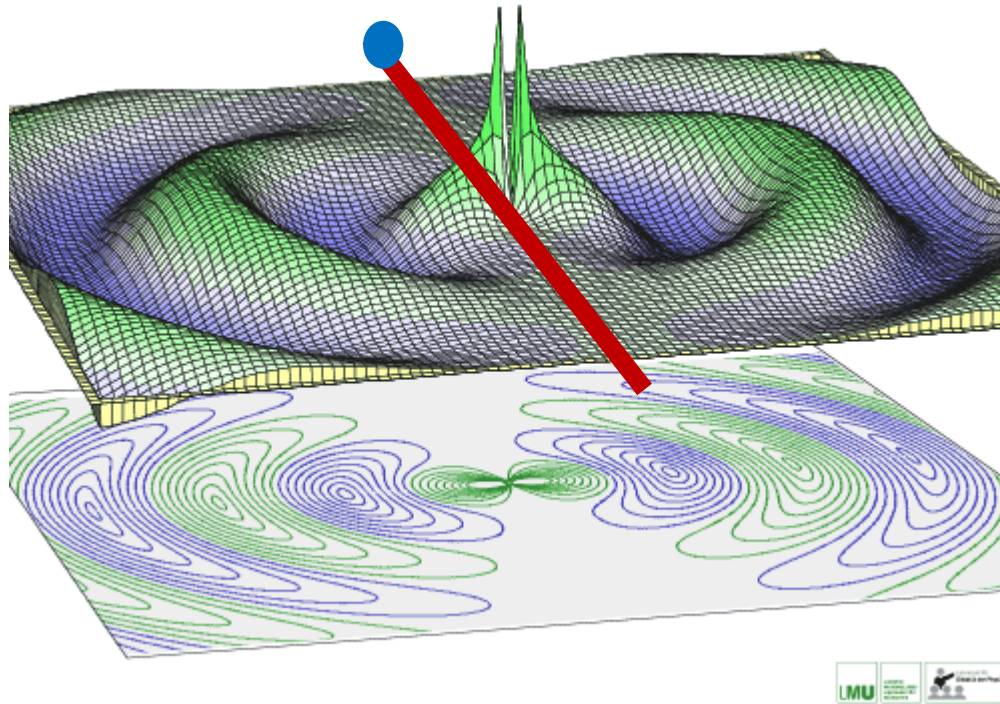
Eigenschaften der Bremsstrahlung



Strahlungsspektrum

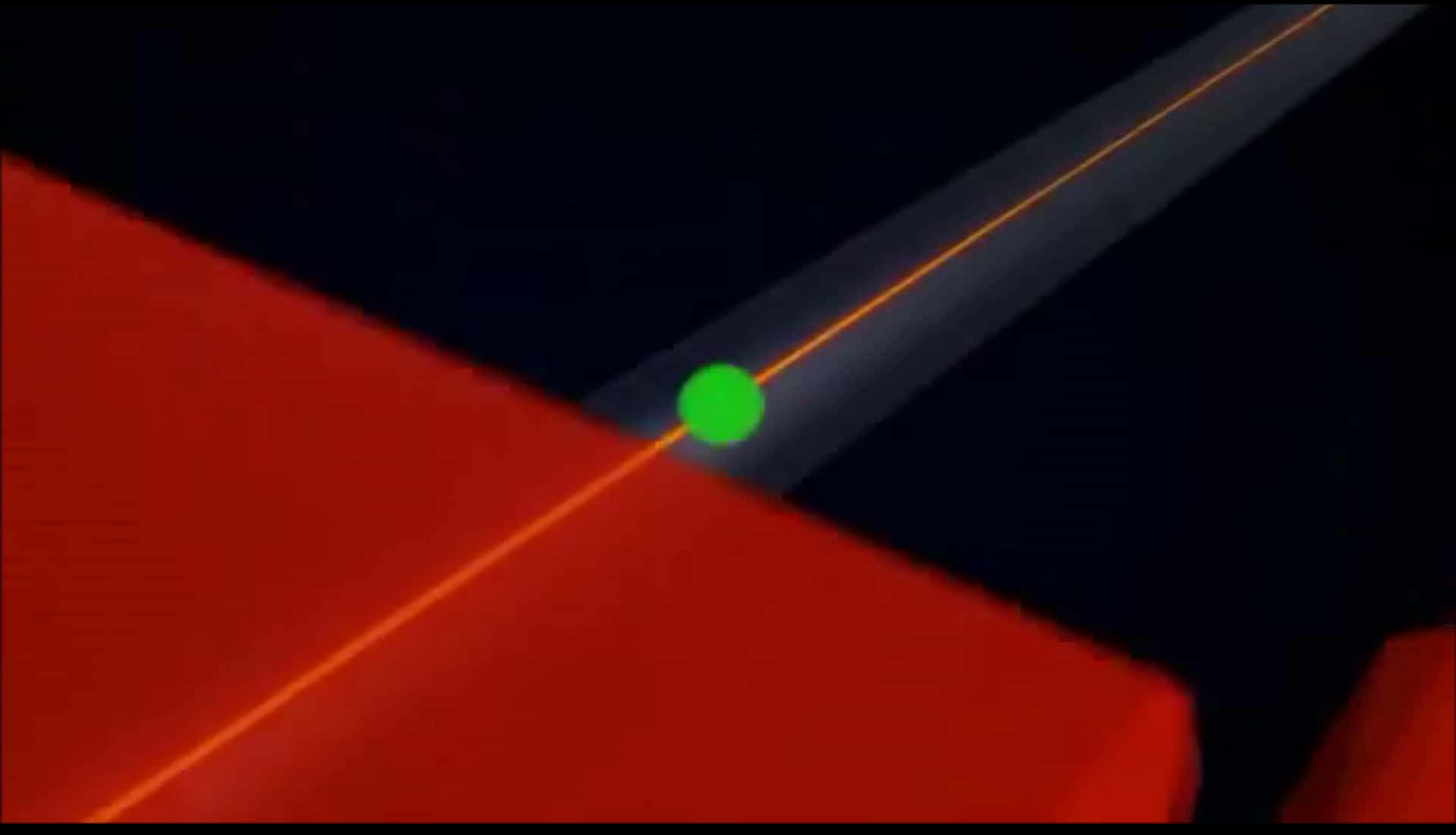


Abstrahlung einer Frequenz: **Antenne!**



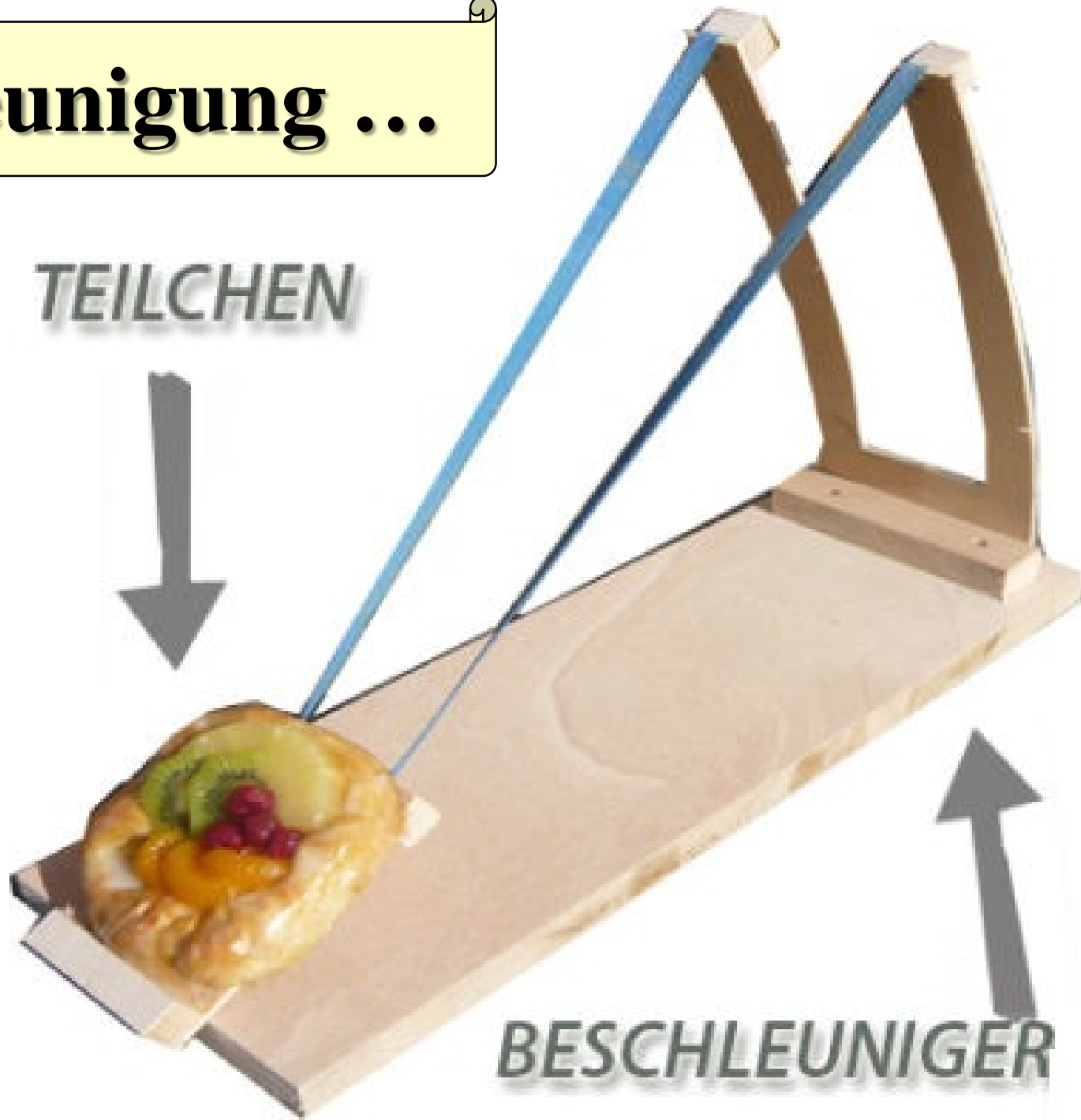
Röntgenstrahlung 0,1-1 nm: 10^{17} - 10^{18} Schwingungen pro Sekunde!

Erzeugung von intensiver Röntgenstrahlung



Beschleunigung ...

TEILCHEN



BESCHLEUNIGER

Ca. 1 Kilometer "kalter" LINAC

Herausforderungen:

- Kompakte Anlagen
 - ultrakurze Pulse
 - „echte“ LASER = long. Koheränz
- Anwendung in der Medizin (Bildgebung)

DN

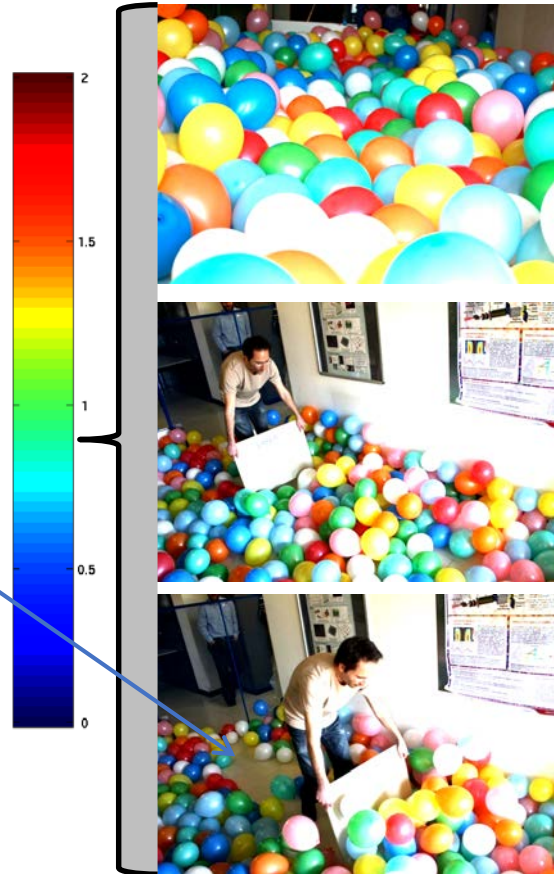
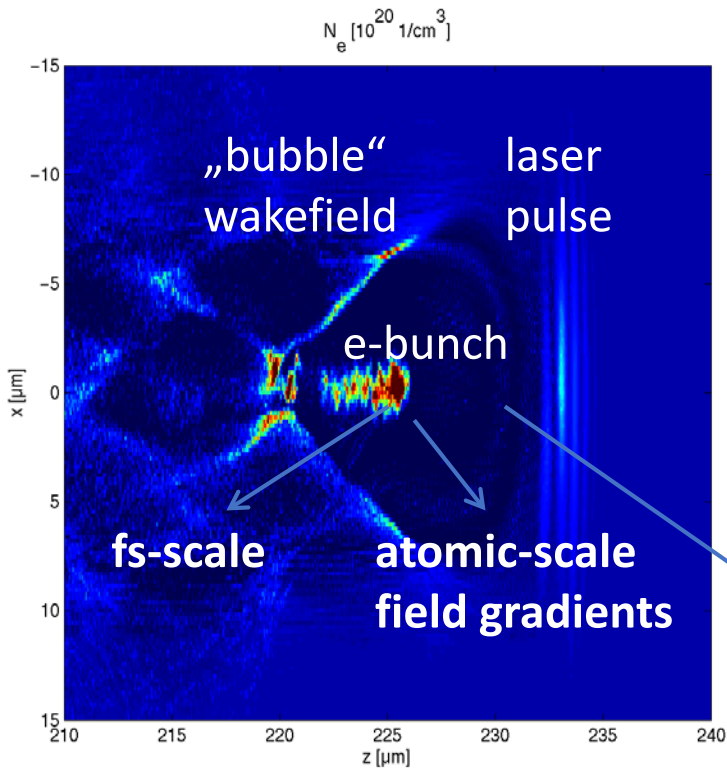




Ente → Hochleistungslaser



LPWA: Wie funktioniert das?

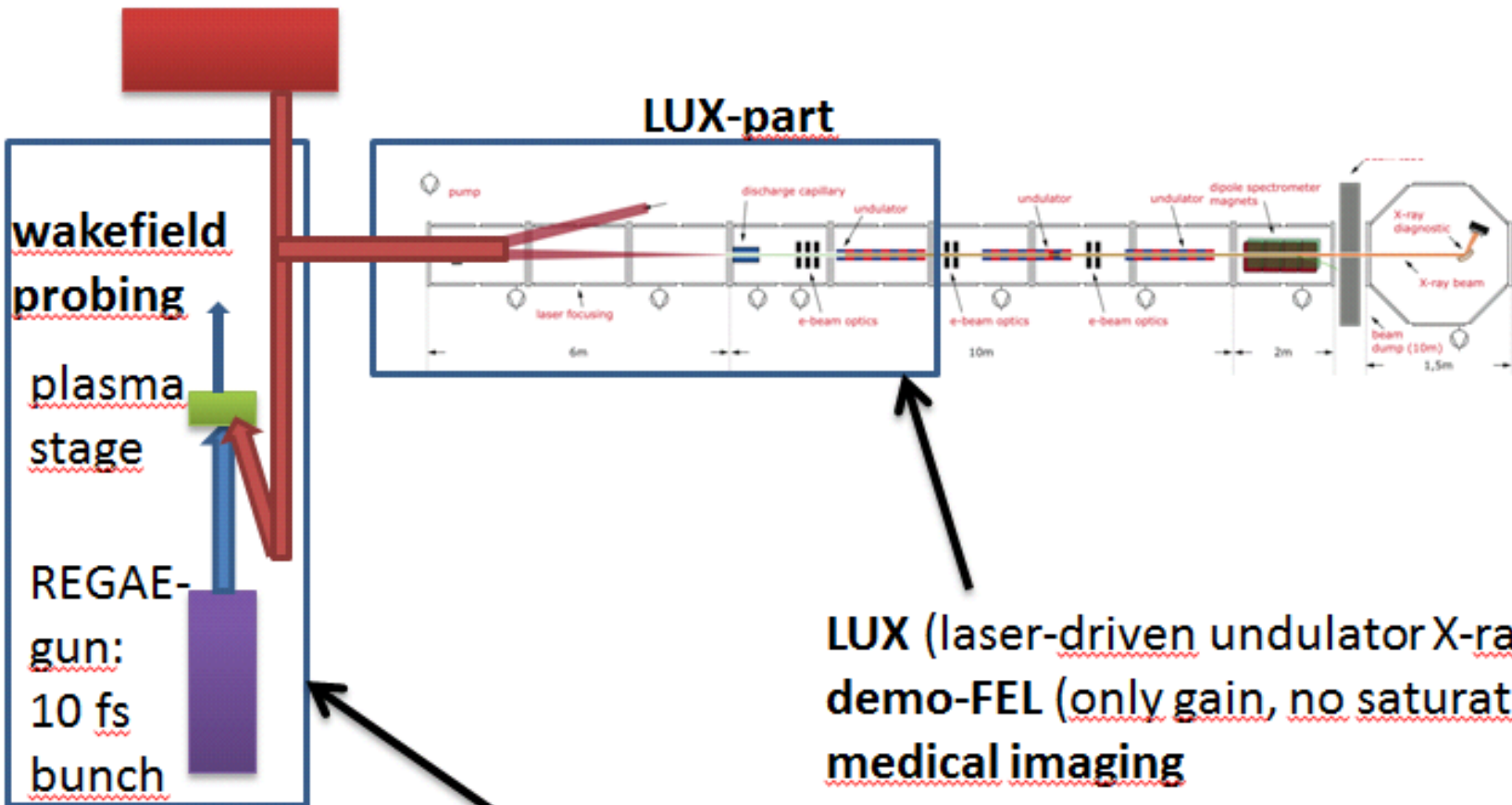


Arbeitsfelder:

- > Table-Top FEL (Undulator)
- > Medizinische Bildgebung (Thomson)

F&E an und mit LPWA

200 TW laser



probing wakefields:
origin of emittance
wakefield's field map

LUX: Laser-Plasma Beamline

ANGUS 200 TW laser



LUX beamline

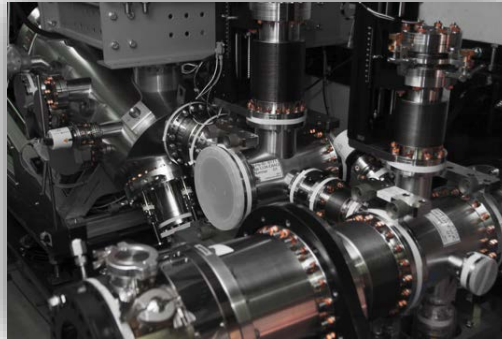
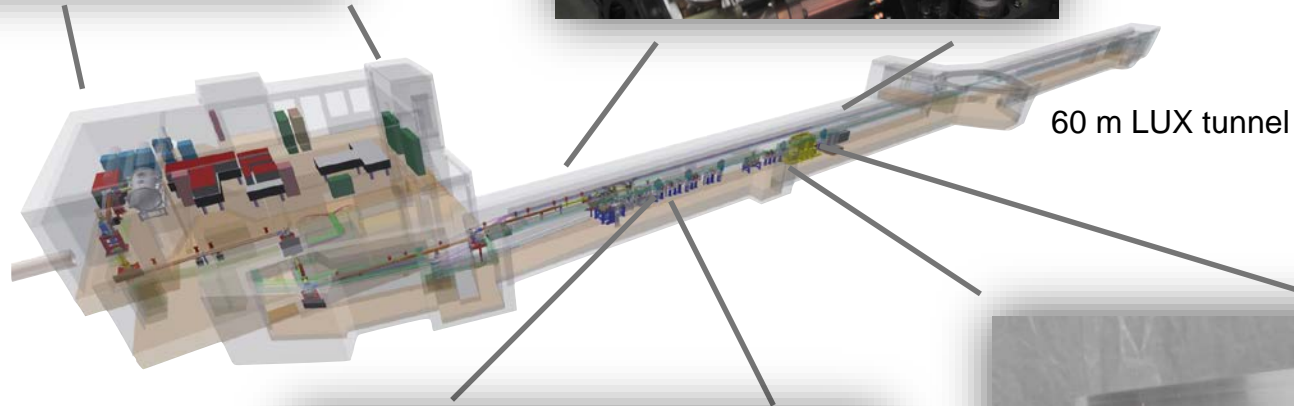


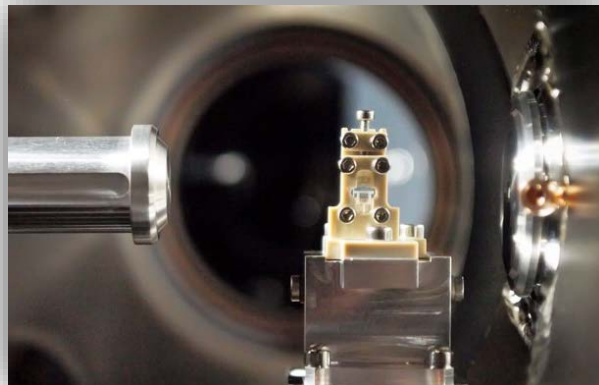
image credits: H Müller-Elsner, I. Dornmair (UHH),
N. Delbos (UHH), M. Trunk (UHH), S. Jalas (UHH)

Andreas Maier
lux.cfel.de

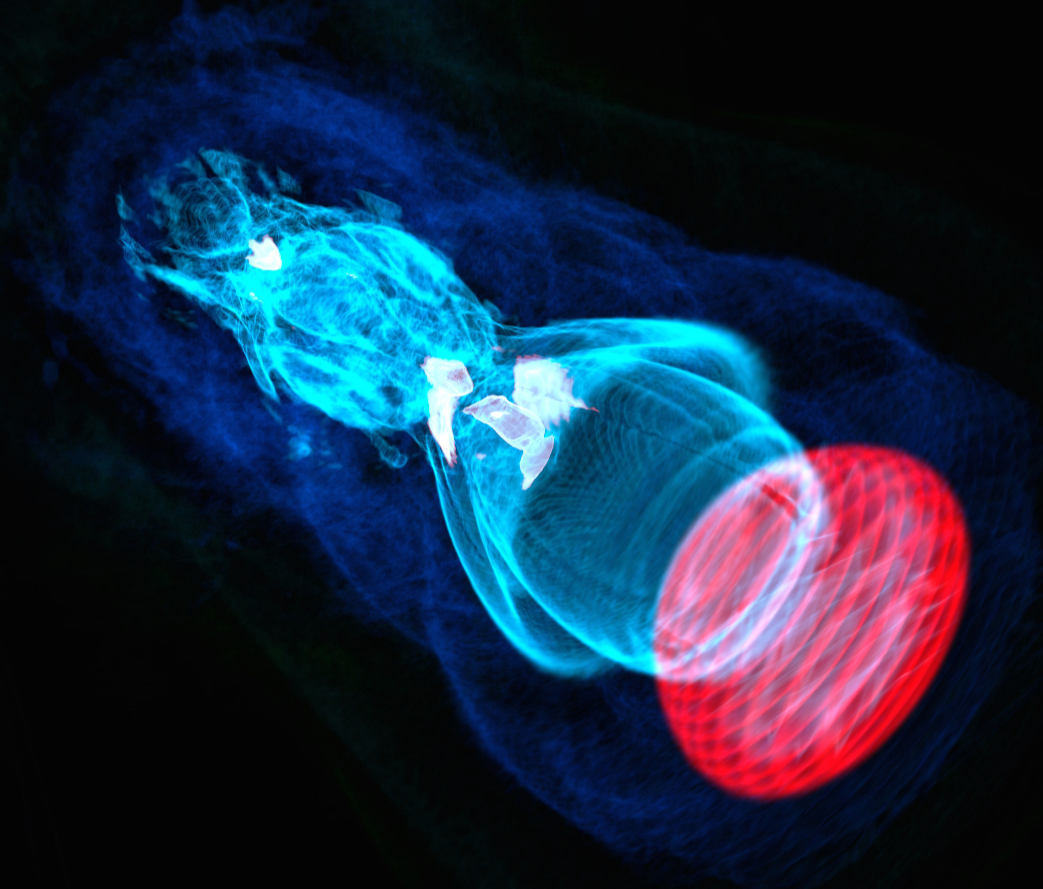


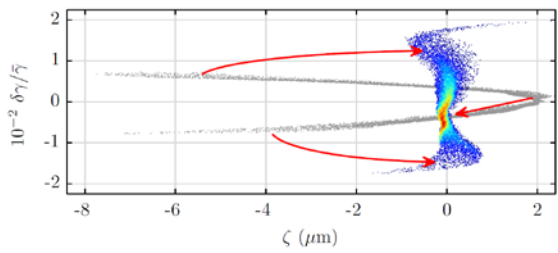
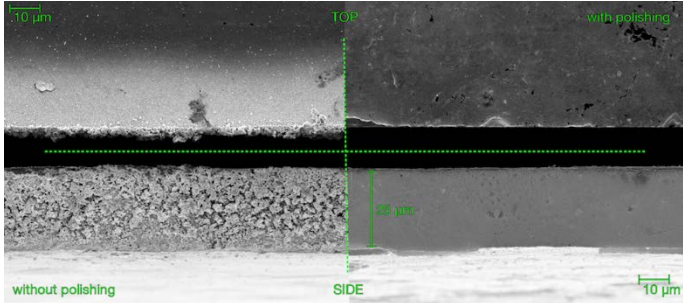
Beast2 undulator
to be installed April. 2017

LUX target

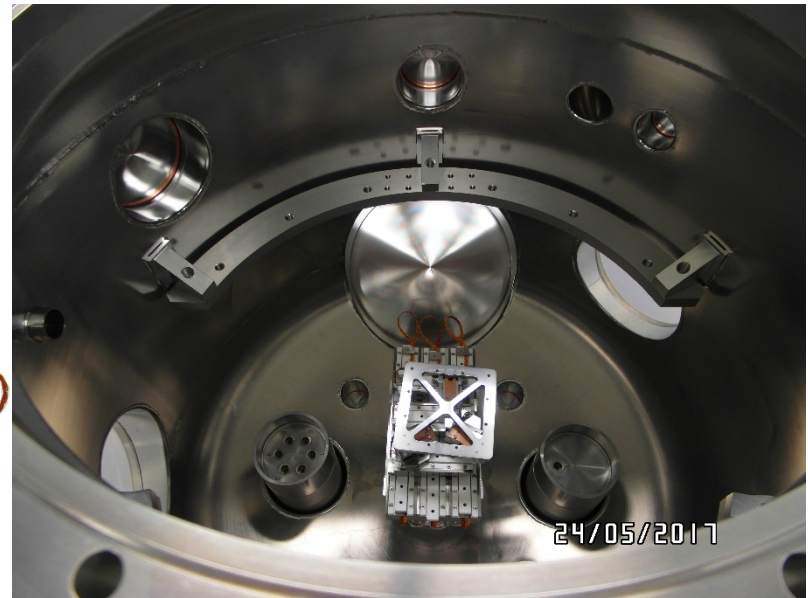
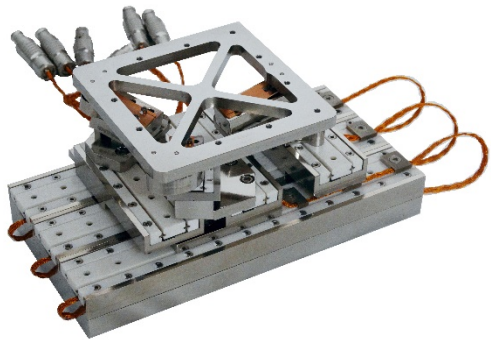
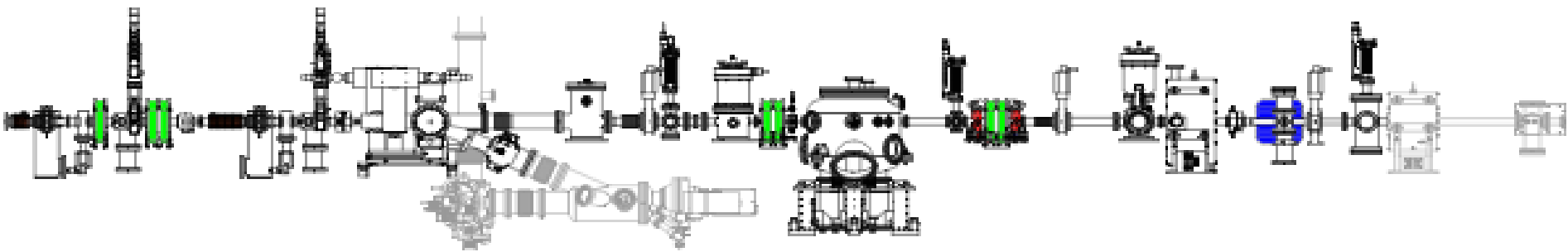


Numerische Simulation der Plasmawelle





F&E @ REGAE: „Probing the Wakefield!“

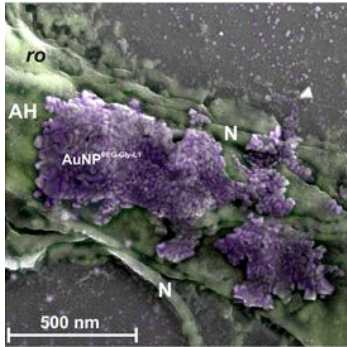


MRT: Magnetresonanztomographie

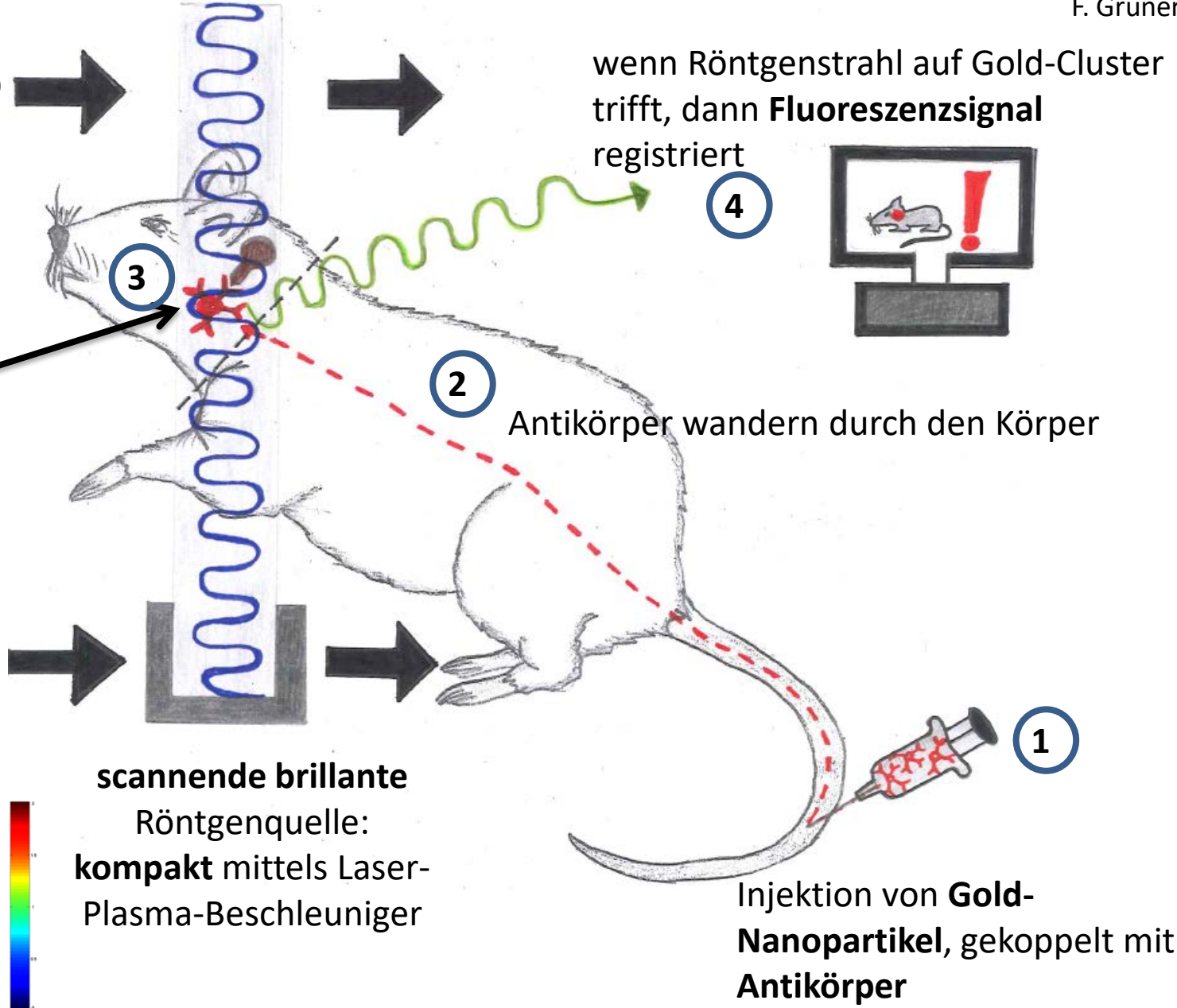


Medizinische Bildgebung mittels Röntgen-Fluoreszenz

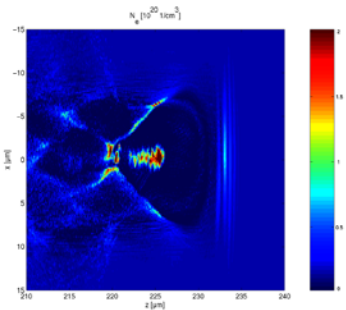
100-1000x
sensitiver als
MRT?!



Antikörper binden
an Krebszellen

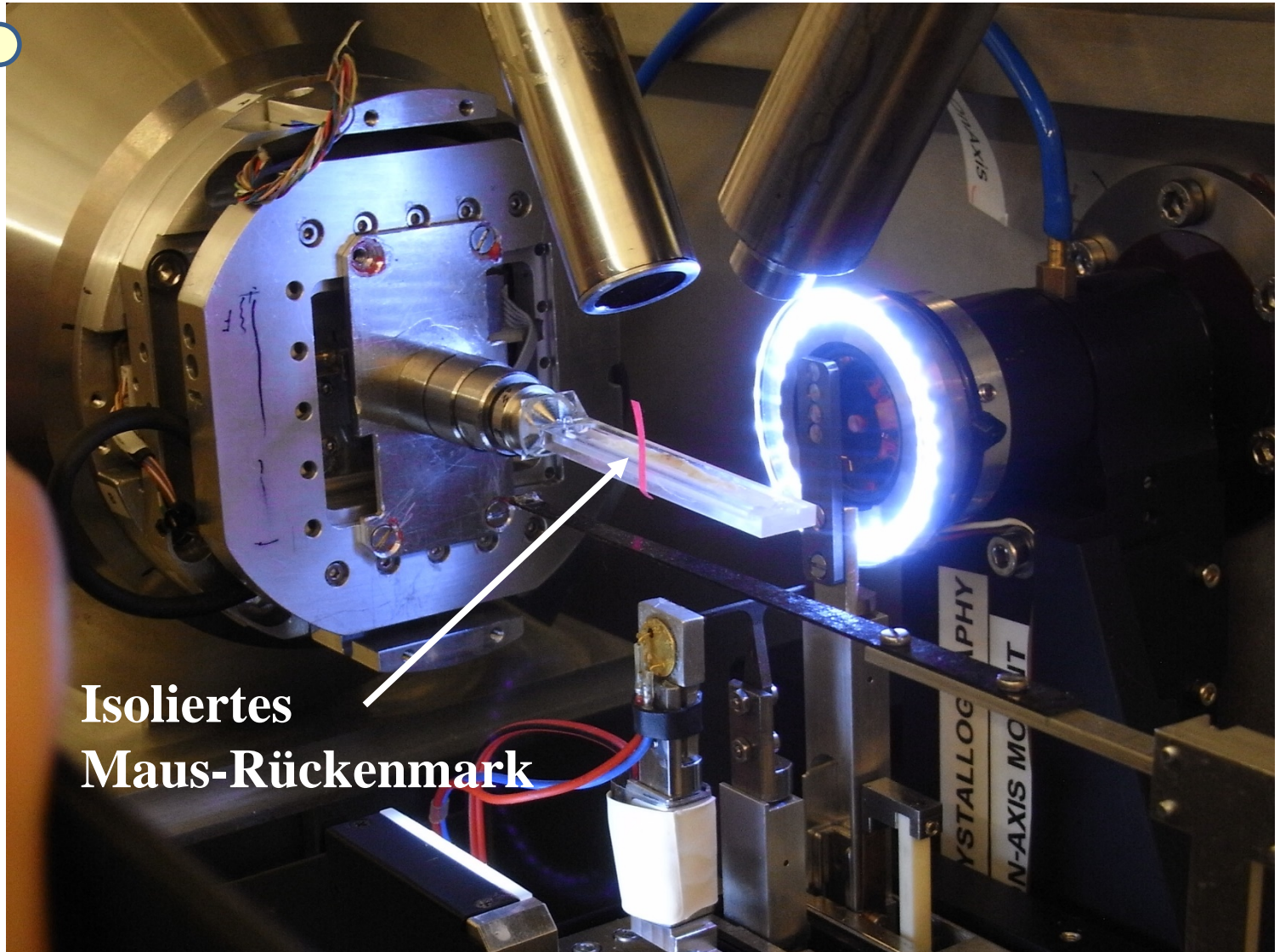


scannende brillante
Röntgenquelle:
kompakt mittels Laser-
Plasma-Beschleuniger



Pilot-Experimente an PETRA III

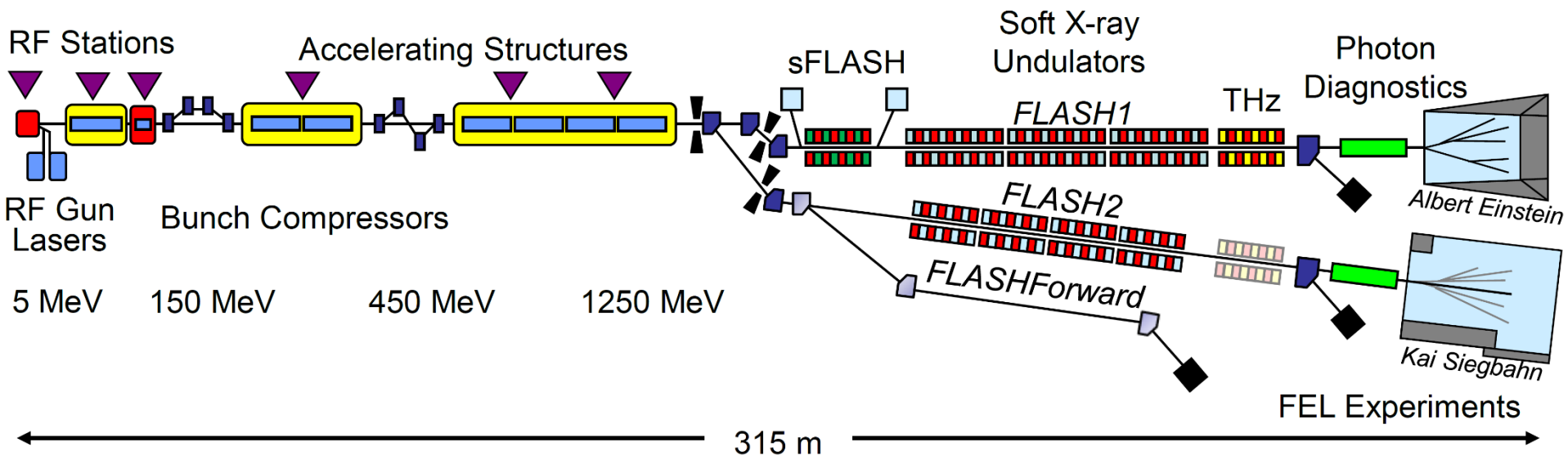
Weltrekord
 im
 Nachweis
 minimaler
 Mengen
 funktionali-
 sierter
 Gold-Nano-
 Cluster

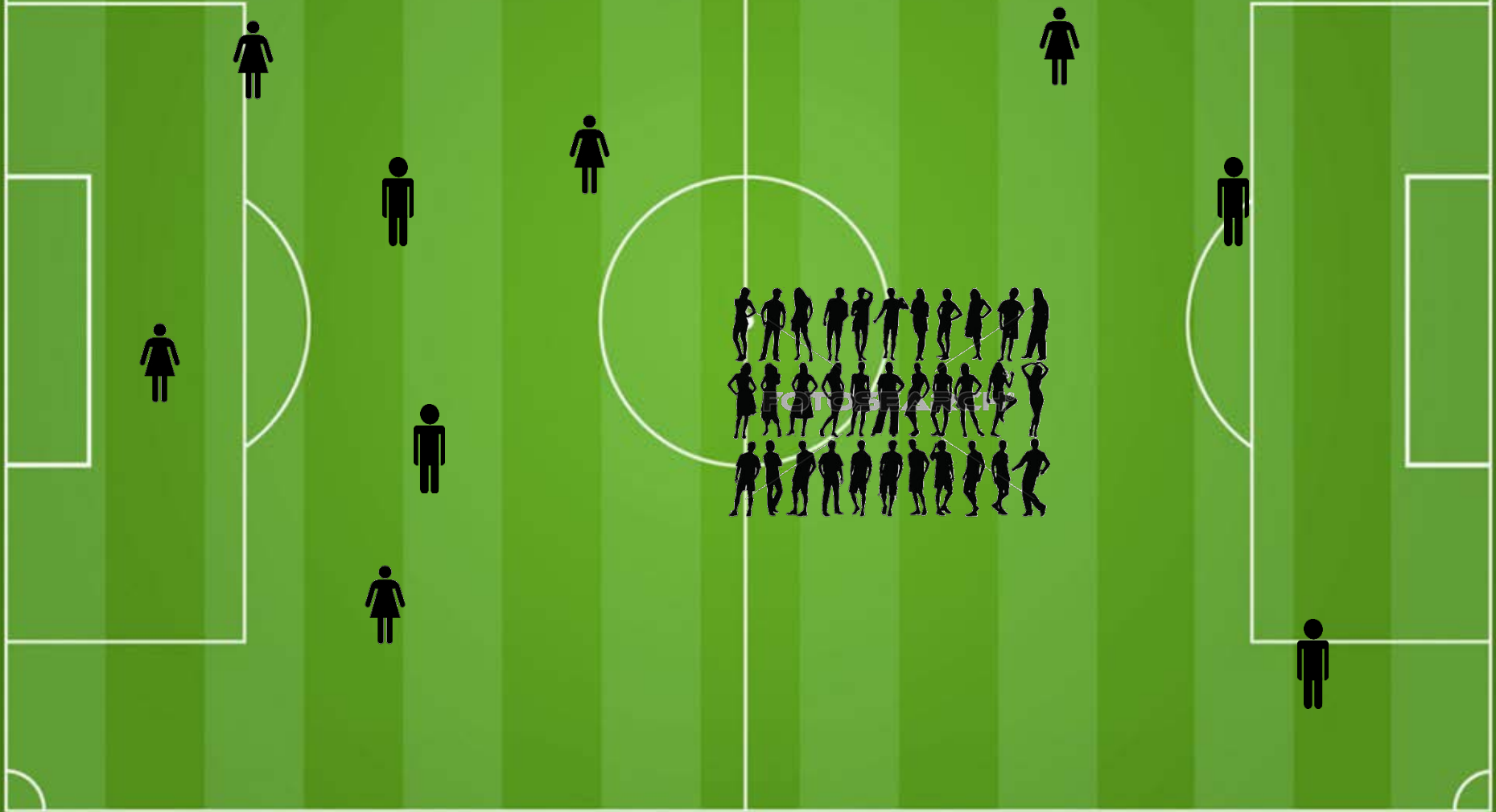


**Isoliertes
 Maus-Rückenmark**

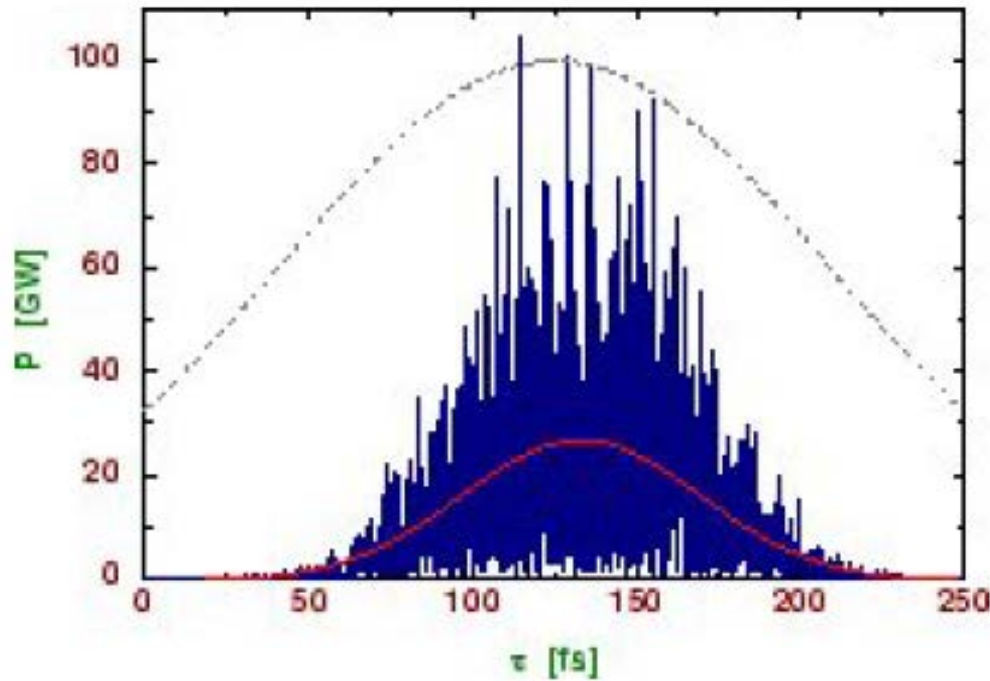
CRYSTALLOGRAPHY
 N-Axis Mount

FLASH





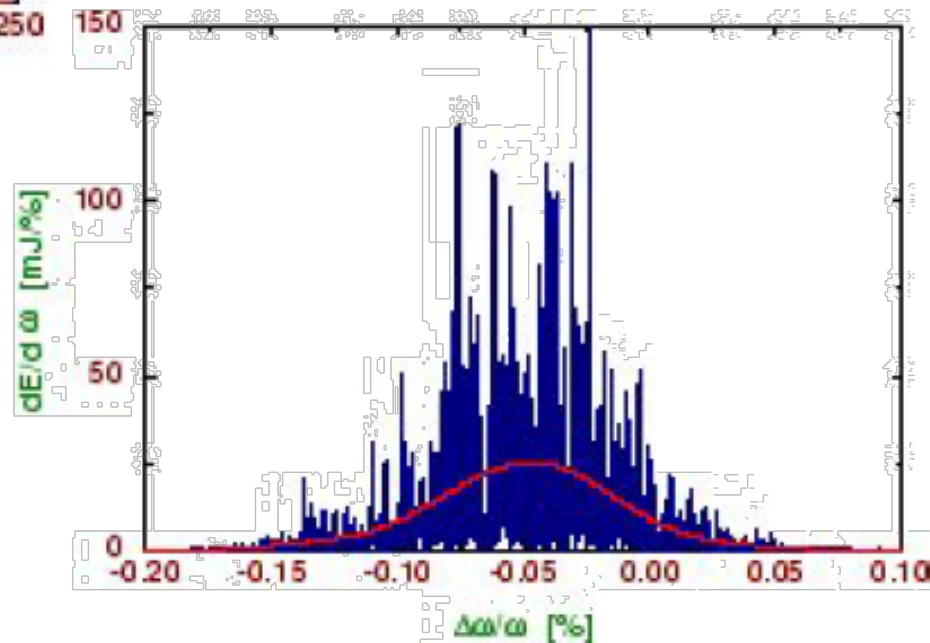
Photonenpulse



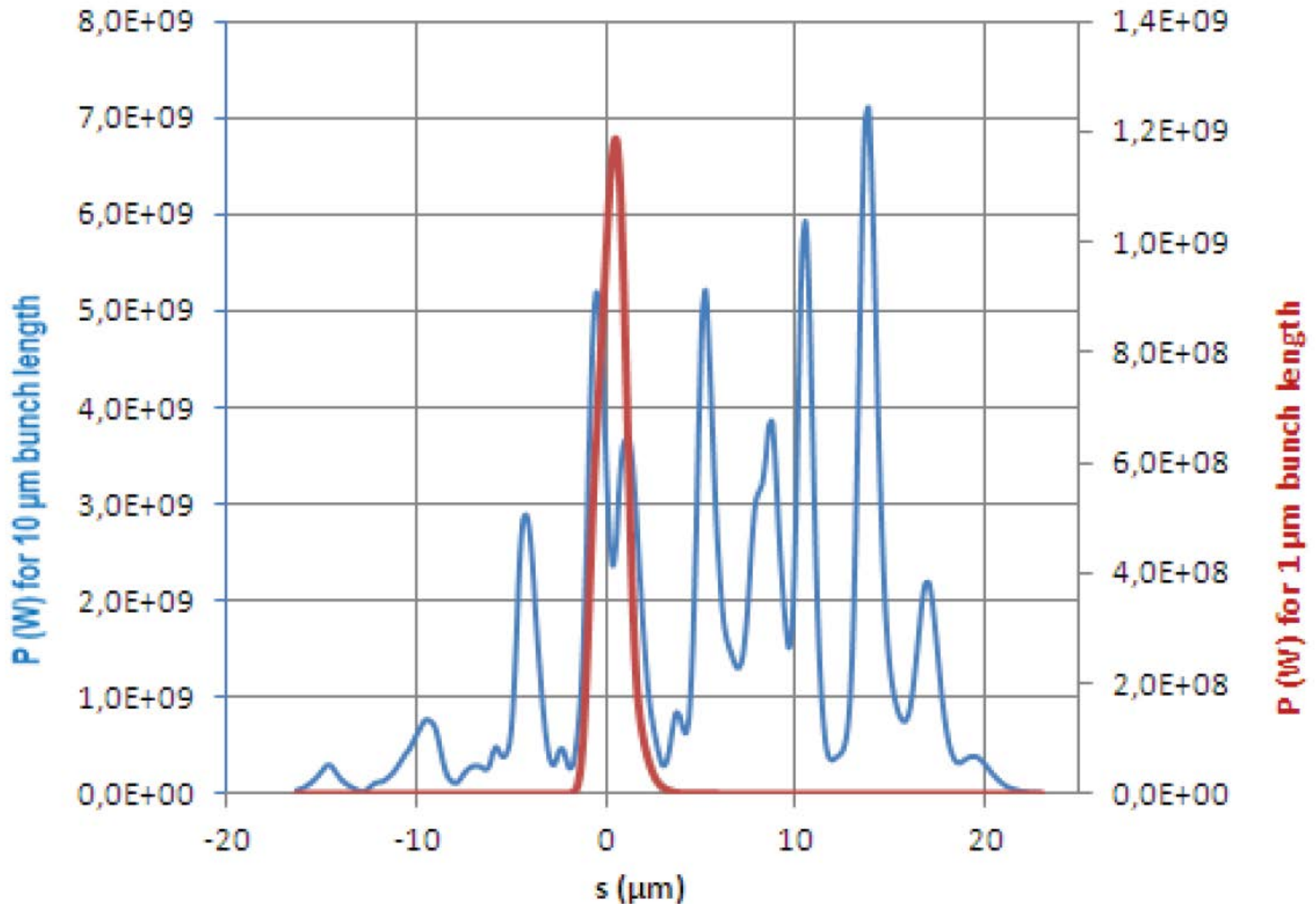
zeitliche Verteilung



Frequenzspektrum

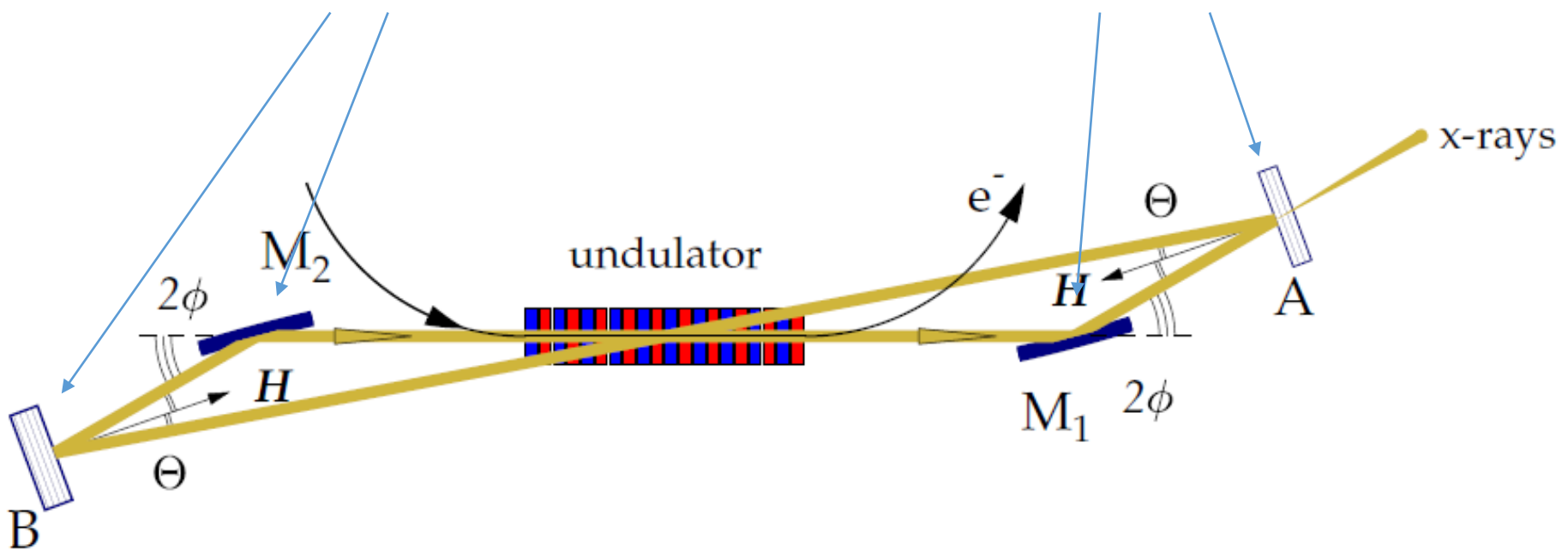


Photonenpuls



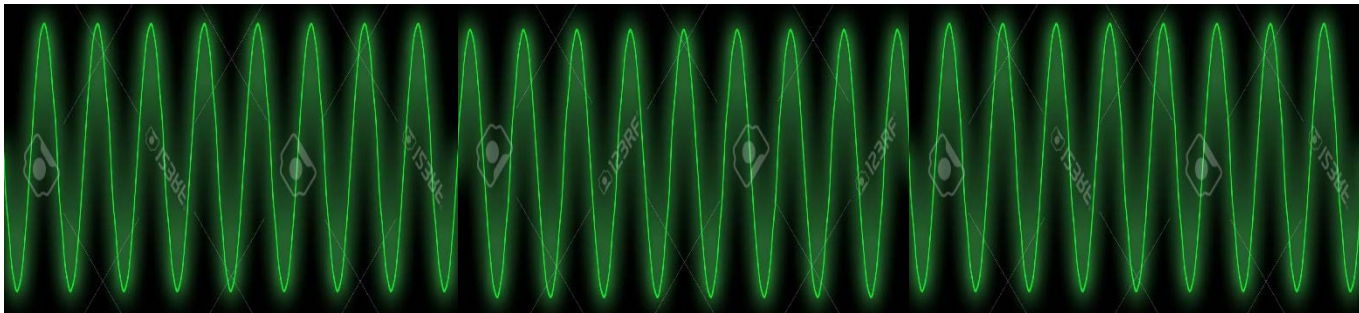
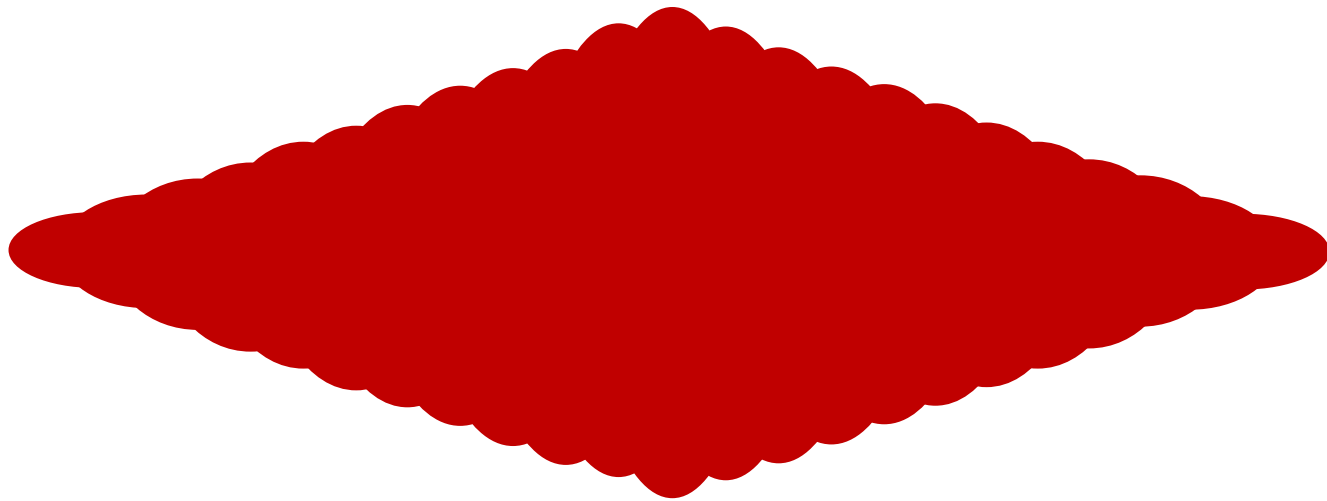
XFEL: ein „echter“ Röntgenlaser?

Diamant-Einkristalle!



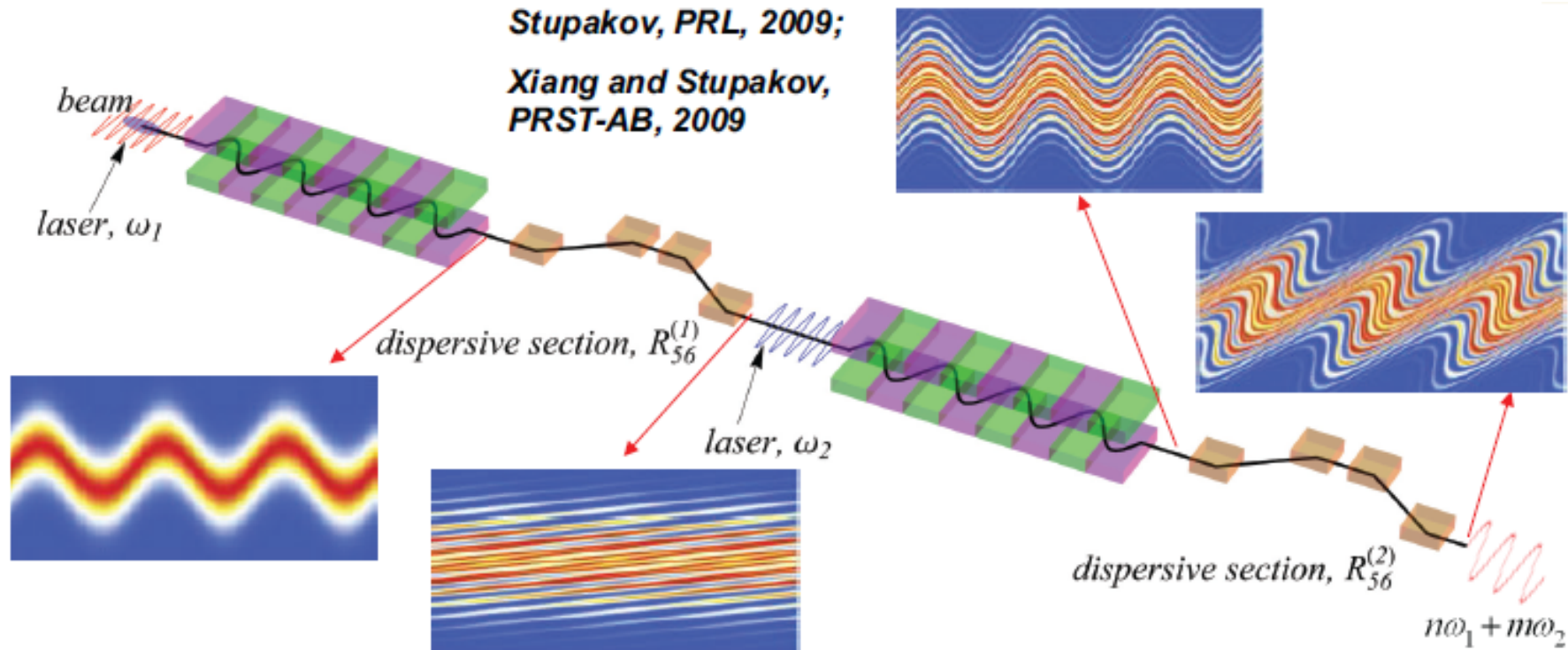
„Harmonic Seeding“:

Erzeugung kurzer Pakete durch Energiemodulation



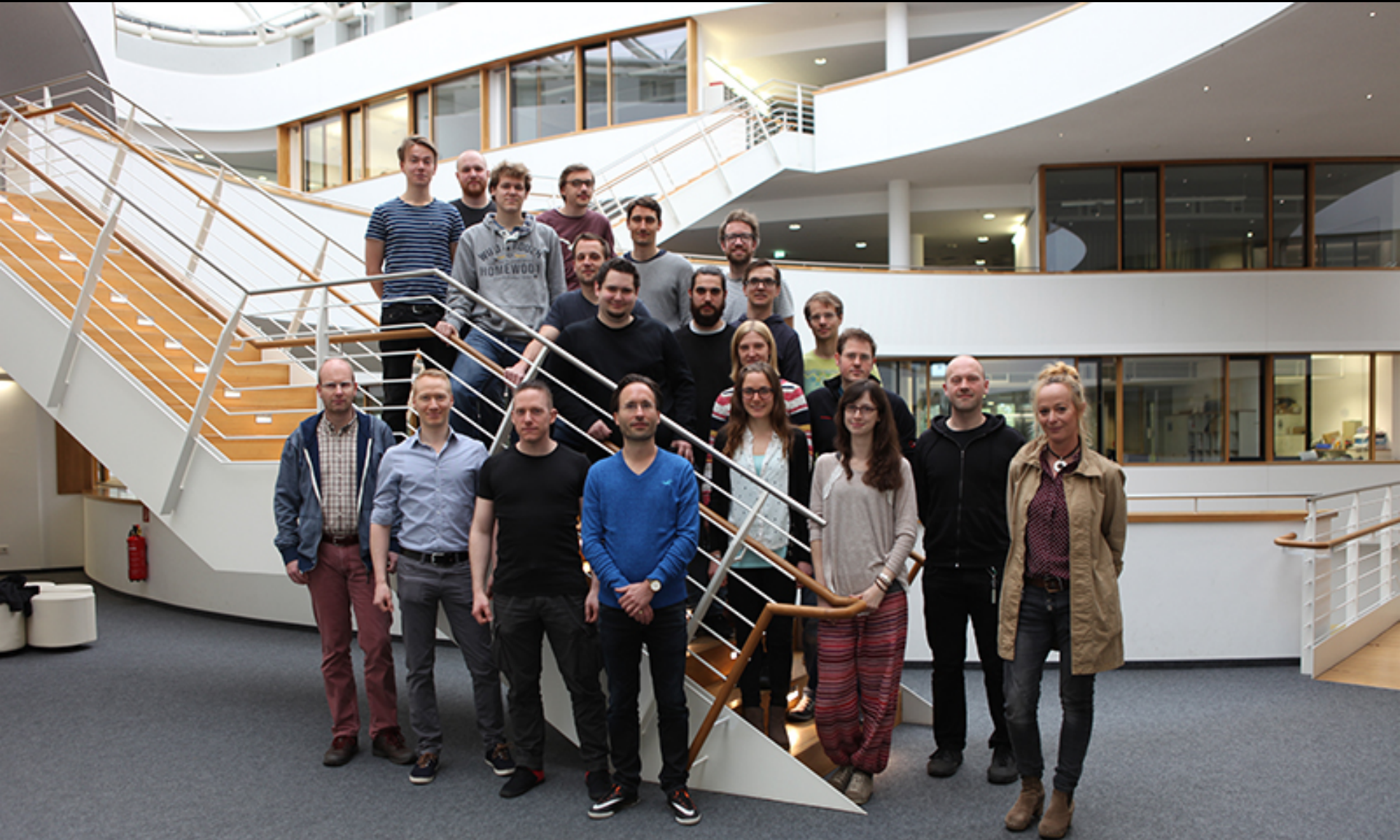
EEHG (echo enabled harmonic generation)

„das“ Seeding-Verfahren der Zukunft?



- ❑ First laser to generate energy modulation in electron beam
 - ❑ First strong chicane to split the phase space
 - ❑ Second laser to imprint energy modulation
 - ❑ Second chicane to convert energy modulation into density modulation
- $n \gg \Delta E / \sigma_E$**

AG Beschleunigerphysik



... leider nicht ganz vollständig auf dem Bild ...