

THz pump & probe facility at FLASH2



Nikola Stojanovic

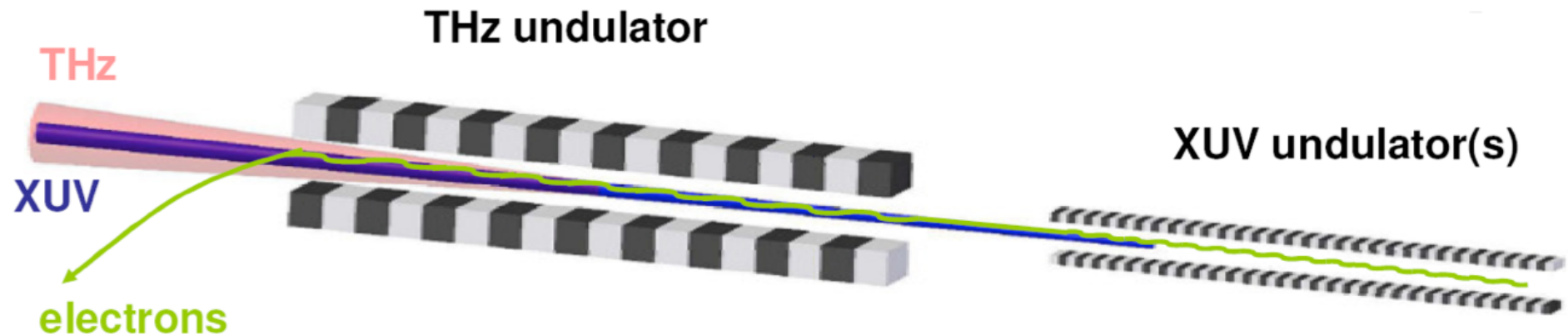
On the behalf of: B. Faatz, M. Yurkov, E. Schneidmiller,
M. Gensch, M. Tischer, S. Schreiber and J. Feldhaus



FLASH accelerator workshop
October 4th 2011



1.1 THz at FLASH: Existing design



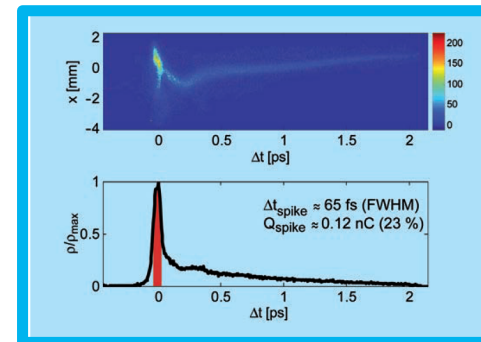
Cascaded design:

- Parasitic operation
- Synchronized to XUV pulse

Short electron bunch:

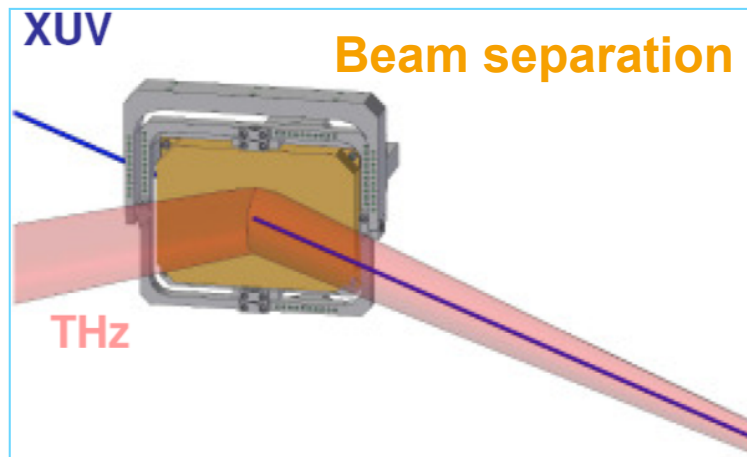
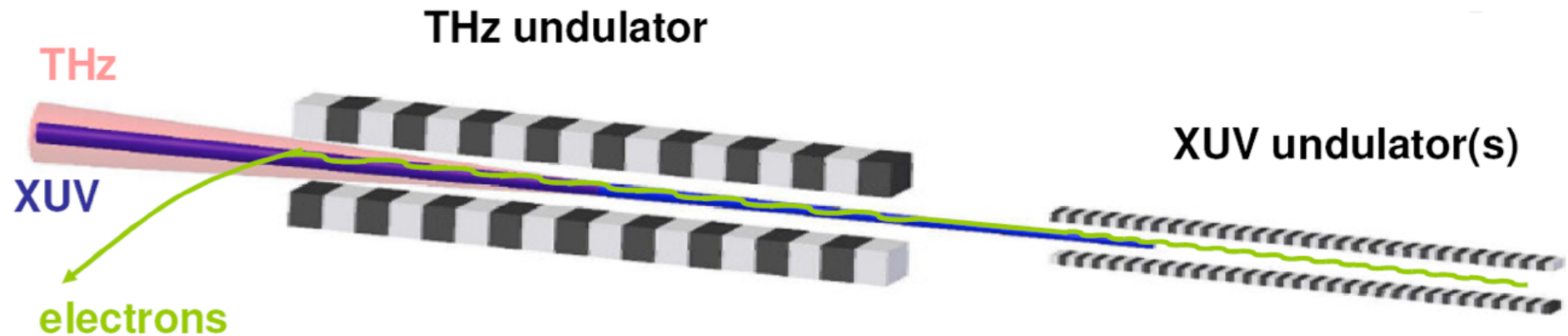
- Intensity $\sim N_e^2$ (up to 70uJ)
- Coherent and CPE stable

Tunable: (10 – 230 μm)

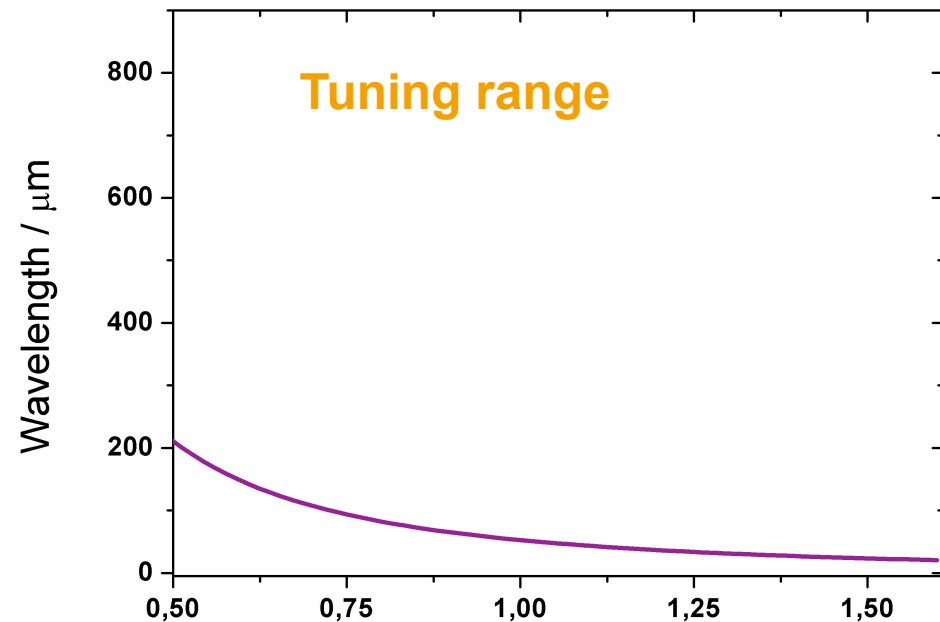


- B. Faatz et al., NIM A 475 (2001) 363.
- G. Geloni, E.L. Saldin, E.A. Schneidmiller, M.V. Yurkov, Nucl. Instr. Method A 528 (2004) 184–188.
- Gensch, M. et al. New infrared undulator beamline at FLASH. Infrared Phys. Technol. 51, 423–425 (2008).

1.2 THz at FLASH: Existing design



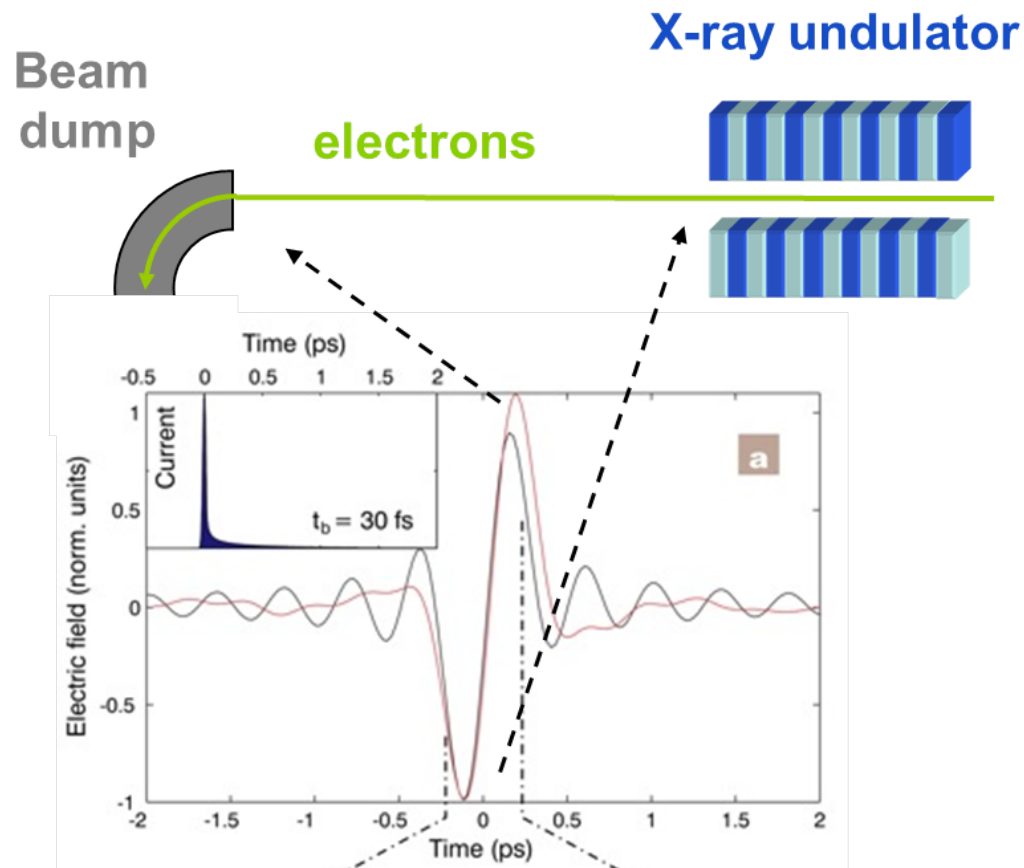
Peak Magnetic field 1.2T (K=44)



- B. Faatz et al., NIM A 475 (2001) 363.
- G. Geloni, E.L. Saldin, E.A. Schneidmiller, M.V. Yurkov, Nucl. Instr.
- Gensch, M. et al. New infrared undulator beamline at FLASH. Infrared Phys. Technol. 51, 423–425 (2008).

1.3 THz at FLASH: Single cycle pulses

... for Free!



Calculation and measurement*

*F. Tavella, N. Stojanovic, G. Geloni, M. Gensch,
Few fs synchronization at 4th generation light
sources, *Nature Photon.* (2011).

Single cycle (edge radiation):

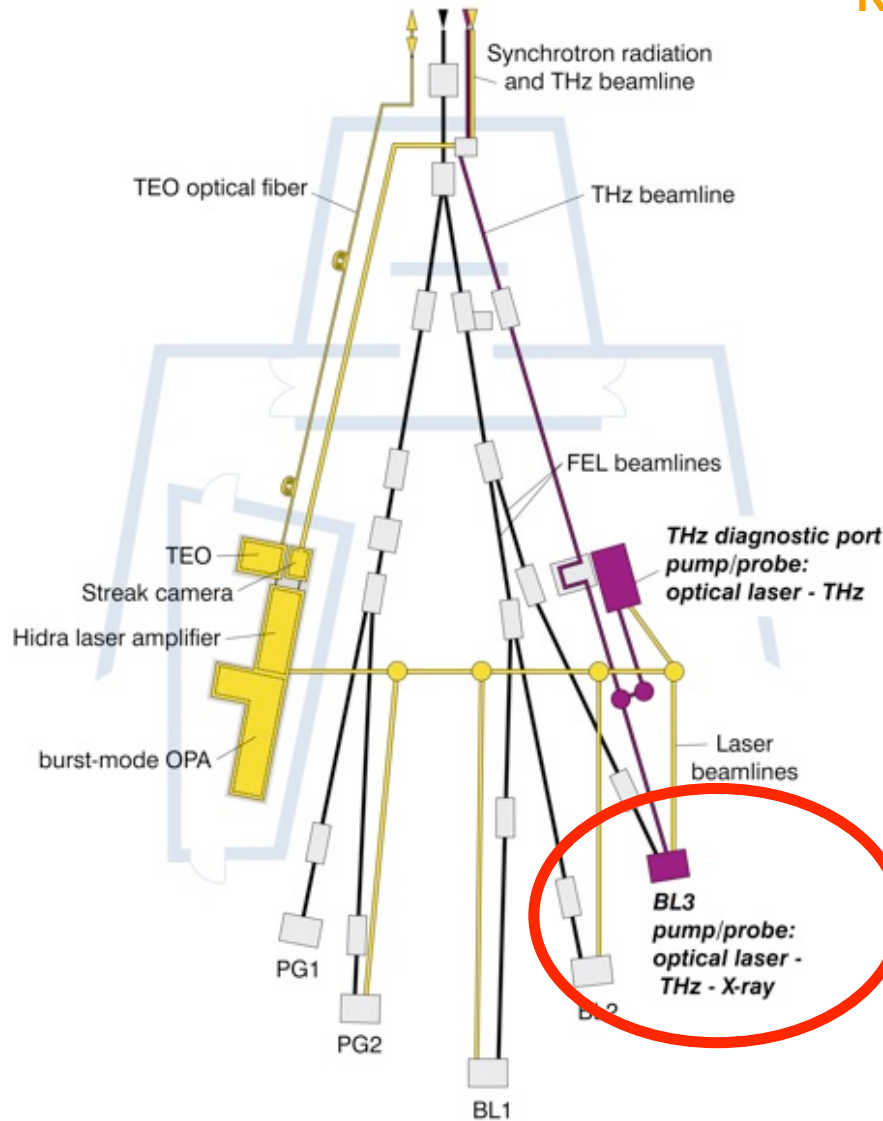
- up to 10uJ
- Synchronized to XUV pulse
- Coherent and CPE stable
- Intensity $\sim N_e^2$
- Parasitic

Uni-HH & DESY, to be published



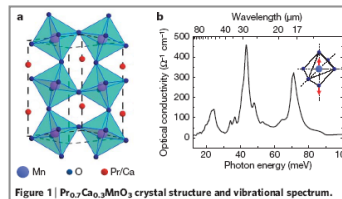
1.4 THz at FLASH: User experiments

Resonant vibrational control in complex materials



1) *in strongly correlated oxides*

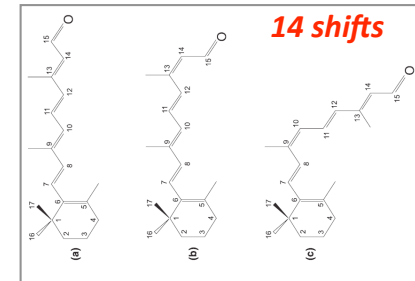
M. Gensch (HZDR, Dresden) + CFEL ...



9 shifts

2) *of biomolecules*

Dr. T. Laarmann (DESY) + ...

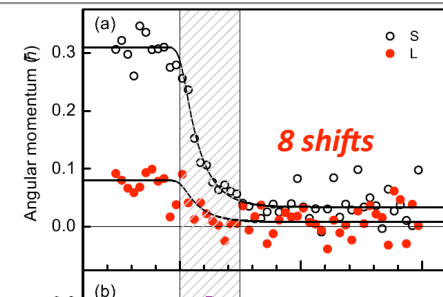
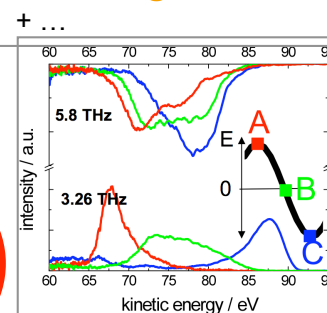


3) *Control of magnetization in ferromagnets*

Dr. H. Duerr (SLAC) + CFEL + DESY + UNI HH...

4) *Photoelectron*

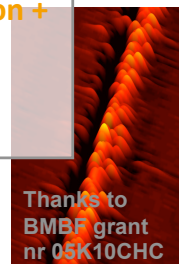
Striking UNI-HH + DESY



5) *Pulse duration + Timing*

DESY + users

20 shifts



Thanks to
BMBF grant
nr 05K10CHC



1.5 THz at FLASH: User experiments

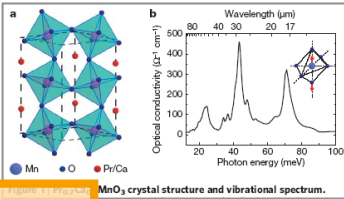
Resonant vibrational control in complex materials

1) *in strongly correlated oxides*

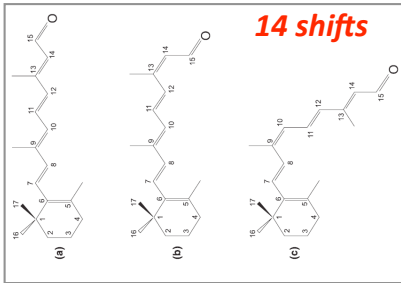
M. Gensch (HZDR, Dresden) + CFEL ...

2) of biomolecules

Dr. T. Laarmann (DESY) + ...



9 shifts



14 shifts



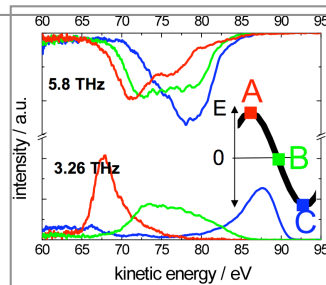
More than 700 hours of THz operation!

3) Control of magnetization in ferromagnets

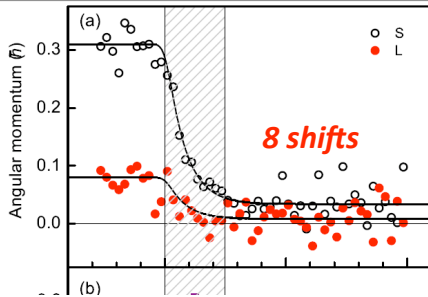
Dr. H. Duerr (SLAC) + CFEL + DESY + UNI HH...

4) Photoelectron

Streaking

$$+ \dots$$


8 shifts



8 shifts

5) Pulse duration + Timing

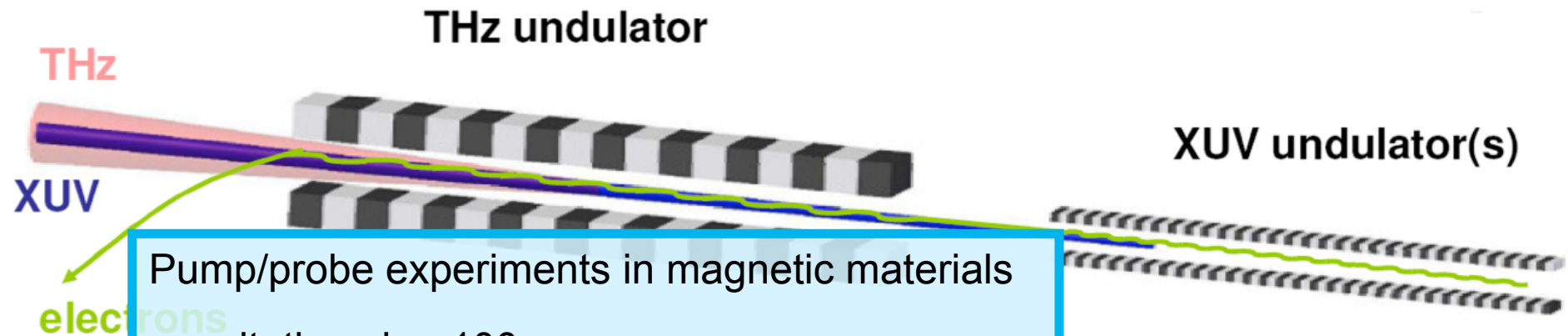
DESY + users

20 shifts

Thanks to
BMBF grant
nr 05K10CHC



1.6 THz at FLASH: Existing design

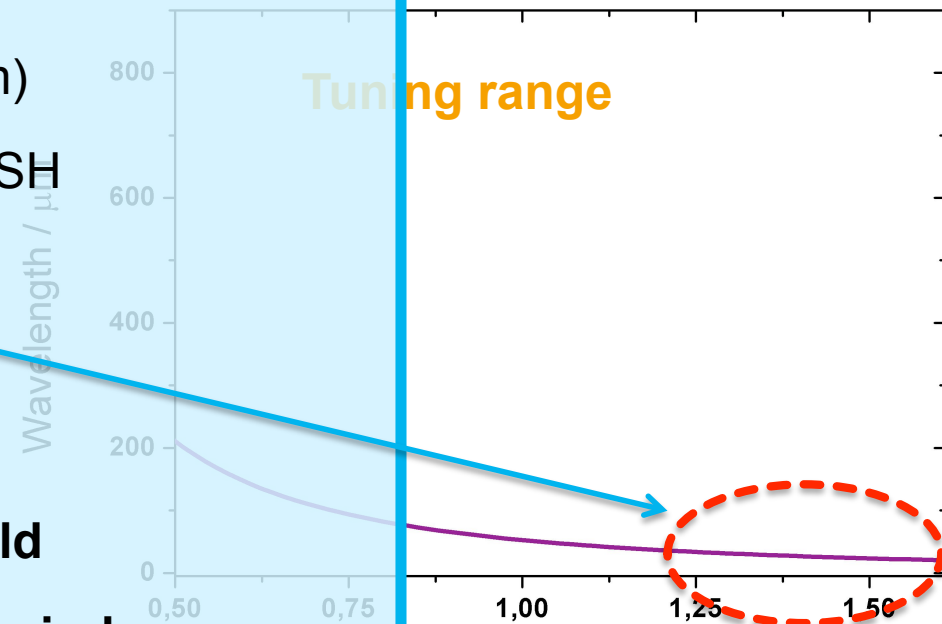


Pump/probe experiments in magnetic materials

- excitations in $>100\mu\text{m}$ range
- short XUV wavelengths ($<2\text{nm}$)
- existing THz undulator at FLASH
 - $33\mu\text{m}$ @ 1.25GeV
 - $21\mu\text{m}$ @ 1.6GeV
- **Solution:**

- **Higher magnetic field**

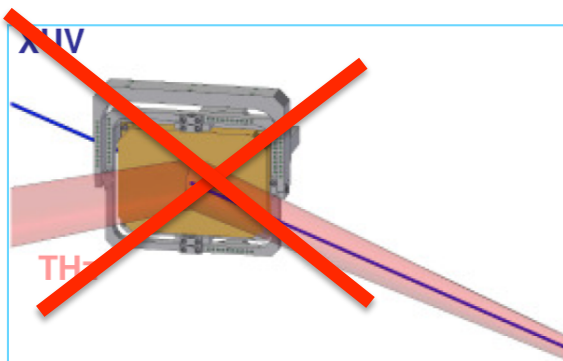
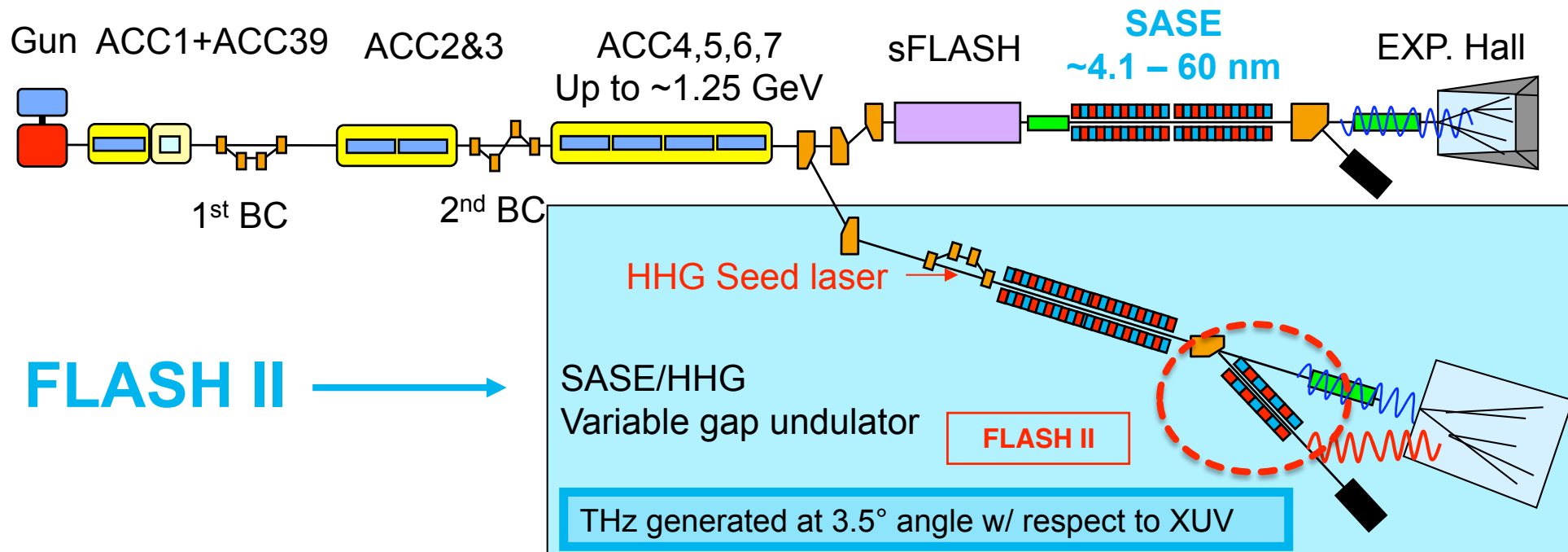
- **Longer undulator period**



Electron energy / GeV

- B. Faatz et al., NIM A 475 (2002)
- G. Geloni, E.L. Saldin, E.A. Schneidmiller, M.V. Yurkov, Nucl. Instr. and Meth. A 447 (2000)
- Gensch, M. et al. New infrared undulator beamline at FLASH. Infrared Phys. Technol. 51, 423–425 (2008).

2.1 THz at FLASH2



- Aperture-free optics:
 - reduced THz losses,
 - improved beam quality
 - prevents unlikely leakage of THz and VIS/NIR to X-ray beamlines

2.2 THz at FLASH2: Electromagnetic device

Normal conducting



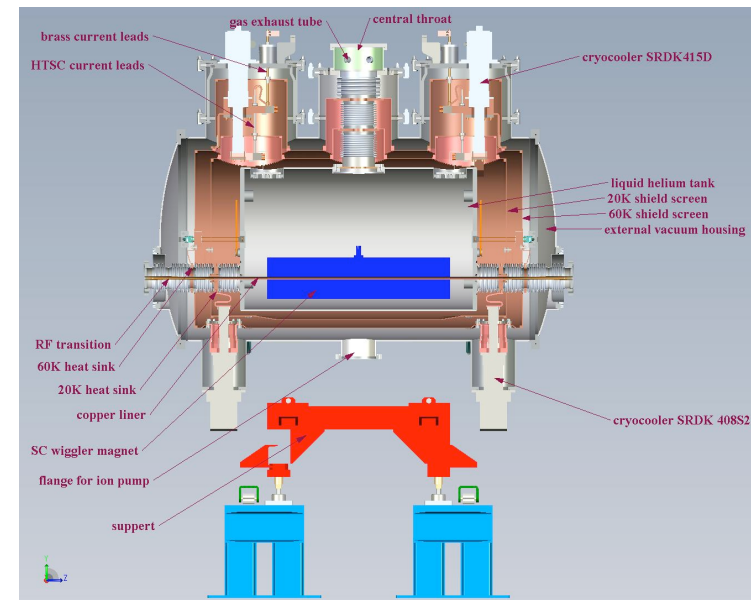
- Moderate field 1.2T ($K = 44$)
- Variable period
- ...

Available space <3.4m (length)

- Width <1m

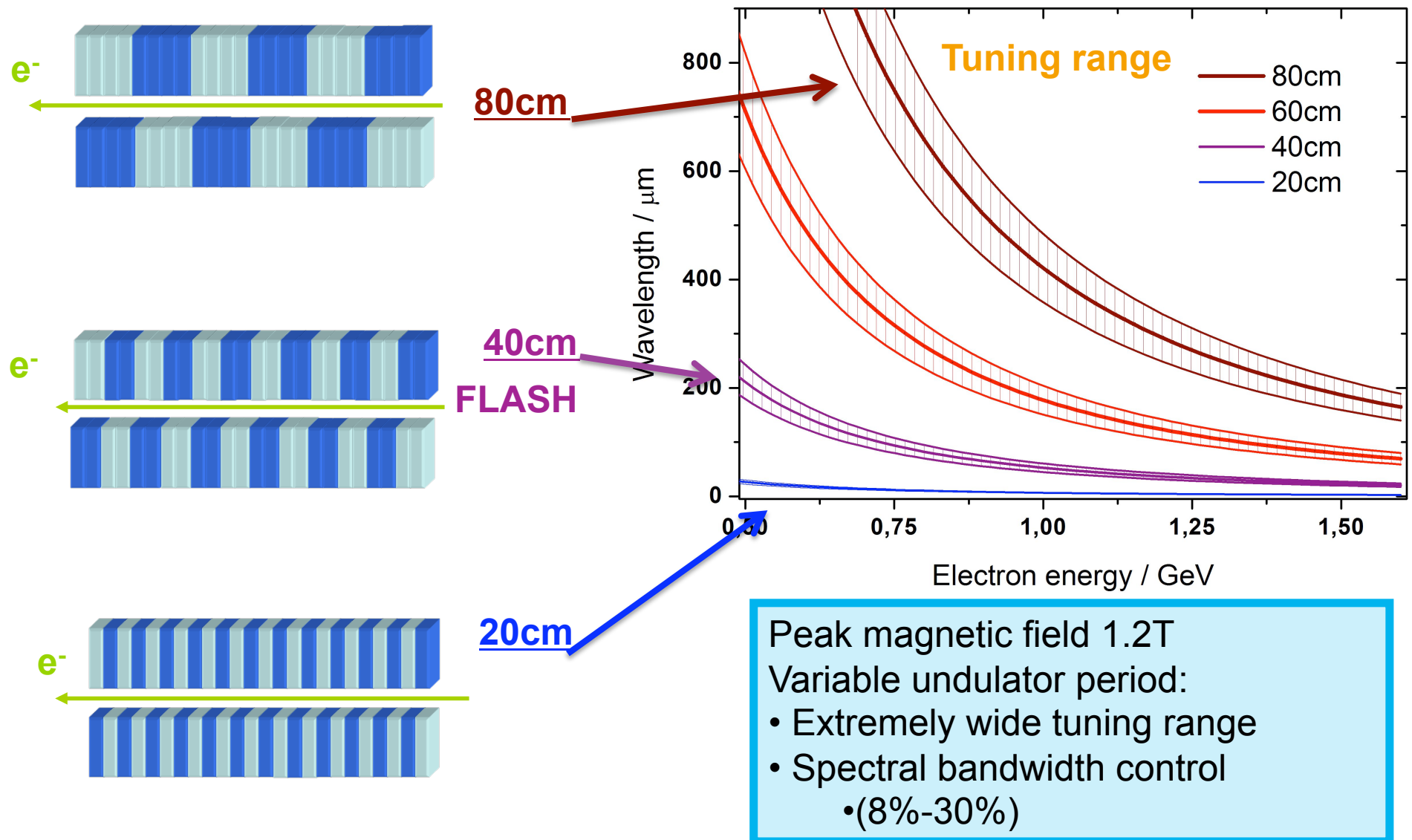
Superconducting

Presentation by M. Yurkov @ 15:05



- Extremely high field ($K > 100$)
- Low power consumption
- ...

2.3 THz at FLASH2: Variable period



2.4 THz at FLASH2: Summary

THz pump probe facility at FLASH 2

- No have funding yet (but might be there soon ...)
- DESY, HZDR, BINP (Novosibirsk) and/or JINR (Dubna)
- Use reserved space of 3.4m length in FLASH2 tunnel
- Electrical and cooling installations (100kW in case of NC)
- Earliest installation on 2013
 - Installation preparation before is already taking place
- Installation should take 3-4 weeks
 - Access to the tunnel is needed but doesn't exclude other work
- Estimated commissioning 15 shifts (2014 & 2015)
 - Most of them parasitic



Thank you for your attention

