

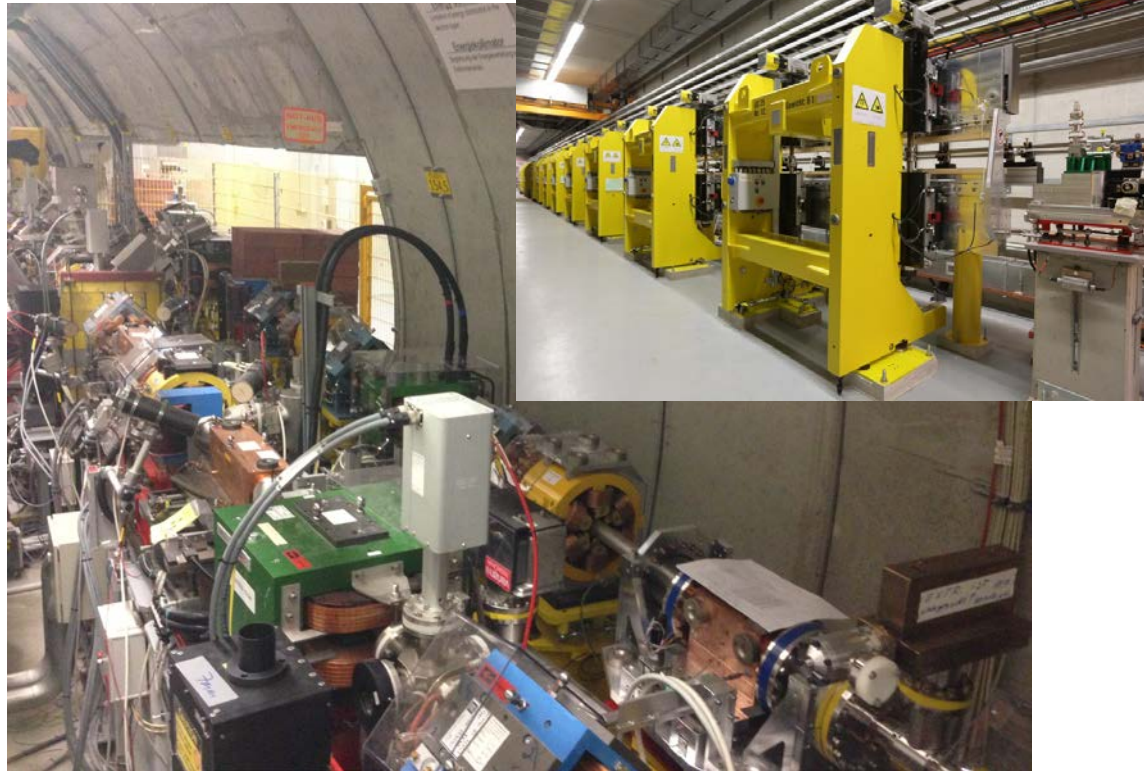
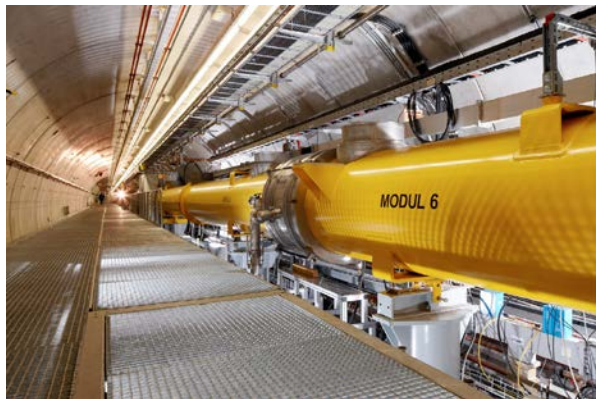
# 1<sup>st</sup> Lasing at FLASH2

**FLASH.**  
Free-Electron Laser  
in Hamburg

## FLASH – Free-Electron Laser User Facility at DESY

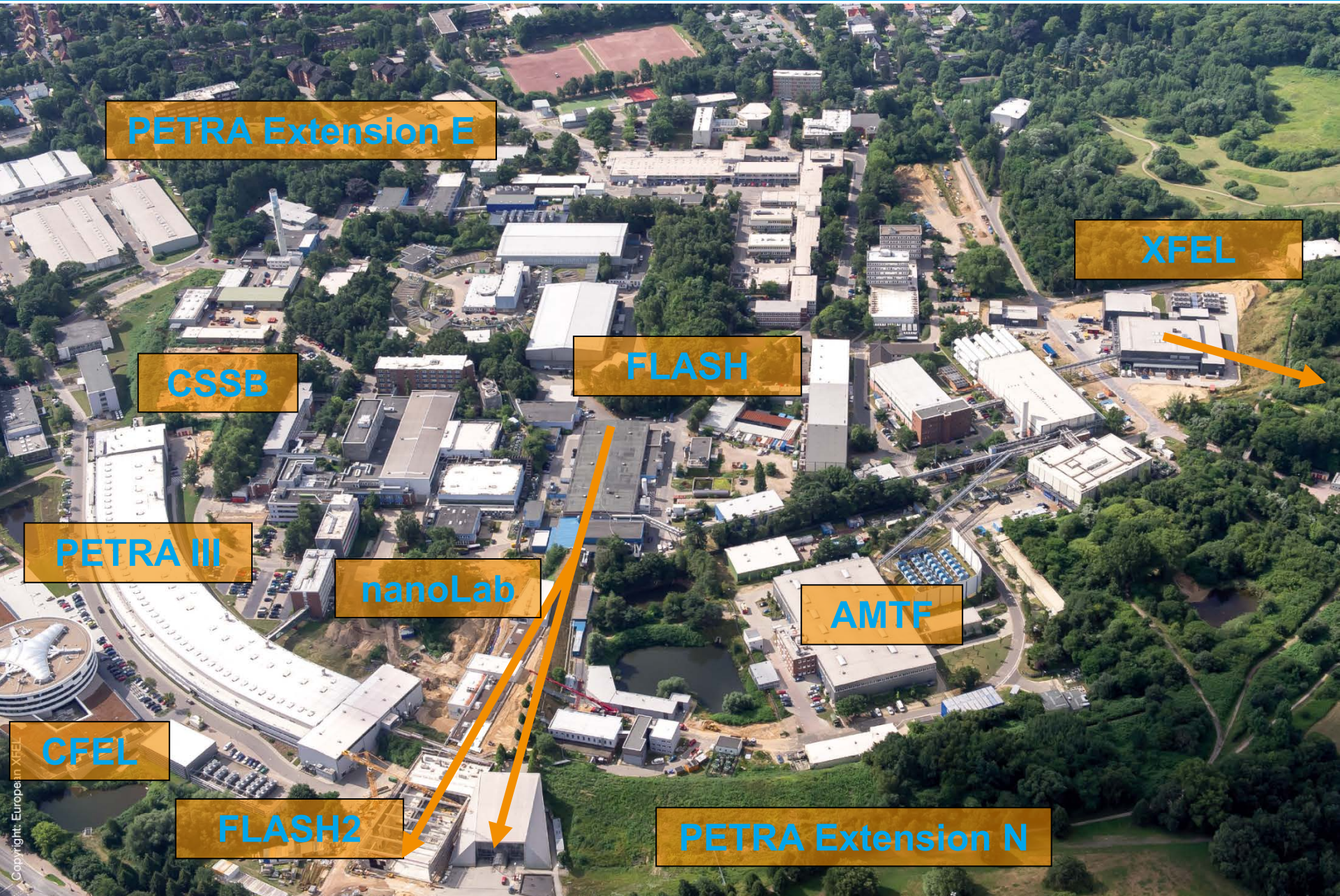
Siegfried Schreiber, DESY  
on behalf of Bart Faatz,  
for the FLASH team

FEL Conference 2014, Basel  
25-29 August, 2014



# DESY 2013 with FLASH2 under construction

**FLASH.**  
Free-Electron Laser  
in Hamburg



PETRA Extension E

CSSB

PETRA III

nanoLab

CFEL

FLASH2

FLASH

AMTF

PETRA Extension N

XFEL

# FLASH Layout 2014

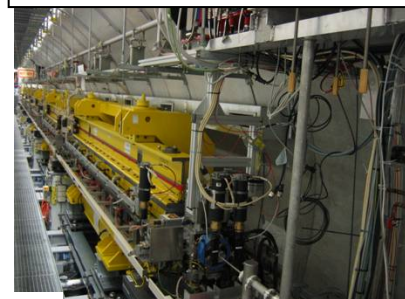
> 3<sup>rd</sup> harmonic sc module 3.9 GHz



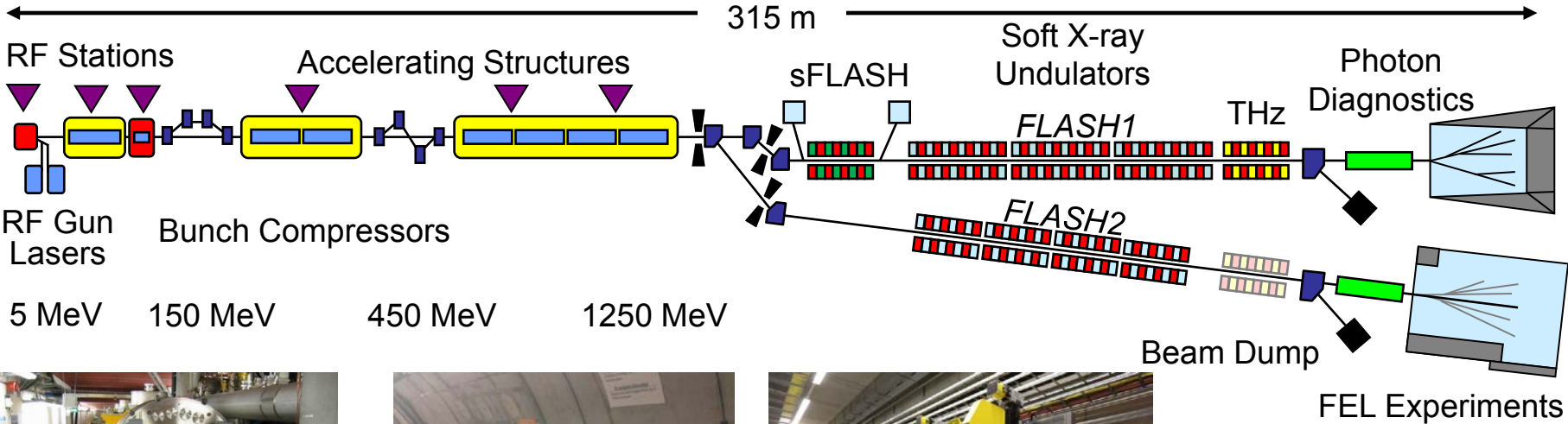
> TESLA type superconducting accelerating modules 1.3 GHz



> FLASH1 fixed gap undulators  
> Total magnetic length ~ 27 m



> FLASH1 Experimental Hall



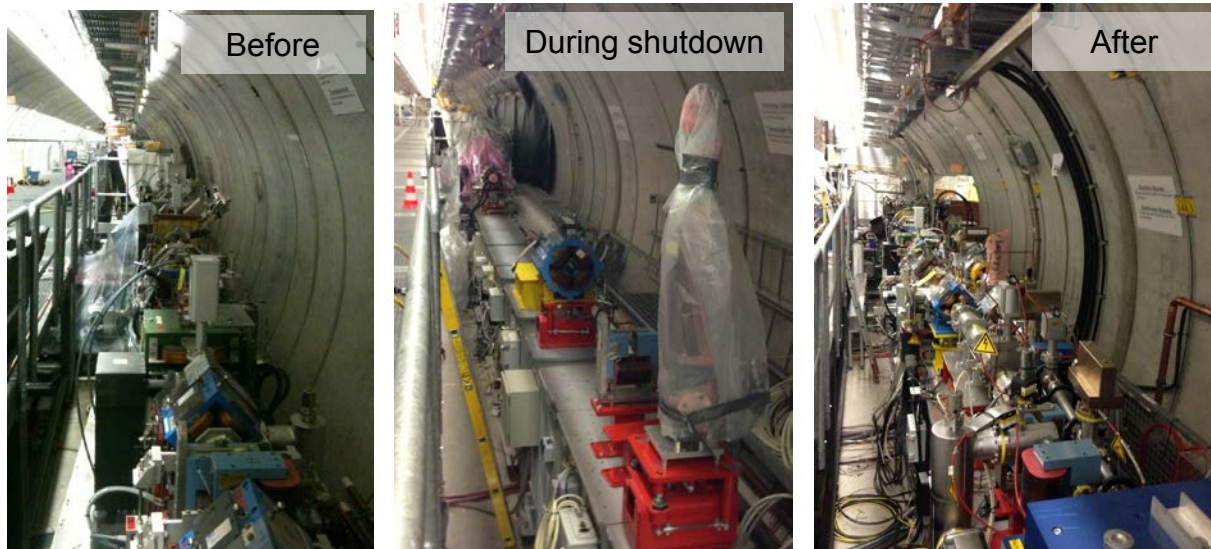
> Normal conducting 1.3 GHz RF gun  
> Ce<sub>2</sub>Te cathode  
> Two Nd:YLF based ps photocathode lasers

> Extraction to FLASH2

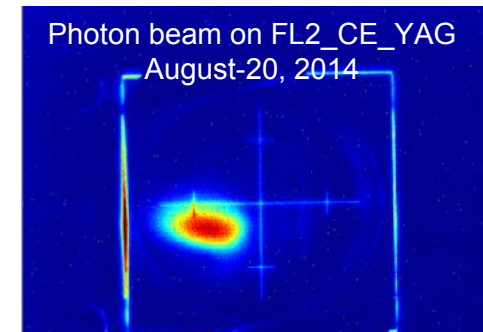
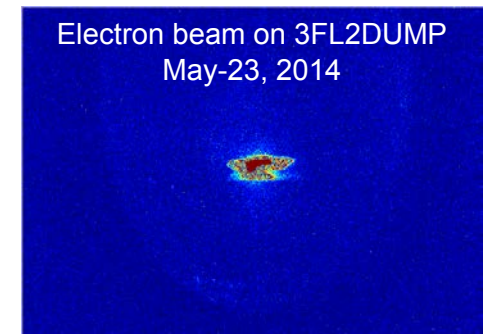
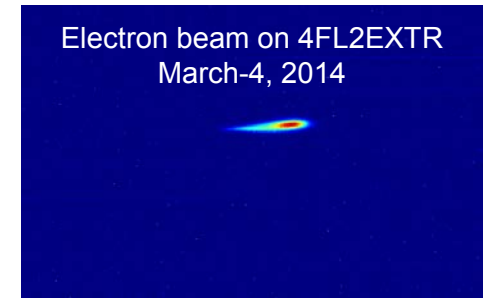
> Variable gap undulator  
> Total magnetic length ~ 30 m

> FLASH2 Experimental Hall

- FLASH shutdown Feb - Jul 2013
  - to open tunnel wall to FLASH2 extraction
  - modification of ~15 m FLASH beamline
  - kicker-septum system to extract FLASH2 beam
  - installation of FLASH2 extraction beamline
- Jul 2013 – Jan 2014 installation FLASH2 beamline during FLASH1 operation

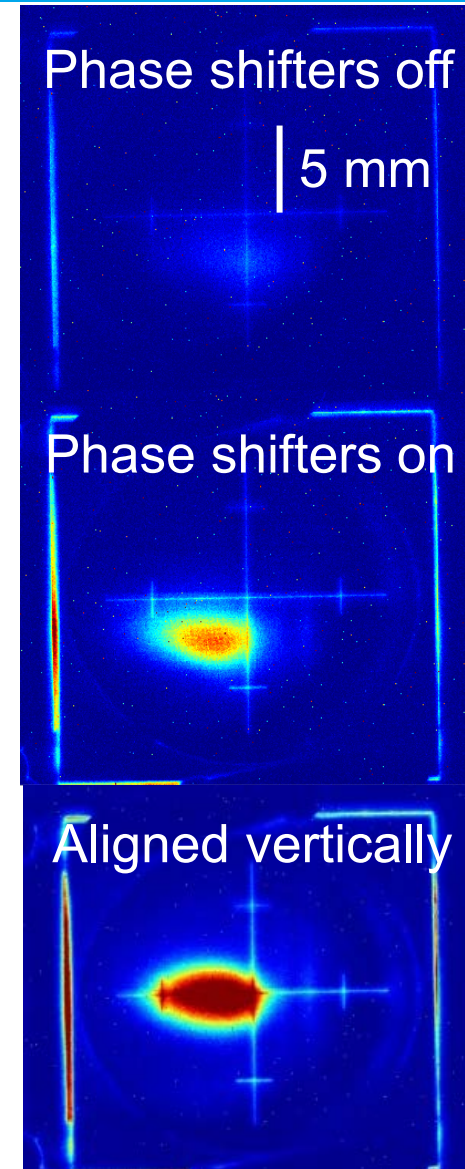


- > First electron beam in extraction March-4, 2014
- > First beam to dump May-23, 2014
- > Simultaneous operation of FLASH1 (SASE) and FLASH2 (electron beam) starting end of May 2014
- > Set-up beam for lasing at 40 nm Aug-20, 2014
  - Closing 1<sup>st</sup> Undulator: 20:11 h
  - Closing 2<sup>nd</sup> Undulator: 20:24 h
  - Closing 3<sup>rd</sup> Undulator: 20:33 h
  - Closing 4<sup>th</sup> Undulator: 20:36 h
  - **First Lasing Image: 20:37 h**
  - Setting Phase shifters: 20:45 h
- > Aug-24: lasing with 20 nm, spectra measured



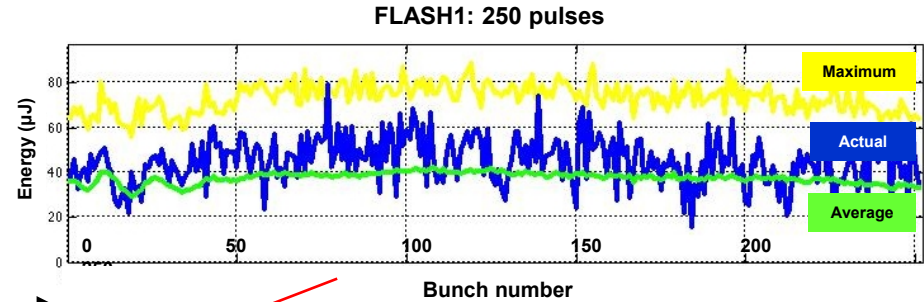
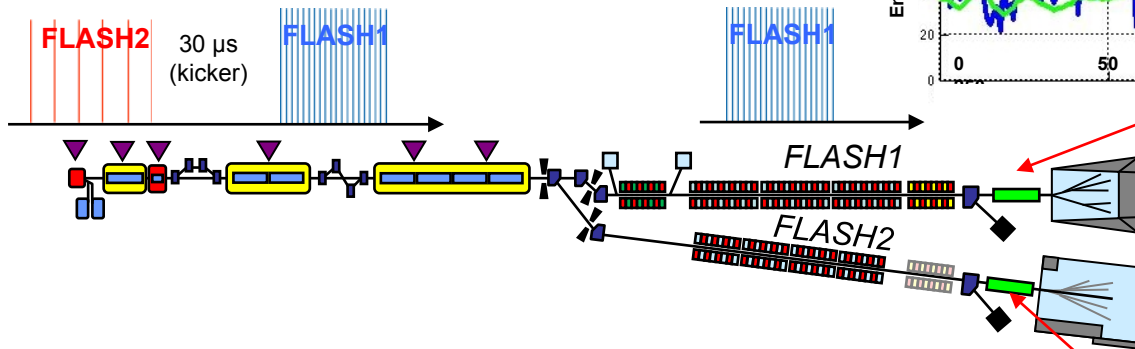
Even though only a Ce:YAG screen was available we can deduce a few SASE parameters:

- > All images single pulse
- > Beam energy 680 MeV, undulator gap 9.5 mm  
→ 40 nm wavelength
- > Strong enhancement of SASE with adjusted phase shifters
- > Opening angle  $\sim 80 \mu\text{rad}$  rms as expected for SASE
  - distance to screen 18 m
  - Spot size on screen  $\sim 3 \text{ mm}$  FWHM (vertically)
  - Spontaneous emission (not observed):  
 $K/\gamma = 1.4 \text{ mrad}$   
→ spot size would be  $\sim 60 \text{ mm}$  (FWHM)
- > Typical SASE fluctuations for non-saturated lasing

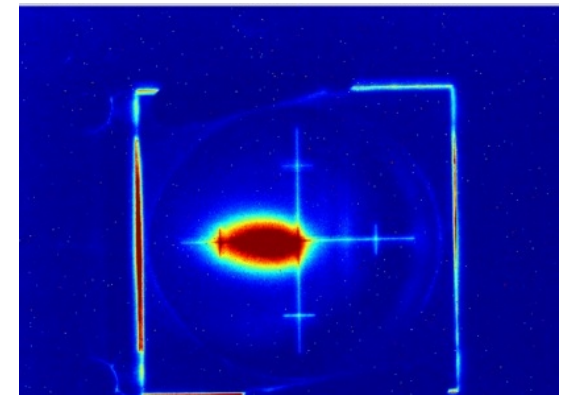
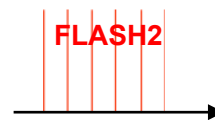


# Lasing FLASH2 in parallel to FLASH 1 operation

- > During lasing FLASH2
- > FLASH1 lasing in parallel with 250 pulses at 13.5 nm



FLASH2 variable gap undulators



# Bunch distribution between FLASH1 and 2



Combined beam in accelerating section

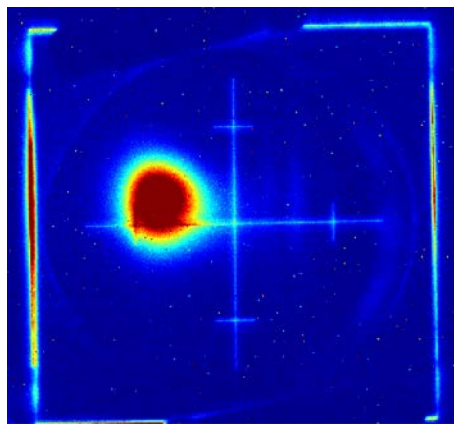
FLASH1 (250 bunches)

FLASH2 (1 bunch)

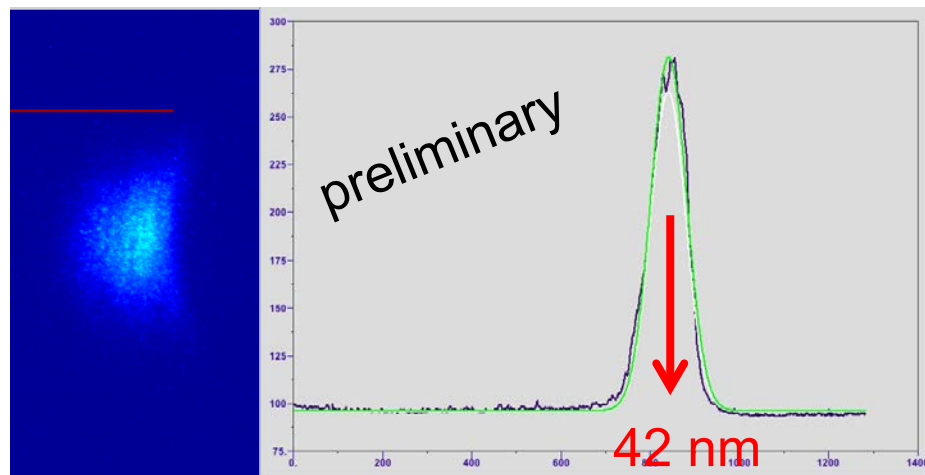
Both FLASH1 and FLASH2 receiving bunches at 10 Hz



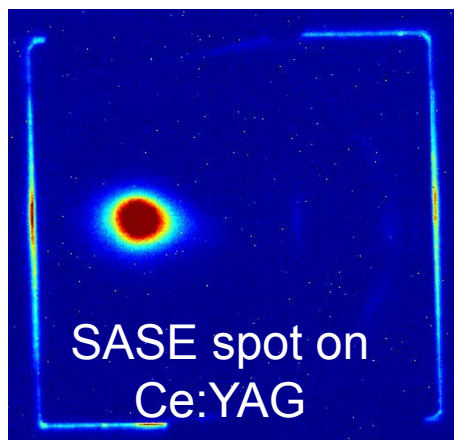
➤ Settings for 40 nm



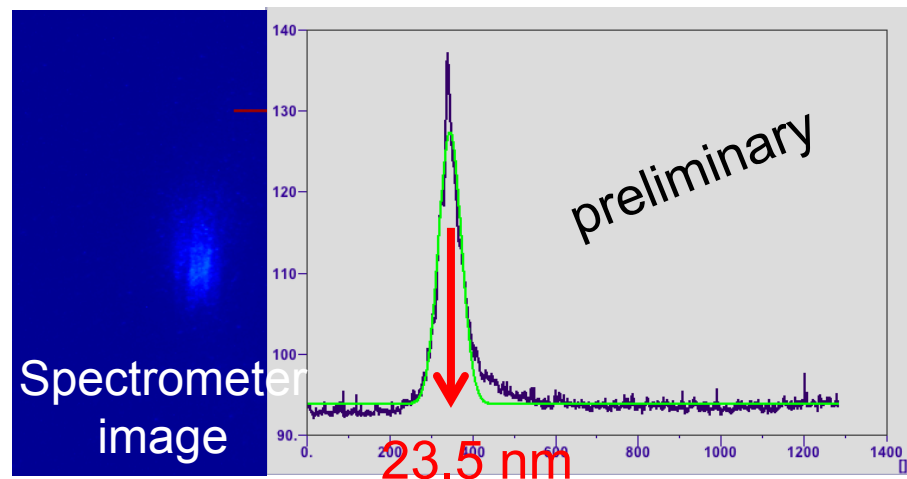
Wavelength 42 nm with 2% bandwidth (FWHM)



➤ Settings for 20 nm



Wavelength 23.5 nm with 1.6 % bandwidth (FWHM)



# People involved in FLASH2 (and many more)

albrecht leuschner, alexander kaukher, alexander petrov, andreas hoppe, andreas noll, andreas liedtke, andreas schoeps, antonio wagner, arik willner, armin brand, arvid hage, axel hauberg, bart faatz, bastian lorbeer, bernhard schmidt, bernward krause, bo liu, britta petersen, brunhilde racky, burghard sparr, christel oevermann, christian gruen, christian schmidt, christoph lechner, christopher behrens, christopher gerth, cornelius martens, daniel meissner, detlef sellmann, dieter mross, dirk keese, dirk noelle, edgar weckert, eike ploenjes, erland mueller, evgeny schneidmiller, evgueni saldin, florian gruener, frank-reinhard ullrich, frank brinker, frank marutzky, frank obier, frank schmidt-foehre, franz tavella, gabi weichert, gernard schlesselmann, hans-joerg eckoldt, hans wise, heinrich muench, helmut remde, henning-christof weddig, holger schlarb, horst-arno bolz, horst-guenter damker, horst schulte-schrepping, igor zagorodnov, iris gehrmann, jan havlicek, jan kuhlmann, jens osterhoff, jianhui chen, joachim spengler, joerg rossbach, joern schaffran, johann zemella, johannes prenting, josef feldhaus, josef gonschior, juergen liebinger, juergen schaefer, juliane roensch, jutta bentien, kai tiedtke, karo amyan, karsten kloese, katja honkavaara, kay rehlich, kay wittenburg, kirsten petersen, klaus-dieter jansen, lindemar haenisch, lutz lilje, maciej brachmanski, maike pelzer, maike roehling, margit gibau, marion kuhlmann, markus drescher, markus koerfer, markus schloesser, markus tischer, martin staack, mathias hesse, mathias vogt, matthias felber, matthias scholz, matthias steckel, max goerler, max holz, mi schulz, michael boehnert, michael dressel, michael koepke, michael schmitz, mikhail yurkov, nicoleta baboi, nikola stojanovic, nils mildner, nina golubeva, norbert tesch, olaf borkenhagen, olaf hensler, olaf krebs, pedro castro, raimund kammering, ralph boespflug, reinhard neumann, rolf treusch, siegfried schreiber, silke vilcins, stefan duesterer, stefan koch, stephan molnar, svea kreis, sven ackermann, sven lederer, swaantje mette, takanori tanikawa, thomas bruns, thorsten kracht, thorsten vielitz, tim laarmann, tim wilksen, torsten limberg, torsten ramm, torsten wohlenberg, ulf fini.jastrow, ulrich hahn, ulrich schuetz, valeri ayvazyan, velizar miltchev, vladimir balandin, vladimir rybnikov, werner kook, winfried decking, wojciech jalmuzna

