"DESY - Research for a Better Future"

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FLASH

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Helmut Dosch | Overview DE:

Deutsches Elektronen-Synchrotron DESY Research for a Better Future



DESY/European XFEL – Turkey cooperation

- In connection with German-Turkish Year of Science - bilateral agreement on ministerial level
- various activities to boost DESY/European XFEL-Turkey collaboration:
 - Delegation visits, roadshows, science days, workshops
 - Goal: Initiate ideas for cooperation projects / activities around X-ray sources



Ministers Johanna Wanka and Fikri Isik January 2014

Science Bridging Nations www.deutsch-tuerkisches-wissenschaftsjähr www.turk-alman-bilimyilicom

The new Challenge.

Mechanics Thermodynamics Electrodynamics

Observing

19th Cent

von Laue

......

Quantum Mechanics X-rays Quantum Control of Matter and Energy Access to Time Domain



of Quantum Phenomena



Atoms, Molecules

Fluctuations

Understal



X-Ray Challenge of the 21st Century.

"When the going get's tough"



Era of Crystalline Matter

you are here

Crystalline Matter you are

Ordered Structures Equilibrium Phenomena Phase Diagrams Era of Complex Matter

Locally Ordered Structures Nonequilibrium Phenomena Transient States

Lab-Based X-ray Sources

Synchrotron radiation

X-Ray Lasers + High Brilliance SR



X-Ray Facilities at DESY.



PETRA III









High Tech Analytics Real Conditions



FLASH.

"X-FEL Big Bang"





- Jan 2005
- Energy range
- Pulse energy
- Pulse duration
- Peak power
- Bandwidth $\Delta\lambda/\lambda$

first lasing at 32 nm

- ~0.3 1 GeV
- ~6.5 60 nm
- 5 100 µJ
- ~10 50 fs
- 1 10 GW

~0.7 - 1 %

- Critical tests of - SASE principle
 - Scientific case

First FEL X-ray Laser

- User operation
- Multi user potential (FLASH II)



FLASH Science.

Impressive list of discoveries:



FLASH publications 2009-2014

150 ref. publications 40 high Impact Journals many cover stories













photonics



European XFEL



1.145 Mio € construction105 Mio €/y operation60% Germany



European XFEL



The Centre for Free Electron Lasers

International Center for FEL Science and Ultrafast Phenomena



XFEL Killer-App. Femtosecond Nanocrystallography

XFEL discloses structure of enzyme related to sleeping seekness

Single shot 10 fsec images

CSPAD detector

(z = 93 mm)



Be lenses

Undulator (420 m upstream)

HC Chapman CFEL-DESY



XFEL Killer-App. Femtosecond Nanocrystallography

XFEL discloses structure of enzyme

related to sleeping seekness





Trypanosoma brucei cathepsin B

Science TOP 10 2012



Redecke, Nass et al. Science on | (2013) 6, 2016 | page 13



Center for Structural System Biology, CSSB













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Photon Science Roadmap 2015-2035





Photon Science: Status in Europe

Facility	Location	Energy	N⁰ BL	Lab Info	Comments
Storage Rings					
ESRF	Grenoble	6 GeV		Upgrade MBA	
PETRA III	Hamburg	6 GeV	24	Upgrade MBA 2025	Hard Energy X-ray Facilities
ALBA	Barcelona	3,0 GeV			
Diamond	Didcot	3,0 GeV			
MAXIV	Lund	3,0 GeV 1,5 GeV		construction 7BA	Medium Energy X ray Eacilities
SOLEIL	Paris-Saclay	2,75 GeV			Medium Energy A-ray Facilities
ANKA	Karlsruhe	2,5 GeV		closes user op in 2018	
SLS	Zürich	2,4 GeV			
ELETTRA	Trieste	2,0-2,4 GeV			
BESSY II	Berlin	1,7 GeV		Upgrade VSR 2018	Soft X-ray Facilities
SOLARIS	Krakow	1,5 GeV		replica MAXIV 1,5 GeV	
X-ray Lasers					
FLASH	Hamburg	1,25 GeV		Upgrade CW, Seeding, Energy	Soft x-ray laser upgrade FLASH II
EU.XFEL	Hamburg	17,5 GeV			Europ. X-ray Laser
SwissFEL	Zürich	2,1-5,8 GeV			under construction
FERMI	Trieste	HGHG		λ = 100nm-10nm	

Research on batteries



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Microelectronics

Example: Electromigration & failure modes

Challenge



conductor traces

PETRA III Non-destructive view inside microchips 10 nm resolution





We need:

Microscopic understanding of diffusion mechanisms etc. inside microelectronics



3D X-ray microscopy < 1 nm resolution in-situ and operando

Goal: microscopic details of electromigration !











PHOTON SCIENCE PROJECT 2020+

PETRA IV Project Ultimate Storage Ring 2025



DESY is inviting international partners to join this world-wide unique project !



PETRA IV Project







