Thierry Strässle :: Chief of Staff PSI :: Paul Scherrer Institut

PSI-Welcome & Introduction

PSI Summer Student Program 2016, 06.07.2016

Synopsis of the ETH-domain within Switzerland

Swiss Federal Council

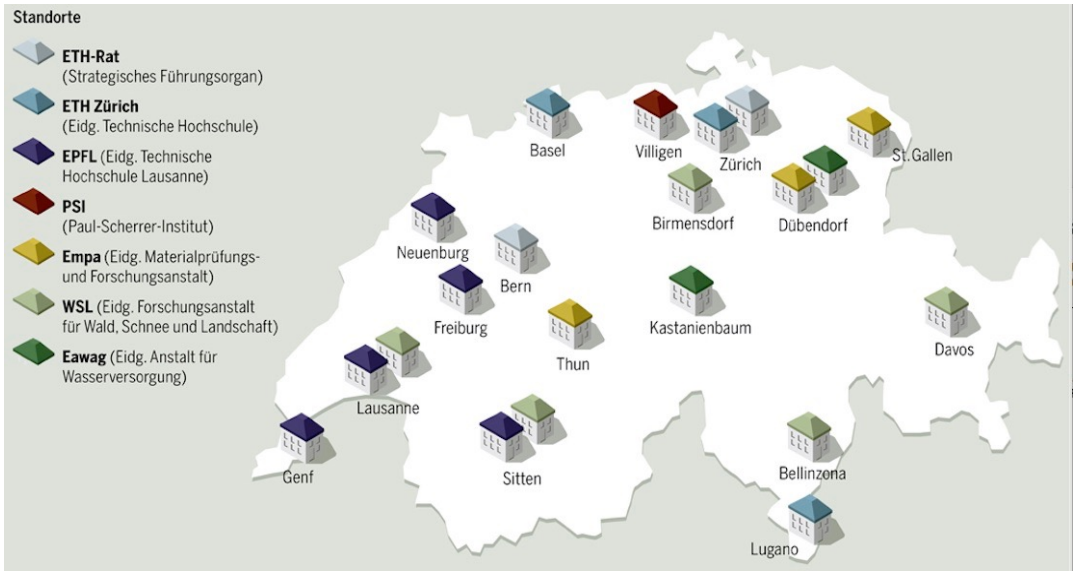
EDA | **EDI** | **EJPD** | **VBS** | **EFD** | **WBF(*)** | **UVEK**

(SERI)

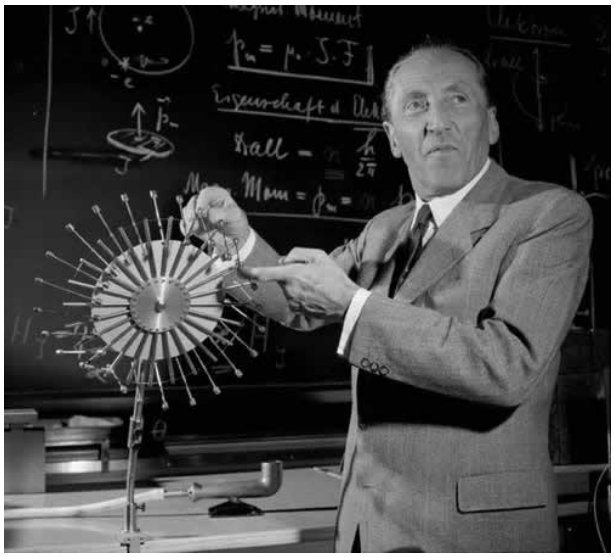
(*) WBF = Federal Department („ministry“) of Economic Affairs, Education and Research

ETH-Board

ETH-Domain



Paul Scherrer (1890–1969)



- Studied physics and mathematics at the Swiss Federal Institute of Tech-nology (ETH) Zurich, in Koenigsberg and in Goettingen, Germany
- 1920: professor of experimental physics at ETH Zurich; 1927: Director of the Institute of Physics. Was famous for the clarity of his lectures
- Researched x-ray scattering on crystals, liquids and gases. Later research work was in nuclear physics
- 1946: President of the Swiss Study Commission on Atomic Energy
- Involved in the foundation of CERN

side note: On 1st January 1988, the Swiss Institute for Nuclear Research (SIN) and the Federal Institute for Reactor Research (EIR) were merged to form the Paul Scherrer Institute (PSI).

Overview

← Basel Germany ↑ Aarau/Bern ↓ Zürich →

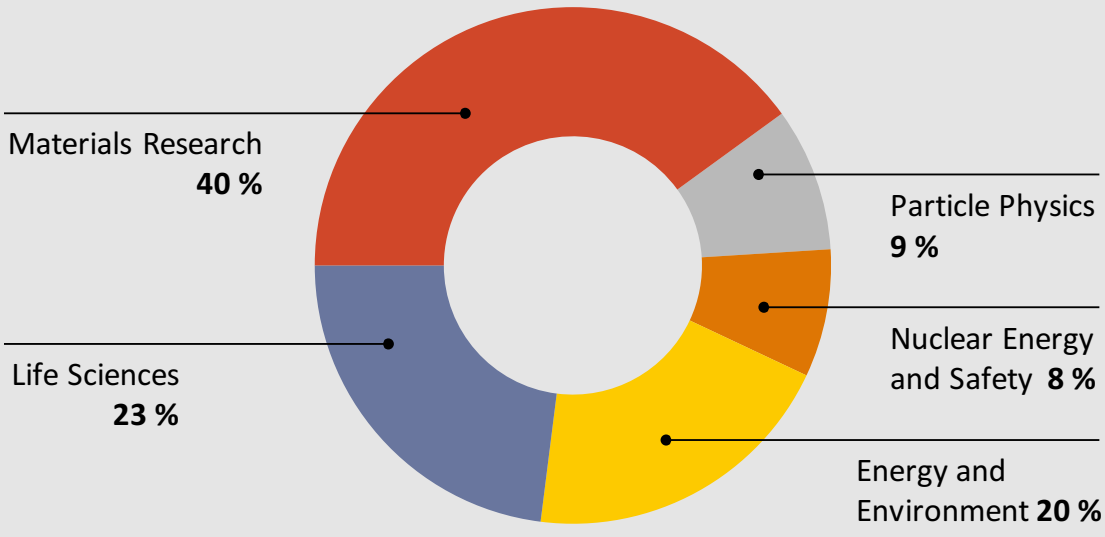
Key figures

ETHZ	EPFL	PSI	Empa	WSL	Eawag
Swiss Federal Institute of Technology Zurich	Swiss Federal Institute of Technology Lausanne	Paul Scherrer Institute	Swiss Federal Laboratories for Materials Testing	Swiss Federal Research Institute for Forestry, Snow and Landscape	Swiss Federal Institute of Aquatic Science and Technology

PSI funds (global budget)	270	MCHF
External funding	100	MCHF
Staff	2000	
• Externally financed	650	
• Doctoral students	330	
• Apprentices	100	
External users: people / visits	2300 / 5300	per year
Number of scientific publications	1200 (> 12.2% high impact)	per year
PSI employees with teaching duties at both ETH and universities	100	
Patient visits (proton therapy treatment)	5500	per year

Budget

Distribution to main research areas (first party funding)

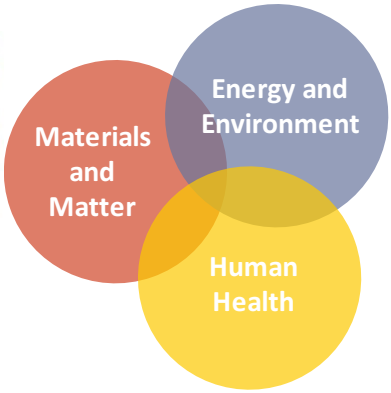


In-house research: excellent publications in various fields

High-impact publications 2015 (with PSI co-author)

JOURNAL	ISSN	IMPACT	#PUBL
ACCOUNTS CHEM RES	0001-4842	24.373	1
ACS CATAL	2155-5435	9.174	4
ACS NANO	1936-0851	14.412	1
ADV ENERGY MATER	1614-6832	16.581	5
ADV FUNCT MATER	1616-301X	12.311	1
ADV MATER	0935-9648	18.172	5
ANGEW CHEM INT EDIT	1433-7851	12.060	9
ASTRON ASTROPHYS REV	0935-4956	13.872	1
B AM METEOROL SOC	0003-0007	10.666	1
CHEM MATER	0897-4756	9.210	9
CHEM REV	0009-2665	50.679	1
CHEM SCI	2041-6520	9.203	1
CHEMSUSCHEM	1864-5631	8.653	1
COORDIN CHEM REV	0010-8545	13.174	1
CURR OPIN STRUC BIOL	0959-440X	8.077	1
ENERG ENVIRON SCI	1754-5692	19.198	1
J AM CHEM SOC	0002-7863	11.726	5
J AM SOC NEPHROL	1046-6673	9.621	1
J MATER CHEM A	2050-7488	7.449	2
J PHYS CHEM LETT	1948-7185	7.536	2
MOL CELL	1097-2765	15.052	1
NANO LETT	1530-6984	14.887	2
NANOSCALE	2040-3364	7.762	7
NAT CHEM BIOL	1552-4450	14.273	1
NAT CLIM CHANGE	1758-678X	15.462	1
NAT CLIM CHANGE	1758-678X	15.462	1
NAT COMMUN	2041-1723	11.904	24
NAT MATER	1476-1122	44.046	2
NAT METHODS	1548-7091	31.232	1
NAT PHOTONICS	1749-4885	33.413	1
NAT PHYS	1745-2473	19.777	4
NAT REV MOL CELL BIO	1471-0072	41.496	1
NAT STRUCT MOL BIOL	1545-9993	12.479	2
NATURE	0028-0836	41.296	10
P NATL ACAD SCI USA	0027-8424	10.563	4
PHYS REV LETT	0031-9007	7.360	28
PHYS REV X	2160-3308	9.055	2
SCI TRANSL MED	1946-6234	13.845	1
SCIENCE	0036-8075	35.263	4
SMALL	1613-6810	8.646	1

category size	344
category use	40
total publications	1234
publ. in category	151
fraction	12.2%
mean impact (publ. in cat.)	14.94



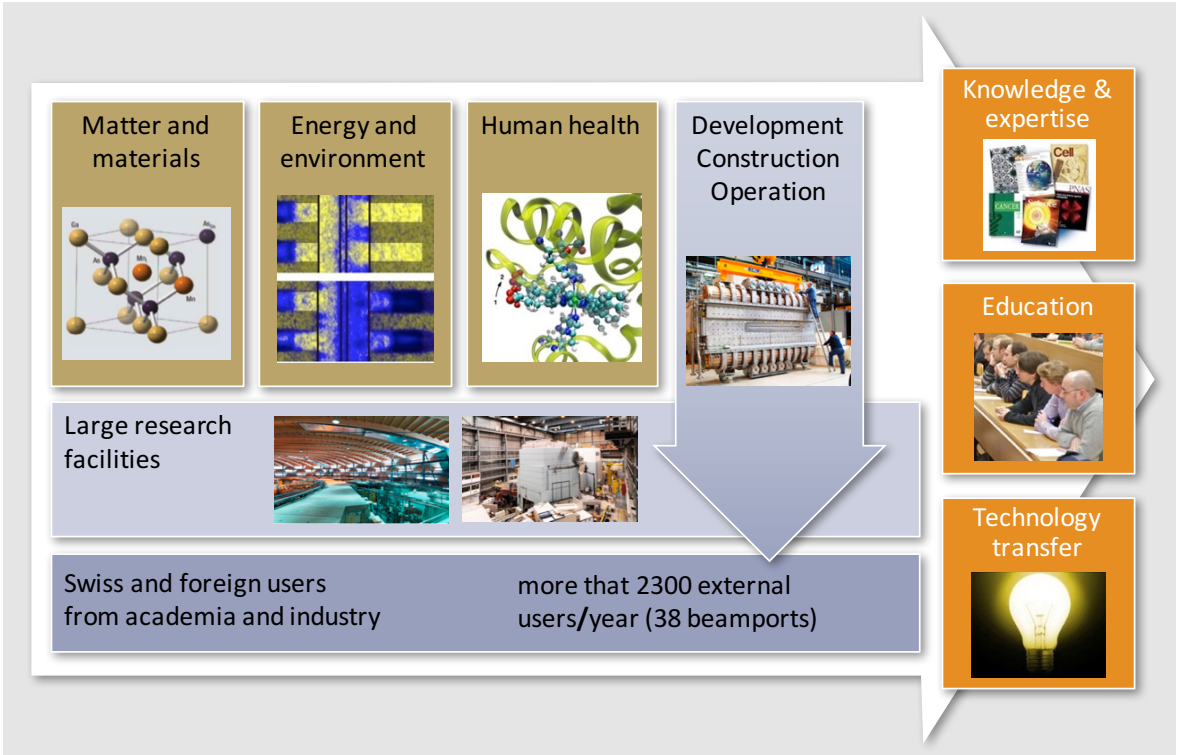
12% (11 %) of publications with impact factor > 7.4 in more than **40 (42)** different journals.

source: ISI Web of Knowledge analysis
only publications with PSI authors or co-authors

2015 (2014)

quantity, quality, breadth

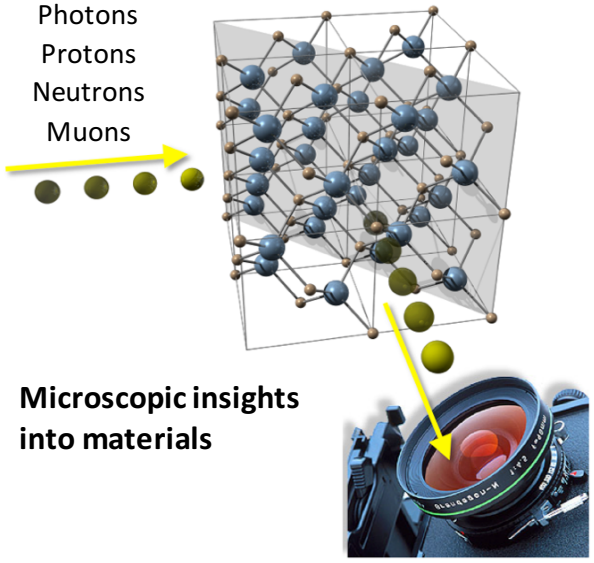
Our Mission



Large-scale facilities at PSI

Research at large-scale facilities

Photons
Protons
Neutrons
Muons



Microscopic insights into materials

Synchrotron Lightsource
Neutron Source
Muon Source

Strahllinien an der Synchrotron Lichtquelle Schweiz (SLS)

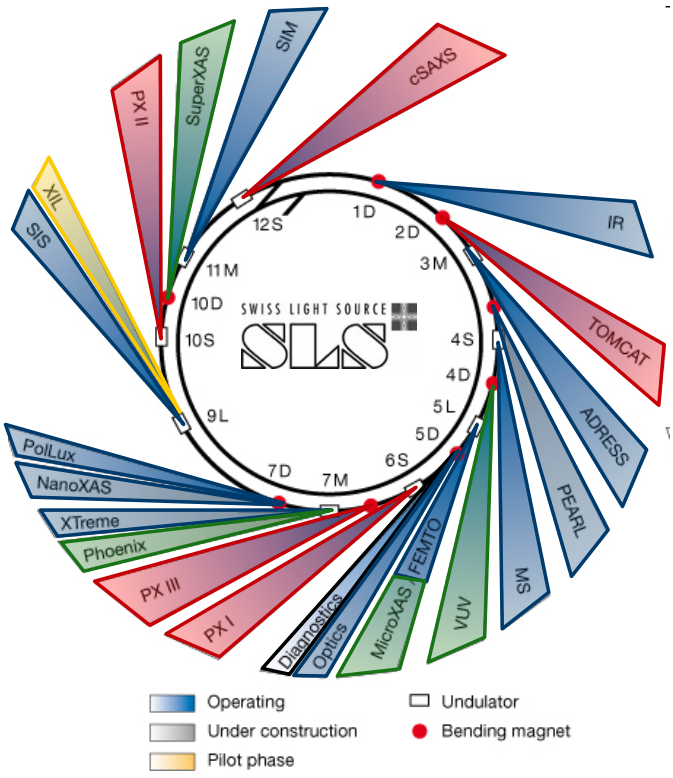
SYN
Synchr. Rad. & Nano-Techn.

LSB
Bioimaging & MX

LSC
Condensed Matter

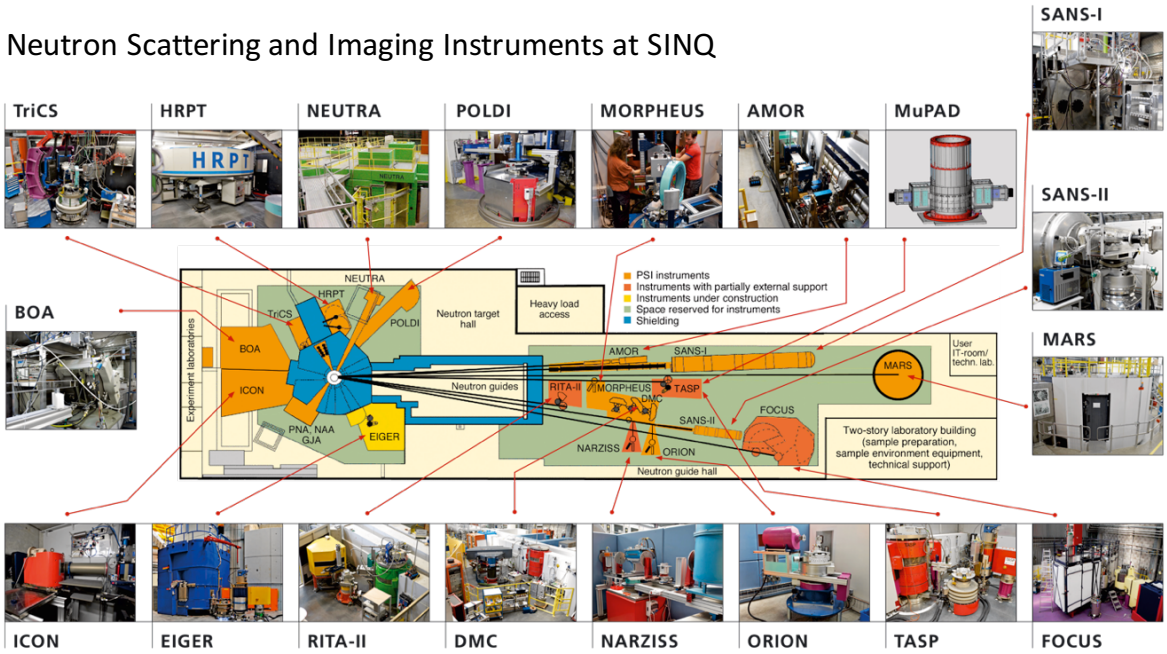
LSE
Energy & Environment

LMN
Micro- & Nano-Techn.



Instruments at Swiss Neutron Source SINQ

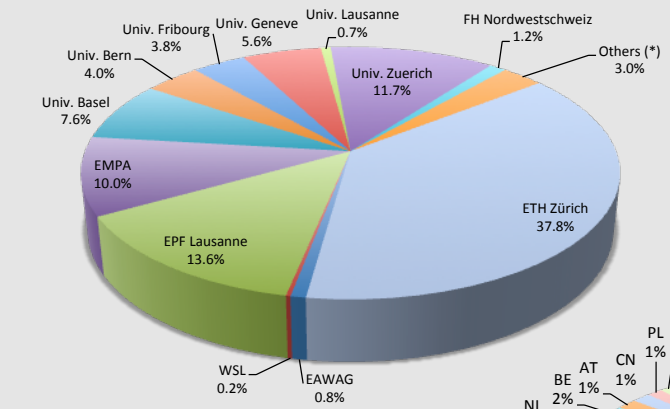
Neutron Scattering and Imaging Instruments at SINQ



Further Information: www.psi.ch/sinq/instrumentation

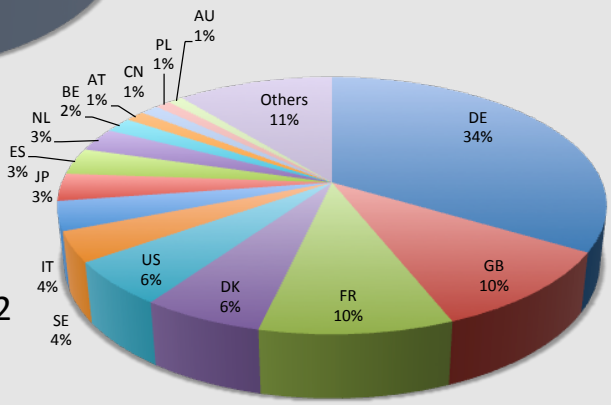
all instruments are open to the national and international user community

External users (w/o PSI) – academic research



(*): 17 further Swiss institutions < 0.5%

Switzerland ≈ 1/2



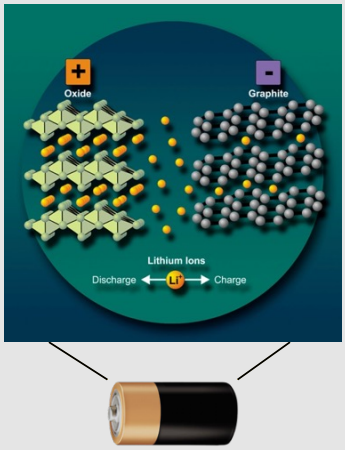
international ≈ 1/2
(EU: 82 %)

Nobel laureates at our large-scale facilities

Kobilka	(pre) & post	G protein-couples receptors, NPC2012	
Ramakrishnan	pre & post	structure & function of ribosom, NPC2009	
Yonath	pre & post	structure & function of ribosom, NPC2009	
Steitz	pre	structure & function of ribosom, NPC2009	
Hänsch	pre & post	laser spectroscopy, NPP2005	
Walker	post	Na+/K+-ATPase, NPC1997	
Ernst	pre & post	NMR, NPC1991	
Michel	post	photosynthetic reaction center, NPC1988	
Müller	pre & post	high-Tc superconductors, NPP1987	
Rubbia	post	weak interaction, NPP1984	

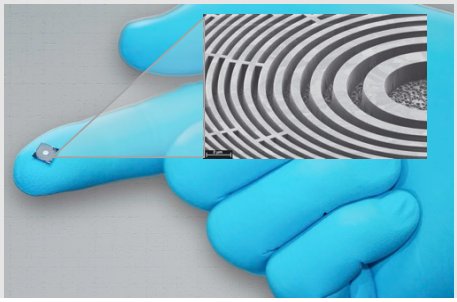
pictures:Wikipedia

Matter and Materials Research



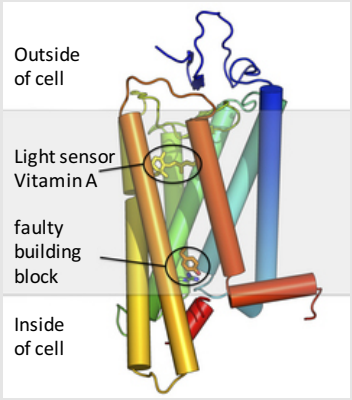
Development of new materials for lithium ion batteries to maximize the number of charge cycles.

Use of **myons** to determine the proton radius.

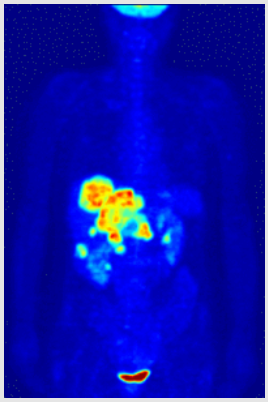


New **manufacturing techniques:** micrometer sized structures of a diamond lens.

Human Health



Structure of proteins
for the targeted development of new drugs



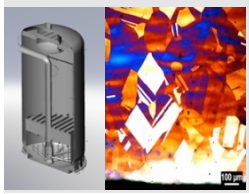
Radio pharmaceuticals
for the diagnosis of tumours

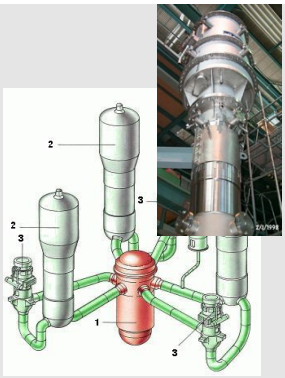
Proton therapy for
- destruction of tumours
- protection of healthy tissue

Energy research

Nuclear safety

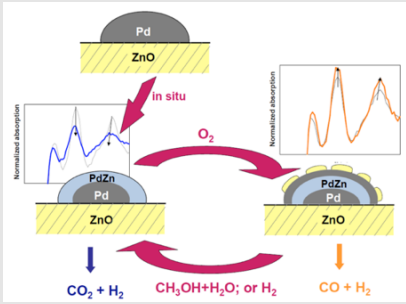
Understanding processes, monitoring materials ageing



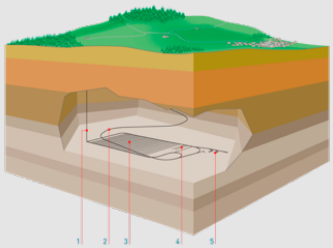


Catalysis

Understanding and better use of catalytical reactions

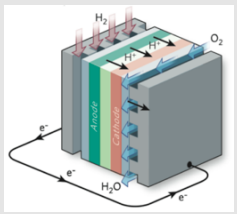


Deep geological disposal

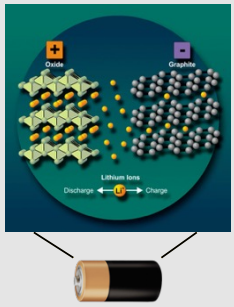


Understanding of interactions radionuclides and rocks/minerals

Electrochemistry

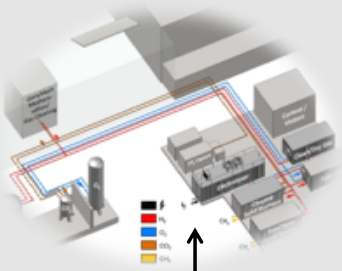


Fuel cells

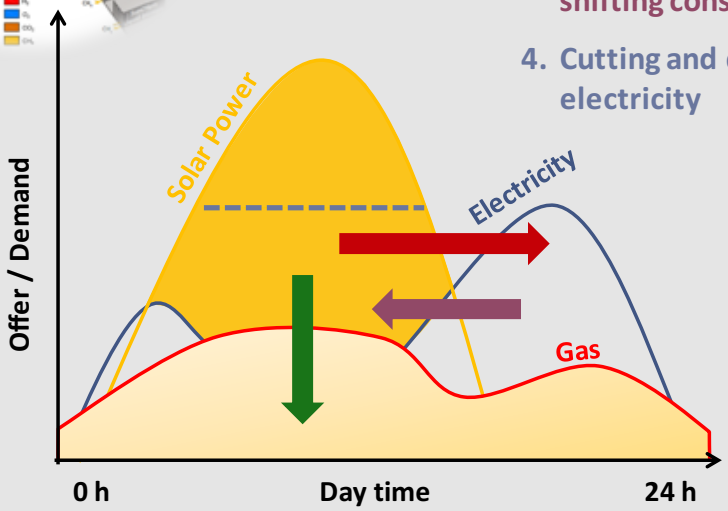


More efficient batteries

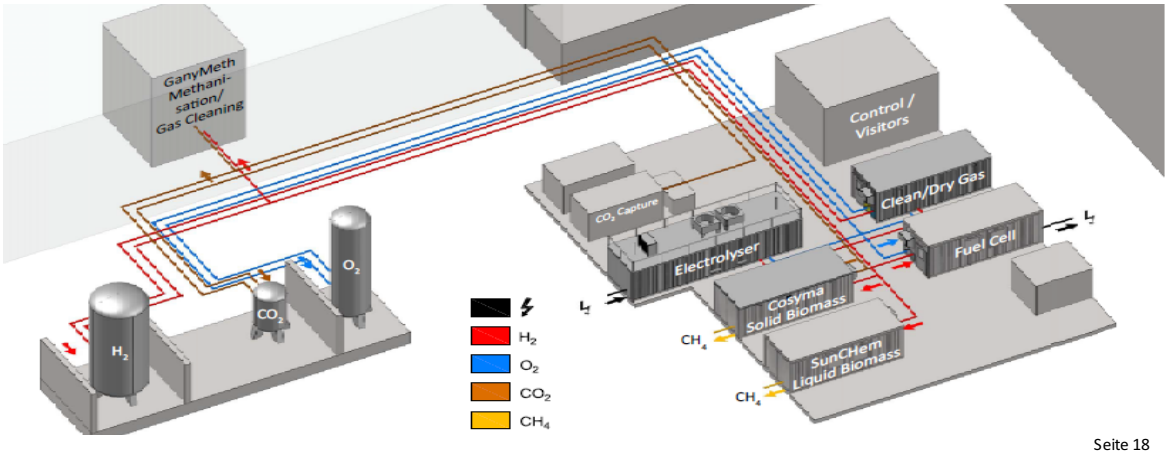
How to deal with intermitting energy sources ?



1. **Electricity storage for later use**
2. **Conversion of electricity to other energy forms**
3. **Controlling and temporally shifting consumption**
4. **Cutting and discarding surplus electricity**

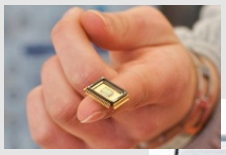


"Energy System Integration" Plattform ESI

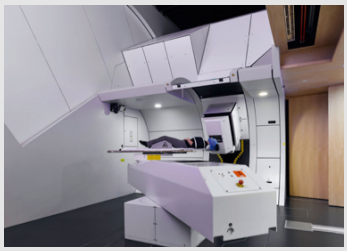


PSI technology inside!

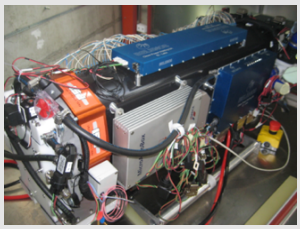
Detectors
State-of-the-art by DECTRIS



Electronics
Oscilloscope on a chip

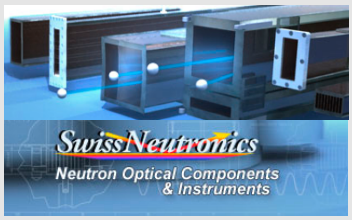


Accelerator technology
Dedicated medical cyclotoron (Varian)



Fuel cells
Components and system integration

Fast detectors/electronics
EIGER – next generation single-chip detector

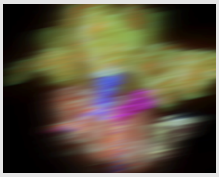


Neutron optics
Components by SwissNeutronics

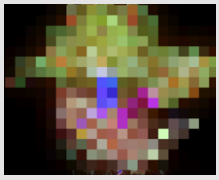
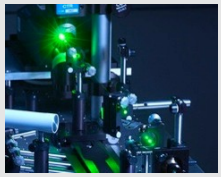
Member of SWITZERLAND INNOVATION

SwissFEL – a forefront research infrastructure for CH

Synchrotron light
fine, slow

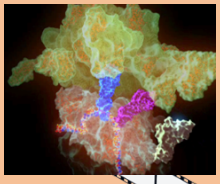



Optical laser light
coarse, fast

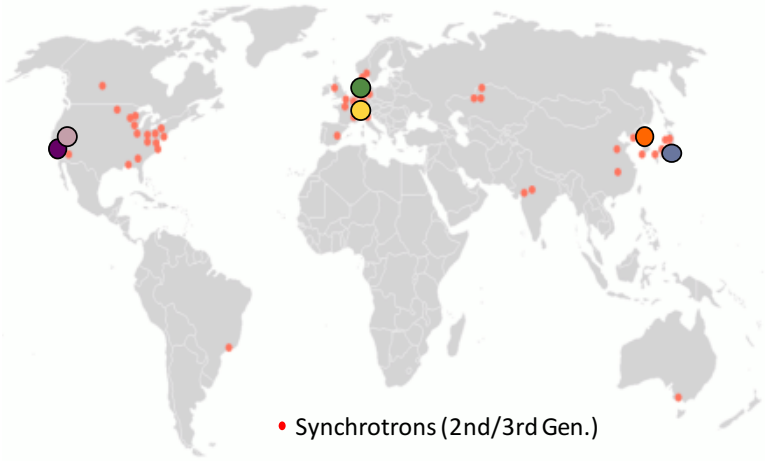



SwissFEL
fine **and** fast at extremely high intensity

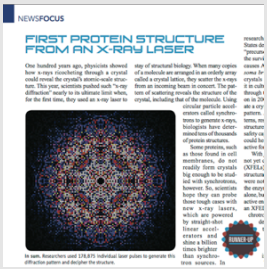

a national free-electron
x-ray laser for Switzerland


New, direct insights into physical, chemical and biological processes governing our everyday lives

X-ray Free Electron Lasers – worldwide



- LCLS, SLAC (USA) (since 2009)
- LCLS-2, SLAC (USA) (under studies)
- SACLA (Japan) (since 2011)
- European XFEL (Europa) (in construction, 2016)
- PAL XFEL (Südkorea) (in commissioning, 2016)
- SwissFEL (Schweiz) (in construction, 2016)


NEWSFOCUS

FIRST PROTEIN STRUCTURE FROM AN X-RAY LASER

Science
AAAS

Science Magazine considers XFELs as potential game-changers in structural biology!
called 1 of the 9 “Up-Runners” of 2012

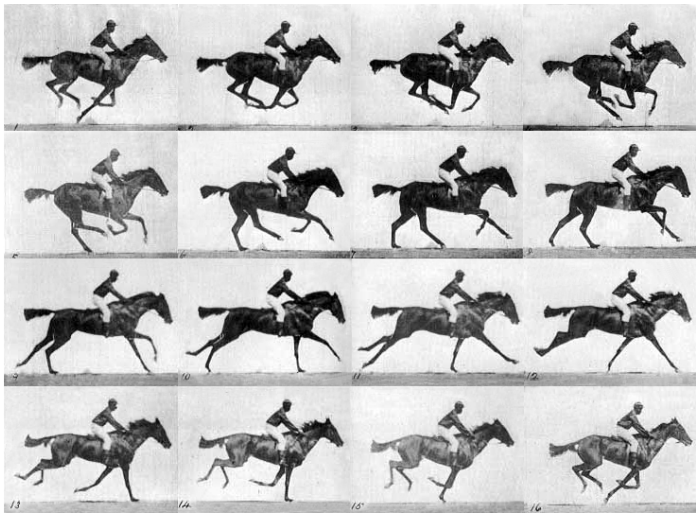
From molecular photography to molecular movies

TIME RESOLUTION

„today“

Louis Jacques Mandé Daguerre
Portrait of J.B. Sabatier-Blot, 1844
exposure: few minutes

„tomorrow“



Eadweard Muybridge
Running Horse, 1872
exposure: few milliseconds

Tailor-made drugs

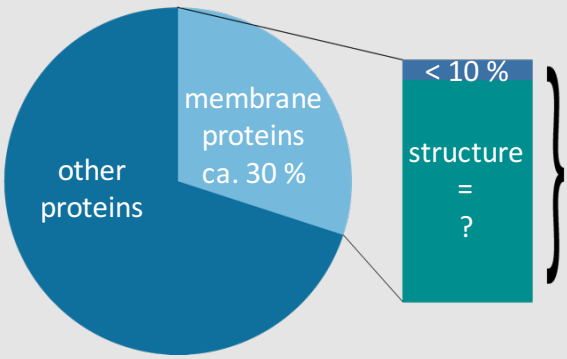
BRILLIANCE

Entrance of unwanted substances in a cell

The drug works like an accurately fitting plug

Highly efficient drugs

The knowledge of the Structure of membrane proteins will enable the production of tailor-made drugs in the future.

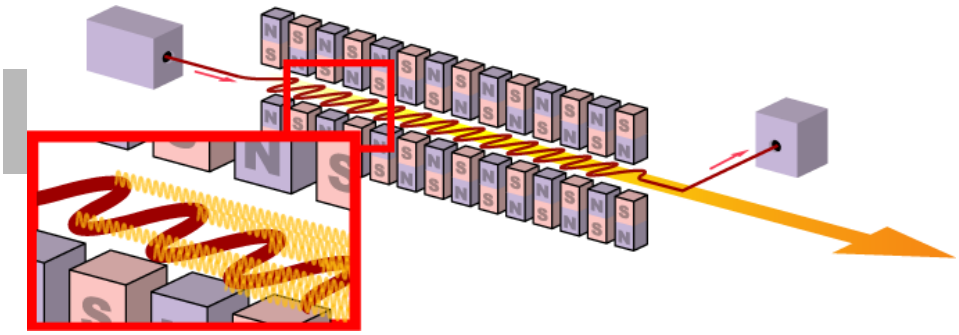


Today: only < 10 % of structures known (e.g. SLS)

SwissFEL will produce results for the development of highly efficient drugs

with SwissFEL very small crystals (< µm) can be measured.

principle and advantage of FEL lasing



SwissXFEL parameters

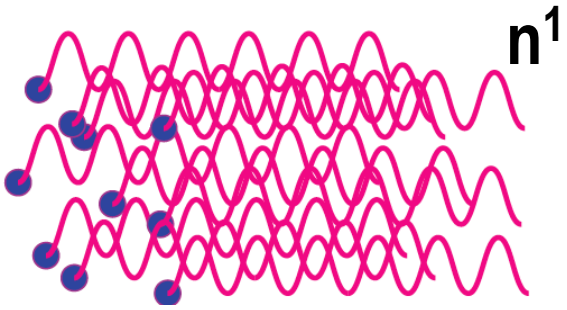
Wavelength 0.1..10 nm

Pulse duration femtosec.

Pulse energy 2 µJ – 50 µJ

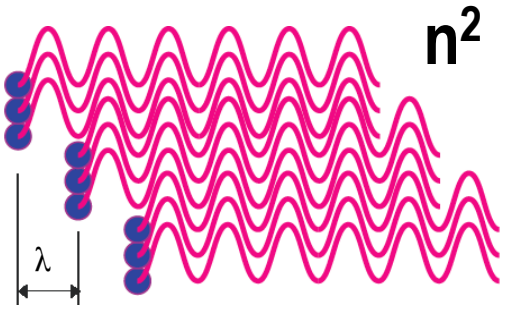
Repetition rate 100 Hz - 400 Hz

spontaneous incoherent



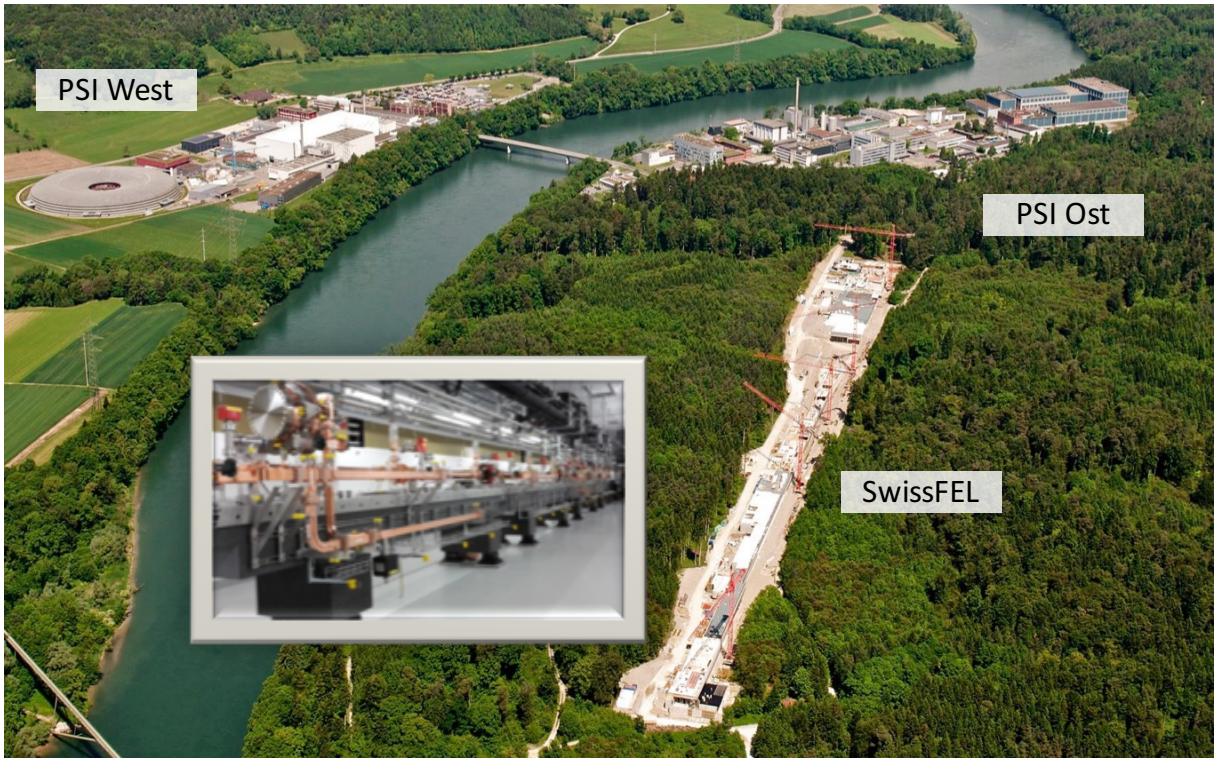
3rd generation light sources

Coherent (self-assembly)



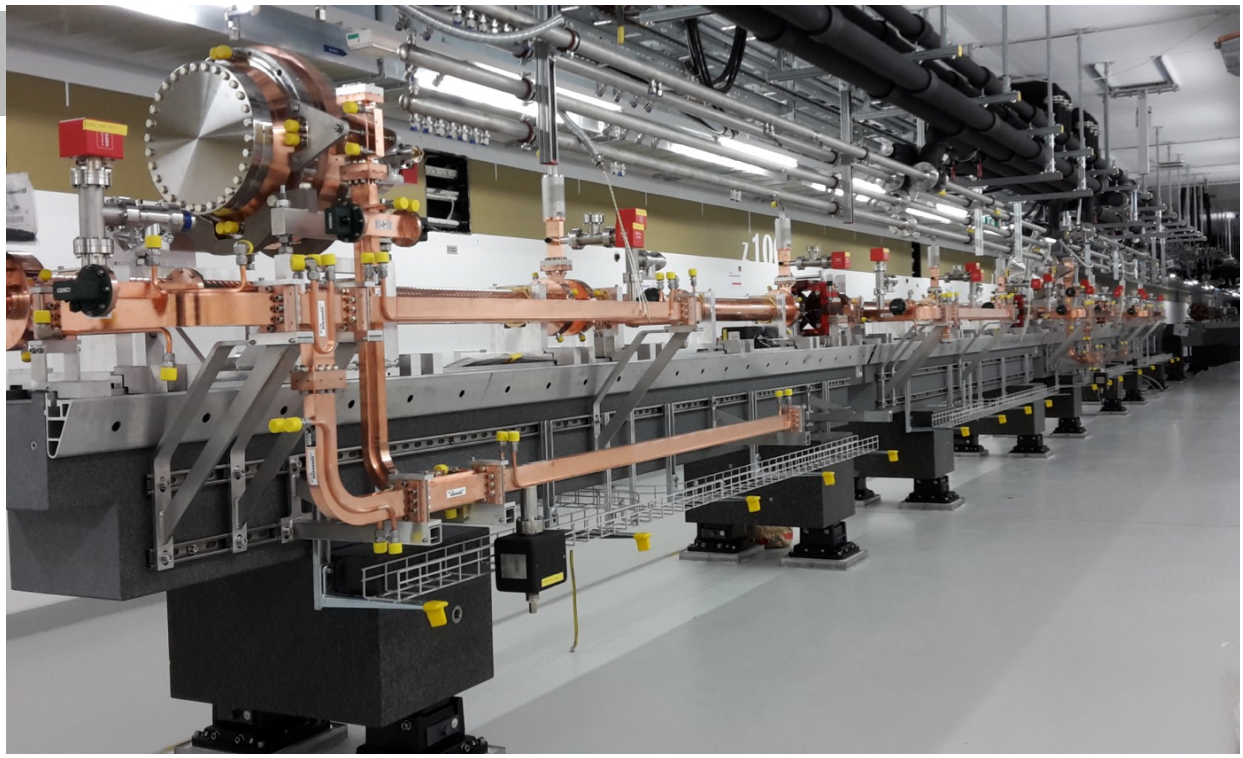
4th generation light sources (FELs)

SwissFEL / commissioning in 2016 / users 2017



C-Band Linac Modules in SwissFEL Tunnel

presently 48 out of 104 accelerating structures installed



First users of SwissFEL

PSI serving “ locally ” & “ globally ” research and industry

SwissFEL 2016