

PAUL SCHERRER INSTITUT

PSI



Summer Students – Introduction to PSI

Christian Rüegg :: Director :: PSI

PAUL SCHERRER INSTITUT



### 2024 lecture programme

Lectures will typically have a length of 45 minutes. Some of them will be followed by a visit of the laboratories. Coffee and Gipfeli will be served 30 minutes before the lectures in the WHGA foyer.

Date	Time	Location	Topic(s)	Speaker(s)
02.07.2024	10:00	OSGA/EG6b (Coffee afterwards in OASE)	Introduction to PSI Welcome from the PhD and postdoc association Welcome from the sports club	Christian Ruegg Natan Garrivier Ben Martin
03.07.2024	10:00	WHGA/001	SwissFEL	Christoph Bostedt
10.07.2024	10:00	WHGA/001	BIO	Jörg Standfuss
17.07.2024	10:00	WHGA/001	Particle Physics	Klaus Kirch
24.07.2024	10:00	WHGA/001	Proton therapy	Tony Lomax
31.07.2024	10:00	WHGA/001	Scientific Computing Theory and Data	Andreas Läuchli
07.08.2024	10:00	WHGA/001	Life of a PhD student at PSI	Arnau Alba Jacas, Renato Bellotti

### 2024 social activities and lightning talks

Date	Time	Location	Activity
24.07.2024	17:00	Outside OASE	Barbeque
31.07.2024	14:00	WHGA/001	Lightning talks by summer students (followed by apéro)
07.08.2024	14:00	WHGA/001	Lightning talks by summer students (followed by apéro)

**PSI SUMMER  
STUDENT  
PROGRAMME  
JULY 2 - AUGUST  
7,  
2024**

<https://www.psi.ch/en/summerstudents>







**eawag**  
aquatic research

### 1423 People in Education

842 PhD students  
399 Postdocs  
182 Apprentices

### 18553 Hours in Teaching and Practical Training

### 736 Mio CHF Budget

521 Mio CHF Public (Base) Funding  
118 Mio CHF Science Funding by Agencies  
97 Mio CHF Contracts with Industry Partners

### 151 Professors

79 at ETHZ + EPFL  
38 at Swiss Universities  
34 at Universities abroad

### 3923 Employees

1945 Scientists  
1474 Technical Staff  
504 Admin Staff



**ETH DOMAIN**

### THE FOUR RESEARCH INSTITUTIONS IN NUMBERS...

### Large Research and TT Facilities

SLS, SwissFEL, SINO, SpS, CHRISP, ESI, NEST, move

### National Tasks\*

National Forest Inventory, National Air Pollution Monitoring Network, Ecotox Centre, Center for Proton Therapy at PSI (CPT)

### 13 Sites in 9 Cantons

AG, BE, GR, LU, SG, TI, VD, VS, ZH

\*only a representative selection

### 1652 externally funded Science Projects

483 from SNF  
215 from EU  
94 Innosuisse  
860 from other sources

### 2741 Contracts with Industry Partners

352 Research Projects  
242 Licences  
2147 Customer Orders and Scientific Services



**Empa**

Materials Science and Technology



PAUL SCHERRER INSTITUT





# Paul Scherrer Institute – ETH Domain

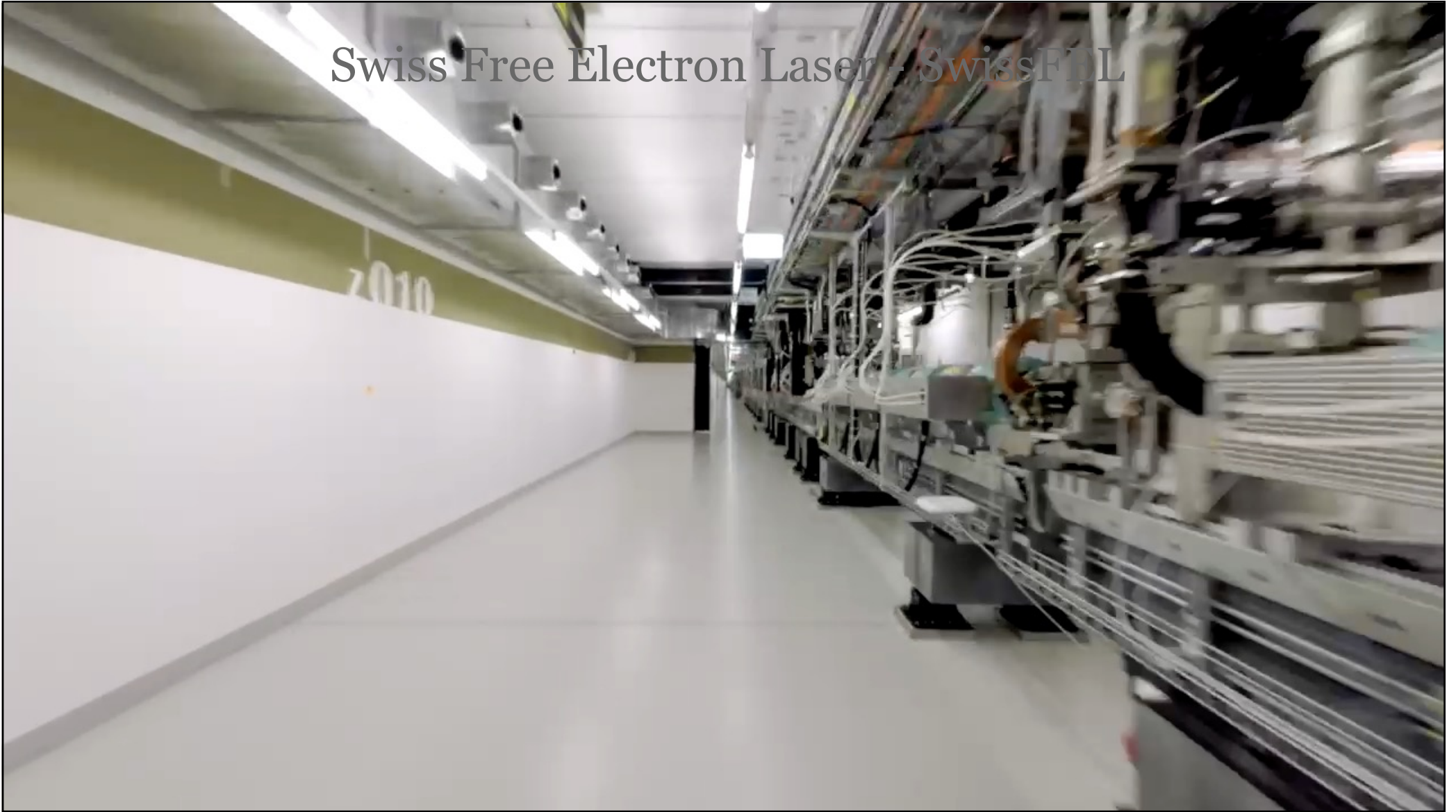
**ETH** zürich

**EPFL**





# Swiss Free Electron Laser - SwissFEL







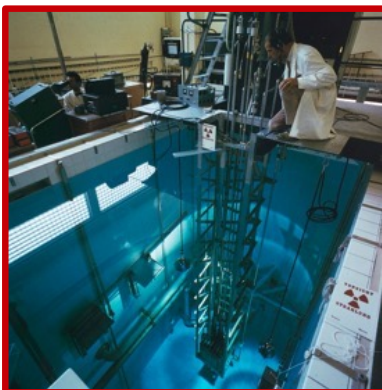
# Paul Scherrer Institute – ETH Domain

<b>ETHZ</b> Swiss Federal Institute of Technology Zurich  	<b>EPFL</b> Swiss Federal Institute of Technology Lausanne  	<b>PSI</b> Paul Scherrer Institute  	<b>Empa</b> Swiss Federal Laboratories for Materials Testing  	<b>WSL</b> Swiss Federal Research Institute for Forestry, Snow and Landscape  	<b>Eawag</b> Swiss Federal Institute of Aquatic Science and Technology  
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PSI funds (global budget)	280	MCHF
External funding	110	MCHF
Staff (PSI and affiliated)	2500	
• Professors at ETH, EPFL, universities	64	
• Engineers and technicians	1000	
• Postdocs, PhD students, apprentices	720	
External users: people / visits	2400 / 4900	per year
Number of scientific publications	1400	per year
Patient visits (proton therapy treatment)	6300	per year



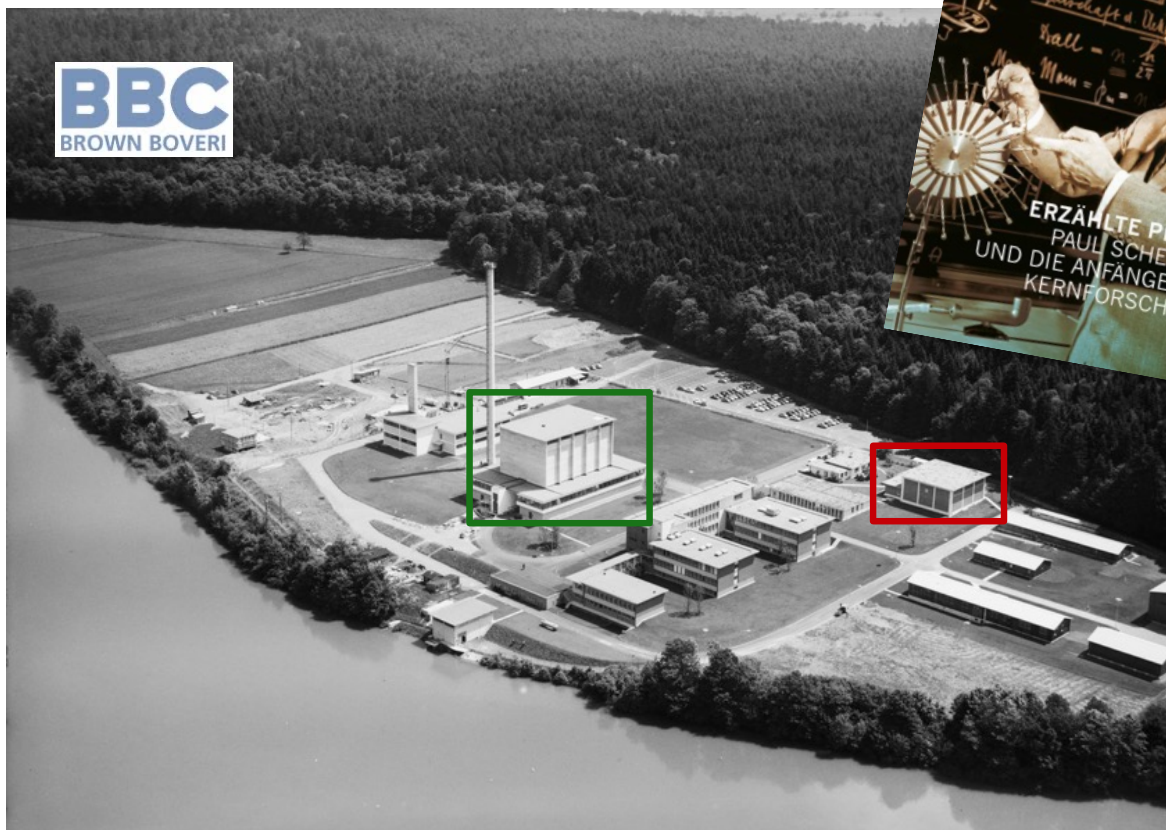
# The Start: EIR in 1960



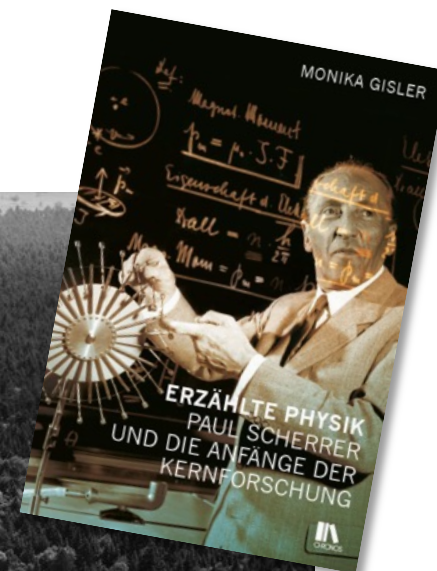
SAPHIR (1957–1993)



DIORIT (1960–1977)



Eidgenössische Institut für Reaktorforschung (EIR, now PSI Ost), ca. 1960





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PSI



Misson and Science Program



FUNDAMENTALS  
OF NATURE

ENERGY AND  
CLIMATE

ACCELERATORS  
from  
conception  
to data

▶ EXCELLENCE IN SCIENCE  
AND TECHNOLOGY

▶ WORKFORCE  
OF THE FUTURE

▶ INNOVATION

▶ BIG MACHINES FOR SCIENCE  
AND INDUSTRY

FUTURE  
TECHNOLOGIES

HEALTH  
INNOVATION

LARGE SCALE ENGINEERING AND PROJECT REALISATION

TECHNOLOGY TRANSFER, INDUSTRY COLLABORATION

**ETH** zürich

**EPFL**

PAUL SCHERRER INSTITUT

**PSI**

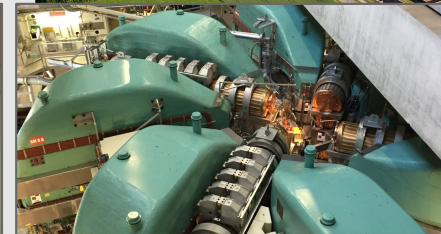
**Empa**

Materials Science and Technology



**eawag**  
aquatic research 000

ETH DOMAIN



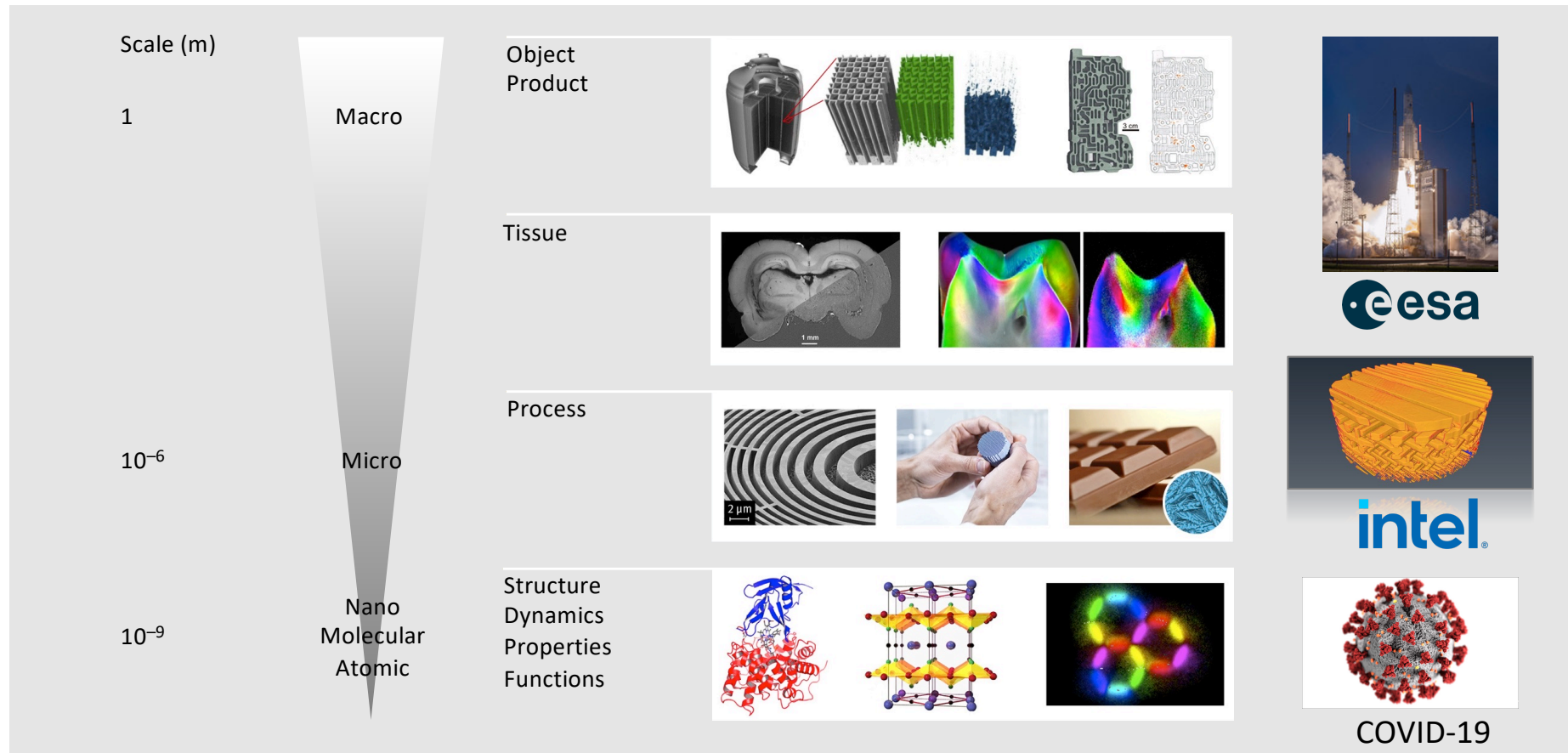
## What is **Matter** ?

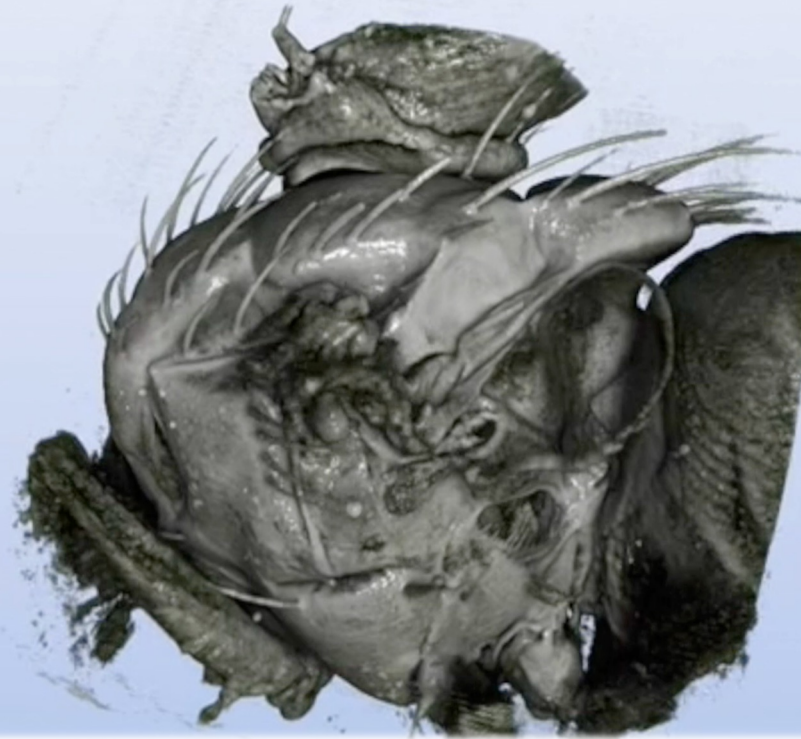
Subatomic insights through particle collisions

## What are the **Materials** properties ?

Particles allow microscopic insights explaining materials' properties







R. Mokso *et al.*



# Studying “Materials” – X-ray Tomography

## 22-nm & 100-nm Intel processor

Holler *et al.*

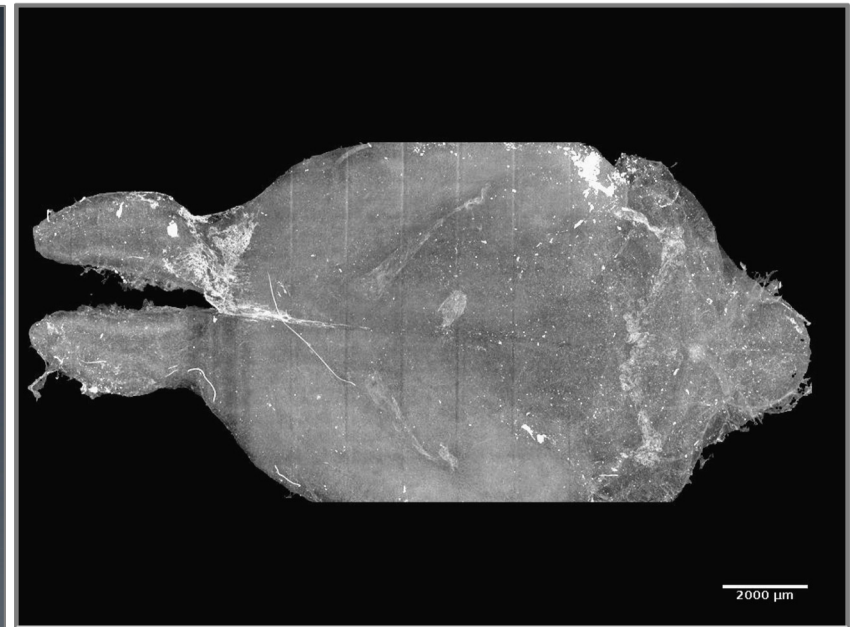
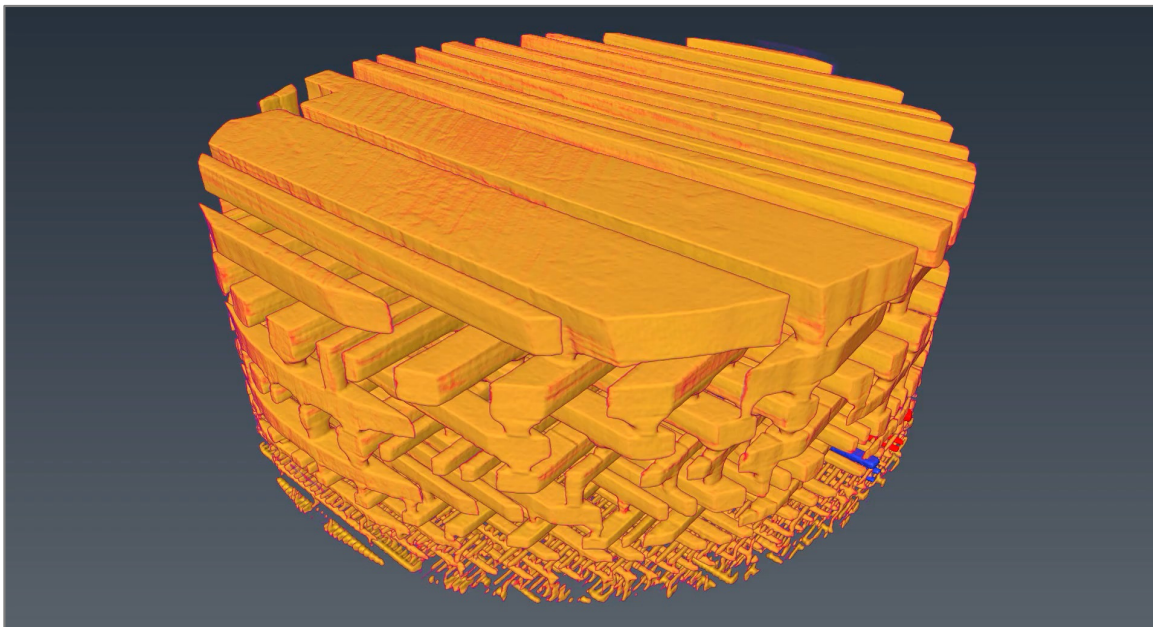
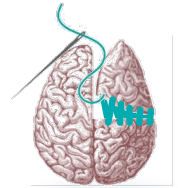


## 3D mouse brain

Miettinen *et al.*



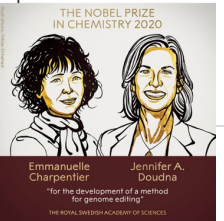
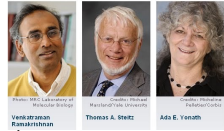
Human Brain Project



5000 μm

# Health Innovation – Protein Crystallography

The Nobel Prize in Chemistry 2009  
"for studies of the structure and function of the ribosome"



- 2/3 academic research 1/3 proprietary research
- 1000 users, 4000 publications
- 8000 protein structures
- Nobel highlights
- 9 industry beamline partners

NOVARTIS

Roche lead:pro

PROTEROS REACH RIGHT FASTER idorsia

MAX-PLANCK-GESSELLSCHAFT CRELU a WuXi AppTec company

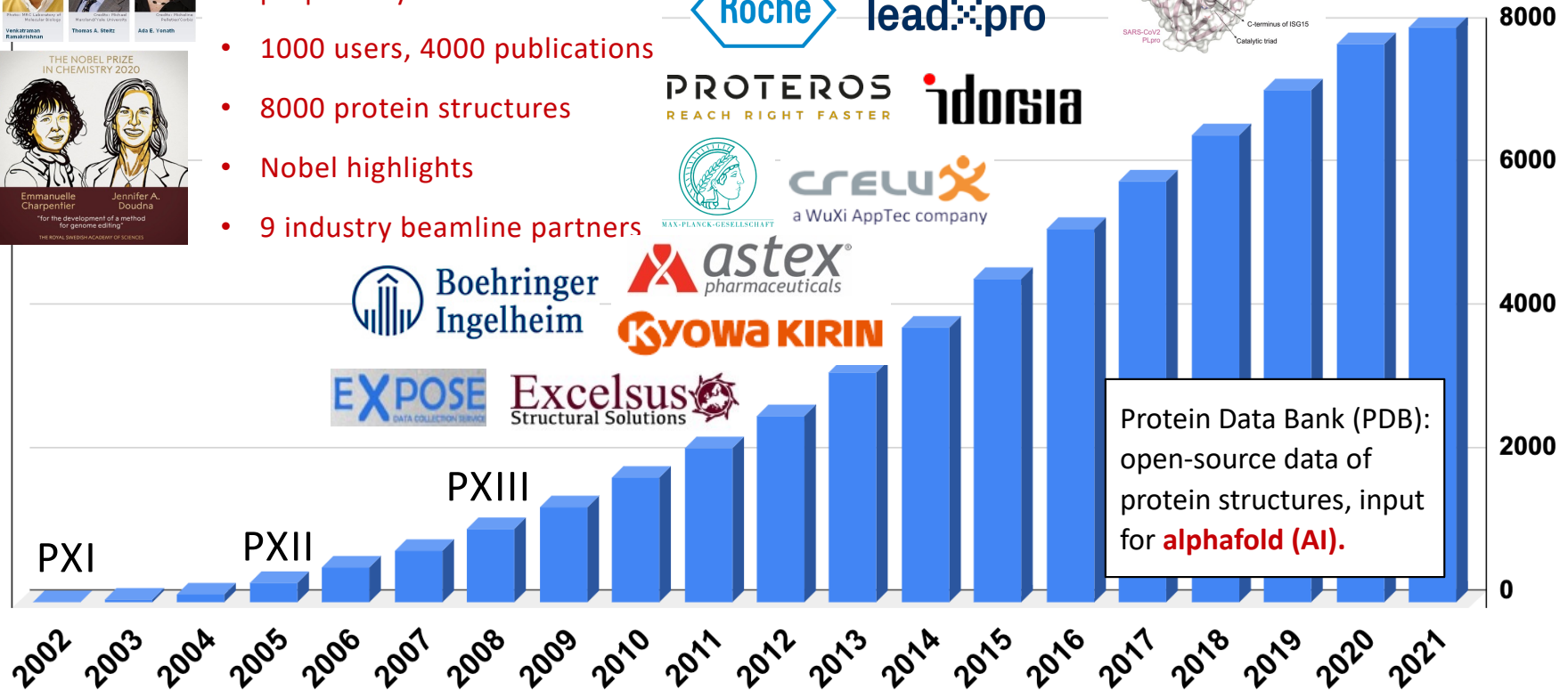
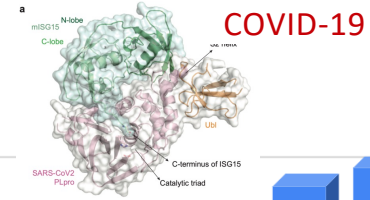
Boehringer Ingelheim

astex pharmaceuticals

KYOWA KIRIN

EXPOSE DATA COLLECTION SERVICE

Excelsus Structural Solutions



Protein Data Bank (PDB): open-source data of protein structures, input for **alphafold (AI)**.



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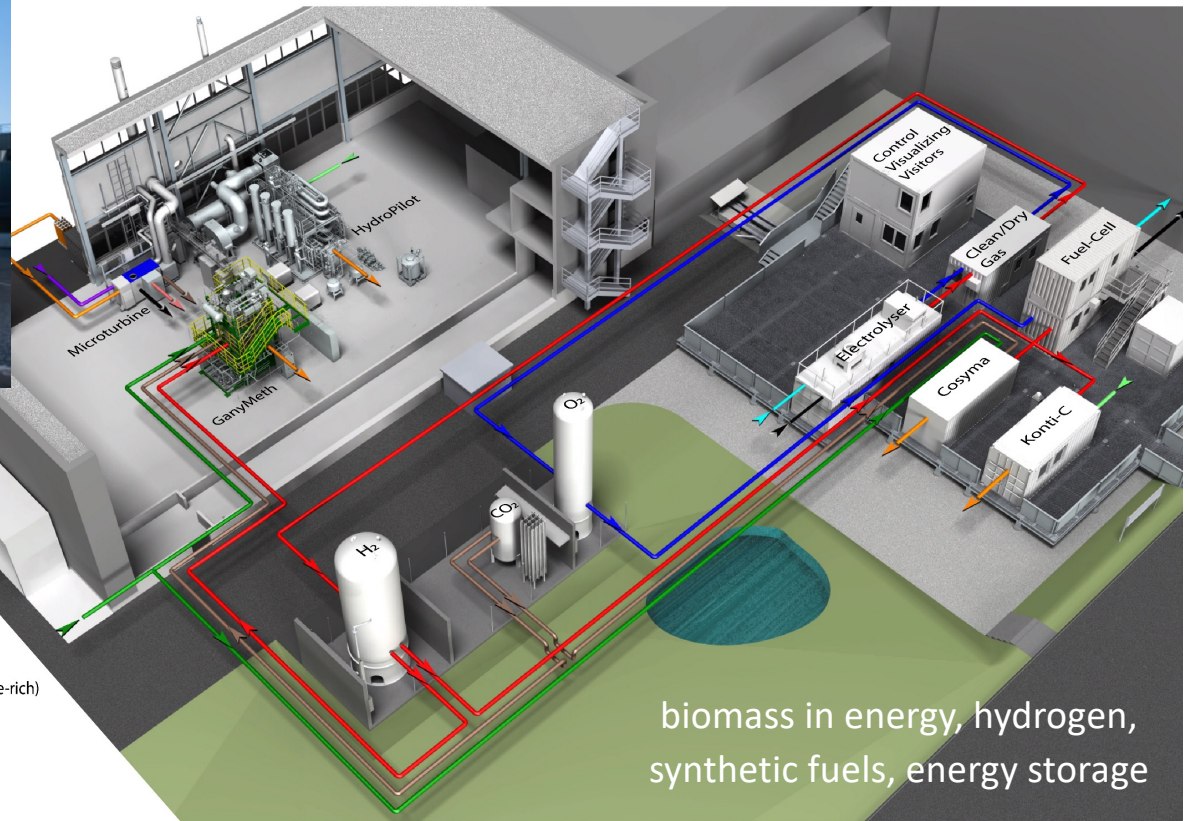
**Empa**

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**eawag**  
aquatic research

ETH DOMAIN



## CGES

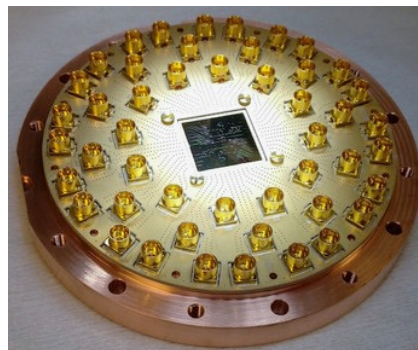
Coalition for Green  
Energy and Storage  
1 MW Pilot Plants  
ETH, EPFL, PSI, Empa  
> 35 Companies  
3 Cantons



## Scientific Computing, Data Science and Quantum Technologies

Large-scale simulations, modeling, and data science became an integral part of nearly all fundamental and applied science projects.

- **Computational material science, chemistry and biology are a huge opportunity.**  
=> **New Division for Scientific Computing, Theory and Data.**
- **Quantum Computing and Machine Learning/AI are new, disruptive technologies.**  
=> **ETH-PSI Quantum Computing Hub** and **PSI Hub of the Swiss Data Science Center**



EPFL

SDSC

ETH zürich

CSCS

MARVEL




NATIONAL CENTRE OF COMPETENCE IN RESEARCH

UNI  
FR



PSI, 17 May 2022



 Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra  
Swiss Confederation

 **ETH-BEREICH**

## First ESA Competence Center in Switzerland

**Use-Inspired Research. Topics defined by ESA:**

Materials (**PSI** and **Empa**), Quantum (**ETHZ**), Data (**EPFL**), Sustainability (**EPFL**) and further topics (e.g. with partners like UZH).

Access to **large-scale facilities** and **electronics testing at PSI**.

**Vision:** ESA Center and European space industry in Switzerland. Larger CH shares of large ESA (science) missions.

**Start:** Q1 2024



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Large-scale Research Infrastructure Projects





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# Swiss Light Source SLS

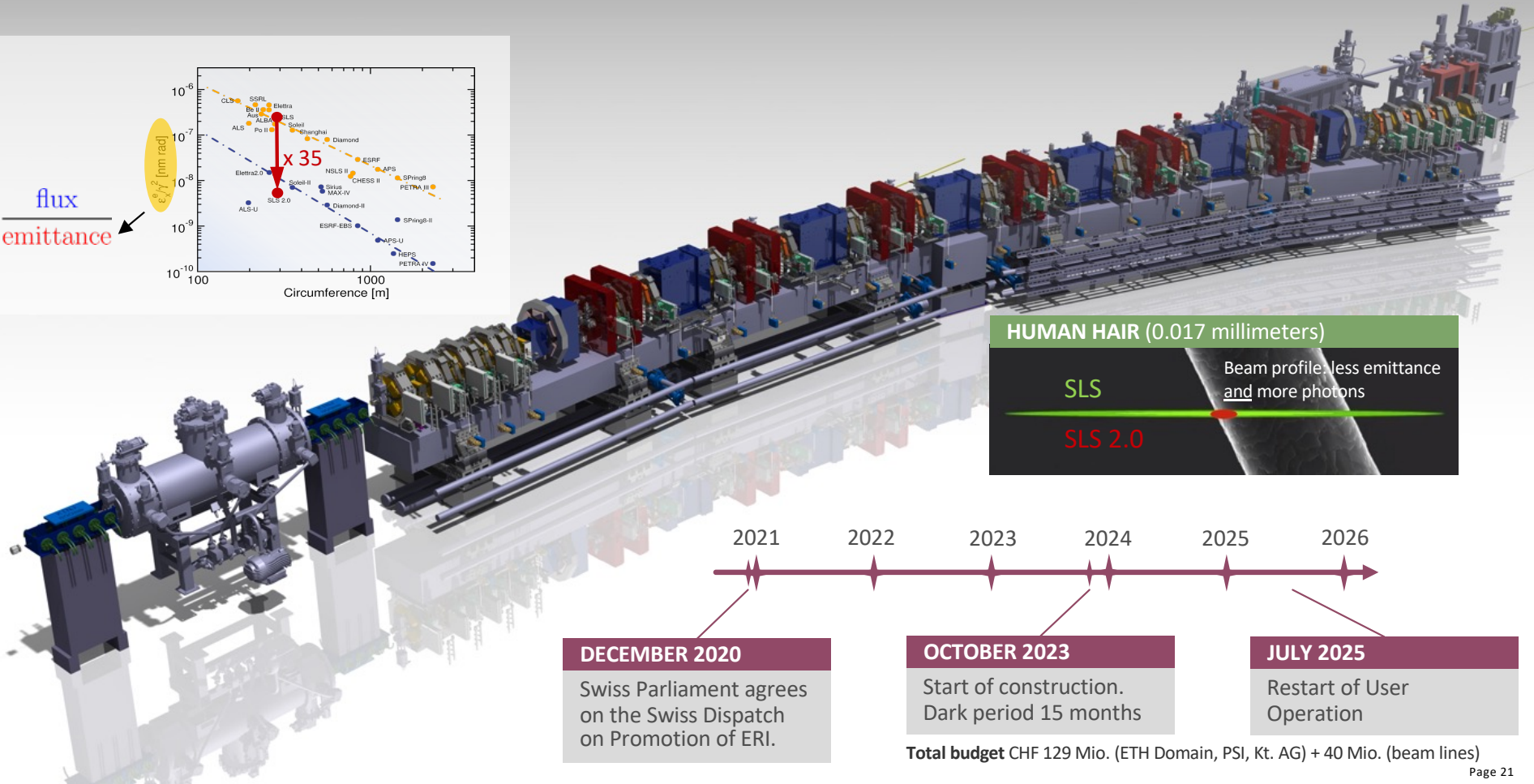
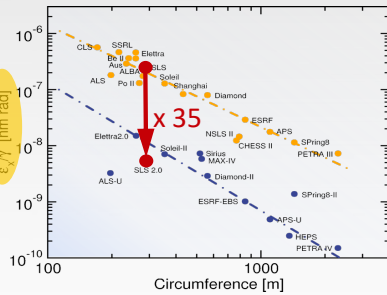




# SLS 2.0: The success story continues

$$B = \frac{\text{flux}}{\text{emittance}}$$

Brilliance



**HUMAN HAIR (0.017 millimeters)**

SLS

SLS 2.0

Beam profile: less emittance and more photons



**DECEMBER 2020**  
Swiss Parliament agrees on the Swiss Dispatch on Promotion of ERI.

**OCTOBER 2023**  
Start of construction. Dark period 15 months

**JULY 2025**  
Restart of User Operation

**Total budget** CHF 129 Mio. (ETH Domain, PSI, Kt. AG) + 40 Mio. (beam lines)



PAUL SCHERRER INSTITUT



PSI offers a world-wide unique combination of large-scale facilities and technology platforms for a broad range of research and development in science and medicine, education and collaboration with industry. **High-tech Infrastructure for science and innovation. Accessible to the World!**

Own science and technology program and the combination with world-leading schools EPFL and ETH is a huge **know-how** and **talent pool**.

**Park Innovaare** of Switzerland Innovation is a new innovation park connected directly to the institute. **Fantastic opportunities for intense collaboration with industry.**