
Frithjof Nolting :: Head of LSC :: Paul Scherrer Institut

# Status PSI CB&TP

SFA-AM review meeting 8. February 2023

## Imaging and Diffraction Platform for Advanced Manufacturing and Industrial Processing

In this project, we upgrade the characterization capabilities for advanced manufacturing in particular at the Neutron, the Synchrotron and the Muon facility at PSI, but also for additional characterization.

**Investment in new technology platforms**

- The focus is to improve the performance of existing beamlines by developing new or enhancing existing detectors and improving the sample environment (MS, microXAS, SIM, Poldi, MIXE)
- Fully open to users (via proposal system)
  - Context: SLS 2.0 upgrade

**Financing of key staff to operate and maintain the technology platforms**

- Personal for engineering work, imaging and diffraction data analysis and for support of industrial related activities in advanced manufacturing (Poldi, Tomcat)
- Support of users, method developments and industry projects
  - Follow up: ANAXAM AM-TTC

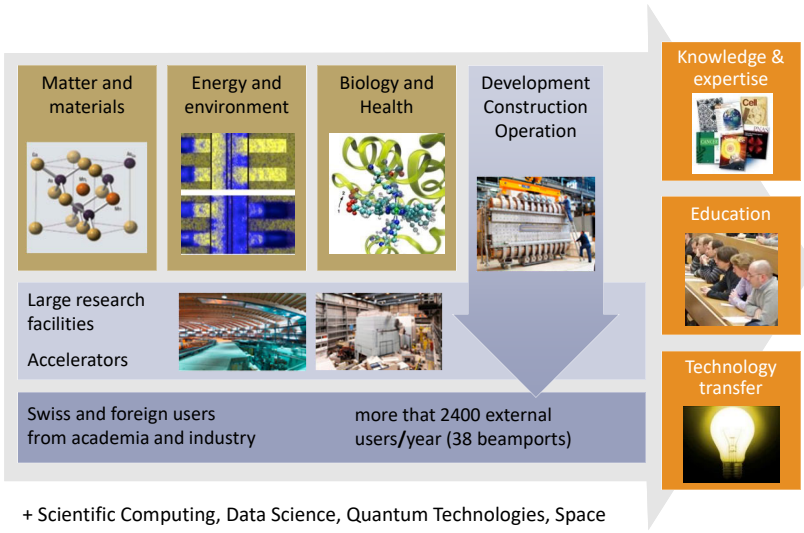
**Co-financing of new professorships**

- Joint group between PSI and EPFL

***In the following some examples will be presented***

## Paul Scherrer Institute – ETH Domain


## PSI Mission




Staff: 2200 PhD/Postdocs/Apprentices: 720 Patients visit: 6300/year

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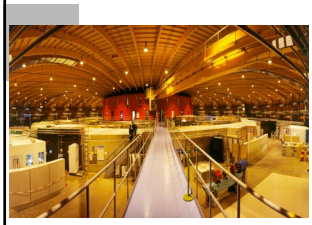
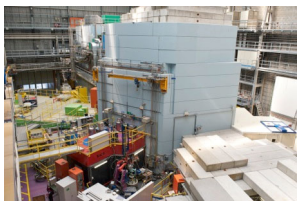
# PSI offers three probes on one campus

Ideally suited for: solid state physics, soft condensed matter, chemistry, biology, materials science….



**SLS: synchrotron X-rays**
- 3rd generation synchrotron
- electron energy: 2.4 GeV
- operational: since 2001
- beamlines: 16



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- spallation neutron source
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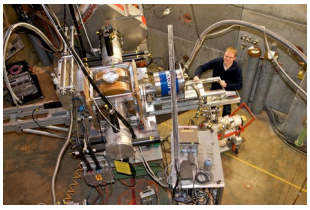

**SmS: m-SR facilities**
- world's most intense continuous muon source
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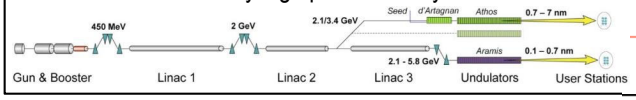
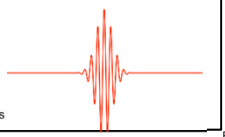
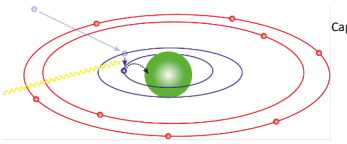


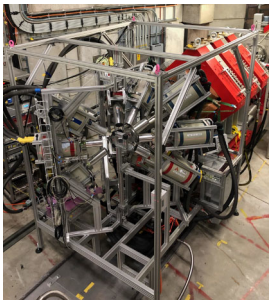


# Muon-Induced X-ray Emission (PSI + EMPA)



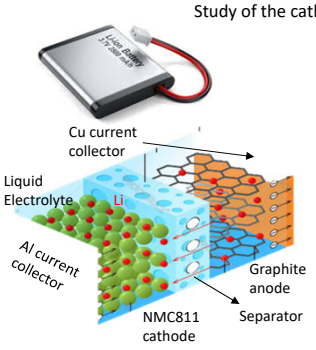
Capture of the muon by an atom and X-ray emission during ist cascade

**Investment:**
**H**igh-energy X-ray detector

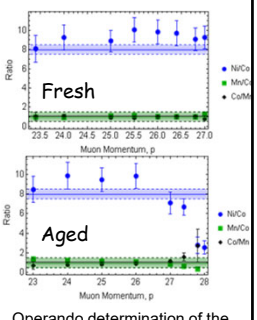


MIXE instrument GIANT (campaign 2022)

**Example of application:**
Study of the cathode degradation in Li-ion battery




NMC811: $Ni_{0.8}Mn_{0.1}Co_{0.1}O_2$




Operando determination of the depth-dependent elemental ratio

Empa - Lab Materials for Energy Conversion/ group Structure and Dynamics Arndt Remhof

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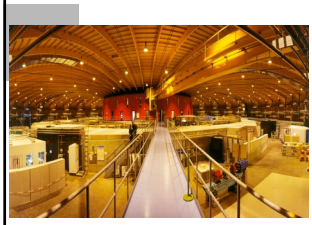

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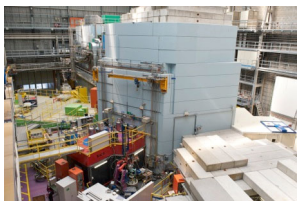

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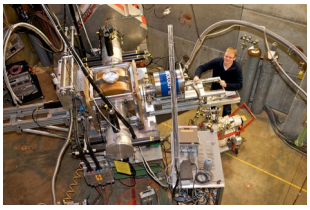

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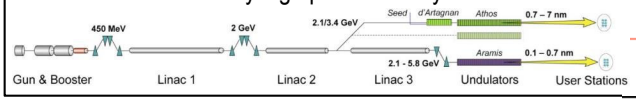
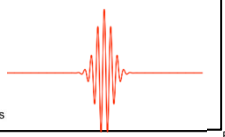


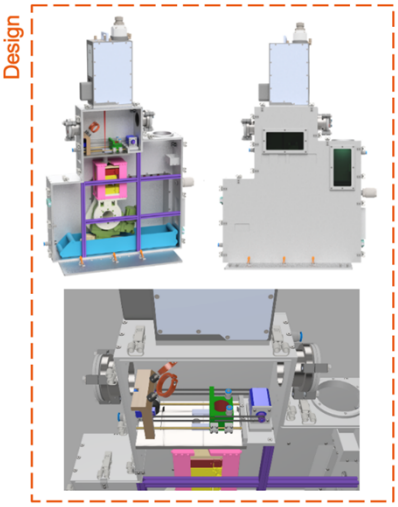





## Investment in POLDI (SINQ) - The n-SLM machine

SLM machine for operando and in-situ AM studies in neutron beam (POLDI)

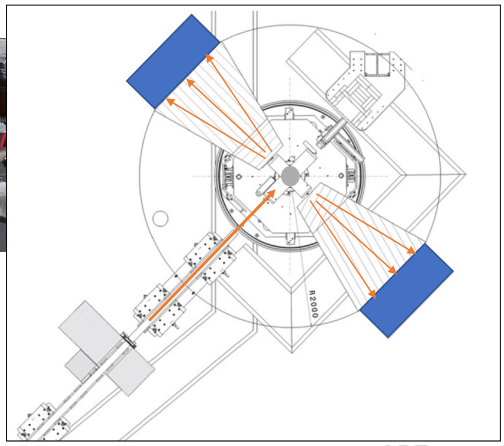
Design



Reality

## Investment in POLDI (SINQ) - Engineering support for new development

**POLDI 1.2**


anaxam
analytics for advanced manufacturing

IFE
Institute for Energy Technology

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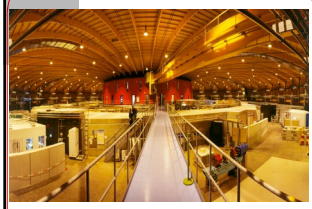

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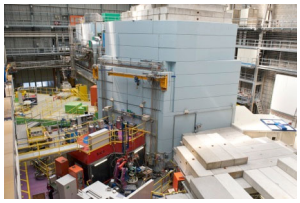

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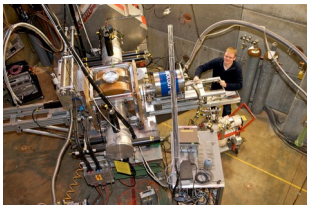

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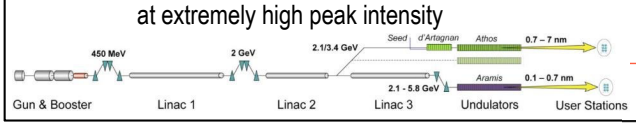


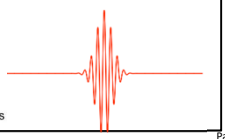

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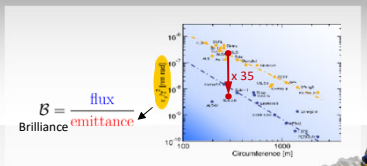
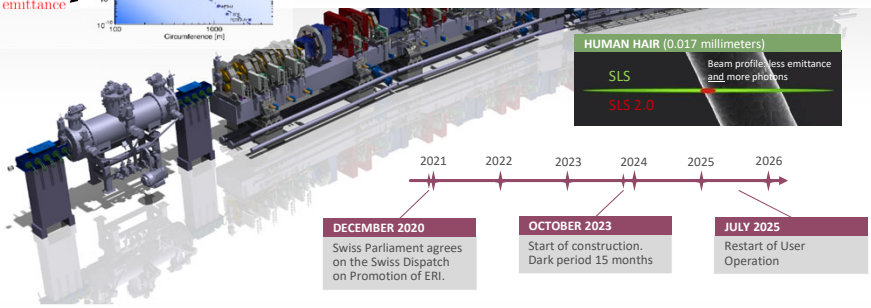
# SLS 2.0: upscaling Swiss Light Source




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



**HUMAN HAIR** (0.017 millimeters)

SLS — Beam profile less emittance and more photons

SLS 2.0

2021 2022 2023 2024 2025 2026

**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

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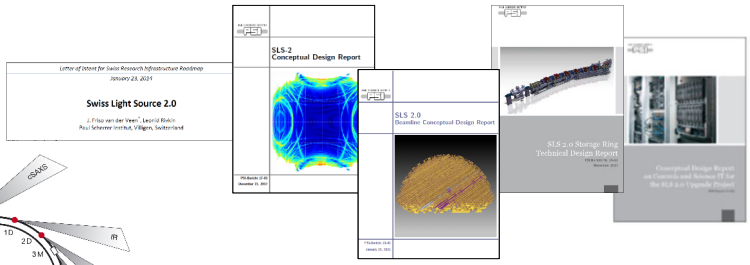
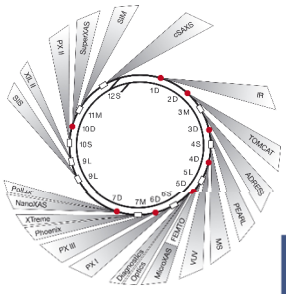
# SLS 2.0 – time line




**Phase 0**
SIM
Debye
PX III
MS
S-TOMCAT

**Phase 1**
I-TOMCAT
PX I
PX II
cSAXS
SuperXAS
PolLux/ISS
Optics/diagnostics

+

**Phase 0**
SIM
Debye
PX III
MS
S-TOMCAT

**Phase 2**
XIL
RIXS
SX-ARPES
microXAS
X-Treme / PHOENIX
VUV
QUEST (SIS & PEARL)
Install 5-T SBs

2020 2021 2022 2023 2024 2025 2026 2027 2028

storage ring lattice defined

SLS 2.0 funding secured

start dark time

tunnel closure

User operation

Shut down

re-start user operation

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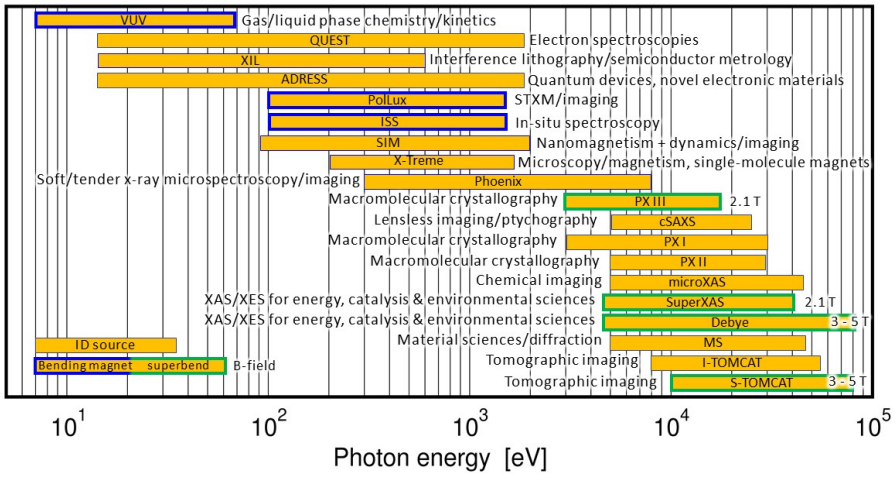
## SLS 2.0 new, better beamline portfolio




SFA-AM Investments at MS, microXAS, SIM, and Tomcat



## Technology Transfer Center ANAXAM

a analytics n with neutrons a and x x-ray for a advanced m manufacturing

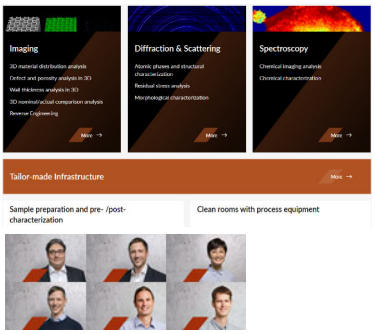
Advanced Manufacturing

Our mission

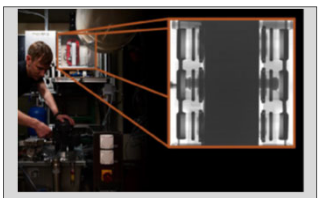
We provide industry access to cutting-edge material analytics originally developed for basic research, but now made available to address industrial challenges.


Our vision

Advanced analytics for the products and processes of tomorrow





"Working with ANAXAM, who created the tailor-made test bench, and in combination with neutron imaging, we were able to investigate non-destructively the micro-movements of the brake components."
Audi Sport GmbH

Main sponsors

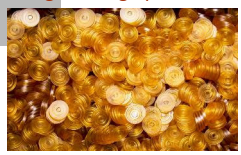
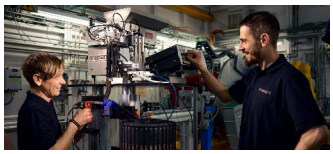
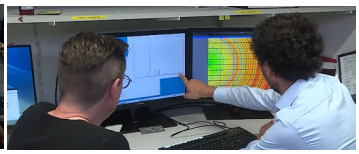
Supporter

Members selection

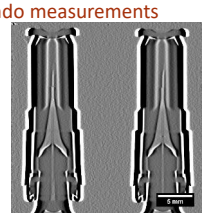
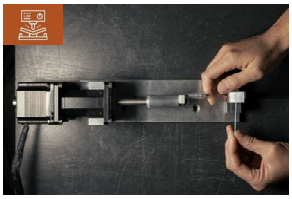
www.anaxam.ch

## Tailor-made infrastructure

High through put measurements of 100’000 samples

In-situ / operando measurements


ANAXAM invests into the infrastructure at Material Science, Tomcat and Polid beamline

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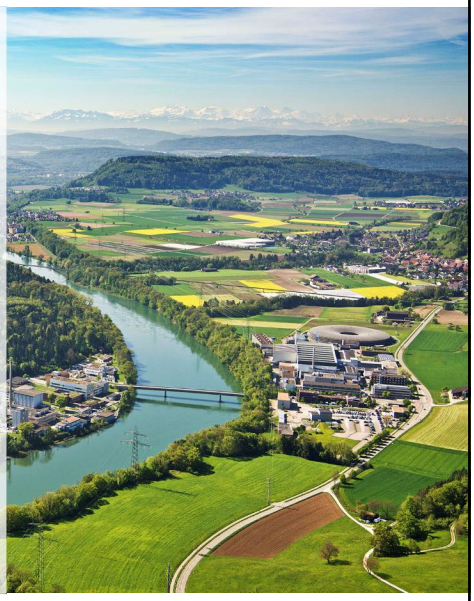
## Wir schaffen Wissen – heute für morgen

**PSI an ideal place for advanced micro- and nano-structure analytics for Advanced Manufacturing**

**Funding of SFA-AM enables to improve capabilities and make them to the scientific community and to industry available**



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