SULF – Sample and User Laboratory Facilities

STAP Samples and User – April 2021

PRESENTED BY MONIKA HARTL

2021-04-26

1 SULF introduction and status

1 postdoc + 2 master students

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SULF intro & status

2

On-site installation

3

Support of ESS projects

Sample and User Laboratory Facilities

Group within the Scientific Activities Division SAD

- Groups within SAD
  - Sample environment **SE**
  - Scientific Coordination and User Office **SCUO**
  - **Sample and User laboratory facilities SULF**
  - Deuteration & macromol. crystallization **DEMAX**

SULF

Supports sample handling, e.g. preparation and characterization of samples close to the instrument, before, during, and after the experiment.

Supports ESS operations, e.g. materials characterization in case of failure for technical and science directorate, cooling water analysis (qualitative)

Key facts (construction)

- ✓ €2.62 M budget
- ✓ €1M lab fit-out (STFC)
- ✓ €70k RML glove boxes (U. Tartu)
- ✓ In-kind projects essentially finished!

Key facts (operation)

- ➢ 3 FTE (now) => 6 FTE (total)

Budget per year (not confirmed):

- ➢ €100k labs-infra/equipment
- ➢ € 10k consumables
- ➢ € 15k equipment (small)

❖ Currently **2 FTE** less than planned by 2021

Why are user laboratories necessary?

Short, medium and long term needs -> see part 3 of the talk

Short term needs:

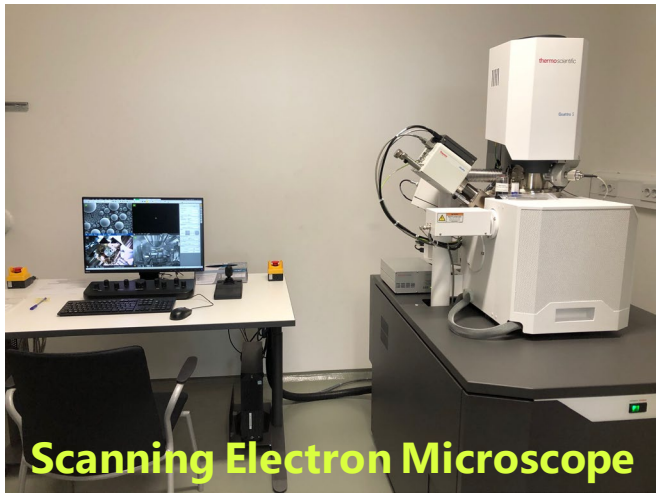
- Support for the construction project for critical path sub-projects to ensure "ready-for-beam-on-target" (RBOT) and "beam-on-target" (BOT).

Medium term needs:

- Support for the commission phase (initial ops) of the machine
- Providing Radioactive Materials Laboratory in time for BOT

Long term needs:

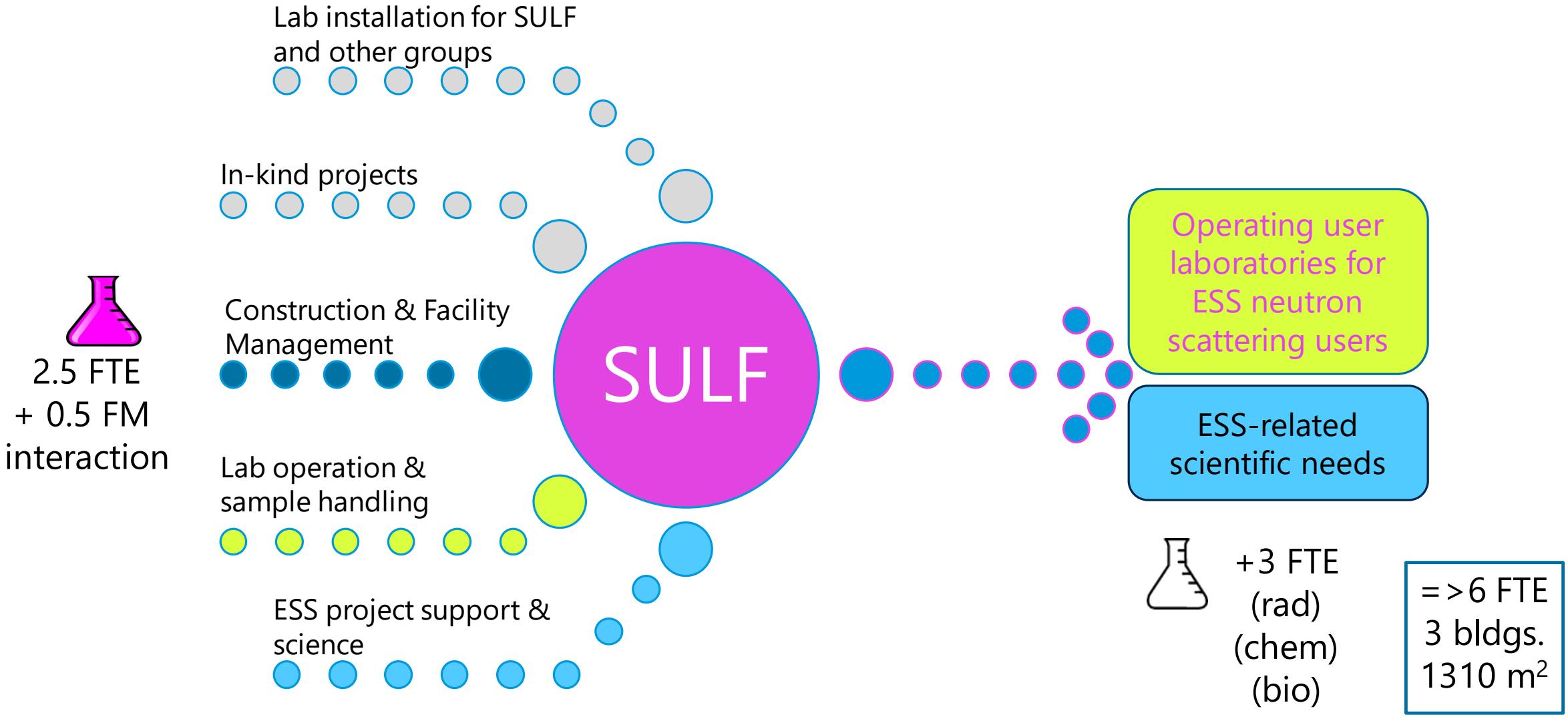
- Preparing for First Science
- ESS operations support



Well-functioning labs come with expertise of the scientific and technical staff.

SULF scope – now and later

Now ---------- Later



SULF interactions

Project coordination

Who: stakeholders, SANBER (contractors), SKANSKA, QA

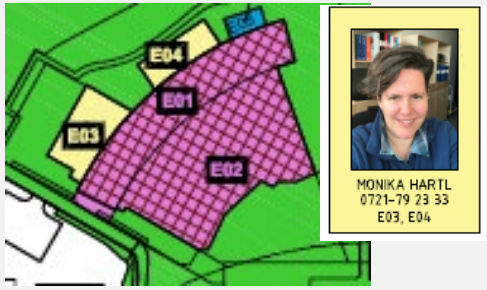
- **Lab installations**: planning, procurement, scheduling, surveying, lab owners
- **Support for instrument labs** (sample storage, ventilation, …) -> transition to NSS
- **Safety/quality** of installed labs and planned labs

SULF and partner measuring

Area coordination

Who: workers in E03/E04, SANBER, SKANSKA, FM

- **Keep track** of work in E03/E04: planning, scheduling, arranging
- Stay on top of **safety and housekeeping** in the area including risk assessment
- **ADVANTAGE: flexibility in scheduling!**



Construction Support

Who: Facility Management, stakeholders

- Assuring **services are supplied** (house vacuum, waste water testing, internet,…)
- **Change-requests** for requirements not met (ducting, radiators, doors/ badge readers ….)
- Requests (drilling through walls, loading on floors…)
- **Engineering drawings** for ESS
- Electrical document changes (consultant)

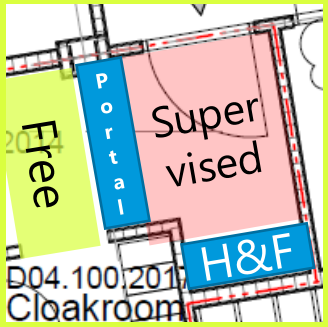
SULF interactions

ESS project support (more information: part 3)

Lab Operations: Safety, security & training

Who: OHS, RP, Security, Training

- **Safety**: day-to-day, safety walk-downs, quarterly safety meetings
- **Training**: transition to online training for labs
- **Security**: Access discussions and practicalities –now and later
- **RP**: Radiation monitors



Lab Operations:

Who: Cryo Group, OHS, Logistics, SCUO, FM

- **Delivery:** gas cylinders, l-N_2 waste containers/removal
- **Chemical inventory** system
- **Shipping**: delivery of perishable items to freezer
- **Sample handling** / shipping (test shipment from outside EU) – connection to user office software

ESS Project support & science:

Who: Target, Accelerator, Instruments, SAD

- Collaboration with Target (joint instrumentation for materials research)
- Collaboration with Accelerator (luminescent screen development)
- pH and conductivity measurements of water
- Collaboration within SAD – gas handling, electro-chemistry

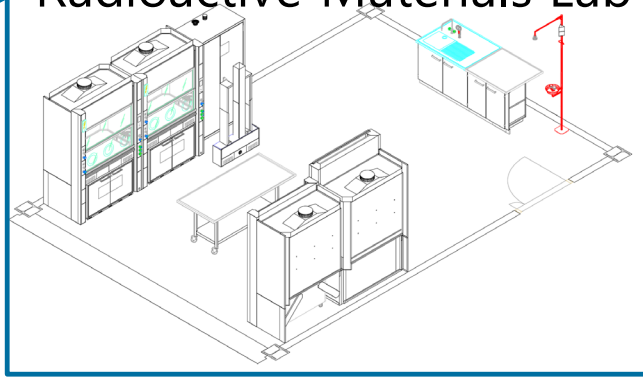
SULF: installation

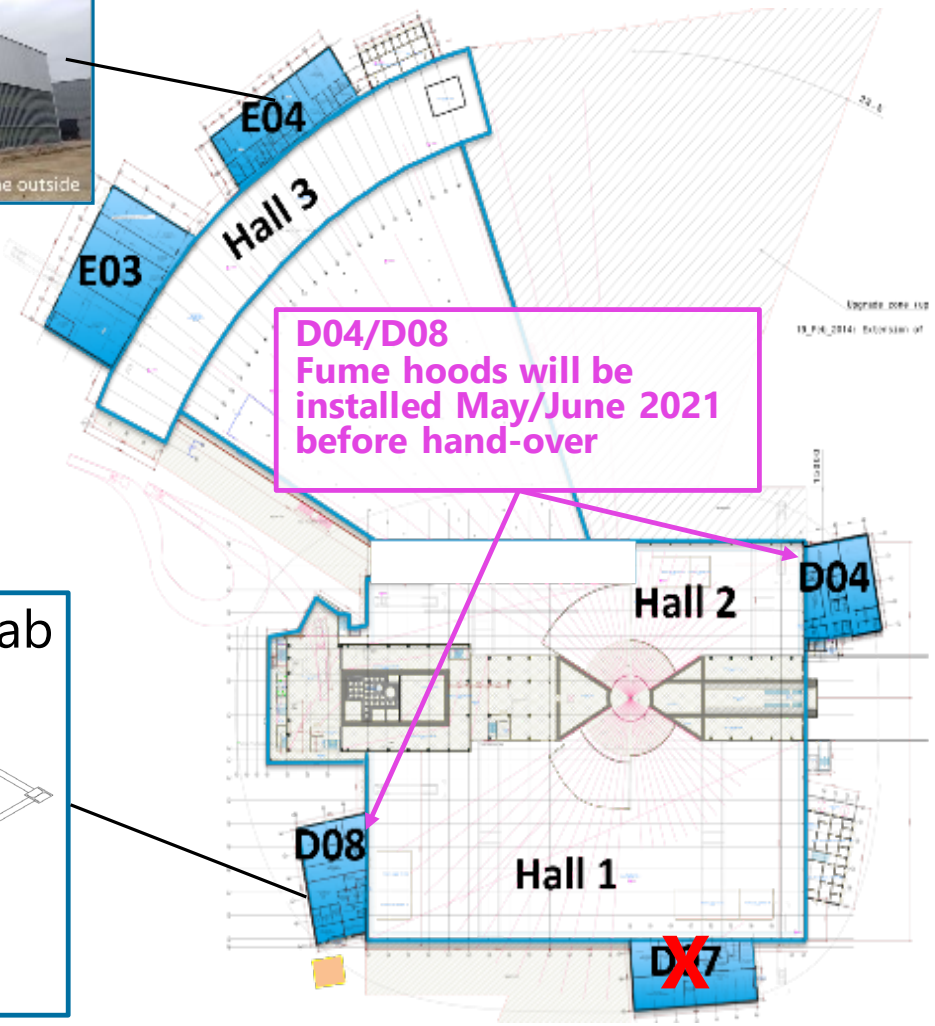
SULF has moved to site (office move in Jan. 20 // labs in Dec 20)

- Handover E03/E04 12/2019
- **Laboratory in operations 01/2021**

Critical for BOT

Radioactive Materials Lab





Hall3

Instr.	NMX / **Beer** / **C-Spec** / **Bifrost**
	Miracles / **Magic** / T-Rex / Heimdal
E03	1 × Engineering
E04	1 × Life Science, 1 × Cold room
	1 × Instrument room
	1 × Chemistry, 1 × Characterization

Hall 2

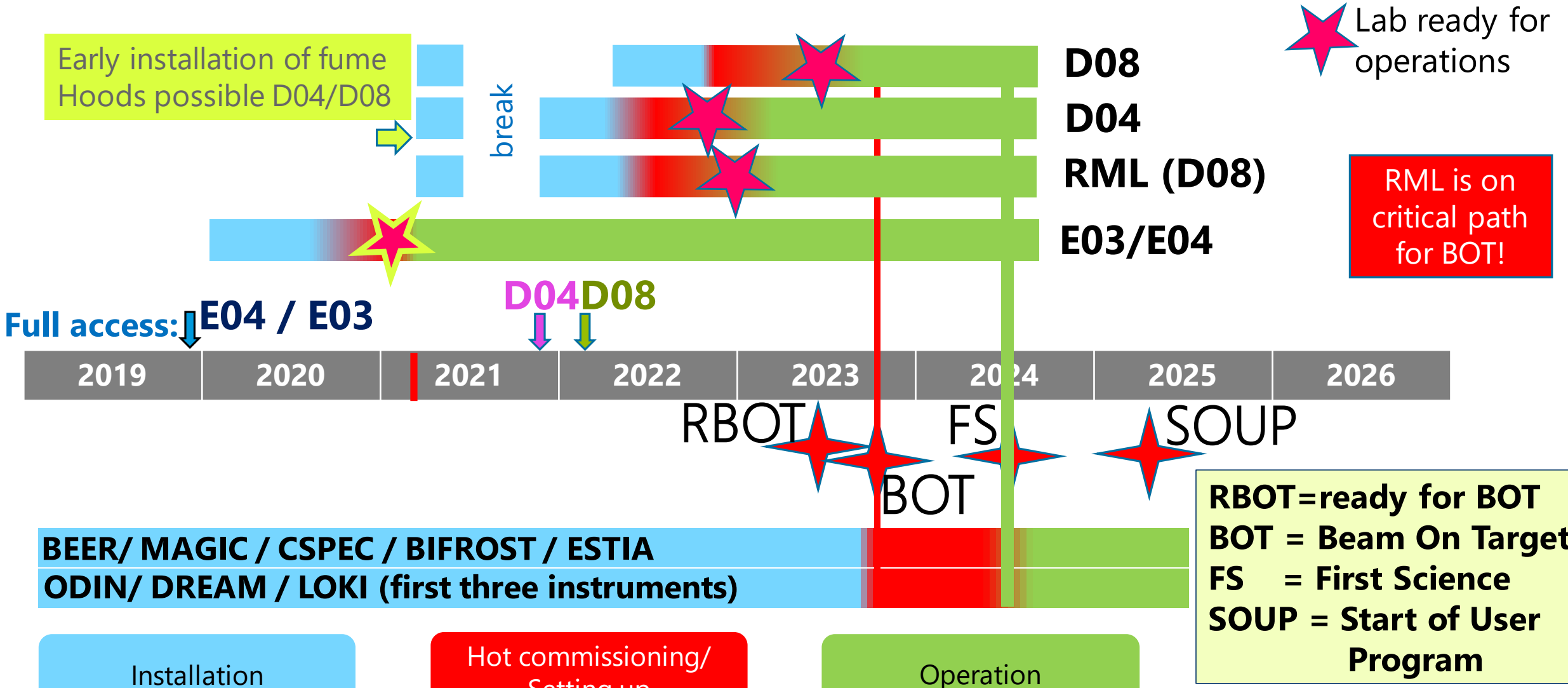
Instr.	Freia / **Loki**
D04	1 × Life Science, 1 × Cold room
	2 × Instrument room

Hall 1

Instr.	**Estia** / Vespa / Skadi / **Odin** / **Dream**/
~~**D07**~~	~~1 × Life Science, 1 × Cold room~~
D08	1 × Chemistry, 1 x Radioactive Mat. L.

SULF Timeline / Schedule

Still on track provided no further delays due to pandemic



Mitigations for Covid-19 related delays

What can SULF do?

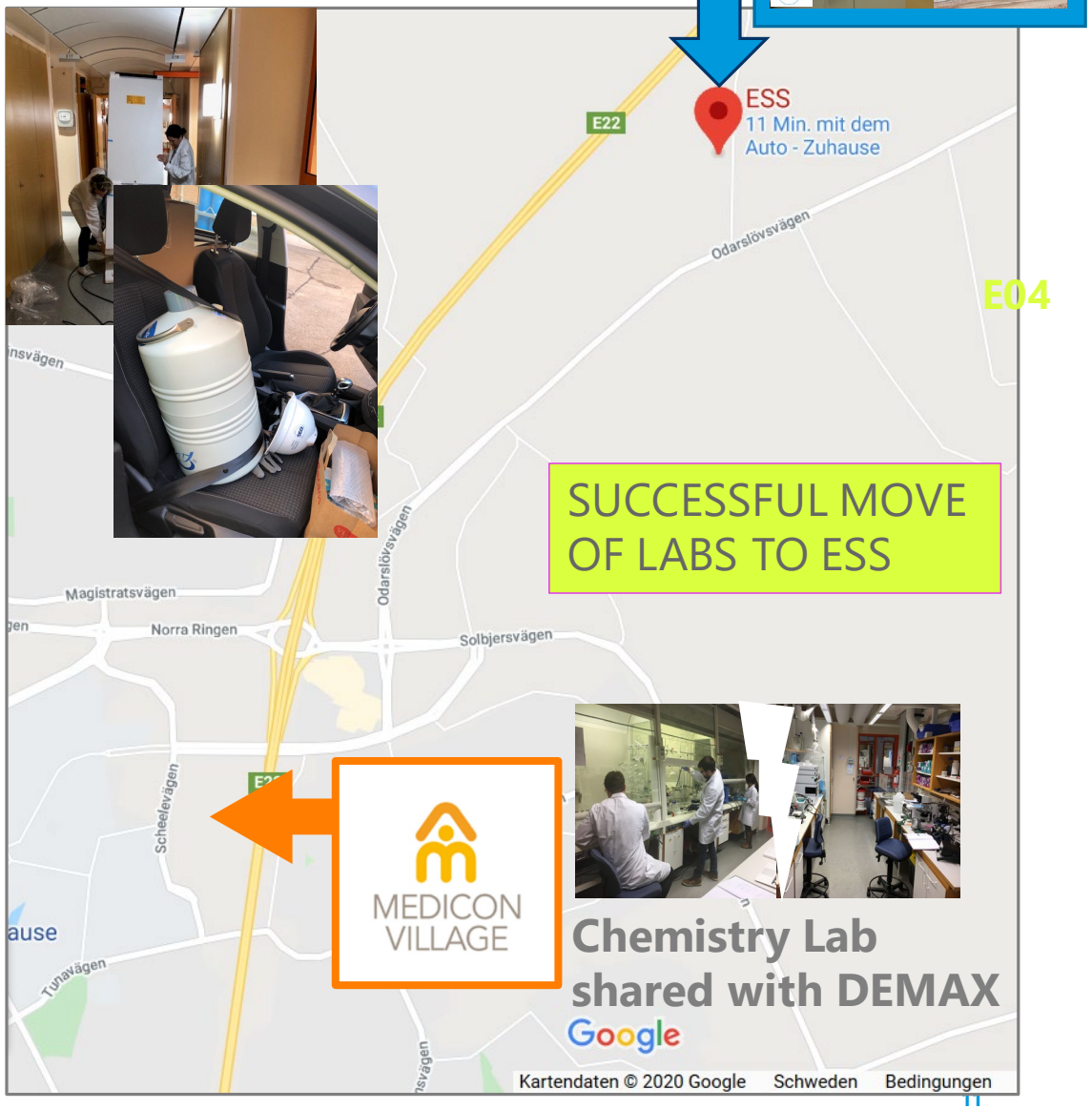
- SULF staff is allowed on site as we need to work in the labs following C19 rules (limited number of people, masks, distance, C19 test)
- In dialog with ESS-internal C19 group to keep rules up to date, e.g. discuss vaccination as reason not to quarantine
- **SULF mantra: Don't stop working** – keep preparing restart of construction
- Keep close contact with lab-outfitter (Sanber), establish to-do list to prepare for worker's return (hiring of equipment, training, scheduling…)
- Get construction work done that is not part of the fit-out and can be done with local workers (corrective action on building, data patch panels, waste water …) or by ourselves (ultrapure water, shelves,…)

SULF achievements

Since spring 2020

- **Move** of equipment and chemicals from rented lab to permanent lab **successfully finished** in January 21.
- **Electrical panels all upgraded, documented** and power is on thanks to our consultant Gustav Svendsen.

- Both SULF **in-kind projects are successfully finished** (pending report)
- SULF is still **well in time** with delivery of milestones.
- SULF procured a **powder diffractometer** (STAP suggestion 2020) and operates a **Scanning Electron Microscope** (Target) -> detailed equipment list in breakout session
- SULF **labs in E04** are officially **in operations!**



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SULF – on-site installations

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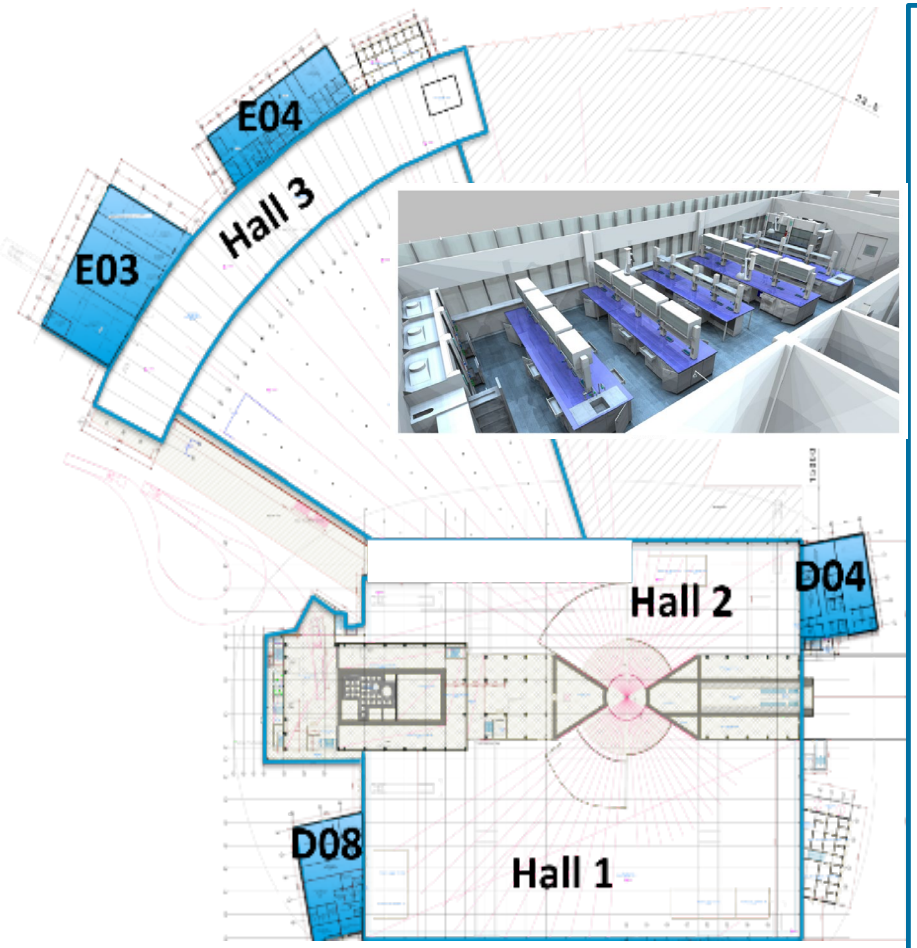
Lab fit-out for E04/RML/D04 – in-kind

ISIS, STFC, UK provided user laboratories in E04, D04 and RML



UK in-kind: Labs have been fitted out
In-kind complete.

Laboratory fit-out in-kind by STFC (M. Jura):

E04: level 100 (ground floor):

Large LS&SCM laboratory with spectroscopy room, and fridge/freezer (cold) room (4 FHs, 2 extraction points)

Physical Characterization & cutting& polishing lab

level 110 (first floor)

Large Chemistry Laboratory (4 FHs, 4 extraction points)

D08: level 100

Radioactive Materials Laboratory (4 FHs)

D04: level 100

Large chemistry laboratory with appliance room, instrument room and fridge/freezer room (5 FHs, 4 extraction points)

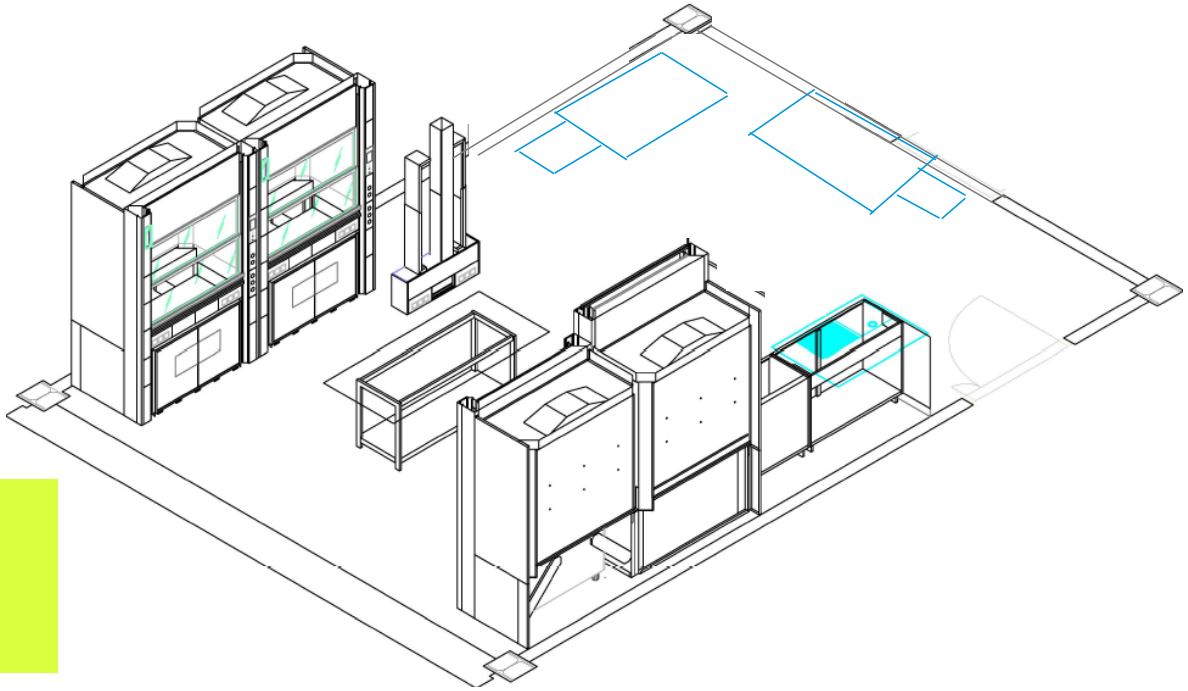
Glove boxes for the RML – in-kind

University of Tartu, Estonia, provides two glove boxes

The RML (radioactive materials lab) will have two glove boxes:

- **"dry box"** = 3-arm glove box with access port for sample stick/ cladded area
- **"reaction box"** = 2-arm glove box with solvent trap

Glove boxes have arrived safely and are waiting for installation (April 26)



Estonian in-kind: Glove boxes for radioactive materials will be commissioned in our X-ray lab
Will move to D08 when RML is ready. In-kind complete.

What did we do in construction so far?

Support the construction of chemical and technical labs & instrument utilities

- SULF = Interface to CF when related to laboratories and chemistry (requirements, services, supplies) hand-over of an empty shell –> fit out to a functional room

MAGIC

MORE MAGIC

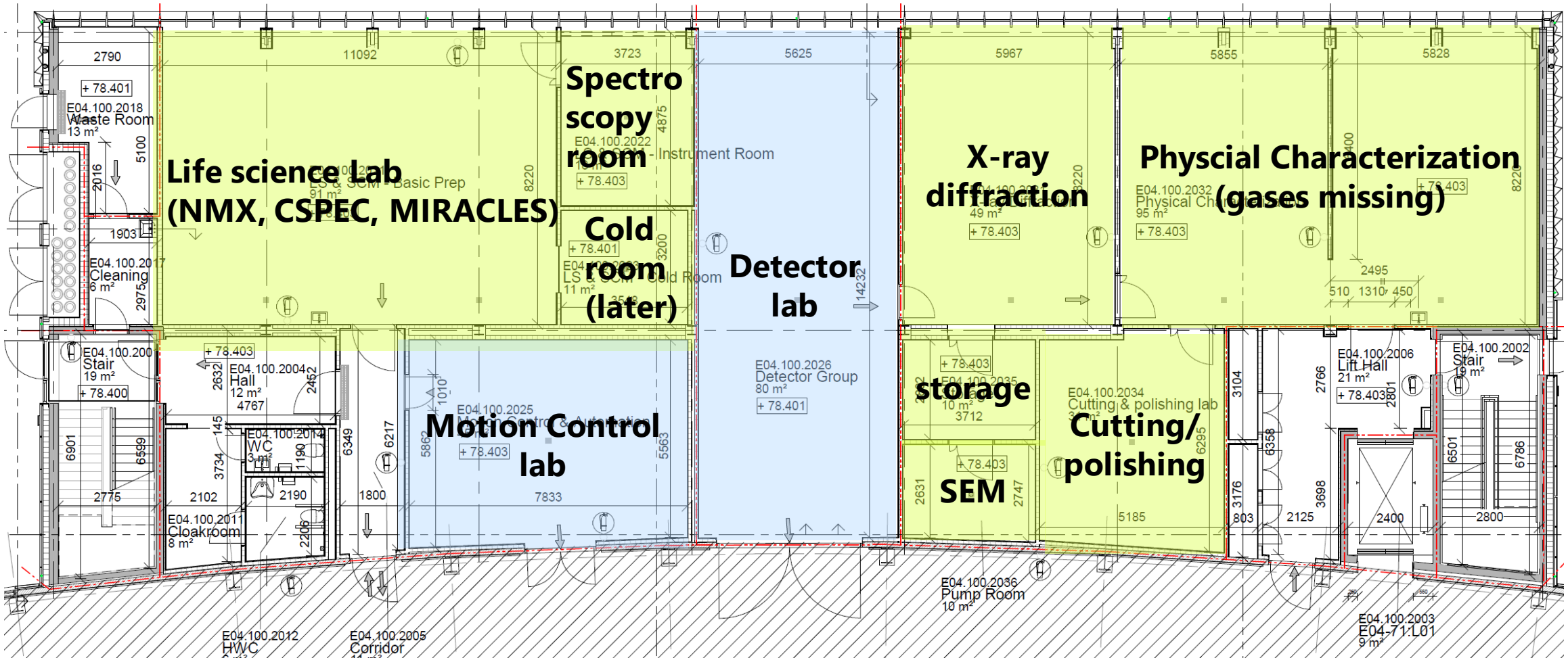
- SULF supports & coordinats lab fit-out for other groups (sample environment, detector, optics, motion control)
- First to move offices – had to organize move to E04…

and whatever else was needed….

(toilet paper, coffee, waste bins, printing supplies…)

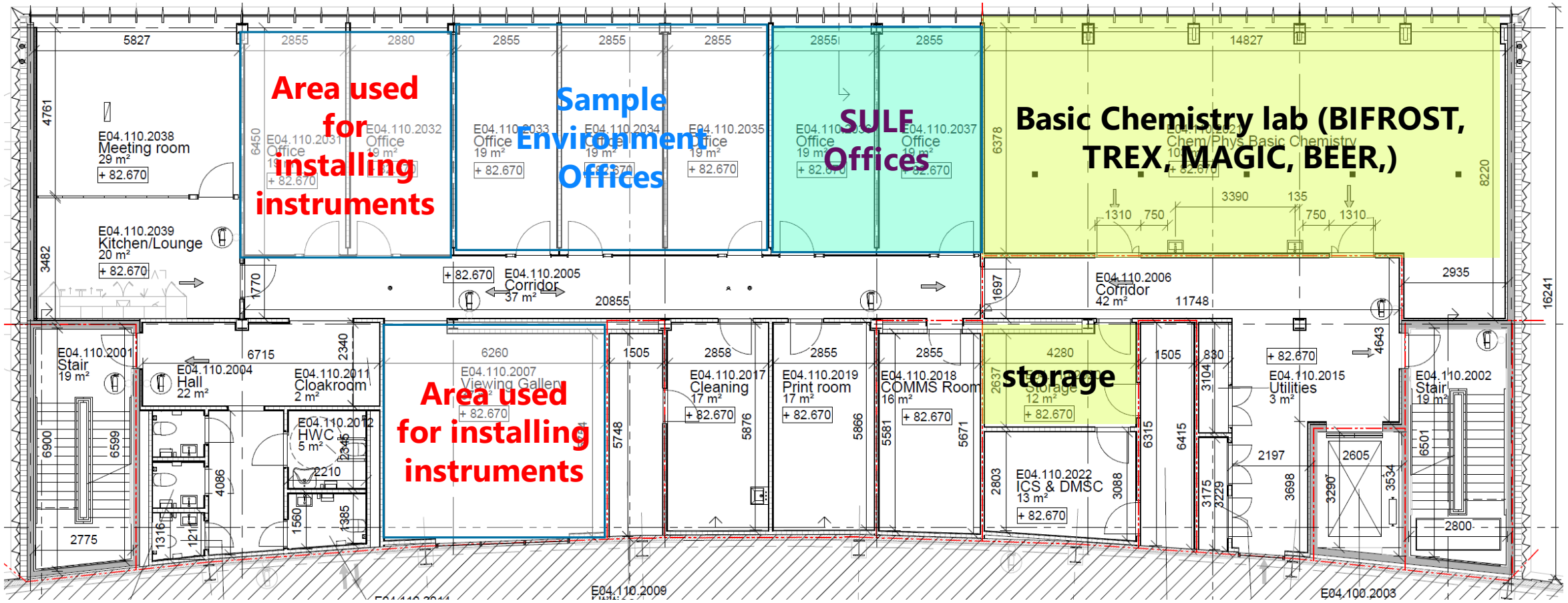
Finished installations: E04 Level 100

ground floor

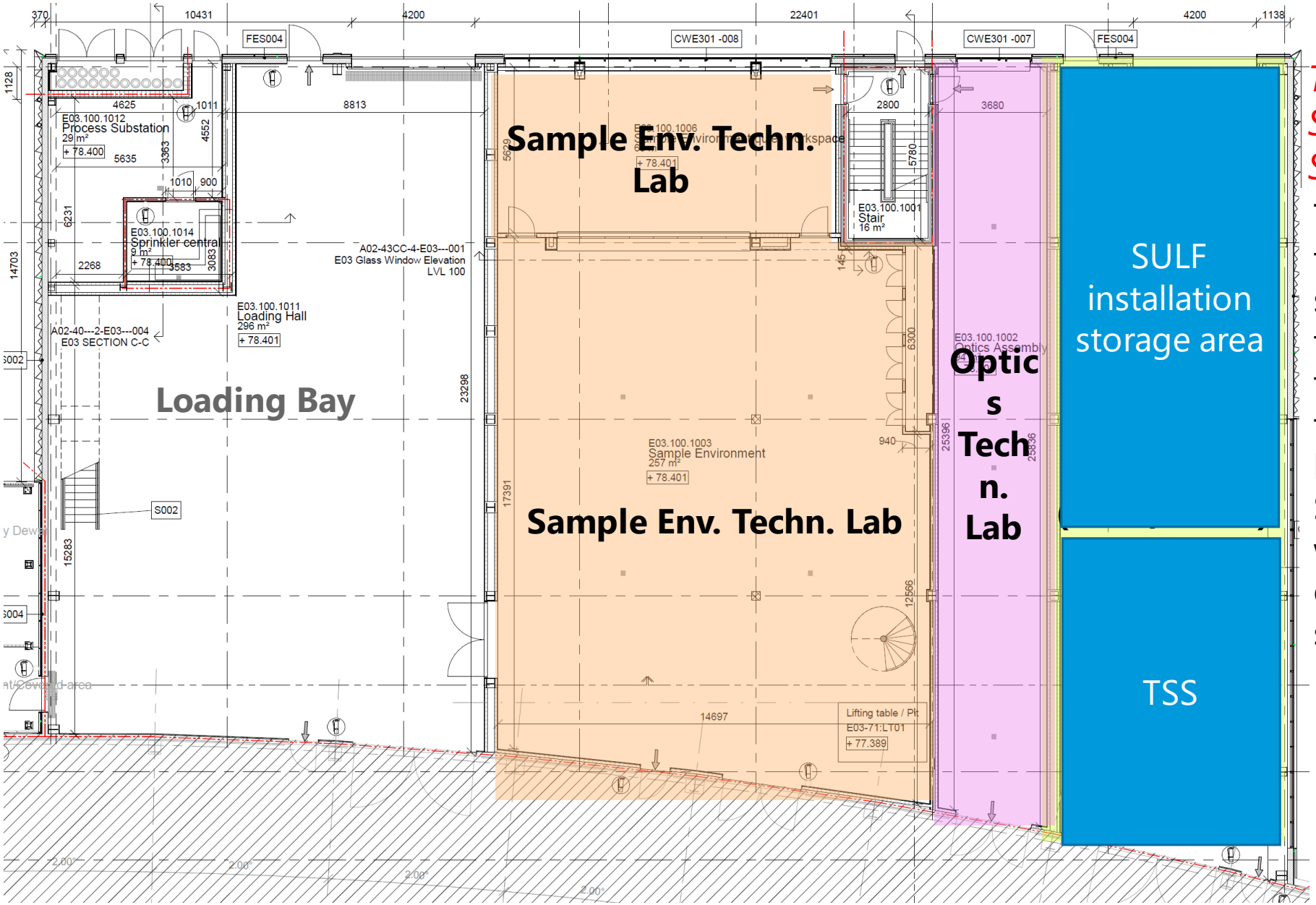


Finished installations: E04- Level 110

First floor



Finished installations E03 – SLIME

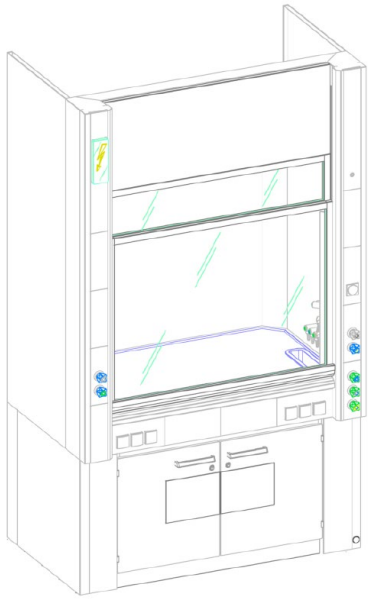


Target Safety Systems moved into SLIME lab

TSS needs a place to develop the safety controls for the target until they can move into the target building later on this year. SULF supported with changes to electrical fit-out to suit TSS needs.

Next step in installations – fume hoods

May/June 2021 – fume hood (FH) installation in D04 and D08



Why do we install before hand-over:

- Lessons learned from E-buildings: better to install before building is finished (less corrections needed afterwards).
- Testing of the building control and ventilation system in one effort – less work/time/costs for SKANSKA and for us.

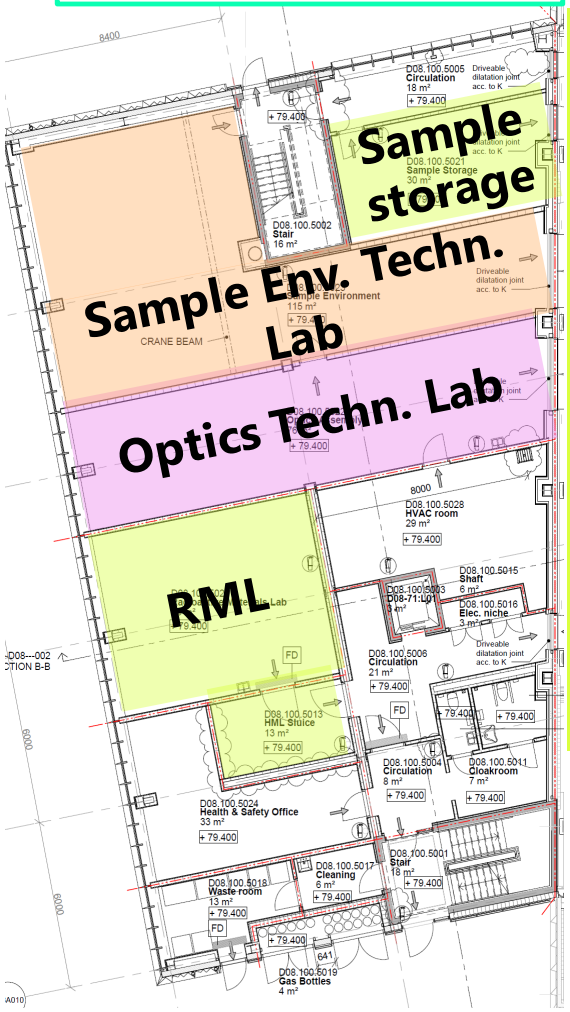
STATUS of next installation step:

- procurement for FHs and installation is done – contract with Sanber
- Weekly coordination meetings with SKANSKA ongoing
- Koettermann, Germany, started to manufacture
- **Site shifts for us will start again May 3rd -> supervision of installation**

Next steps: D08 Installations FHs

15 Fume hoods to install in all areas

D08.100: ground floor

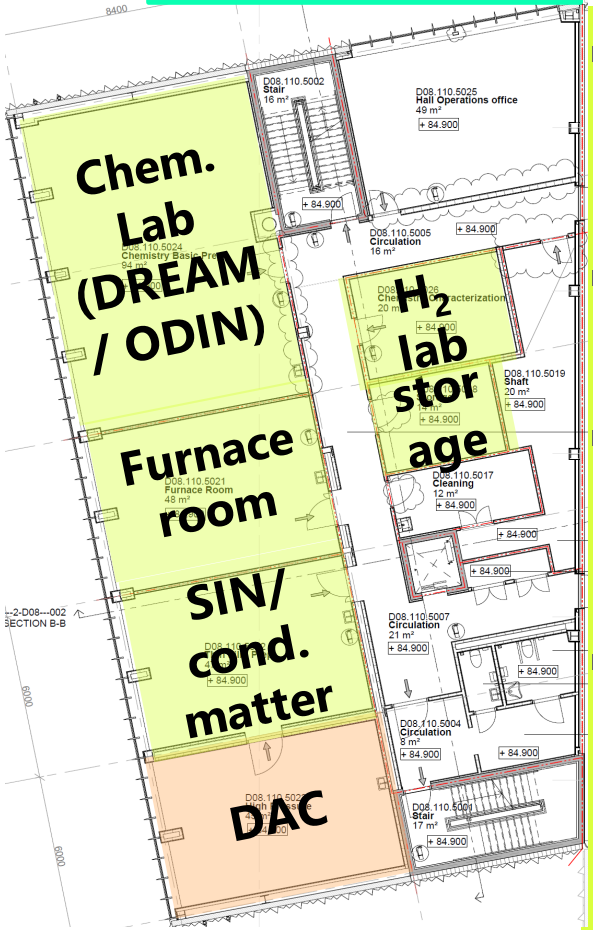


Radioactive Materials Laboratory (RML) *Critical for beam on target,* ***4 FHs***

Changing area *in front of RML – cabinets/benches*

Sample Storage – *cabinets/benches/inert cabinet*

D08.110: first floor

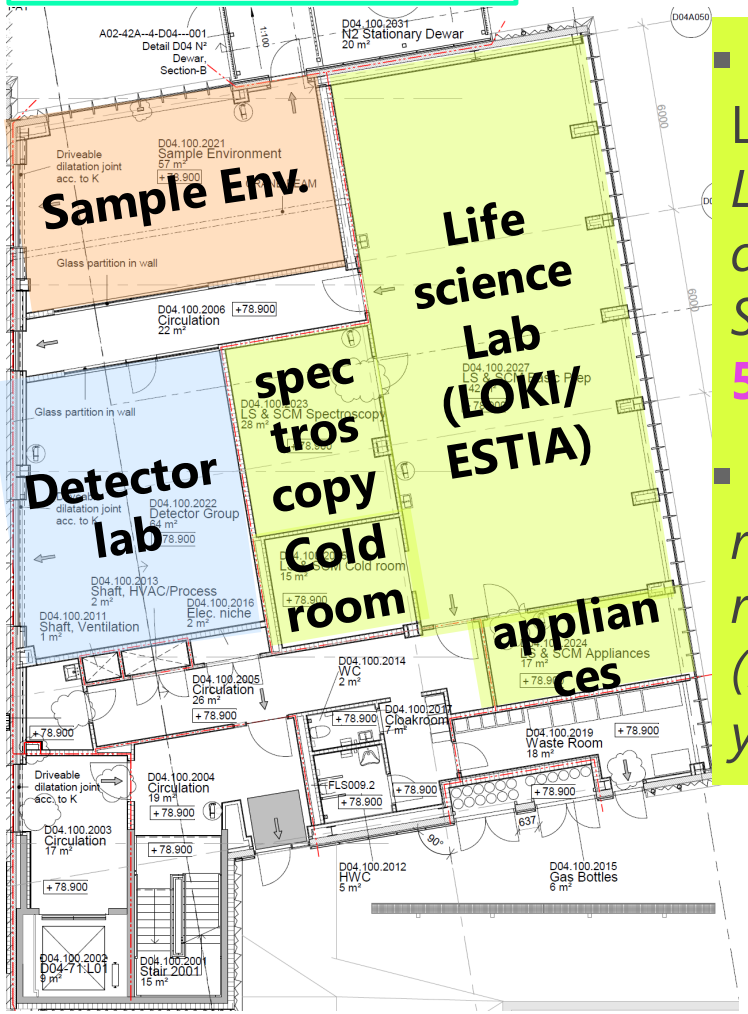


- Chemistry Laboratory servicing DREAM (only chemlab for D01) **6 FHs**
- Energy Research/H_2 lab *(ATEX rated)* **1FH**
- Furnace Room *with special ventilation; support for cond. matter synthesis*
- Surfaces and Interfaces Room (SIN): *hard cond. Matter, with thin films, nanoparticles* **1 FH**

Next steps: D04 Installations FHs

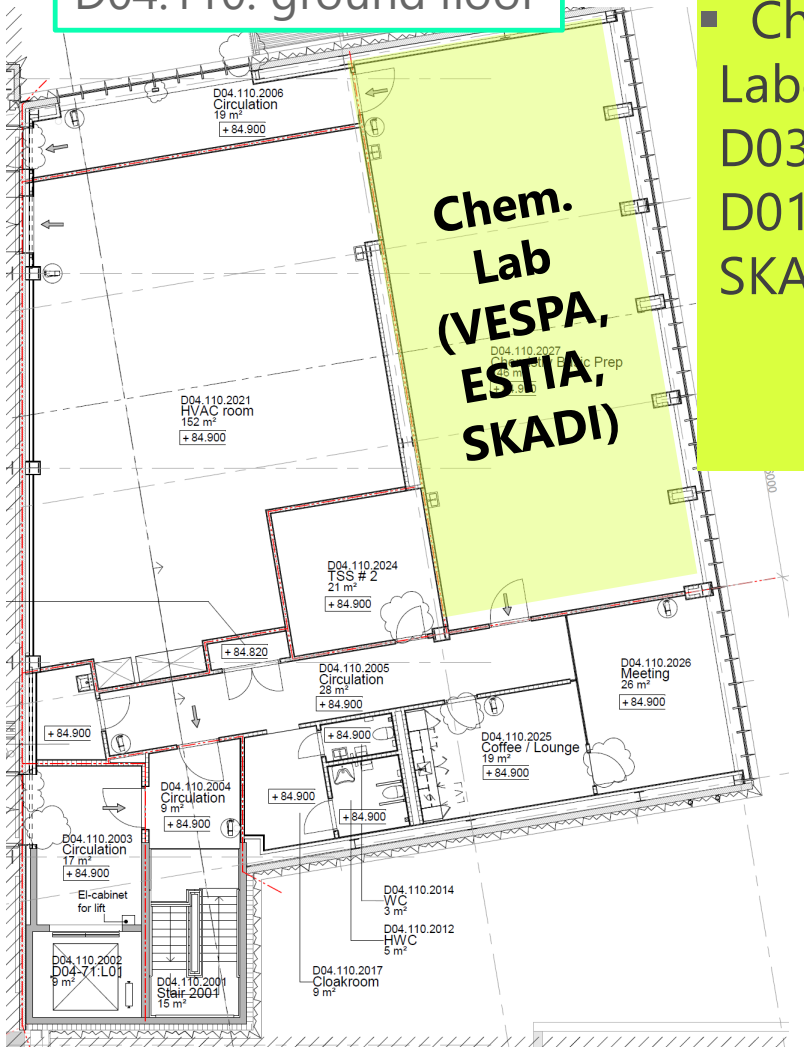
13 Fume hoods to install in all areas

D04.100: ground floor



- Life Science Laboratory for *LOKI/FREIA & collaboration with SE next door* **5FHs**
- *spectroscopy room, appliance room, cold room (not constructed yet)*

D04.110: ground floor



- Chemistry Laboratory servicing D03 (LOKI/FREIA) & D01/East side (ESTIA, SKADI, VESPA) **6 FHs**

Summary – on-site installation

In-Kind projects:
- both finished pending the report / both successful
- good partnerships established to ISIS and University of Tartu
- scientific and technical collaborations will remain

Installations:
- installations in E04/E03 chemical labs completed;
- fume hoods installation in May/June 2021 on track;
- safety between ESS and SKANSKA well coordinated
- logistic and rigging team both know us by now – works well.
- ESS bureaucracy still extensive (see previous STAP)

Future installation after handover:
- furniture/utilities for D04/D08 requires tender
- need more help from procurement

SULF is on track and therefore does not qualify for extra support

3

SULF – chemistry services for the ESS project

SULF – one chemistry lab for ESS

Expertise and experience resides in SULF

REASONS to have one chemistry lab for all ESS located at ESS instead of several small scale labs in each division:

- The **expertise is in SULF** as shown by various involvements, nationally and internationally.
- Having to go to an **outside lab is expensive** and takes longer.
- **Activated materials** cannot easily be sent outside.

We have/are gaining expertise and experience

- Neutron scattering & chemistry (incl. chemistry work for accelerator and target)
- Close collaborations with sample environment, materials group (target), beam diagnostics group -> benefitting both sides.

Why are user laboratories necessary?

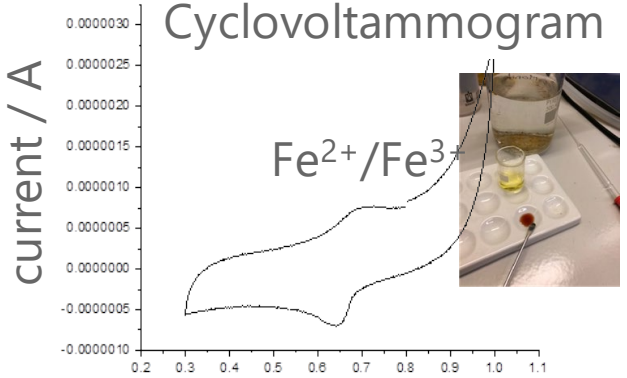
Short, medium and long term needs

Short term needs of ESS:

- Support for the construction project for critical path sub-projects to ensure RBOT and BOT.
  - Material site-acceptance test for the bunker project.
  - Support target moderator workpackage & in-kind partner (FZJ) in developing setup for online ortho/para-hydrogen ratio verification of the liquid hydrogen moderator.
  - Support for the radiation hardness of grease project (critical material decision for the target wheel workpackage)
  - Support for target system engineering material configuration management (collaboration with spallation physics group) – Be, beam dump water analysis, target concrete analysis,….

Water analysis

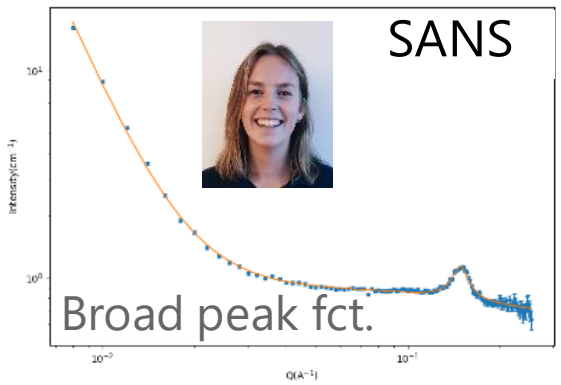
Cyclovoltammogram



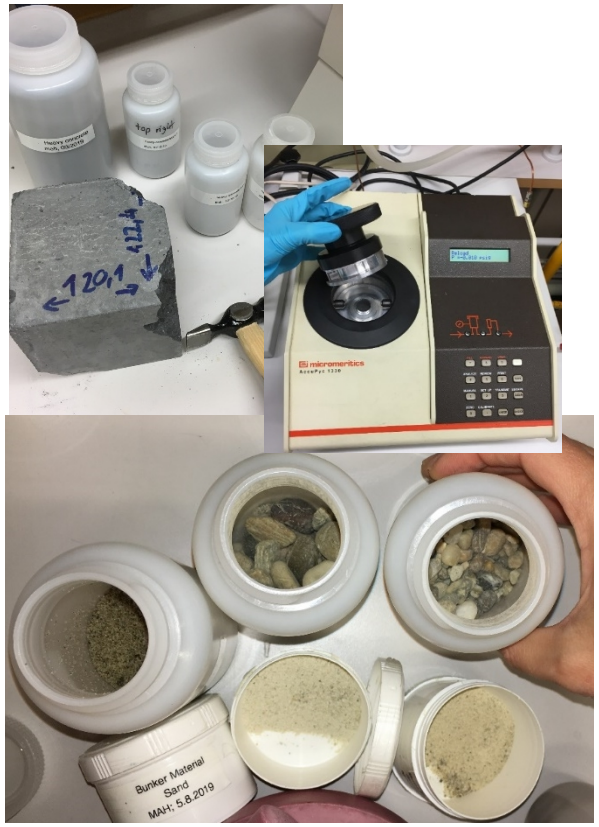
SULF short term support

for the ESS construction project and initial ops

Radiation Hardness of Grease
(collab. Lena Reactor/U. Pavia)
Target wheel, choppers,…



Elemental Analysis of materials
Bunker and shielding, target materials



Ortho-para Hydrogen research for moderator (coll. ESS/JPARC/SNS)

Target Moderator/ online monitoring

Added capability for SULF:
- Microwave digestion furnace
- Fusion instrument
- Expecting in May: ICP-OES

(Previously ball-mill and 10t press)

Why are user laboratories necessary?

Short, **medium** and long term needs

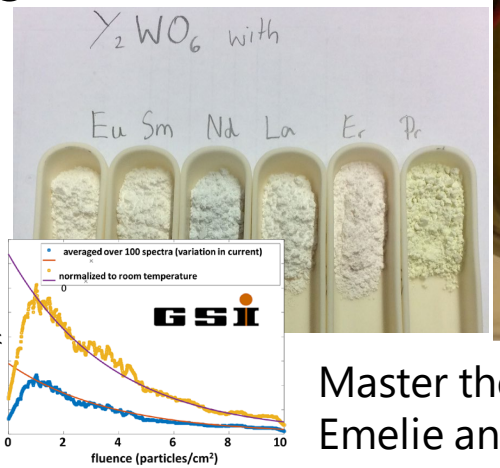
Medium term needs:

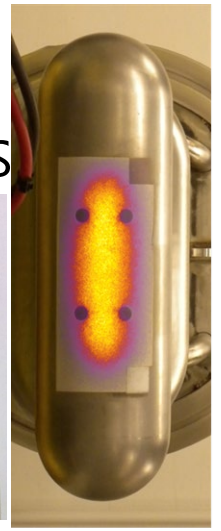
- Support for the commissioning phase (initial ops) of the machine
  - Support for accelerator on the material choice for the luminescence screen on target wheel. (beam steering, performance and safety critical)
  - Provide cooling water and material analysis as needed
  - Support installation of ortho/parahydrogen monitoring system

- Providing Radioactive Materials Laboratory in time for BOT
  - Only permanent area at ESS for analysing activated materials

Beam Diagnostics

Luminescence Screen on target wheel (collab. SNS





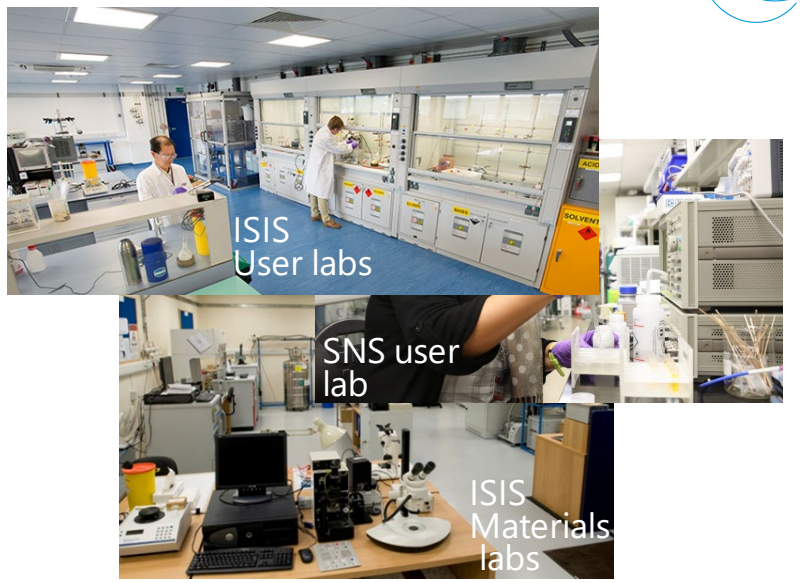
Master thesis:
Emelie and Anton
(Cr-doped Al2O3, YAG)

Why are user laboratories necessary?

Short, medium and **long term needs**

Long term needs:

- Preparing for First Science (ESS is built for small samples and in-situ experiments ->SULF needs to cater to these requirements.
  - prepare, modify and load samples
  - characterize samples before, during and after the experiment
  - Last minute adjustments => saving beam time & costs
- ESS operations support
  - Materials characterization for machine and science directorate in case of failure



Well-functioning labs come with expertise of the scientific and technical staff.
State-of-the-art neutron sources have labs not just sample loading stations !

SULF support: preparing for first science

SULF/sample environment joint projects

SULF ⟷ from lab to in-situ neutron scattering ⟷ **Sample environment/ FLUCO**

0.5 FTE  0.5 FTE

User Lab

- Basic electrochemistry tools
  - Voltammetry/polarography/impedance
- Sample preparation
  - Glove box / Clean area
  - Prepare battery,charge/discharge

NS instrument

Sample Environment

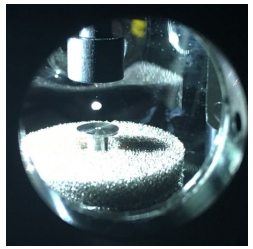
In-kind U. Tartu – electrochemistry cell

Cells compatible with neutron experiment, in situ and operando

- Coin cell, SANS measurements.
- Annular cell for inelastic, diffraction exp.

- Electrochemistry (e.g. cycling of batteries)
- Levitator (testing levitator settings in lab before beamline)
- Gas handling manifold (gas loading at the beamline or in the lab)

Gas handling manifold for corrosives (e.g. NH_3).



Using UV/VIS to test levitator

SULF support: preparing for first science

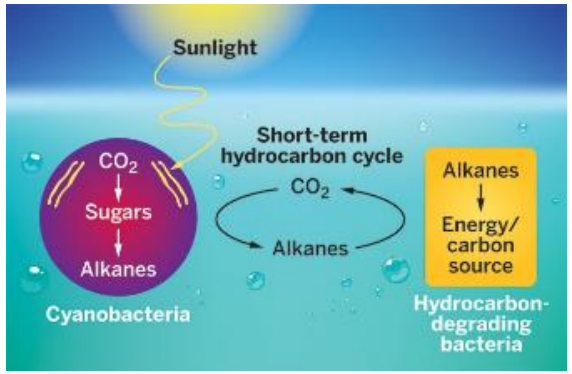
Human Frontier Science Program Grant

Do hydrocarbons induce membrane curvature in photosynthetic organisms?

Cyanobacteria are intricately organized, incorporating an array of thylakoid membranes into the cells. This is the site of photosynthesis.

Cyanobacteria produce hydrocarbons, and hydrocarbons are known to accumulate inside their membranes

Melissa's part: Neutron scattering, e.g. ***NSE/SANS at ILL, SNS and/or FRM-II***

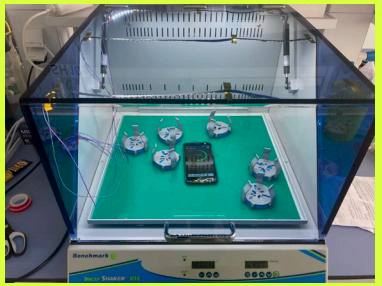


C&EN magazine, 2015, 93(40), p.10

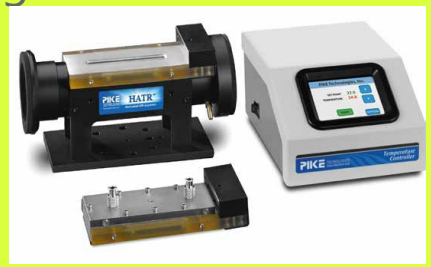
Sophie's research has provided SULF with extended capabilities in life science research:

EO4 now equipped for growth of cyanobacteria (and in future other bacteria)

Autoclave and Shaker Incubator with LED lights installed.



Dynamic Light Scattering instrument and FT-IR accessory for liquids procured:



SULF - conclusions

Catering to neutron scattering instruments as they come online

SULF is on track with

- Laboratory fit-out and has moved to the ESS site.
- Preparation for the user program including safety and sample handling

SULF adds value

- scientific support for machine and science directorate already during construction
- building up capabilities in time for First Science in collaboration with other groups

SULF is crucial

- Support for in-situ experiments / experiments with sensitive samples
- Minimizing beam time loss by checking/modifying samples
- Support for materials characterization for all of ESS during operations

Thank you for your attention

STAP charge for SULF (summarized):

1. **Is SULF on track and staffing sufficient ?**
2. **How to best equip the labs?**
3. **What is useful for ESS to support the project?**
4. **How do we keep to the core business?**

2021-04-26

SULF Group

We sulf problems !