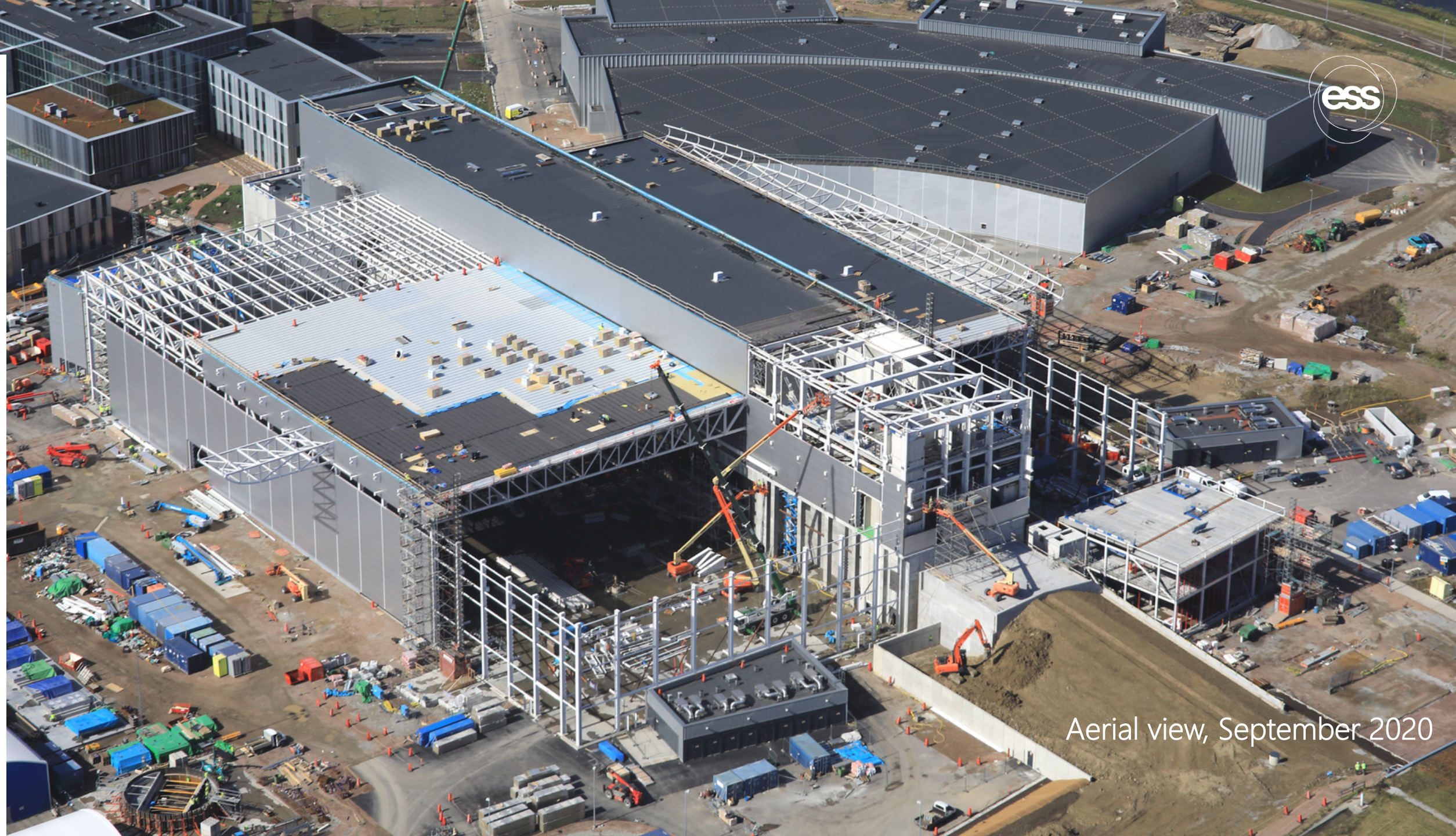
Science Update

IKON 19

PRESENTED BY ANDREAS SCHREYER, DIRECTOR FOR SCIENCE

28 SEPTEMBER 2020


72%
complete



Aerial view, September 2020

Aerial view, September 2018

Instrument Halls

E01 complete. Significant progress on D01 and D03. Started the encircling “sombrero” roof

ESS Offices and Laboratories campus

Buildings complete and fit-out underway. On schedule for occupancy in Q1 2021. Campus Transition team established, developing the overall plan for transitioning from temporary offices, workshops and labs into permanent facilities

Office Building: Atrium

Lab Building: The big hall

Bi-annual ESS-ILL user meetings

#1 10-12 October 2018, Grenoble

hosted by ILL

Focus sessions

- Scientific Potential for Combined or In-Situ Neutron Spectroscopy
- Laue Diffraction for Biology
- Laue Diffraction for Materials
- Spectroscopy in Biological Systems
- Imaging

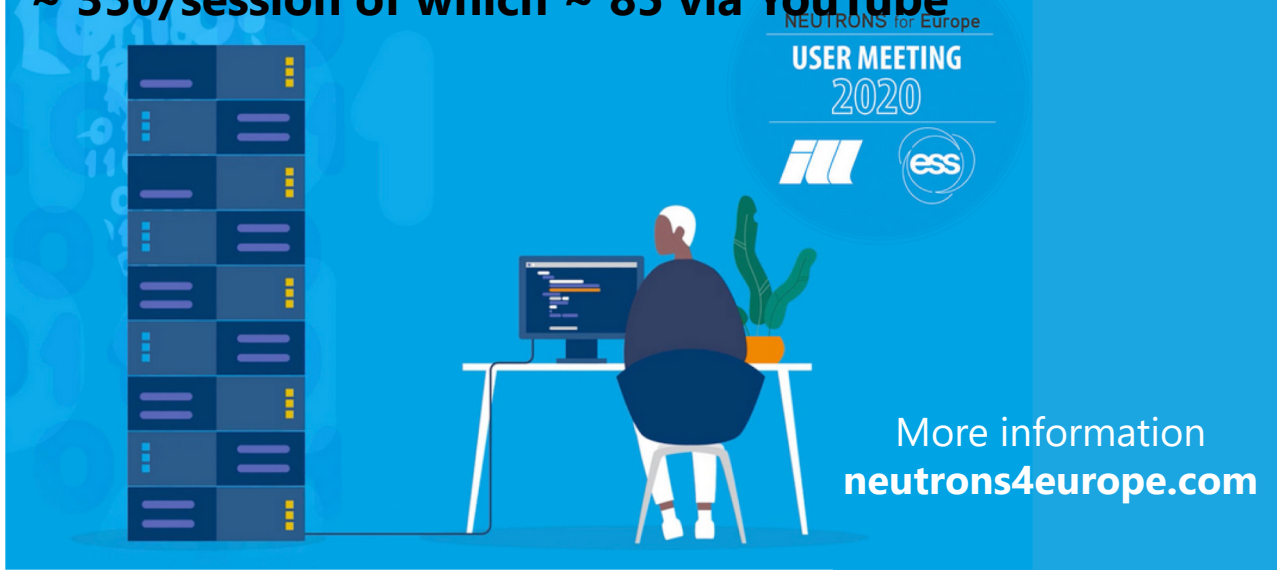
#2 23-25 September 2020, online

Jointly hosted by ESS and ILL

Topical workshops

- ESS - ILL Topical Workshop on Fundamental and Particle Physics
- ESS - ILL Topical Workshop on Imaging, Materials and Engineering
- ESS - ILL Topical Workshop on Chemistry and Magnetism
- ESS Polarisation Workshop
- GISANS Meeting

777 registrants, 508 Zoom accounts active (not all times)
~ 350/session of which ~ 85 via YouTube



The next physical joint user meeting will be hosted by ESS in Lund ir

Pandemic-related measures

Despite the many challenges, ESS has **remained open safely** and made **significant progress** on delivering the project

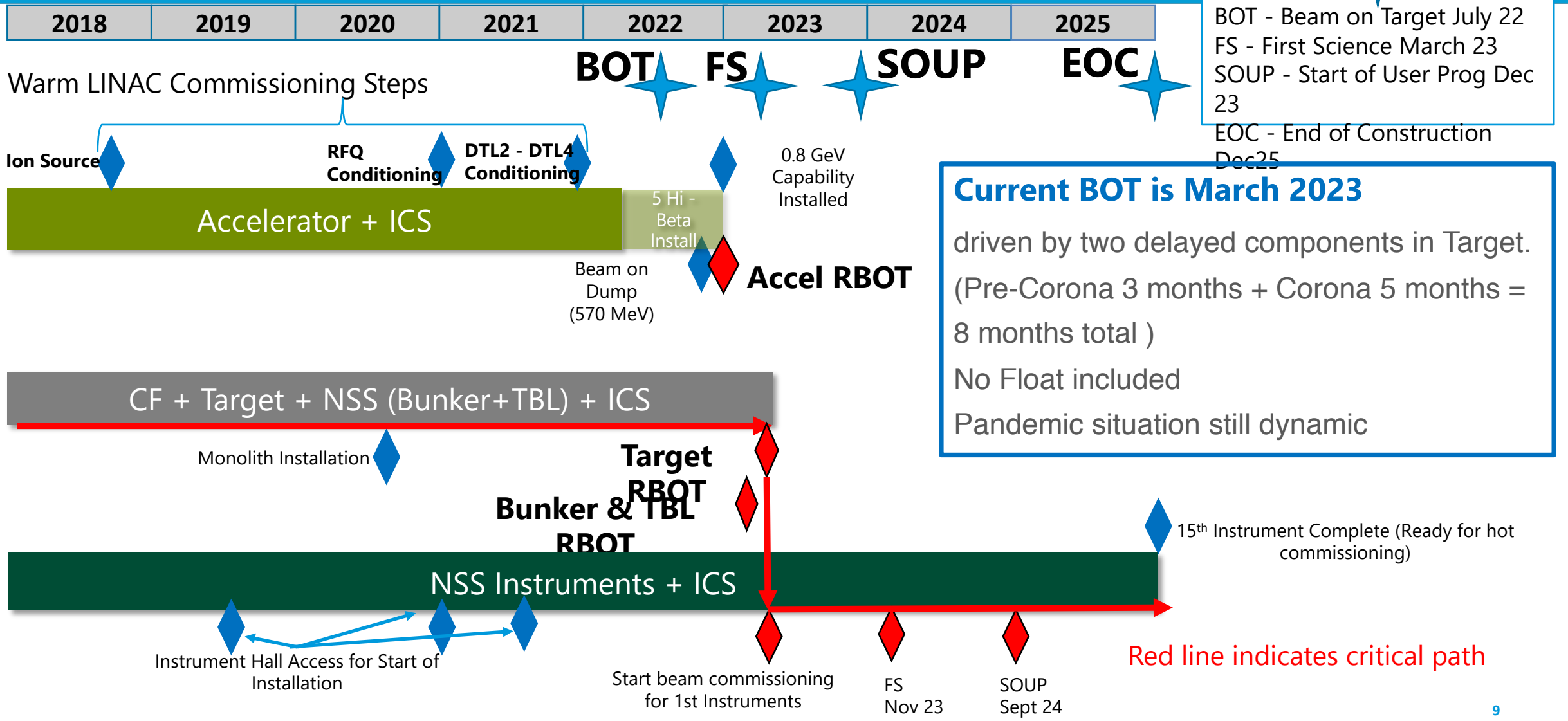
Since 15 March 2020:

- Work from home for those who can
- Work on-site for construction and hands-on technical work (85-90% capacity)
- Work by in-kind partners resuming, including work of IK partners in Lund as travel is now possible (IFJ-PAN, INFN, CEA)
- Detailed survey of in-kind supply chain showing delays of 2-7 months

Since 1 September 2020:

- Re-populating ESS offices at roughly 50% occupancy, with appropriate distancing measures in place

Summary Schedule and Critical Path for Remaining Work



Baseline Dates
BOT - Beam on Target July 22
FS - First Science March 23
SOUP - Start of User Prog Dec 23
EOC - End of Construction Dec25

Current BOT is March 2023

driven by two delayed components in Target.

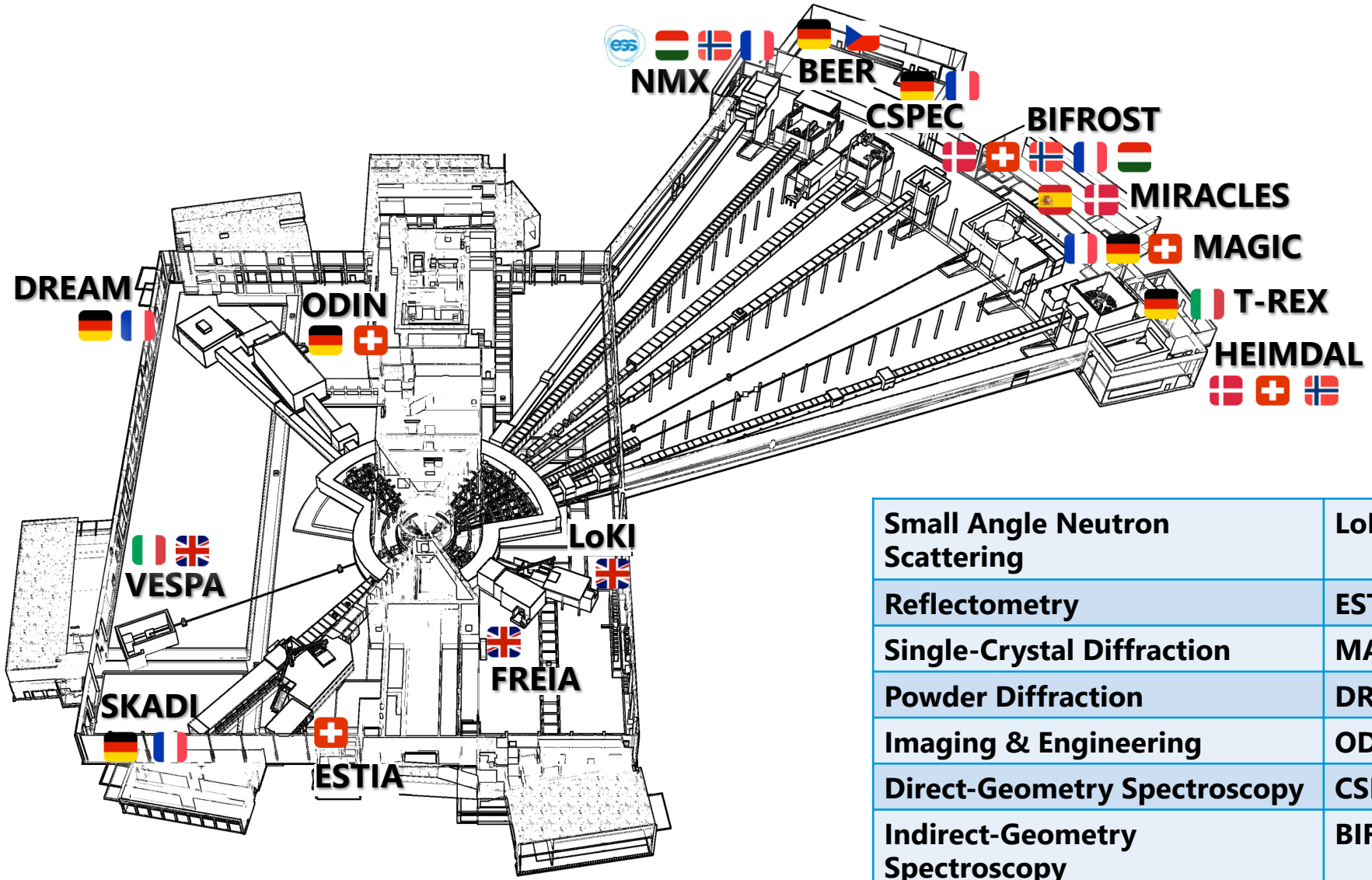
(Pre-Corona 3 months + Corona 5 months = 8 months total)

No Float included

Pandemic situation still dynamic

Instrument Suite

15 instruments under construction



~ 6 of the first 8 instruments (bold) ready at BOT

First 3:
LoKI, DREAM, ODIN

Small Angle Neutron Scattering	**LoKI,** *SKADI*
Reflectometry	**ESTIA**, FREIA
Single-Crystal Diffraction	**MAGiC**, ***NMX***
Powder Diffraction	**DREAM**, HEIMDAL
Imaging & Engineering	**ODIN**, **BEER**
Direct-Geometry Spectroscopy	**CSPEC**, *T-REX*
Indirect-Geometry Spectroscopy	**BIFROST**, MIRACLES, VESPA

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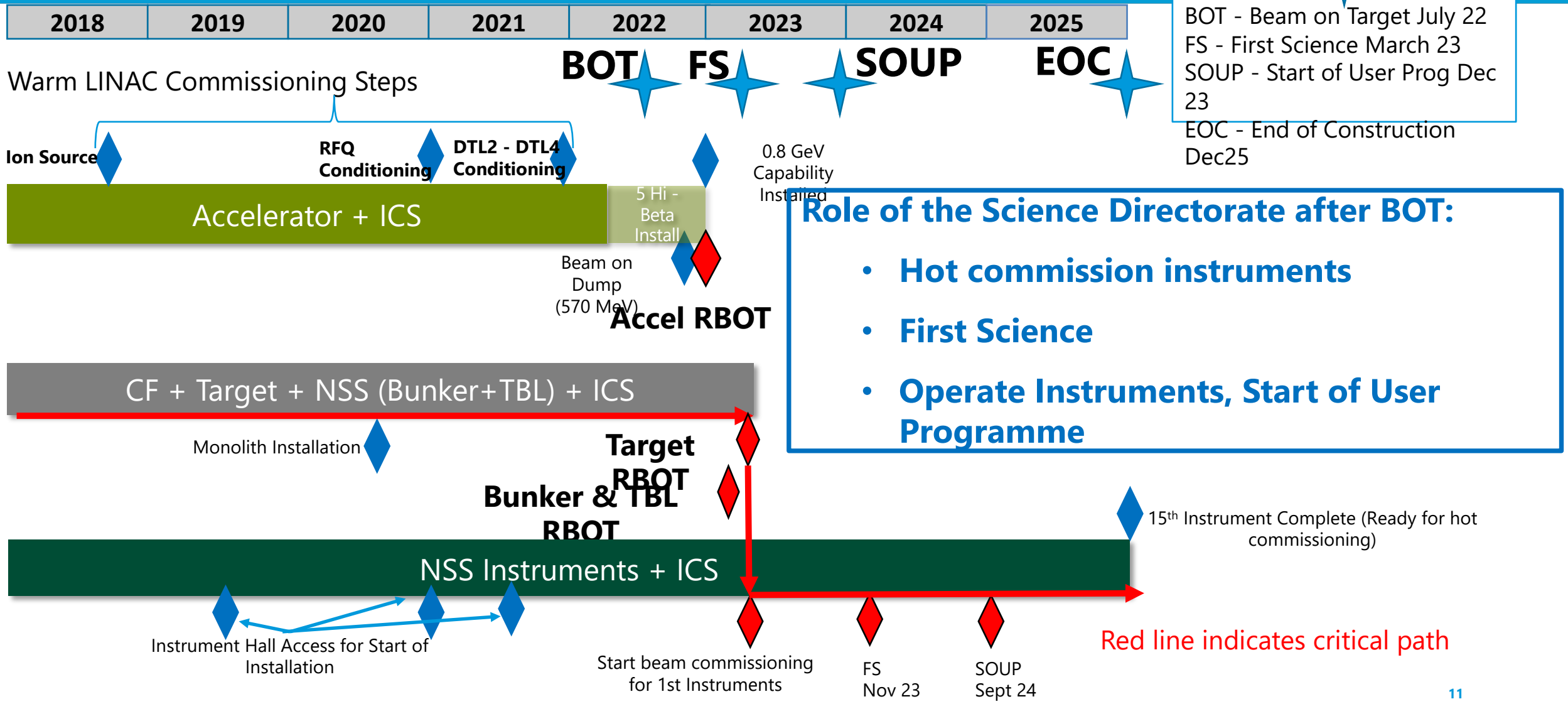

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Role of the Science Directorate after BOT:

- **Hot commission instruments**
- **First Science**
- **Operate Instruments, Start of User Programme**

First Science

Definition presented in response to Annual Review 2018

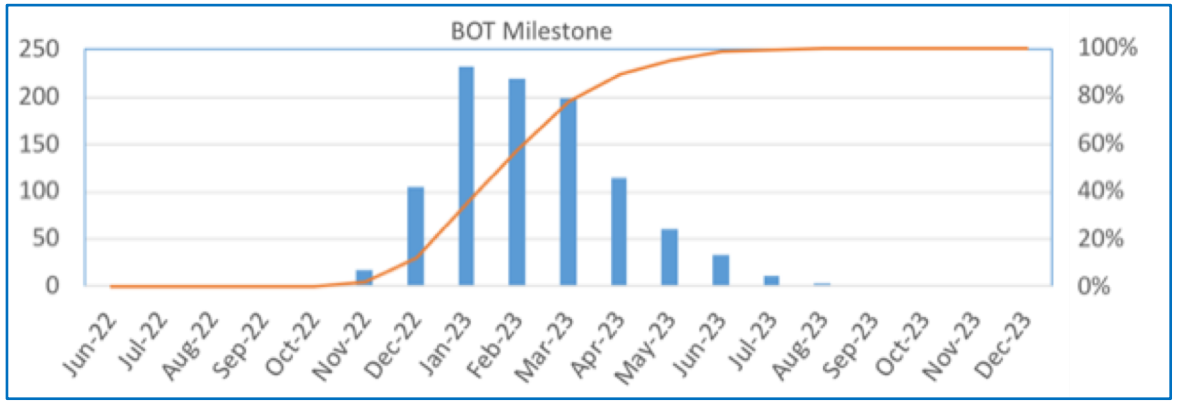
Define a ‘first science’ milestone that we are confident can de delivered in 2023

Define *‘First Science’* as

Target of 3 instruments available, for expert teams, with first results publishable in peer-reviewed journals

***First Science* schedule date is March 2023**

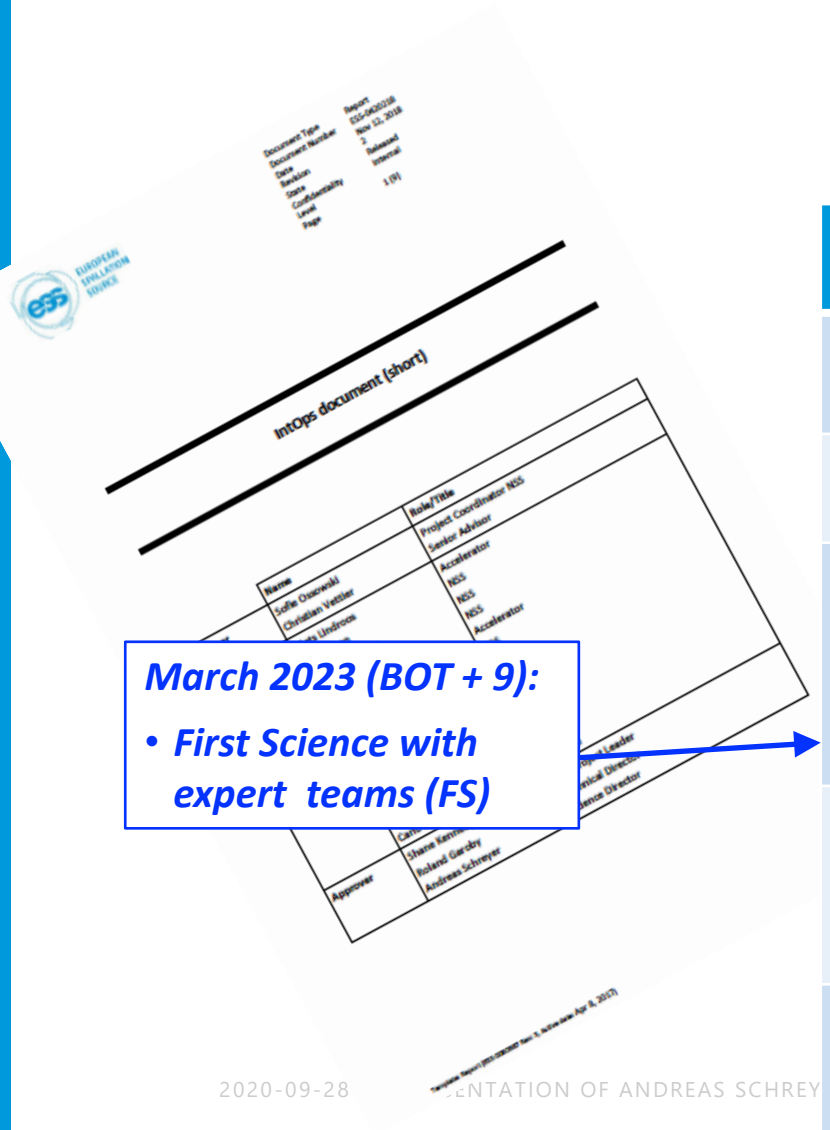
Monte Carlo analysis: 80% probability of success by December 2023



As presented by DG to Council 15 in Feb. 2019

First Science on the ESS Instruments

in line with ESS-0402218



Agreement on priorities for accelerator ramp up & instrument access for first 5 years *(from BOT)*

Period	Dates (months)	Current (mA)	Energy (MeV)	Power (kW)	Production availability	Availability/Total days
BOT -> BOT + 3 months	BOT -> BOT + 3	~ 6	~ 570	~ 140	> 1 shift/week	Not defined
Consolidation	BOT +3 -> BOT + 6	~ 6	~ 570	~ 140	6 shifts/week (consecutive)	Not defined
Performance assessment, Scientific Benchmarking	BOT + 6 -> BOT + 9	~ 6	~ 570	~ 140	9 -12 shifts /fortnight	Not defined
Demonstrate Performance, First Scientific Results	BOT + 9 -> BOT + 12	~ 12	~ 570	~ 280	33 shifts /fortnight	50 days
Ramp & Early science	BOT + 12-> BOT + 18	~ 12	~ 570	~ 280	33 shifts /fortnight	80%, 100 days

First Science (BOT + 9 months)

SAC recommendation

1. **Establish that instruments work properly (Benchmaking)**

2. **Do first science experiments**

- First Science takes place during hot commissioning of the instruments **and** the source
- Instruments will have been handed over to ESS, essential to keep in-kind partners involved
- Need a working neutron source, but availability can still be low
- With SOUP (FS + 9 months) we need an acceptable reliability
- Is essential to not frustrate the user community

How do we plan for First Science?

- Consider all the instruments that will be in hot commissioning 9 months from BOT
- Focus currently on the first 3 – LoKI, ODIN & DREAM – but ensuring all first 8 instruments have plans in place
- All instrument scientists are asked to develop ideas and collaborations
- Cross-collaboration between instrument scientists on different instruments is encouraged
- Instrument Class Co-ordinators help develop ideas and link teams to other ESS groups (e.g. SAD & DMSC)
- STAPs give advice on those plans – already underway
- Plan to include external experts (“Friendly Users”) via transparent process
- Should involve in-kind partners
- Plans are being presented to SAC

How do we plan for First Science?

The Early Science Programme

- Responsibility of the instrument scientists to plan and organise early science programme
  - Expectation that the early science programme will be driven by the instrument scientists and their collaborators [see Instrument Construction Policy]
- Why? In order to deliver on the scientific potential of ESS:
  - Instrument scientists need to understand their instrument – get to know it as a craftsman knows his tools
  - Instrument scientists need to understand the experimental chain end-to-end
  - Instrument scientists need to be scientifically engaged
  - In Kind Partners who built the instruments need to remain engaged

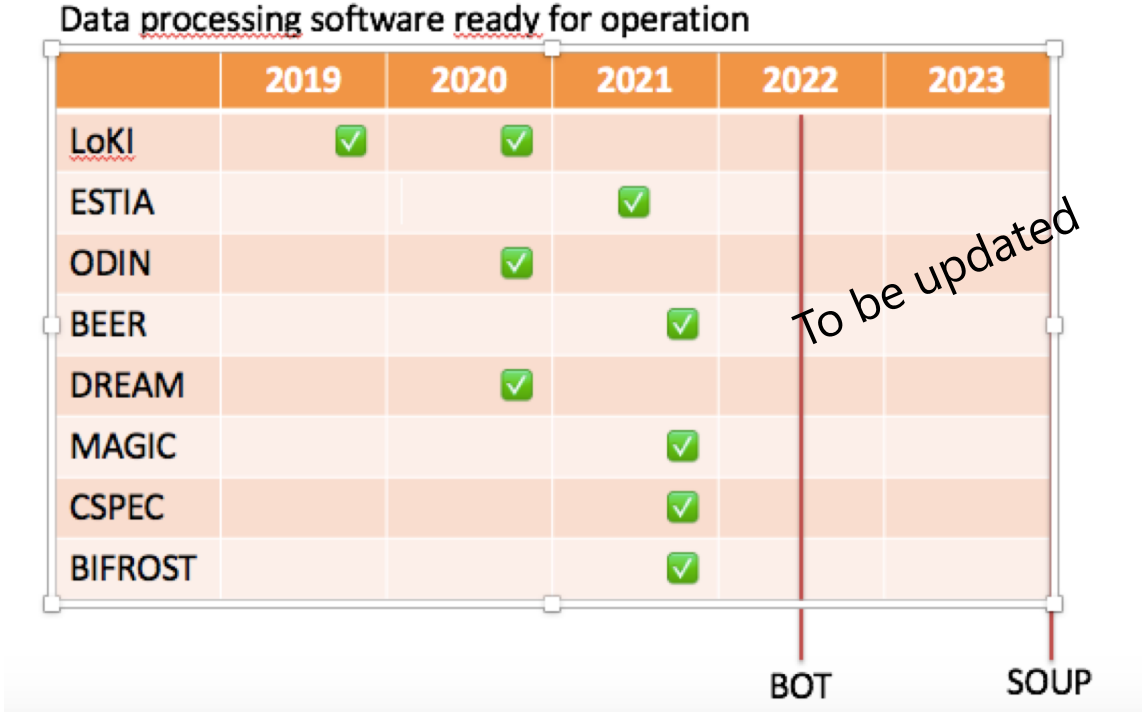
How do we plan for First Science?

User Support, Labs, Sample Environment & Software

Scientific Activities Division

- **User Office SCUO**: policy implementation started, hot commissioning user programme via DEMAX call
- **Deuteration Service DEMAX**: 1st pilot call completed, 2nd 17 proposals evaluated, 3rd to focus on FS
- **User Labs SULF**: E04 lab installation progressing well; analytical support for ESS already available.
- **Sample Environment**: Supporting instruments with standardised mechanical interfaces and supplies.
- **Sample Environment**: Pursuing critical SE systems (pool/specific) for first 8 instruments with prioritisation from instrument teams based on early needs.

DMSC



Associated milestones

2020: Min. 1 Instrument Data Scientists recruited

2022: GUI support for data reduction ready

Challenges

How to include external experts?

- There will be a lot of eagerness to do experiments at ESS
- STAP members are already very engaged in thinking about early science
  - Build on this. STAPs have evolving membership and we are adjusting to include more users and fewer facility experts.
- "Friendly Users" = people who will tell you how terrible it all is, but in private, and then help you fix it.
  - Identify these people early & get them up to speed on instrument concepts so that they can help plan the early science – will need a process for this so we aren't seen as bringing in the "usual suspects" (=> involve SAC).
- Pros:
  - Early involvement of external experts can help accelerate commissioning
  - Can help build community engagement
- Cons:
  - Could push instrument scientists to the side ("let the real scientists in")
  - Risk for bad press if we don't bring in the right people with the right experience

Challenges

Expectation Management

- "First Science" is one of the early first steps towards full user operations
  - Not the same as start of user programme!
  - Planned to be about half way through hot commissioning period, so instrument will only just have become functional.
  - Managing to get a real experiment done, however scientifically straightforward, will be a major achievement!

- Commissioning first long-pulse source at the same time as new instruments.
  - We don't yet know exactly how the source will behave
  - Lots of open questions
  - Early reliability and performance will be low

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SAC fully supports the approach to First Science (presentation by A. Jackson)

After First Science: SOUP

Start of User OPeration

- SOUP: First Science + 9 months
- First call for proposals ~ 6 months before SOUP
- User office up and running
- First Proposal Reviews
- Welcome first (non-expert users) on first instruments which have been sufficiently commissioned to avoid bad surprises
- Sufficient sample environment to allow interesting user experiments
- Software in place for proper data analysis to allow (speedy) publication
- Most of the debugging should be over
- Neutron source should have achieved sufficient reliability
- All of the above is important to create a positive user experience
- Essential for the success of ESS

Conclusions

- ESS is making good progress
- Some impact by ongoing pandemic
- Planning for First Science and SOUP ramping up
- Even if key milestones are delayed, time moves fast!