



**EUROPEAN
SPALLATION
SOURCE**



ESS Accelerator Status and Commissioning Plans

PRESENTED BY NATALIA MILAS

2021-09-14

Agenda



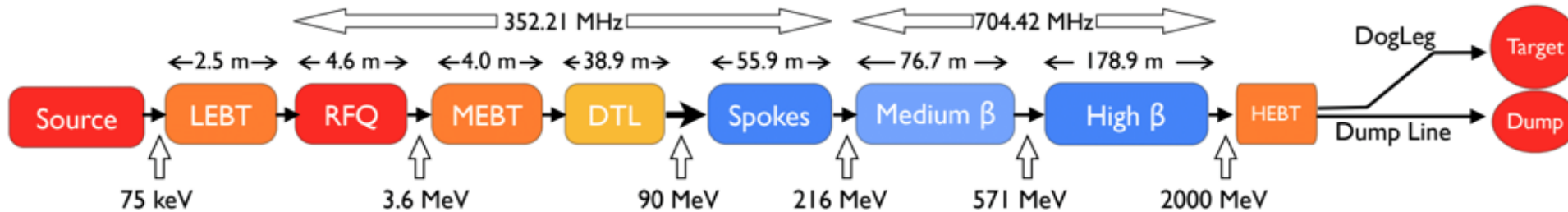
- 1 The ESS project
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- 4 Commissioning plans for the NCL
- 5 SCL installation and plans
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The ESS Project



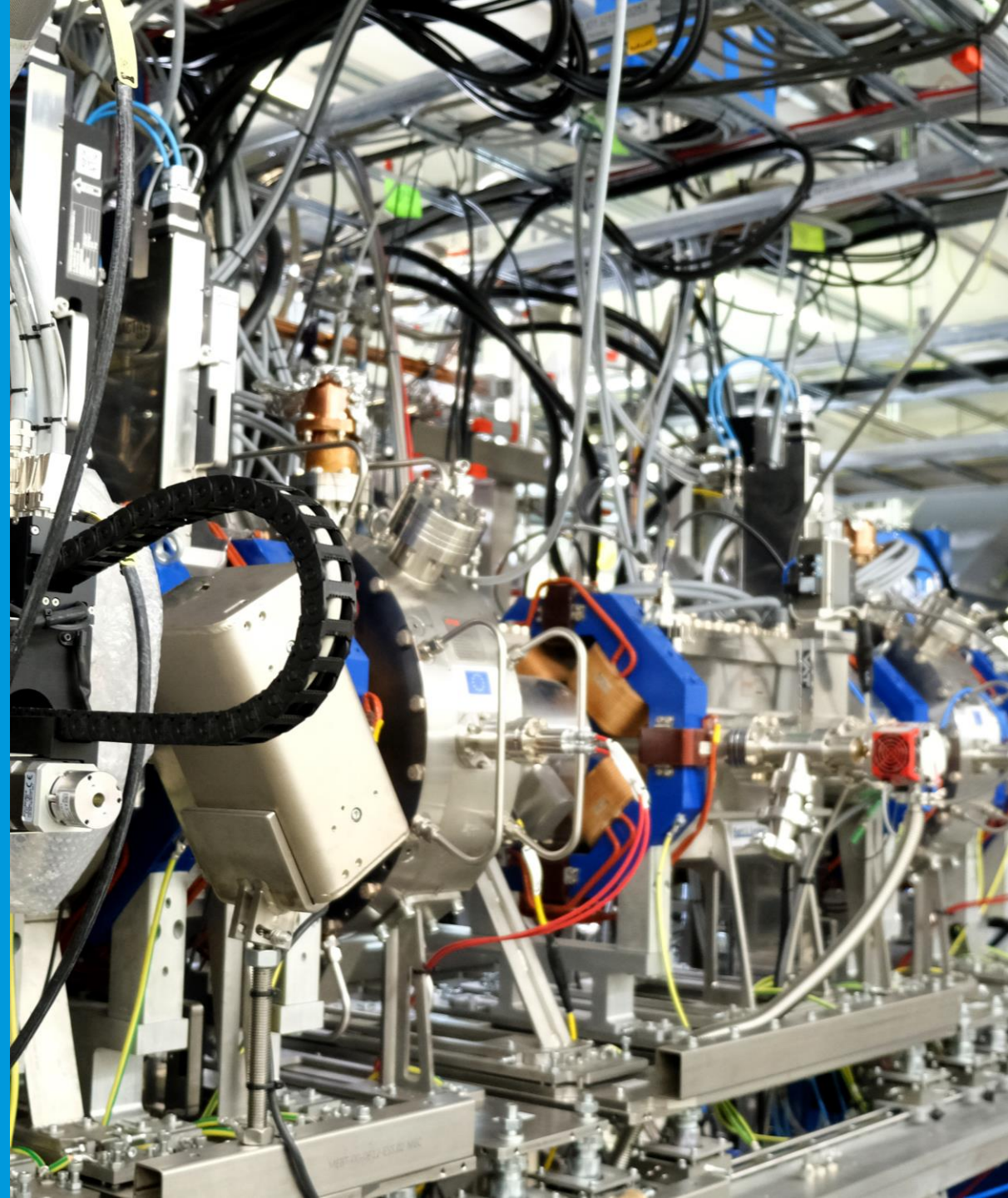
The ESS Project



	Length	No. Magnet	#Cav × $\beta_g/(Opt)$	No. Sections	Power (kW)	IK partner
LEBT (from Plasma)	2.7	2 Solenoids	—	1	—	INFN-LNS
RFQ	4.5	—	1	1	1600	CEA Saclay
MEBT	4.0	11 Quads	3	1	15	ESS-Bilbao
DTL	38.9		5	5	2200	INFN-LNL
LEDP + Spoke	55.9	26 Quads	26 × (0.50)	13	330	IPNO
Medium Beta	76.7	18 Quads	36 × 0.67	9	870	LASA / CEA
High Beta I (~1.3 GeV)	93.7	22 Quads	44 × 0.86	11	1100	STFC / CEA
High Beta II	85.2	20 Quads	40 × 0.86	10	1100	STFC / CEA
Contingency + HEDP	132.3	32 Quads	—	15	—	Elettra
DogLeg	64.4	12 Quads + 2	—	1	—	Elettra
A2T	44.7	6 Quads + 8 Raster	—	1	—	Aarhus Uni
	603.0					

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Current Schedule

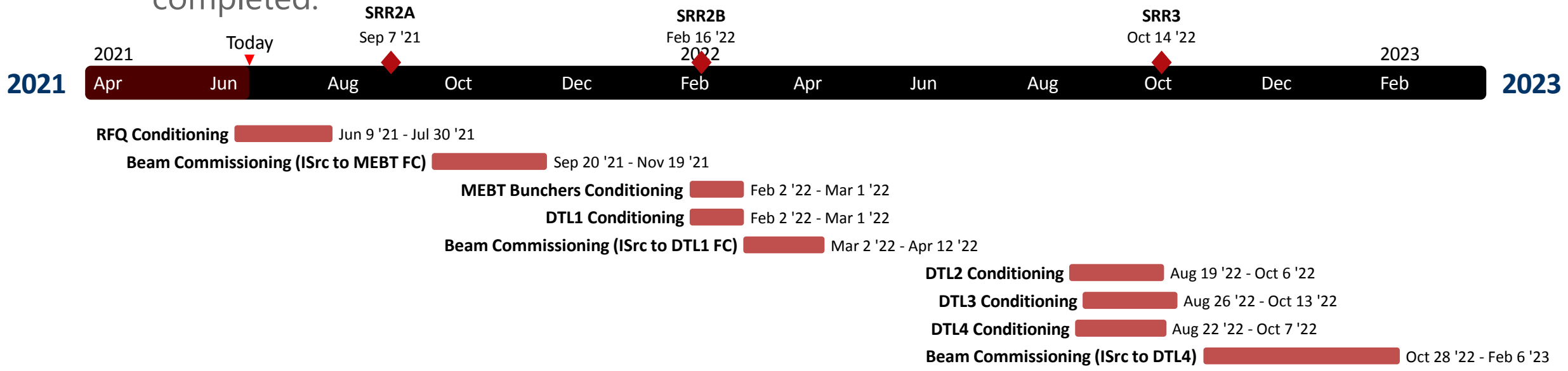




Schedule

NCL and beyond

- NCL installation is ongoing at the moment. Next step is the DTLs installations.
- Cryo distribution line for MB and HB is done. Spokes underway.
- TS2 and Freya are measuring the Elliptical and Spokes cavities.
- Cryo plant, LWU and PRL all installed and tested. RF distribution line is also completed.

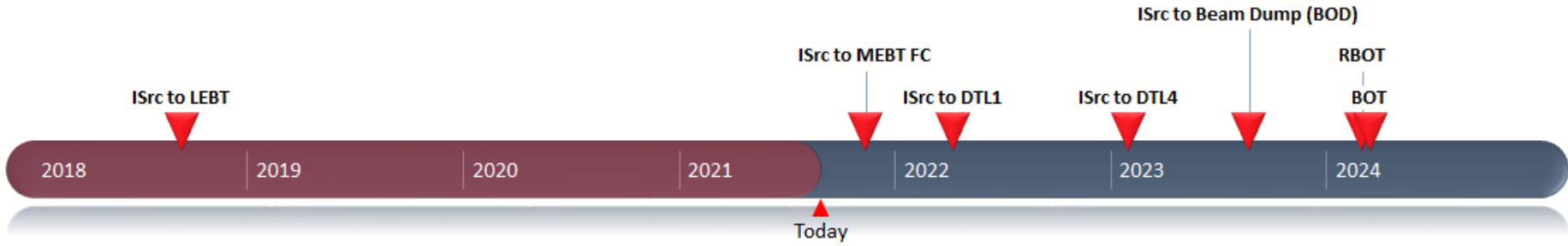
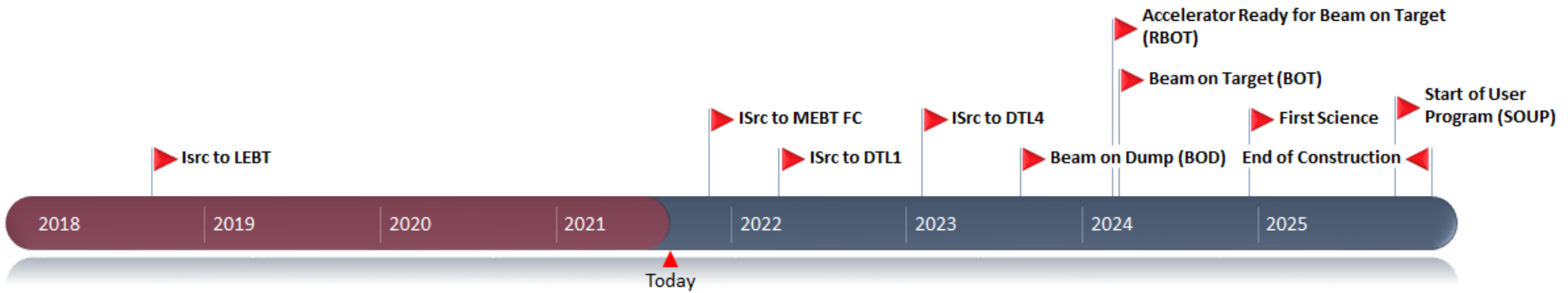


Courtesy: C. Plostinar



Overall Schedule

Latest Schedule



ISrc to LEBT BEam Commissioning

ISrc to MEBT FC Beam Commissioning

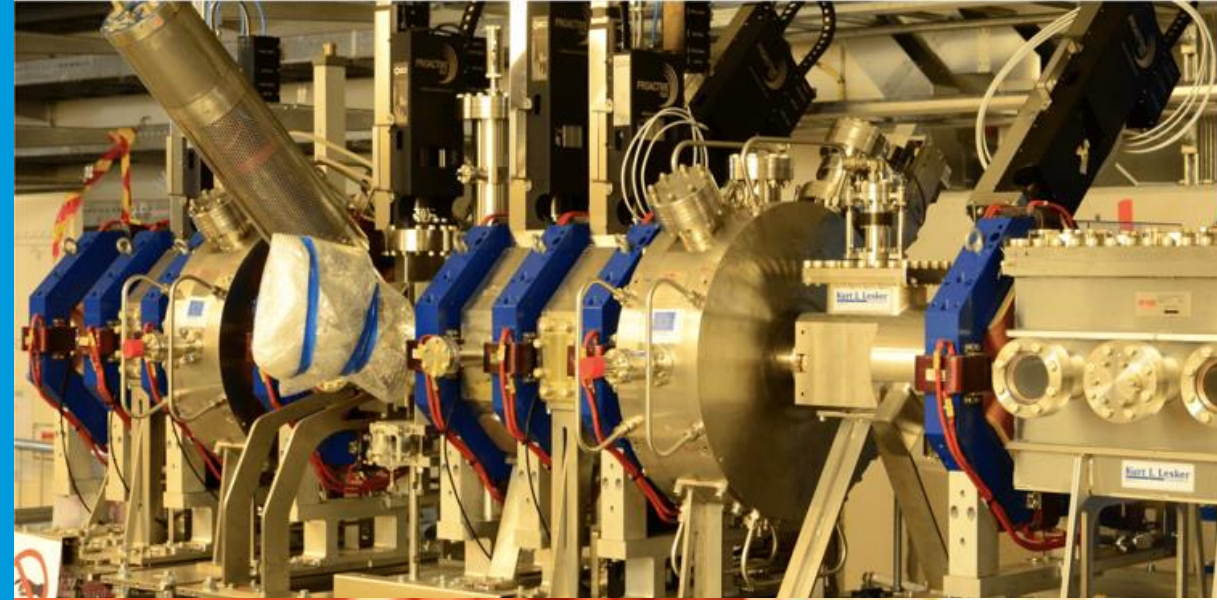
ISrc to DTL1 Beam Commissioning

ISrc to DTL4 Beam Commissioning

ISrc to DMPL Beam Commissioning

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Current Status of the ESS Accelerator

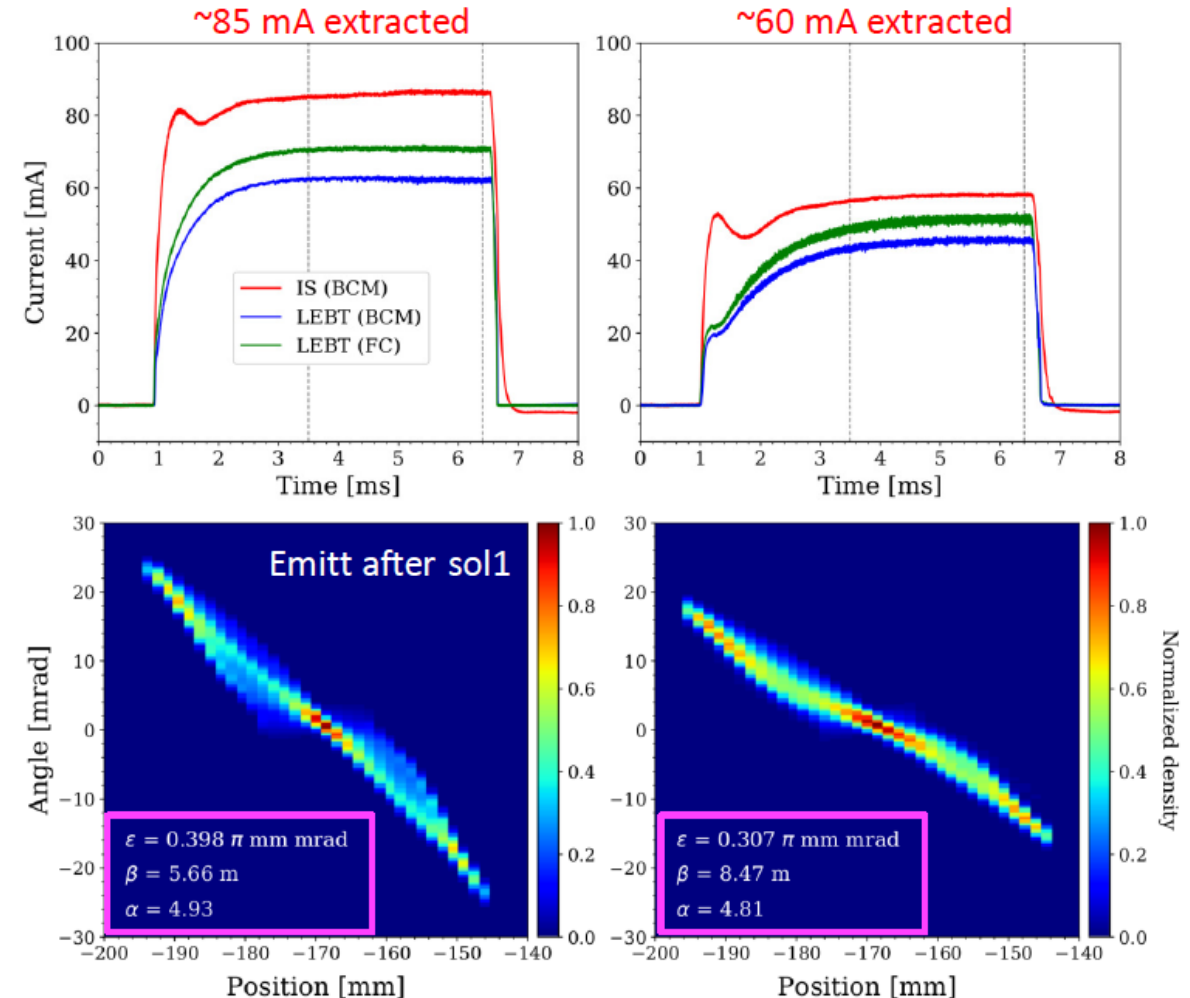


Normal Conducting Linac

Ion Source and LEBT Commissioning (2018-2019)



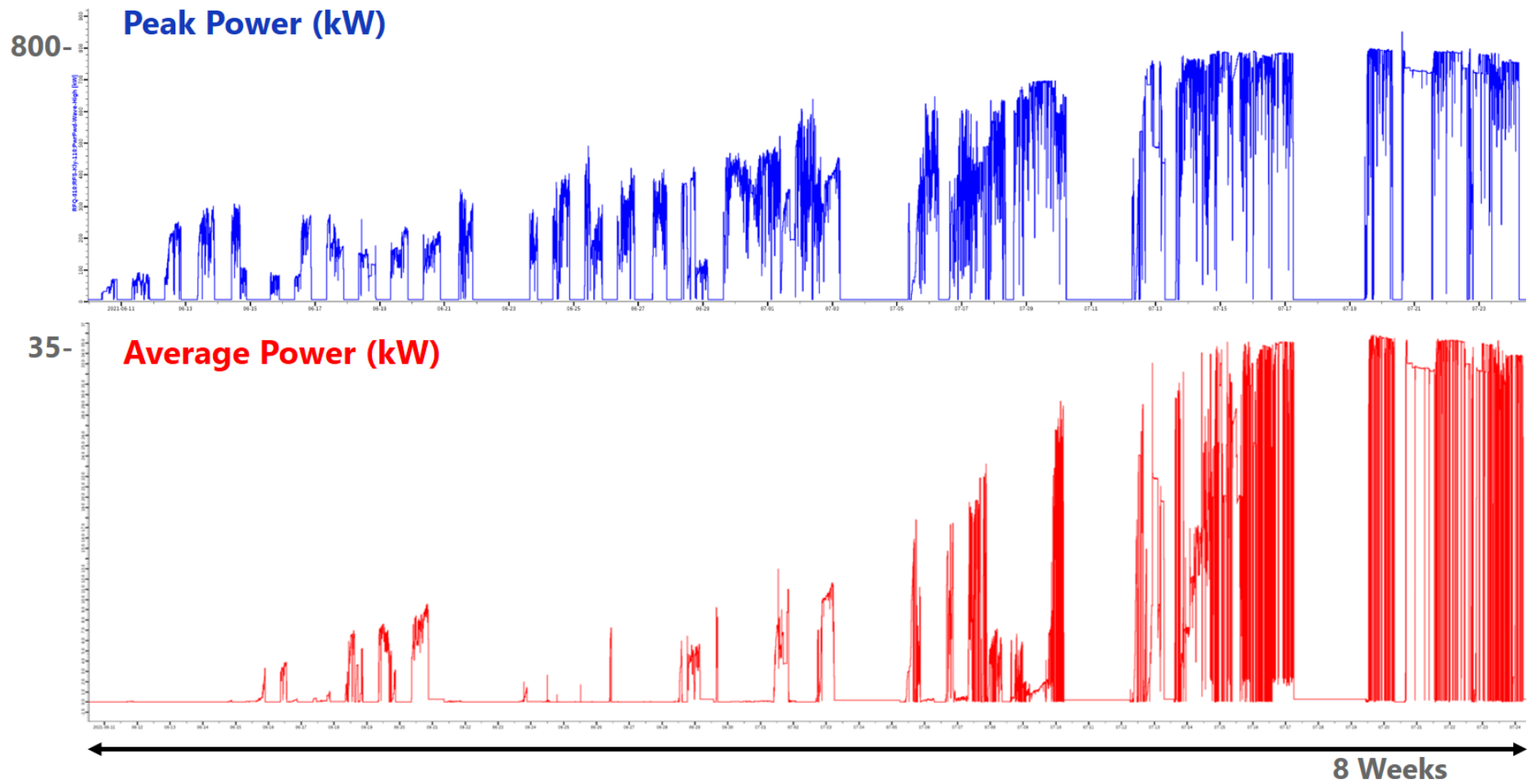
- Source and LEBT were commissioning between 2018 and 2019
- Source proved to be very flexible.
- We suspect the beam is coming out with a larger divergence than expected from simulations (still to be verified)
- Emittance is a bit higher than the design as well.
- Still some equipment left to be tested a commissioning at this next round (2021): iris and new chopper.





Normal Conducting Linac

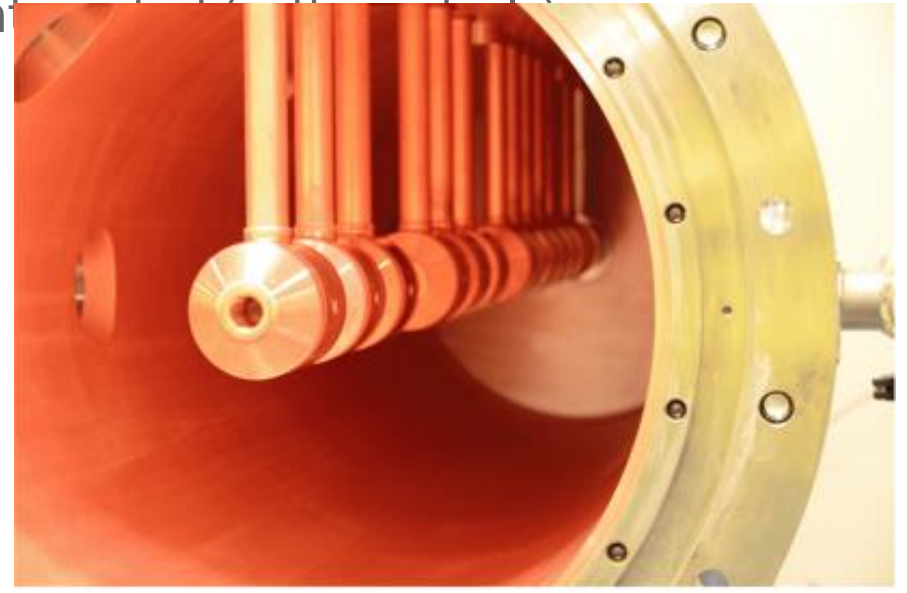
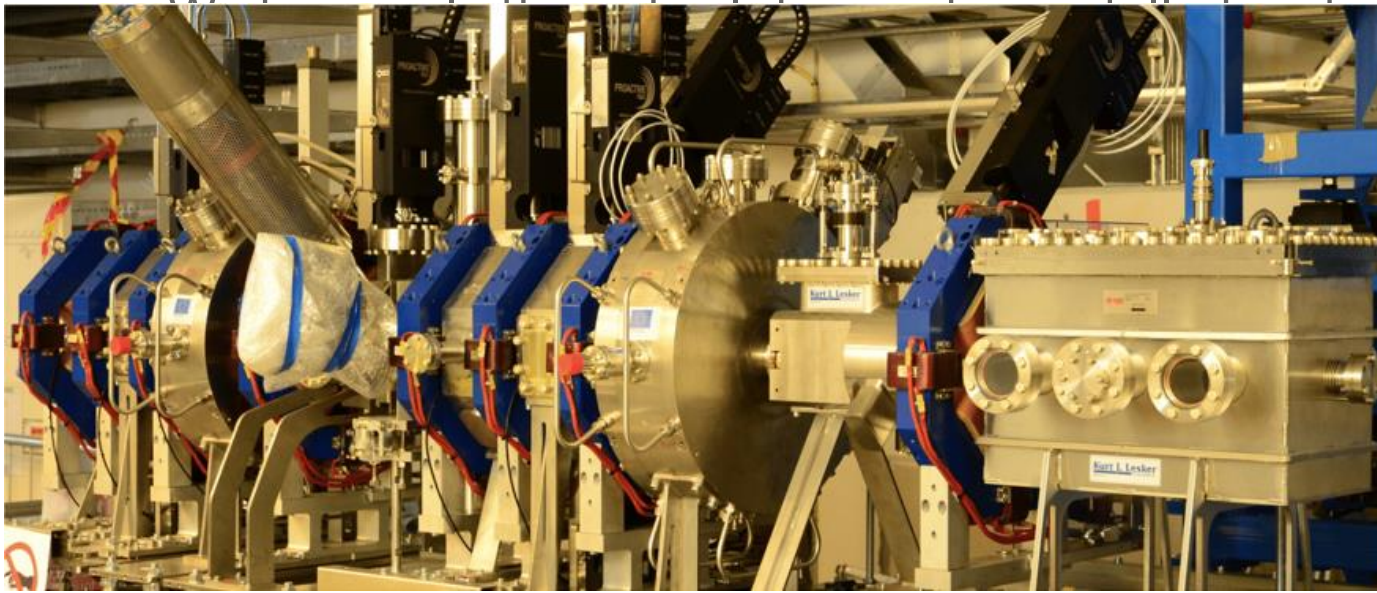
RFQ conditioning was completed in July 2021



Normal Conducting Linac

MEBT and DTL

- DTL1 tank is installed (August 2021) and the next tanks installations will follow in 2022.
- MEBT is fully installed. RF power for the buncher cavities is the one piece still missing.



Infra and Support

RF Distribution Line



NCL RFDS, Tunnel



NCL RFDS, Gallery



SCL RFDS, Tunnel



SCL RFDS, Gallery

Infra and Support

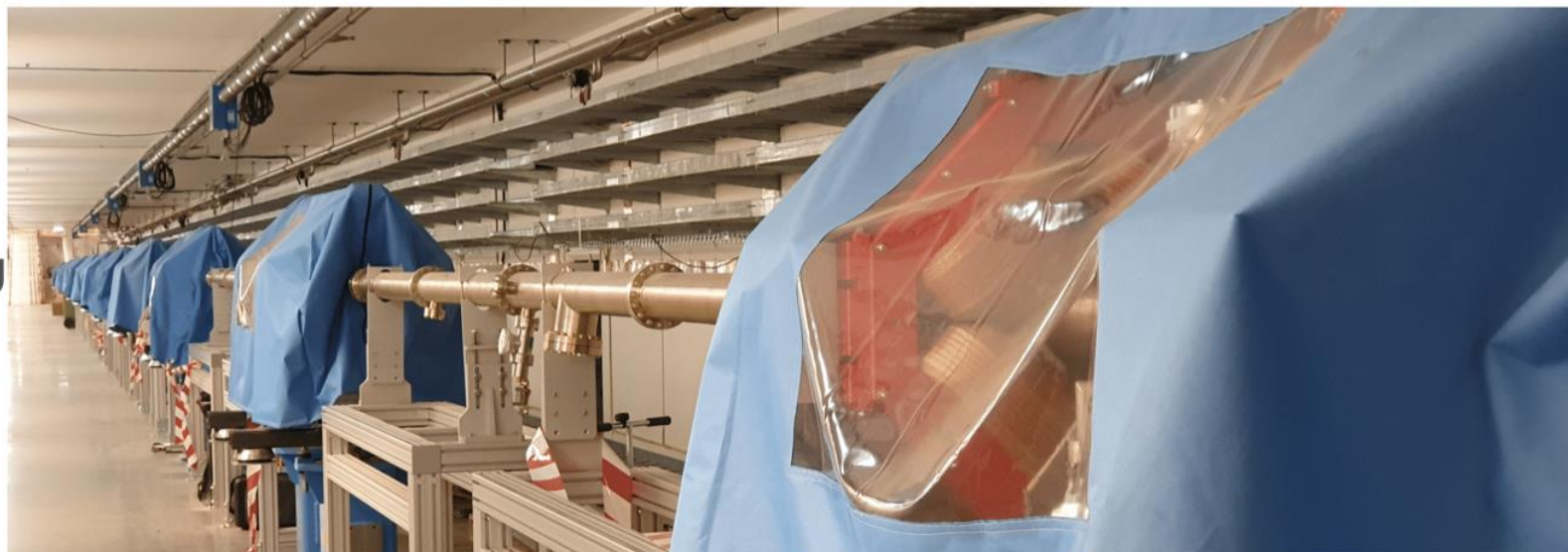
Cryo Distribution System, Phase Reference Lina and Linac Warm Units

CDS



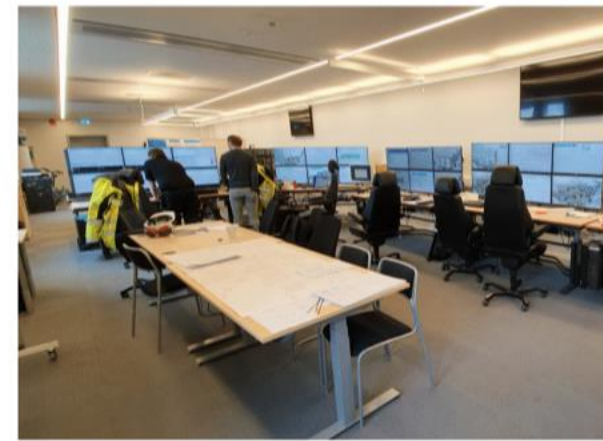
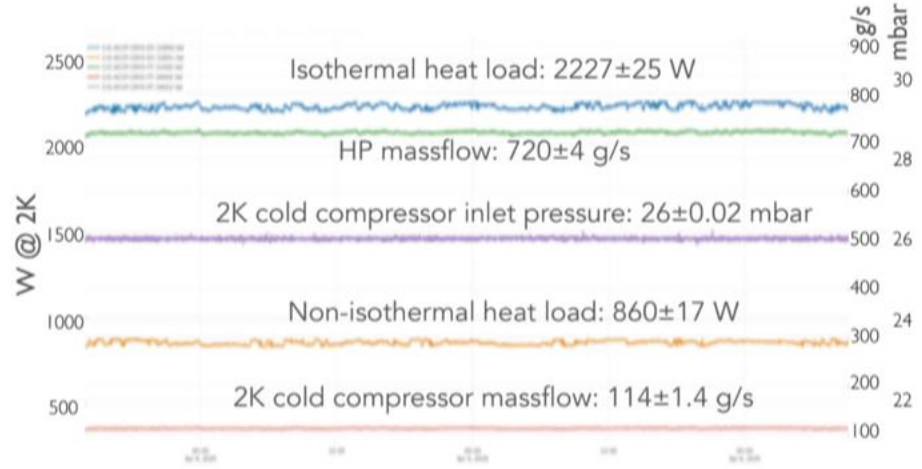
PRL

LWU



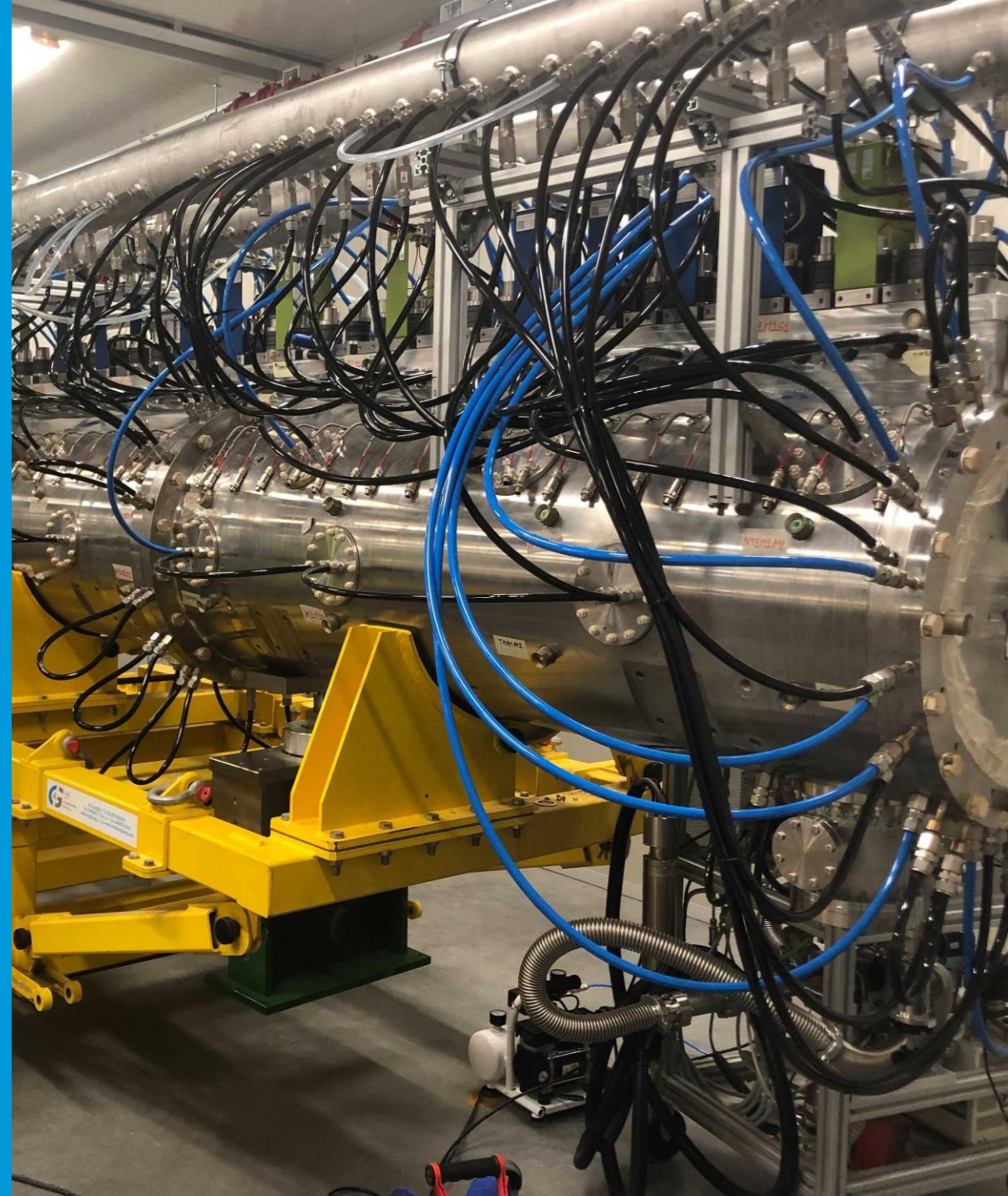
Infra and Support

Cryo Plant



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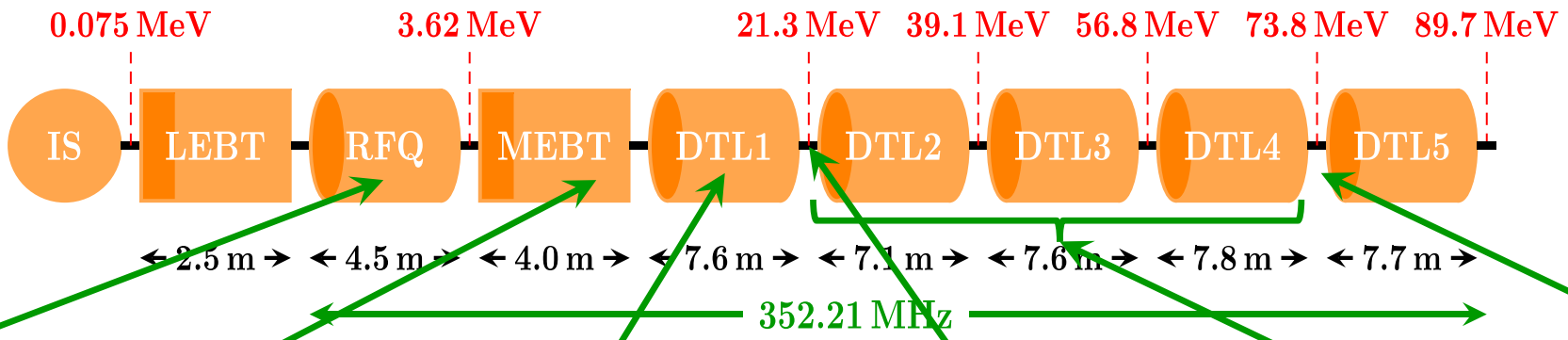
Commissioning plans for the Normal Conducting Linac



NCL Conditioning and Commissioning Phases



NCL Licence to Operate these phases received from SSM



Conditioning

- RFQ

Beam to MEBT FC (SRR2A)

- Ion Source
- LEBT
- RFQ
- MEBT up to the FC
 - Bunchers not powered
 - Critical Diagnostics

Conditioning

- MEBT Bunchers
- DTL1

Beam to DTL1 FC (SRR2B)

- Ion Source
- LEBT
- RFQ
- MEBT
 - Bunchers powered
- DTL1
 - Powered

Conditioning

- DTL2
- DTL3
- DTL4

Beam to DTL4 FC (SRR3)

- Ion Source
- LEBT
- RFQ
- MEBT
- DTL1-4

Courtesy: C. Plostinar

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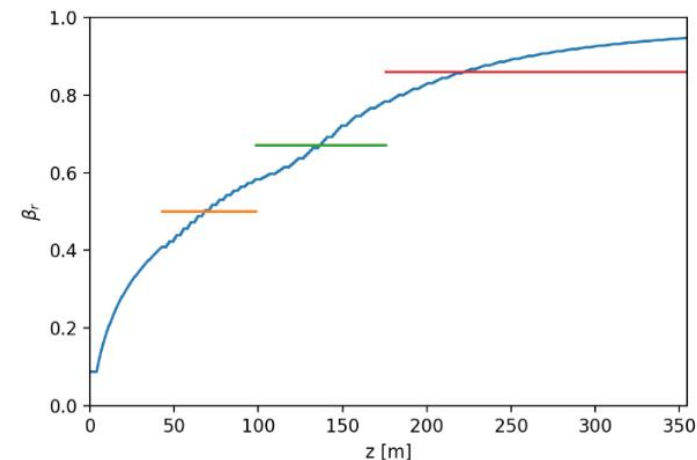
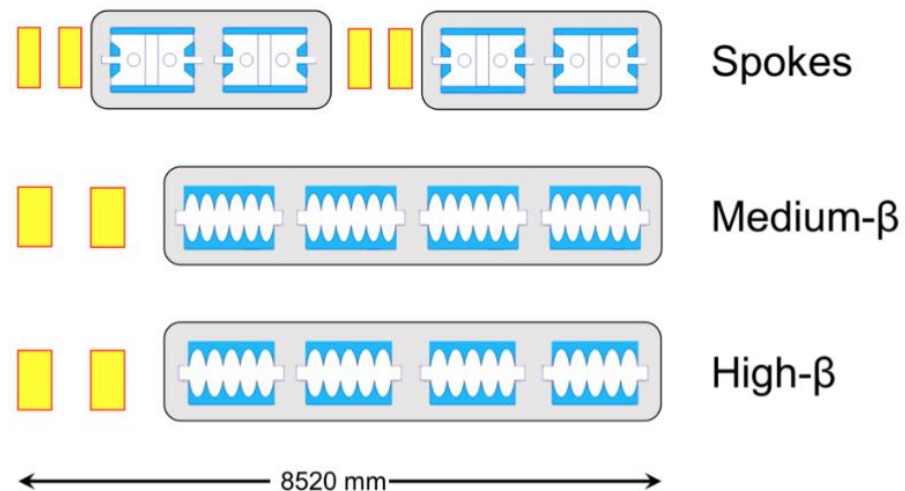
Superconducting Linac installation and plans



Superconducting Linac

Spokes, Medium and High Beta Cavities

- Cavity parameters:
 - Spokes: 2 cavities per cryostat, 13 cryostats in total, max. gradient 9MV/m. Built by IPNO Orsay
 - Medium Beta Ellipticals: 6-cells cavities, 4 per cryostat and 9 cryostats in total. Max gradient is 16 MV/m. Built by CEA.
 - High Beta Ellipticals: 5-cells cavities, 4 per cryostat and 21 cryostats in total. Max gradient is 20 MV/m. Built by CEA.



Superconducting Linac

Test Stands

- Spokes cryomodules are to be tested in Uppsala at Freia Lab (right)
- Elliptical (medium and high beta) cryomodules are being tested at ESS (below)



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Beyond the Accelerator Commissioning



Construction Schedule and Power Ramp-up



Schedule and latest news

- Construction of the ESS complex will be finished by the end of 2021 and the whole site will be handed over from Skanska to us in 2022.
- User Program Schedule
 - Beam on Target is scheduled for 2025, First Science (friendly Users) for March 2026 and Start of User Program for September 2026.
 - We will start with 4 of the 15 scheduled instruments.
- Machine power ramp-up:
 - Start with 571 MeV proton beam (1.3 MW)
 - Increase to 800 MeV (2 MW) (5 cryostats in HB)
 - We will have all cryo and cavities but no RF power for the remaining cavities in the HB. Increase step by step (additional 40 M€)



ESSnuSB and Muon Collider

Projects ESS Beam Physics group is involved
Collaboration

- Talk on ESS contribution to ESSnuSB by Ben Folsom ([ESSvSB Linac and Transfer Line: Lattice Design and Error Studies](#))
- We are also involved in the discussion about the Muon Collider with CERN
 - Proton Complex Working group.
 - We have a final meeting now in October to define the next steps.
 - There are some synergies with EEnuSB and some interesting points to study (source development, linac studies, accumulator and buncher rings etc)



Thank you!

2021-09-14