DFH Cold Boxes production in Sweden

By Rocío Santiago Kern

On behalf of FREIA-UU and RFR Solutions

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- Delivery Schedule to CERN
- Project's Perspectives
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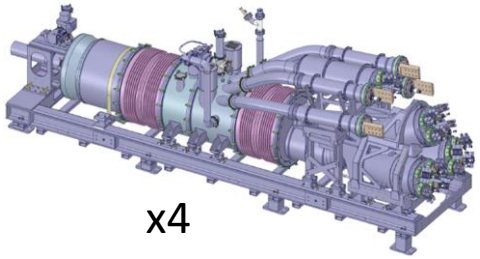
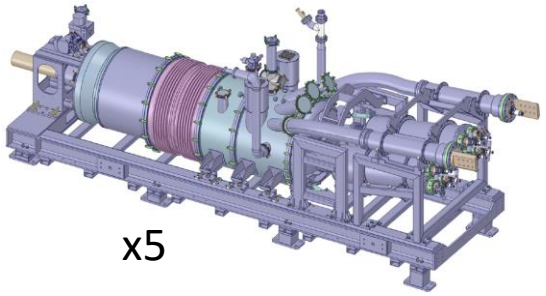
Collaboration Agreement

- KE5162, EDMS 1981185
- Scope of supply:
  - DFHX x4
  - DFHM x5
- **Design** made by **CERN**
- **Design drawings** provided by CERN
- Special situation:
  - Collaboration among **CERN-University-Company**
  - All parties **manufacture pieces**
  - Uppsala University is the bridge between CERN and the company (RFR)



x4



x5

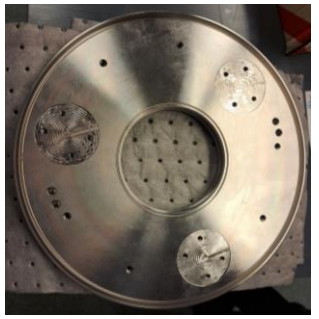
Funding

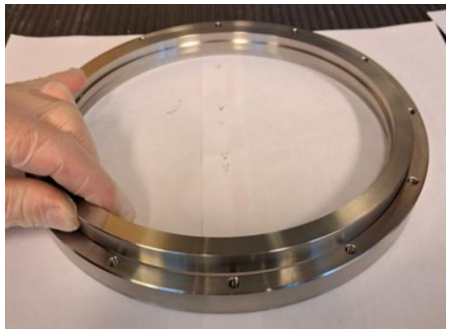
- RFR had experience from Prototype (DFHX1) and would benefit from
  - Planning machining requirements: the amount necessary, how to do it and arrangements with subcontractors
  - Learning new process with Helium leak testing
  - Adapting to strict tolerances

- Money invested in the project
  - Vetenskapsrådet (VR): 10 000 000 + 1 700 000 SEK
  - CERN: 900 000 CHF

Asset Distribution between UU and RFR

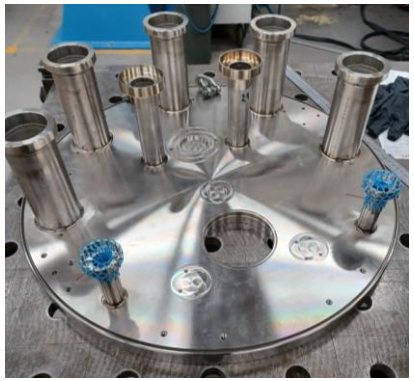
- UU/FREIA workshop:
  - Smaller-size parts that do not require certified welding
    - Max milling length 1035 mm Radius max 500 mm turning machine
  - Subsupplier for silver-coating





Asset Distribution between UU and RFR

- RFR:
  - All the rest of the parts
  - Subsuppliers:
    - Bellows
    - Epoxy components
    - Machining of big chambers (welding done at RFR)



Delivery Schedule to CERN

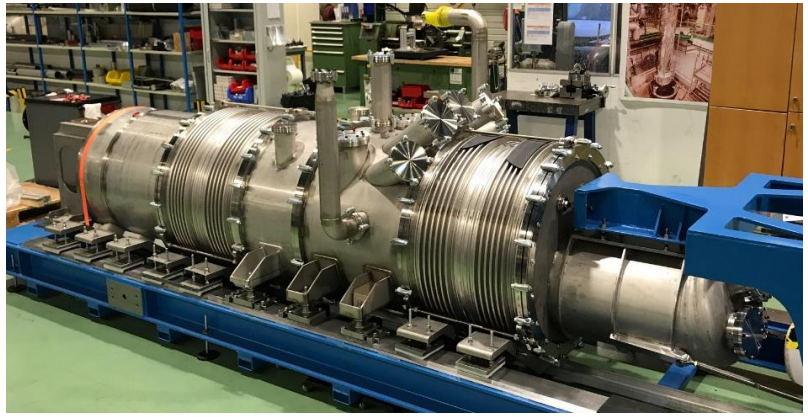
2022			2023											
October	November	**December**	January	**February**	March	**April**	May	**Jun**	July	**August**	September	**October**	November	**December**
x1 DFHX		x1 DFHX		x1 DFHX		x1 DFHX		x1 DFHM		x1 DFHM		x1 DFHM		x2 DFHM
Documentation		Documentation		Documentation		Documentation		Documentation		Documentation		Documentation		Documentation
Excluding components:		Excluding components:												
LHCDFHX0024		LHCDFHX0024												
LHCDFHX0042		LHCDFHX0042												
LHCDFHX0049		LHCDFHX0049												

2023						
Jun	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
DFHX2			DFHX3			DFHX4 and DFHX5
Documentation			Documentation			Documentation
Excluding components:			Excluding components:			Excluding components:
LHCDFHX_0024			LHCDFHX_0024			LHCDFHX_0024
LHCDFHX_0042			LHCDFHX_0042			LHCDFHX_0042
LHCDFHX_0049			LHCDFHX_0049			LHCDFHX_0049

2024							
Jun		**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	
DFHX4	DFHX5	DFHM1		DFHM2	DFHM3	DFHM4	DFHM5
Documentation	Documentation	Documentation		Documentation	Documentation	Documentation	Documentation

Deliveries

- Delivered in total 554 components
- 13 416 pages of documentation
- From all these, there were only 2 pieces that had to be scrapped
  - LHCDFHX_0041: the rings were not parallel
  - LHCDFHX_0049: one of the edges was machined oval and too thin
- Two He-leaks detected, both on welds on LHCDFHX_0024
- Up to now, DFHX2, DFHX3 and DFHX4 have been blank assembled at CERN and are leak tight



LHCDFHX_0041

LHCDFHX_0049

LHCDFHX_0024

RFR's Project Perspective: Lessons Learned

Good

- Preparation of Documentation
- Implementation of the first prototype experience in series production
- PRR:
  - Possibility to think about the manufacturing process
  - Made a few changes along the project
- Have acquired knowledge for future projects

To be improved

- Planning + start the manufacturing
- Production preparation studies
- Importance of quality control during manufacturing
- The challenges of understanding the leak test results
- Continuous reporting

RFR's Project Perspective: Main Takeaways

- Great cooperation, support and learning opportunities (CERN workshop, UU workshop, FREIA)
- High competence development within vacuum technology and helium leak testing
- Manufacturing for demanding tolerances
- Good reference for marketing and brand-building
- Possibility of working with CERN in future projects

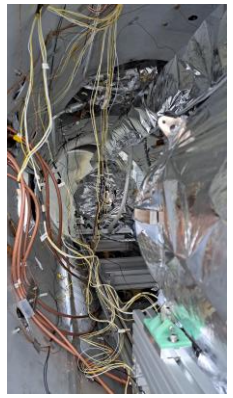
FREIA's Project Perspective

- Valuable insight by examining the project from multiple perspectives: industry and customer (Big Science facility).
- Understanding the intricacies of manufacturing processes and the associated timelines
- Identifying key aspects of the documentation
- Recognizing and addressing potential challenges and complex areas within the project
- Defining non-conformities and how to manage them
- Great cooperation, support and learning opportunities

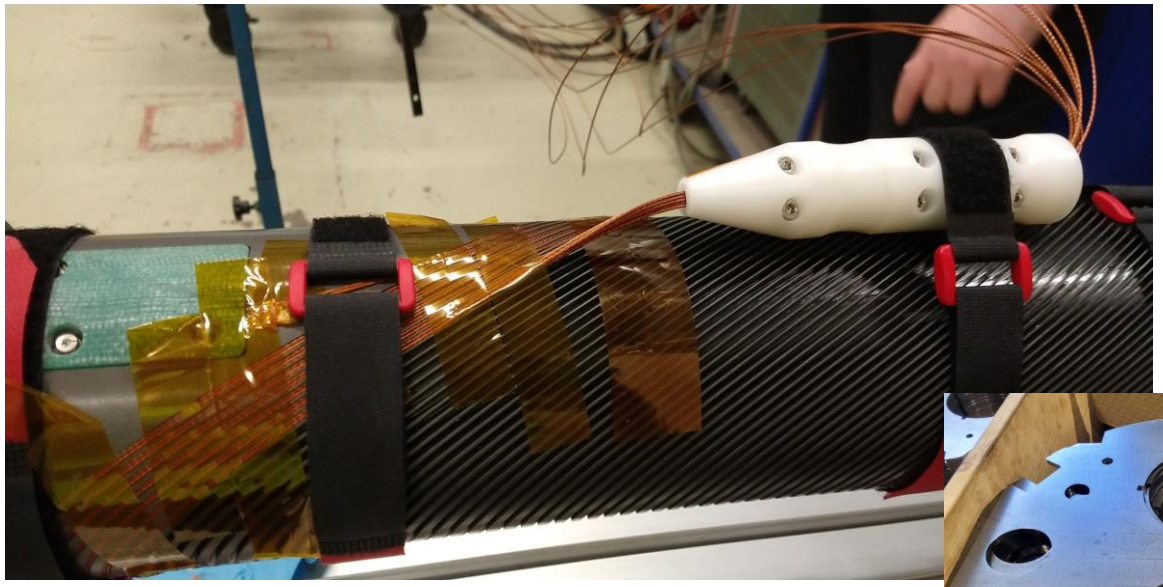
Where Does FREIA Stand now?

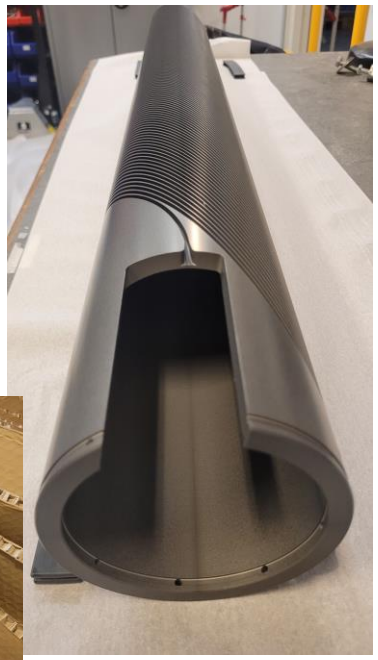
Testing of Supercoducting Cavities for MYRRHA

- MYRRHA: Multi-purpose Hybrid Research Reactor for High-tech Applications, for nuclear waste treatment
- Phase I of the MYRRHA project (MINERVA): design and construction of the first linac section (up to 100 MeV)
- FREIA
  - Will test the double spoke cavities for Minerva (up to 60)
  - Has already tested the first 2 pre-series cavities



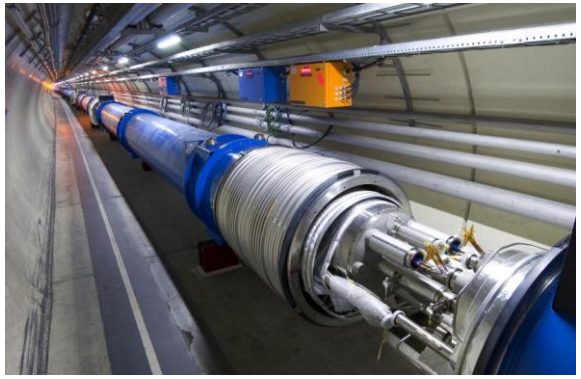
Developing superconducting magnets



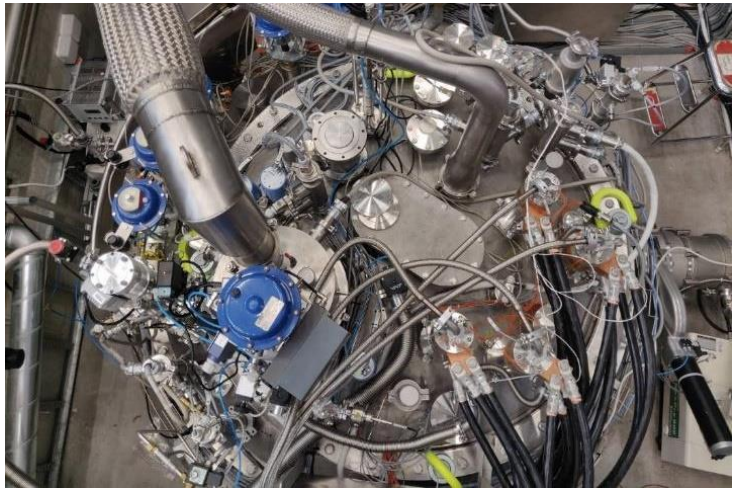


Funded by: Swedish Agency for Regional and Economic Growth, Region Kronoberg, Uppsala University

Superconducting accelerator magnets



Field measurement system with anti-cryostat and rotating coil is on its way!



SuShi – Superconducting Shield

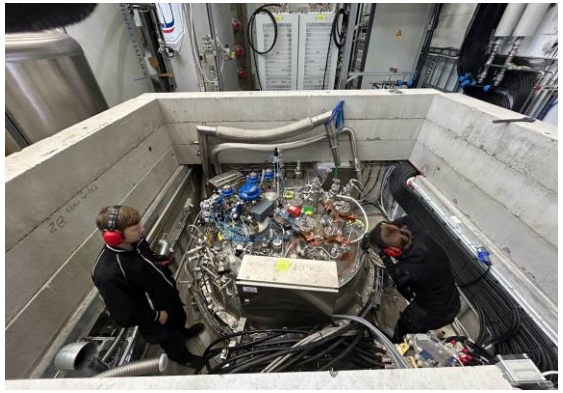
Designed and built by the Wigner Research Centre for Physics, Hungary, test supported by Euro-Labs







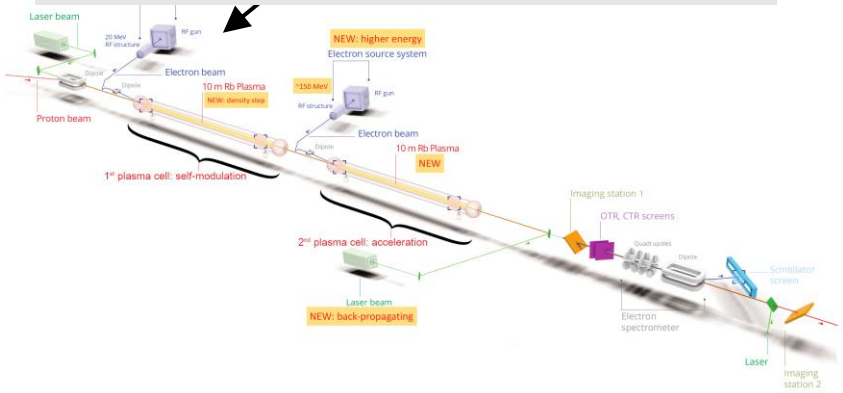




Tommaso Bagni & team

Other projects

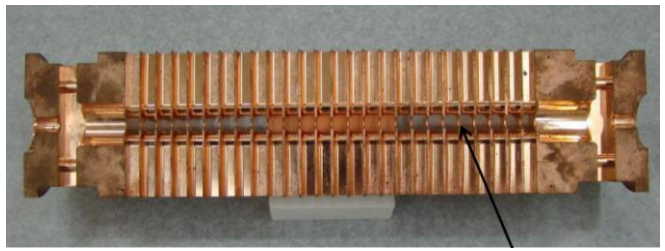
AWAKE: Uppsala develops and delivers RF systems for the two electron injectors for the AWAKE project (run 2).

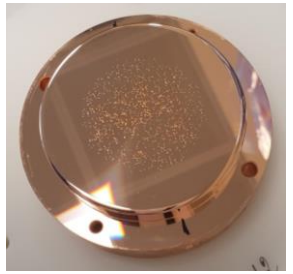


Courtesy: Kevin Pepitone

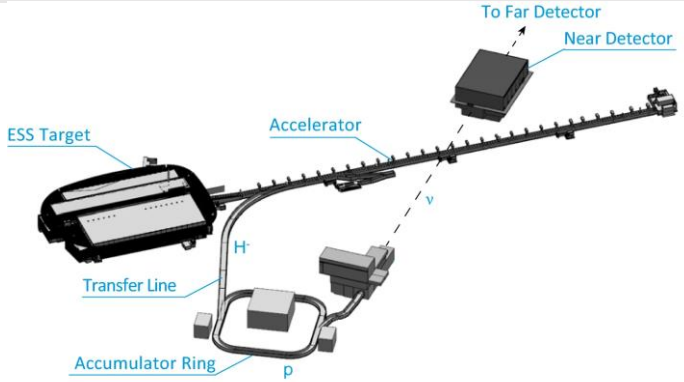
3GHz solid-state amplifier

CLIC: Vacuum discharges in acceleration cavities (e.g. X-band technology for CLIC)





ESSnuSB+: Accelerator development for ESS neutrino Super Beam



Thank you for listening

And special thanks to (on behalf of UU):
Yann Leclercq, Paul Cruikshank, Stefanos Spathopoulos, Amalia Ballarino, Oliver Brüning, Benny Björkander, Mats Lavin, Mikael Siversson, Veljko Pribak, Aryan Mohammadi, Mats Orup and many more…

Any Questions/Requests/Comments/Suggestions?