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FREIA Laboratory

Rocío Santiago Kern

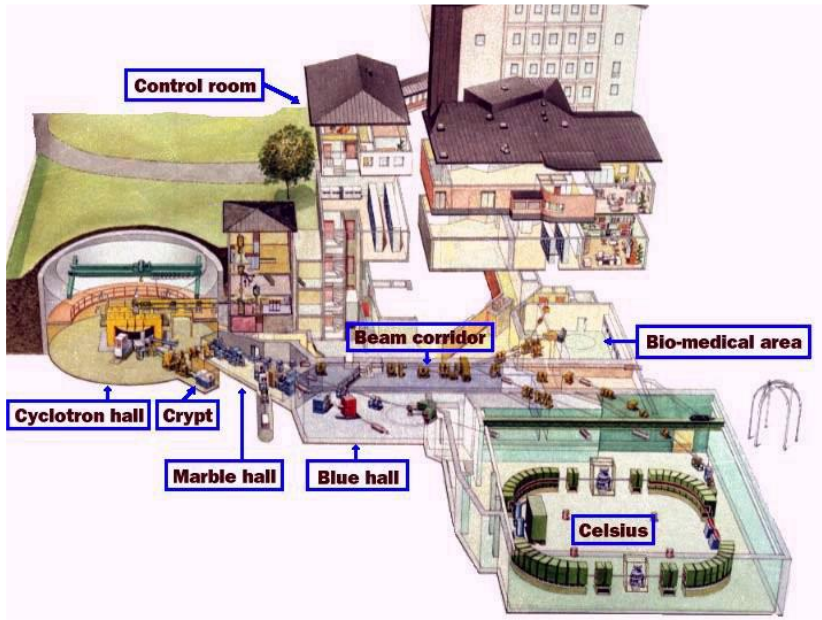
On behalf of the FREIA team

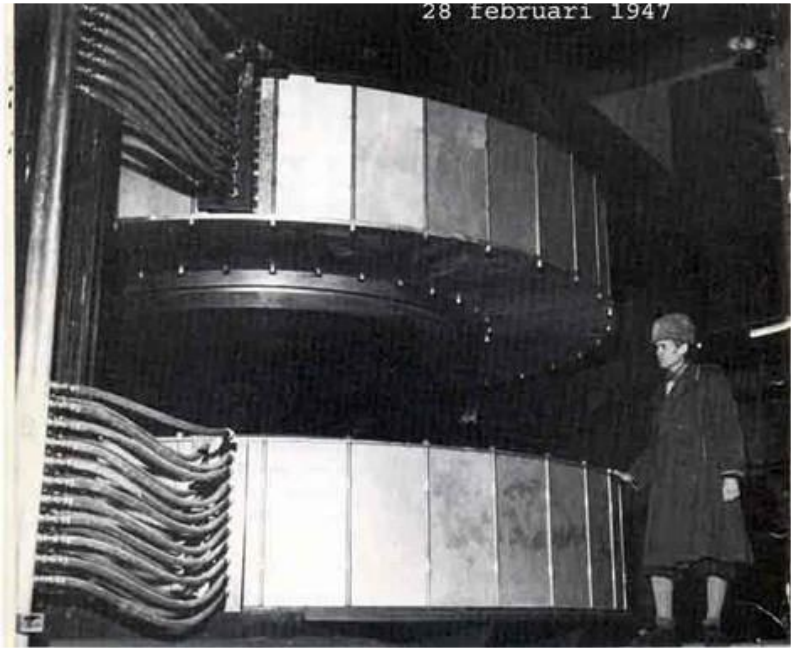
Outline

- Uppsala’s Accelerator History
- The ”idea” of FREIA
- FREIA
- Infrastructure
- Main Projects
- Other projects

Uppsala's Accelerator History

- 1940's: The(odore) Svedberg proposes to build a cyclotron
- Gustaf Werner synchro-cyclotron (1947 - 2016)
  - nuclear physics & oncology
- CELSIUS ring (1984 - 2005)
  - nuclear & particle physics
- CTF3/CLIC (since 2005)
- FLASH/XFEL (since 2008)
- Skandion clinic (est. 2015)





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The ”Idea” of FREIA

- Once it was decided that ESS would be built in Sweden
- Need for a facility to test ESS superconducting equipment
  - Other facilities avaiable ”part time” due to their own projects
  - Reduce logistics by having a facility in Sweden

Extended Writing Group

Work Package (work areas)

1. Management Coordination – ESS (Mats Lindroos)
2. Accelerator Science – ESS (Steve Peggs)
3. Infrastructure Services – Tekniker, Bilbao (Josu Eguia)
4. SCRF Spoke cavities – IPN, Orsay (Sebastien Bousson)
5. SCRF Elliptical cavities – CEA, Saclay (Guillaume Devanz)
6. Front End and NC linac – INFN, Catania (Santo Gammino)
7. Beam transport, NC magnets and Power Supplies – Århus University (Søren Pape-Møller)
8. RF Systems – Uppsala university (Roger Ruber)

Work Packages
Short descriptions

- **WP6: Normal Conducting Linac (INFN, S. Gammino)**
  - *This Work Package will be responsible for the design of the elements of the front-end up to the warm-to-cold transition (proton source, beam transport system, radio frequency quadrupole and drift tube linacs).*
- **WP7: High-Energy Beam Transport, Normal Conducting Magnets and Power Supplies (ISA, S. Pape-Møller)**
  - *This Work package is concerned with the design of a High Enregy Beam Transport system. And it will also define standards for the normal conducting magnets, the corresponding power supplies, beam dumps and collimators for the whole Linac.*
- **WP8: Radio Frequency Systems (Uppsala U, R. Ruber)**
  - *This Work Package addresses the design and development of the RF power generation at 352 MHz and 704 MHz, its control and its distribution system for the ESS Linac.*

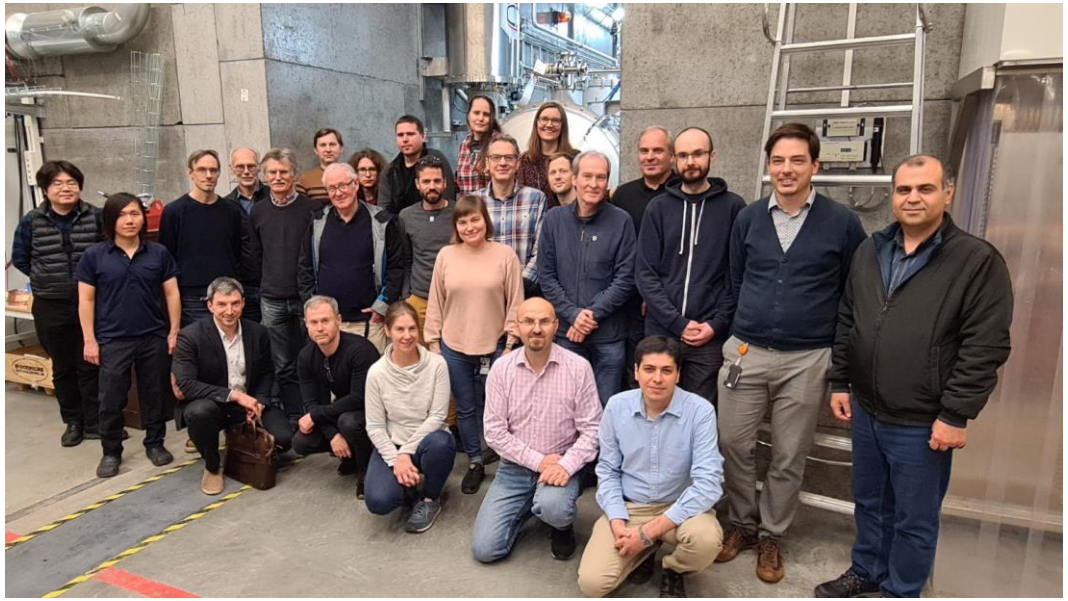
Test stand strategy

- 704 MHz test stand for SC elliptical cavities and a cryomodule
  - Possible sites CERN, CEA, Uppsala and DESY (after XFEL)
  - Study and costing in progress for CERN, CEA and Uppsala
  - Focus in Uppsala on RF source, control and distribution
- 352 MHz test stand for SC spoke cavities and cryomodules
  - One test stand at CEA
  - One test stand under construction at IPNO in Paris
- 352 MHz test stand for NC structures
- Test area for Ion Source development in Catania

From Mats Lindroos’ presentation at the STC Meeting June 2010

FREIA Facility for Research Instrumentation and Accelerator Development

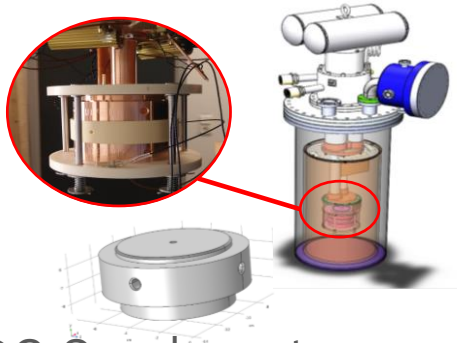
- FREIA is a division in the department of Physics and Astronomy
- Initially funded by KAW, UU and Swedish government, inaugurated in 2013
- **FREIA does not have permanent funding and is currently dependent on project-based support**



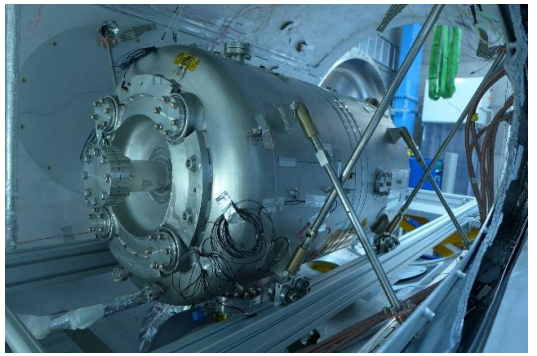
About 25 Researchers, engineers and students

FREIA INFRASTRUCTURE

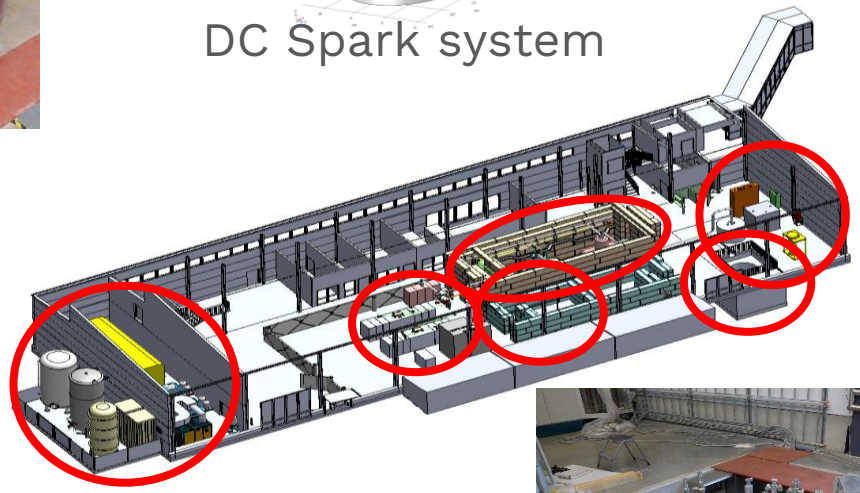
Helium Liquefier



DC Spark system

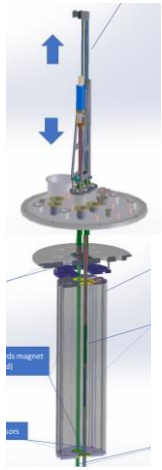


Horizontal Cryostat
HNOSS



Power Amplifiers
RF Distribution System

Vertical Cryostat
Gersemi



MAIN PROJECTS

- From 2015 to 2024 for ESS
- Test of a couple of double spoke cavities with and without fundamental power coupler (FPC)
- Test of an high-ß elliptical cavity with FPC
- Test of 14 double-spoke cryomodules (2 cavities each)

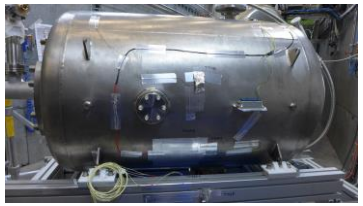
ESS086-P01 High-β elliptical cavity with FPC

Protytpe douböe spoke cryomodule

1st series double spoke cryomodule

Cake!

Romea (double spoke) with FPC



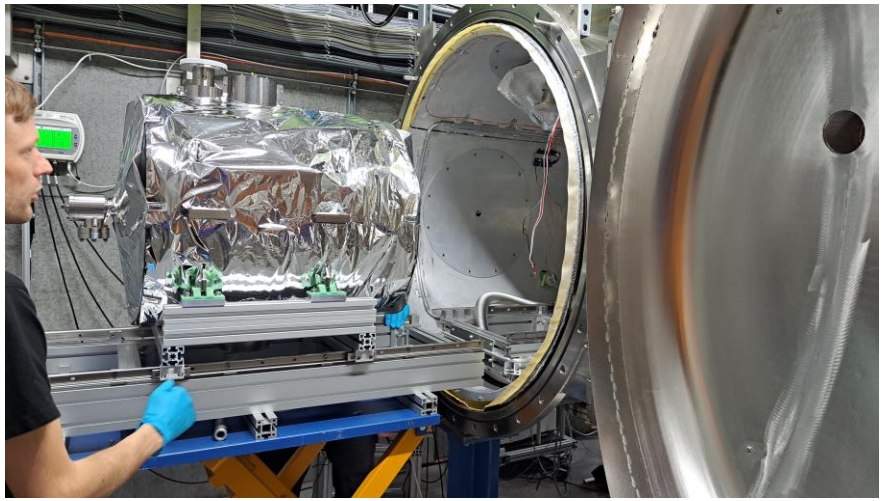
Germaine (double spoke) w/o FPC

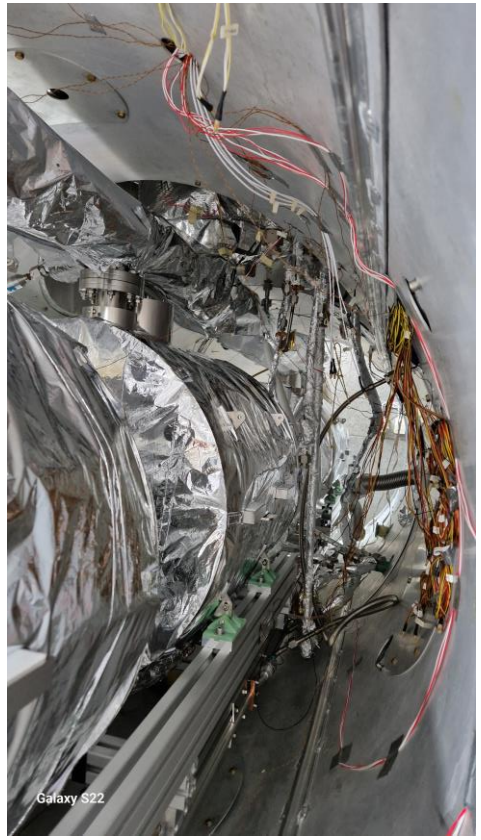
More cake!

MAIN PROJECTS

sck cen
Belgian Nuclear Research Centre

- From 2024 for SCK-CEN (MYRRHA project, Minerva accelerator)
- Test of 53 single spoke cavities (352.2 MHz)
- Test of 26 (tbc) single-spoke crymodules (2 cavities each)





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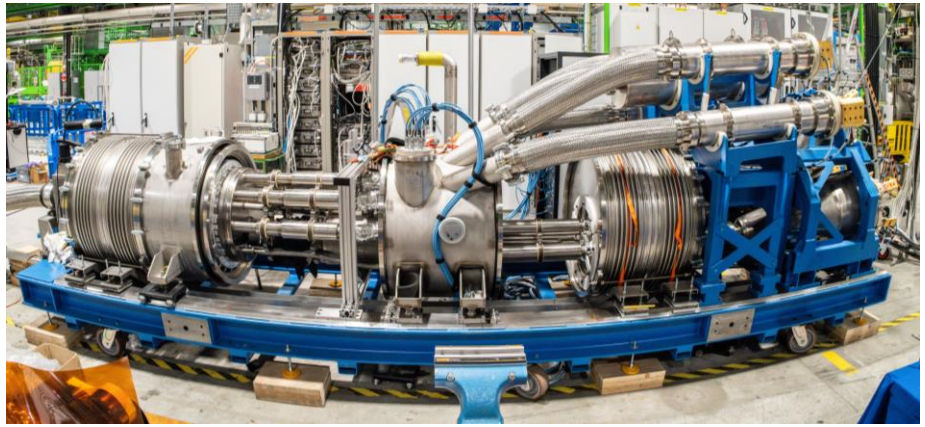
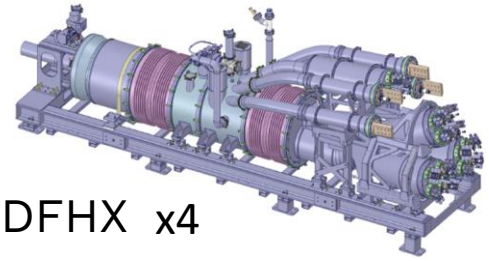
OTHER PROJECTS

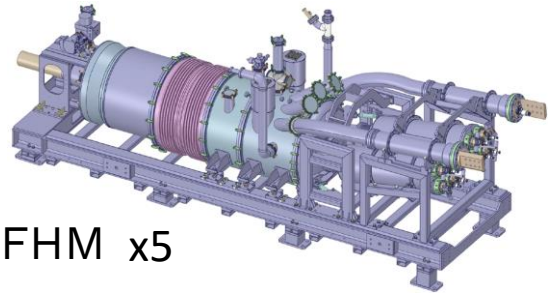
Cold Boxes

- Cryostats for the cold powering of magnets, part of the upgrade of the HL-LHC
- Project QC and part of manufacturing
- Status: completed December 2024





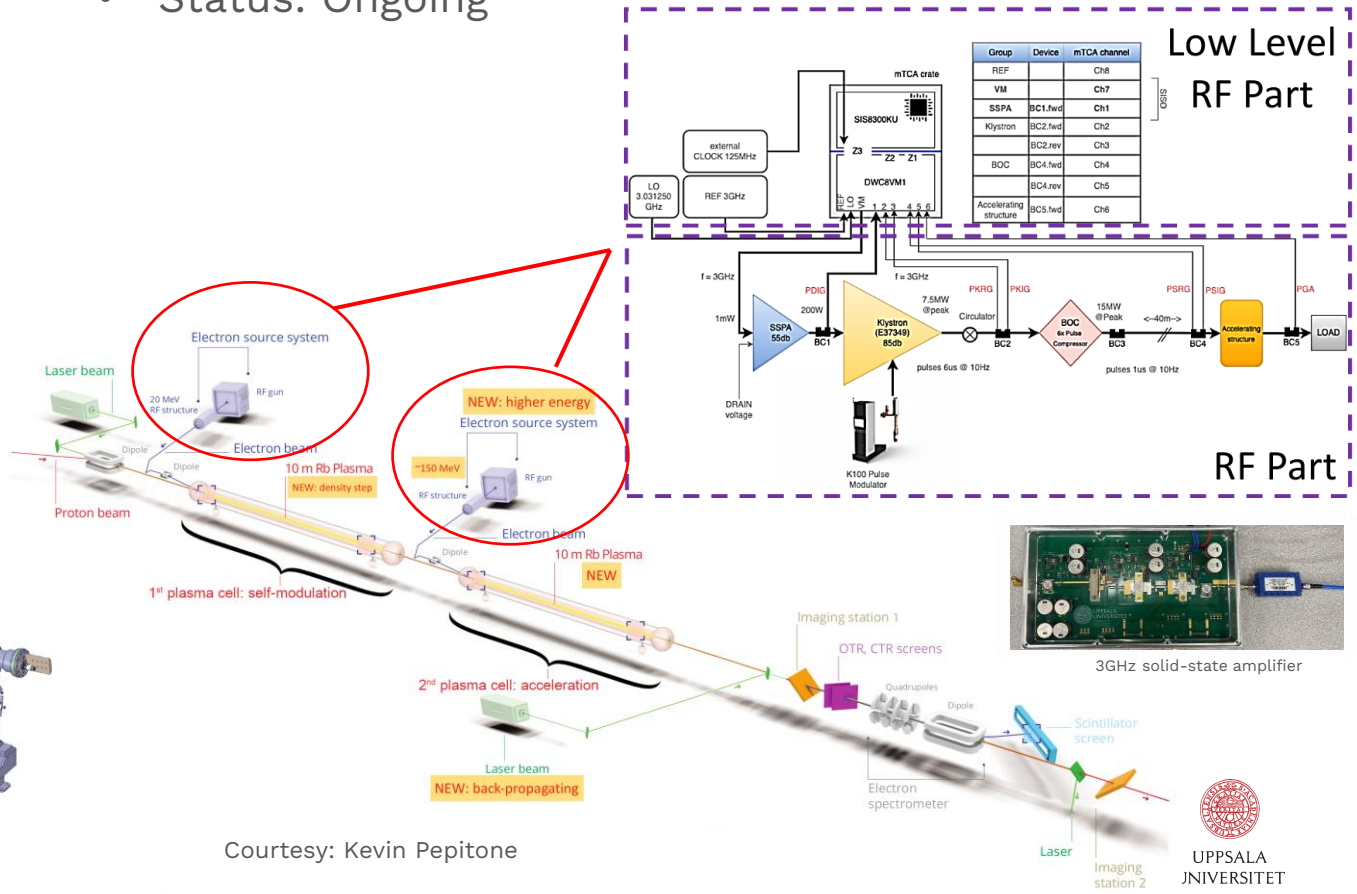
DFHX x4



DFHM x5

AWAKE

- Develop and deliver RF systems for the two electron injectors
- Status: Ongoing



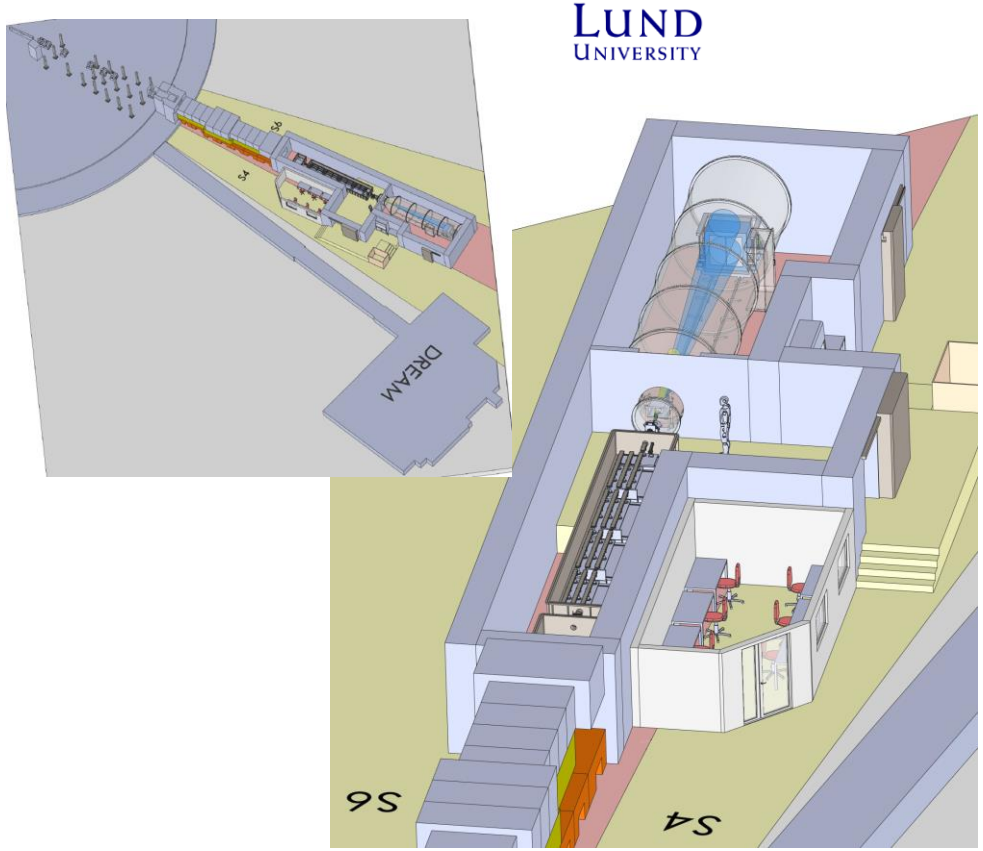
3GHz solid-state amplifier

Courtesy: Kevin Pepitone

OTHER PROJECTS

SAGA (at ESS)

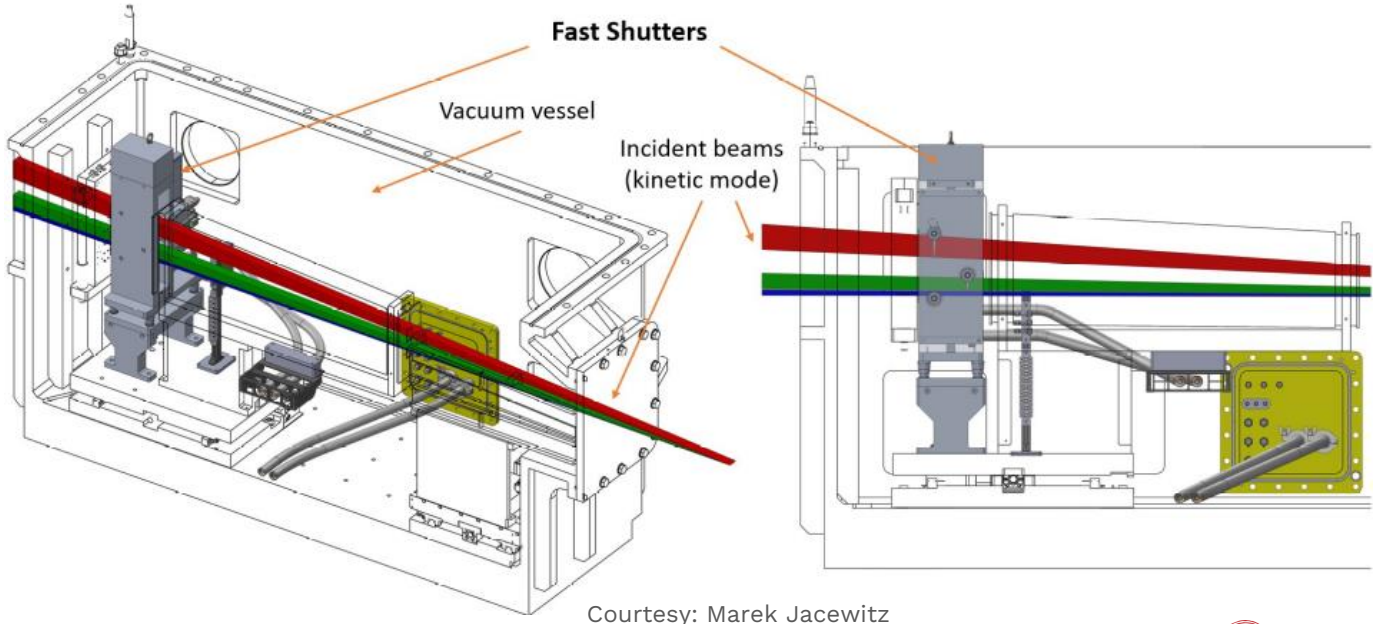
- Design of a Surface Scattering beamline
- Status: Ongoing



Courtesy: Marek Jacewitz

Freia Instrument (at ESS)

- Instrument upgrade by building a fast shutter that will selectively absorb neutrons within three possible collimation trajectories
- Status: Ongoing

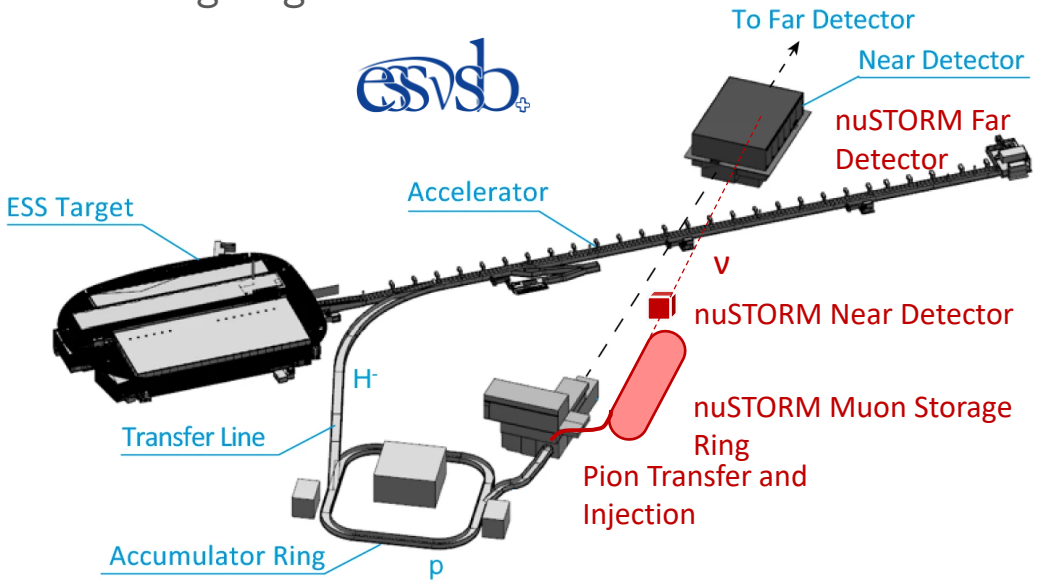


Courtesy: Marek Jacewitz

OTHER PROJECTS

ESSnuSB and ESSnuSB+

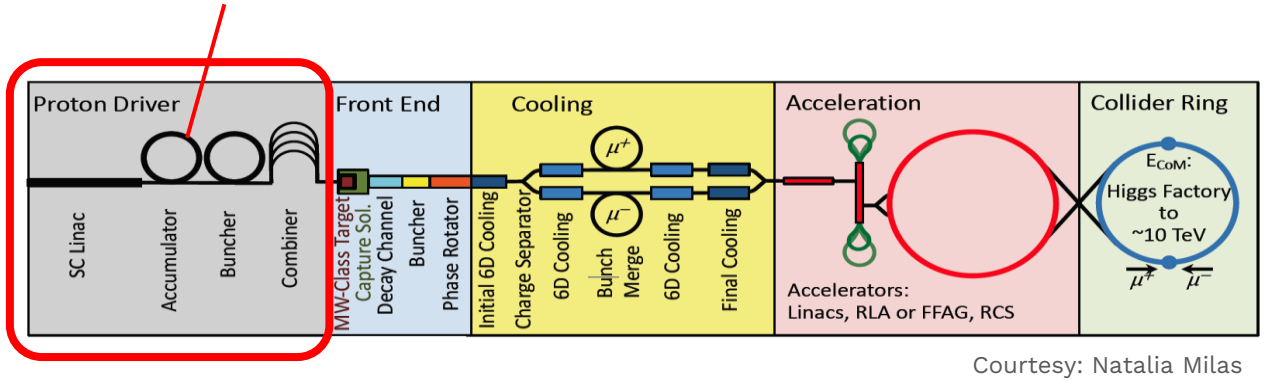
- Project investigating Charge-Parity Violation in the leptonic sector (matter-antimatter asymmetry)
- ESSnuSB: Designed two transfer lines and an accumulator ring
- ESSnuSB+: Designing a muon storage ring for neutrino production (nuSTORM)
- Status: Ogoing



Muon Collider

- Proton driver used to produce the muons.
- Status: Ongoing

Stripping of H^- ions with laser at the injection of the accumulator



Courtesy: Natalia Milas

Co-funded by the European Union

Thank you