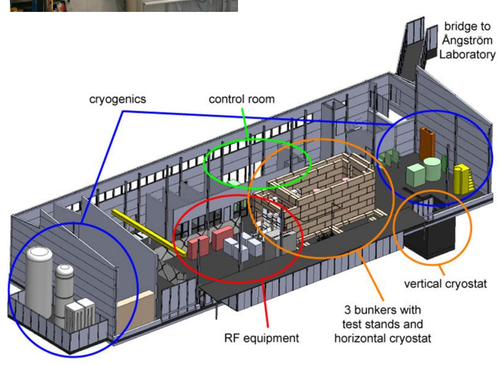
FREIA Laboratory – Uppsala (Sweden)

FREIA stands for "Facility for Research Instrumentation and Accelerator Development". The FREIA Laboratory was established in 2011 within the department of Physics and Astronomy at Uppsala University, to develop and test new particle accelerator and detector instrumentation. Freia is located at the Ångström Laboratory campus and was inaugurated in 2013.

The Freia Hall

The Hall

1000 m² large, 10 m high. Has a 6.3-ton movable crane and other mechanical equipment, office space for ~15 people, small workshops for mechanics and electronics and 50 m² control room.



Bunkers

Three concrete bunkers for equipment producing ionizing radiation.
1 bunker, 10.4 m x 4.0 m x 4.8 m high, with cryostat
2 bunkers, dimension 4.0 m x 2.8 m x 2.4 m high
Monitoring systems for ionizing radiation and oxygen deficiency

Radiation Safety

Interlock system prevents entry into the experimental bunker

Area monitoring detectors outside and inside the bunker

Cryo Plant

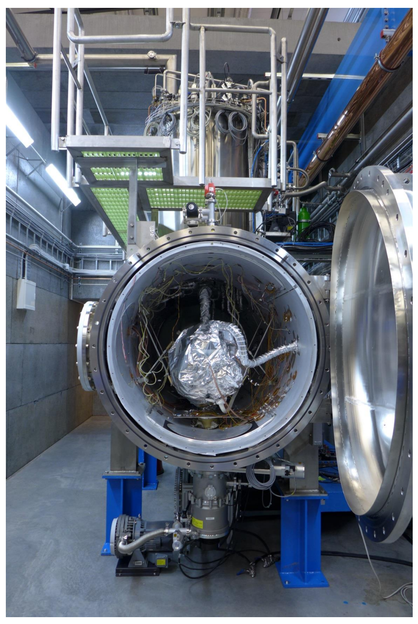
Cryogen Distribution

The cryogenic facility produces and distributes liquid helium and provides liquid nitrogen to the test cryostats in the FREIA Laboratory
In addition it provides these cryogens to all other research departments at the University.

Helium Liquefier

- *Helium liquefier 140 l/h at 1.15 bar.*
- *Liquid helium storage dewar 2'000 l.*
- *Liquid nitrogen storage dewar 20'000 l at 3 bar.*
- *High pressure helium gas storage, 11 m³ at 200 bar.*
- *High pressure helium gas recovery compressor station, 75 m³/h at 200 bar.*
- *Impure helium recovery gas storage balloon 100 m³.*
- *Helium gas sub-atmospheric pumping system, 3 g/s at 10 mbar*

Test Cryostats



Horizontal Cryostat

A versatile horizontal cryostat system for testing superconducting cavities.

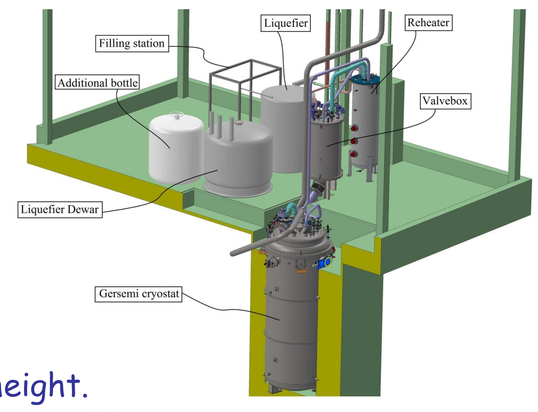
- *Inner measures 3.2 m length and 1.19 m diameter*
- *Range of operation: 1.8 to 4.5 K, 16 to 1250 mbar.*
- *Pressure stability at 16 mbar: +/- 0.1 mbar.*
- *Cooling power at 1.8 K: 90 W.*
- *Internal warm magnetic shielding: mu-metal, 1 mm.*

The facility allows users to characterize 1-2 superconducting cavities at a time at either low or high RF power. Each cavity must be equipped with a helium tank.

Vertical Cryostat (Under development)

Availability: ~Begin ng of 2018

A versatile vertical cryostat system for testing superconducting devices such as accelerating cavities and magnets, either in saturated or sub-atmospheric liquid helium baths.



- Dimensions: 1.1 m diameter, 2.8 m height.
- Range of operation: 1.8 to 4.5 K, 16 to 1250 mbar.
- Pressure stability at 16 mbar: +/- 0.1 mbar.
- Cooling power at 1.8 K: 90 W.
- Superconducting magnets
  - maximum allowed stored energy up to 500 kJ,
  - maximum allowed weight up to 5 ton,
  - 2x 2'000 A four quadrant power converters.
- Superconducting cavities
  - 1 kW RF power in a self-excited loop.

Control and Measurement

RF controls

Self-excited loop, 352 MHz, 1 kW CW.
LLRF controls and RF power measurement

Standard Measurement Equipment

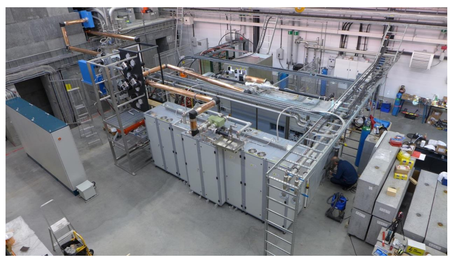
E.g. vector network analyser, frequency generators and oscilloscopes

Epics Control System

The overall control system is based on EPICS . It provides

- *Uniform operator's interface to most equipment in the control room*
- *Common services like data logging, alarm manager, electronic logbooks*
- *Remote access*

RF Amplifiers



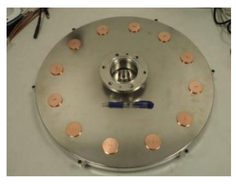
High Power RF Facillity

For research and development of RF power generation, distribution and control for superconducting and normal conducting accelerating cavities for future accelerators

Tetrode based amplifiers

- *2x high power RF amplifier, 352 MHz, 400 kW pulsed, 5% duty factor.*
- *1x high power RF amplifier, 352 MHz, 50 kW CW.*

To be complemented with a 704 MHz, 5% duty factor modulator and klystron



Freia Solid State Amplifier Development

A high efficiency solid state amplifier, 352 MHz, 10 kW.
A high efficient and compact power combiners, 10 kW and 100 kW class.