FREIA Laboratory

Facility for Research Instrumentation and Accelerator Development

"Gersemi" Vertical Test Stand

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Dept. Physics and Astronomy
Uppsala University

SC Magnet Test Stand Workshop - CERN - 13 June 2016

EuCARD-2 is co-funded by the partners and the European Commission under Capacities 7th Framework Programme, Grant Agreement 312453

Uppsala University

UPPSALA UNIVERSITET

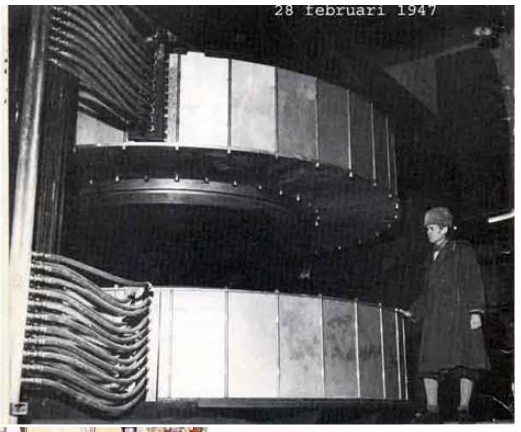
Oldest university in Scandinavia (1477)

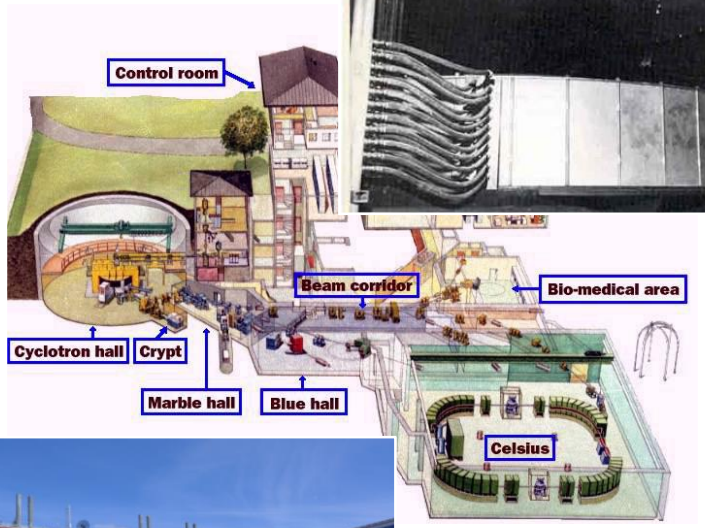
- Sweden
  - 9.7 million (pop.), 450'000 km^2, 430 GEur (BNP)
- Uppsala
  - 25'000 students, 9'000 staff, 630 MEur annual bud
  - 7 faculties of theology, law, medicine, pharmacy, arts, social sciences, languages, educational sciences, science and technology
  - university library and hospital
- Faculty of Science and technology
  - 10'000 students, 1'800 staff
  - historical profiles: Linnaeus, Rudbeck, Celsius, Ångström, Siegbahn, Svedberg
  - R&D areas:
    - physics, chemistry, biology, earth sciences, engineering, mathematics, IT

Uppsala 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



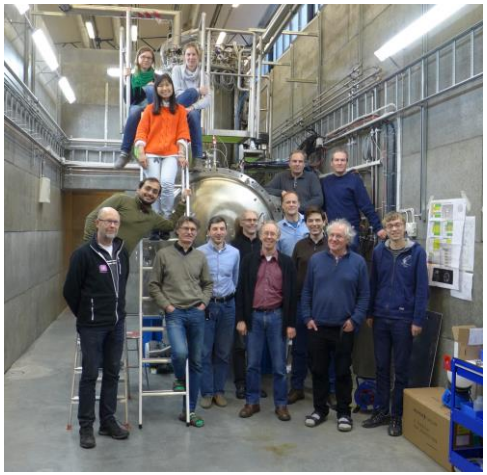


- CTF3/CLIC (since 2005)
- FLASH/XFEL (since 2008)
- ESS (since 2009)

- FREIA laboratory (est. 2011)
- Skandion clinic (est. 2015)

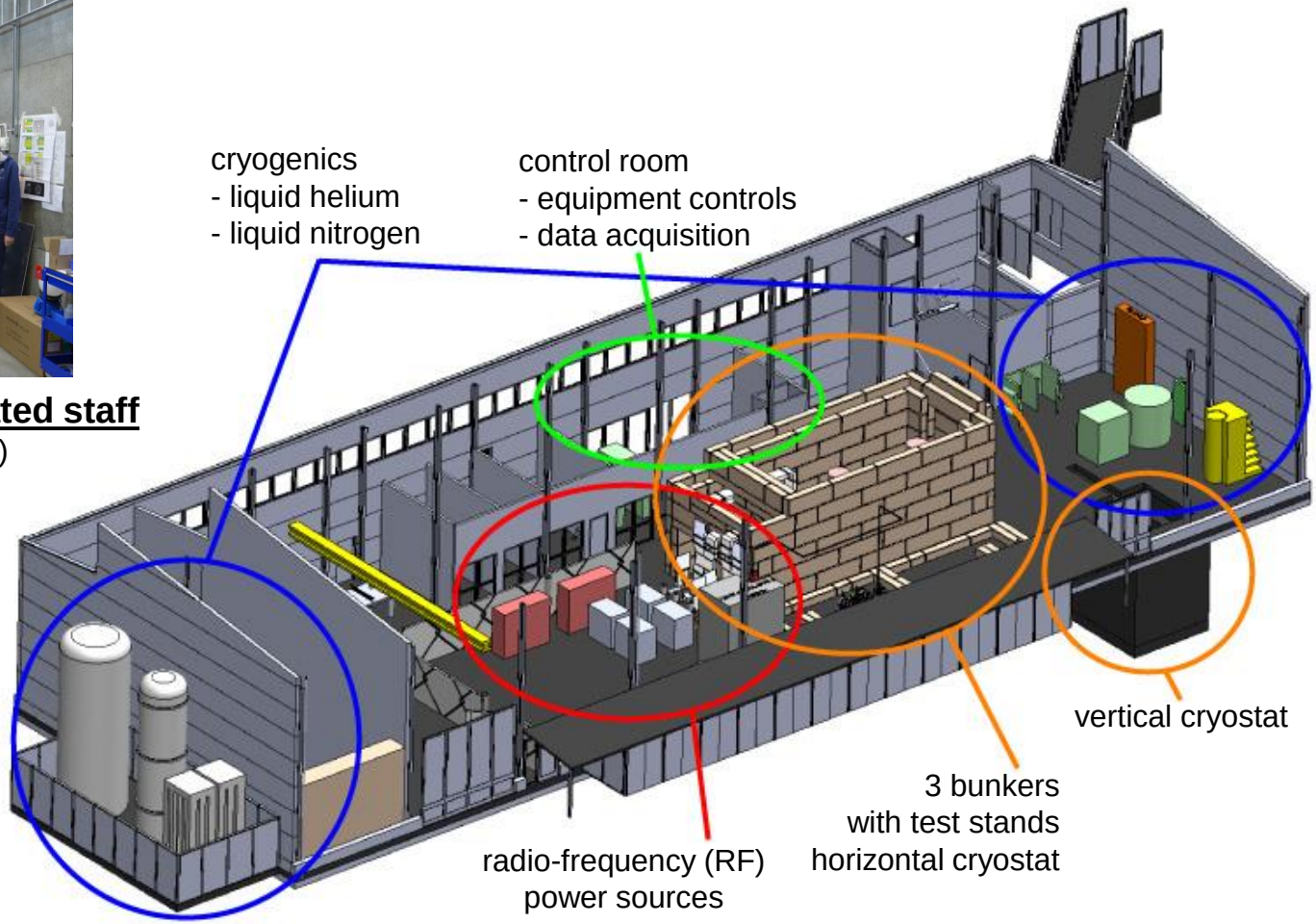
FREIA Laboratory

Facility for Research Instrumentation and Accelerator Development



Competent and motivated staff
collaboration of physics (IFA)
and engineering (Teknikum).

Funded by
KAWS,
Government,
Uppsala Univ.

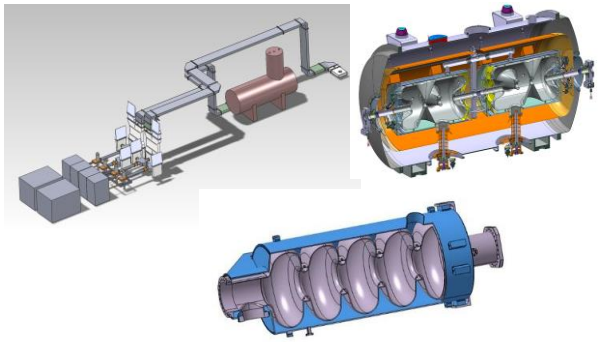


Overview of Activities

UPPSALA UNIVERSITET

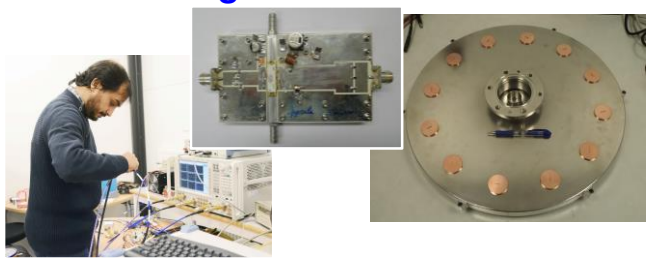
FREIA

ESS SRF Linac



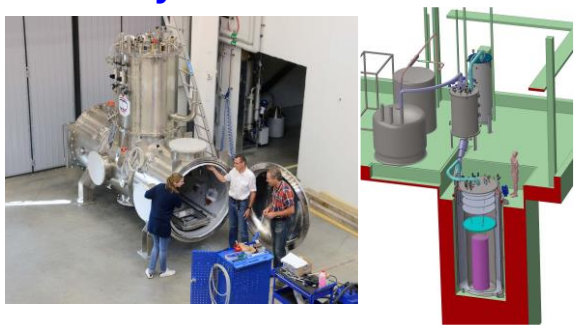
Cryo Distribution

High Power RF

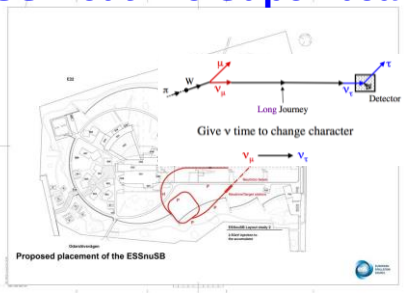


CLIC / CTF3

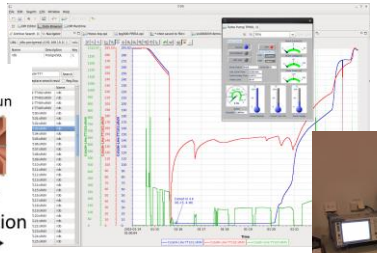
Cryo Test Stands



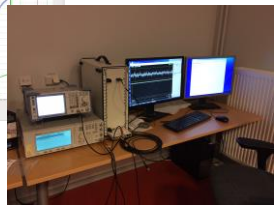
ESS Neutrino Super-beam



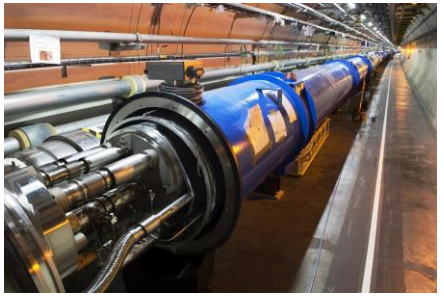
Controls & Data Acquisition



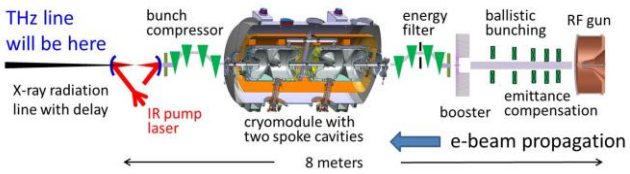
EPICS



HiLumi LHC



THz Coherent Light Source



RF = Radio Frequency
SRF = Superconducting RF

HiLumi HL-LHC PROJECT

EuCARD²

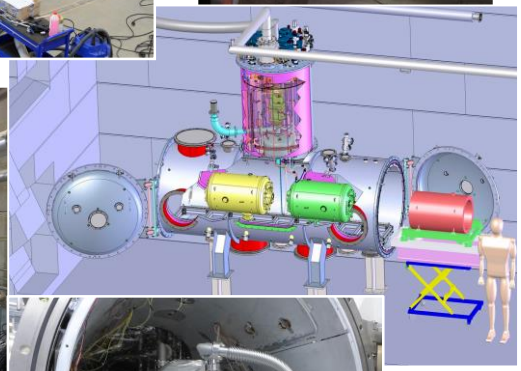
Cryogenics

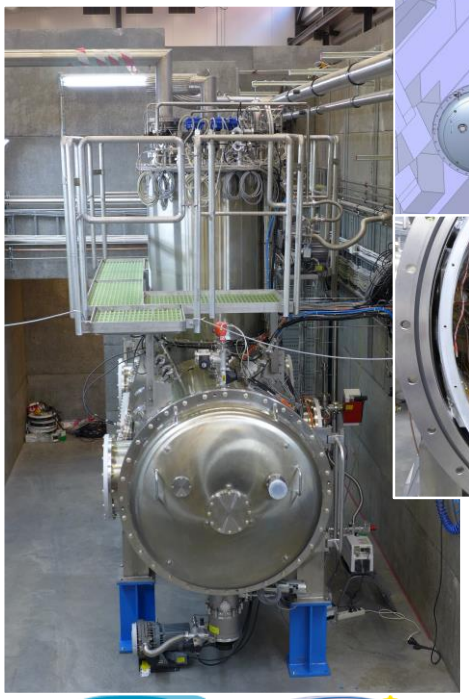
- Helium liquefaction
  - 150 l/h at 4.5K (LN2 pre-cooling)
  - 2000 l LHe dewar/buffer, 3+1 outlets
  - cryostats connected in closed loop
- Gas recovery
  - 100 m^3 gasbag
  - 3x 25 m^3 /h compressor
  - 10 m^3 200 bar storage
- 2K Pumping
  - ~3.2 g/s at 10 mbar
  - ~4.3 g/s at 15 mbar
  - 110(90)W at 2.0(1.8)K
- Liquid nitrogen
  - 20 m^3 LN2 tank

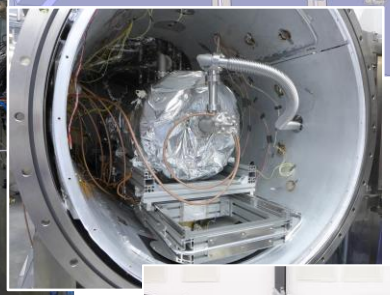

Helium gas recovery system

Sub-atmospheric pumping station

HNOSS Horizontal Cryostat



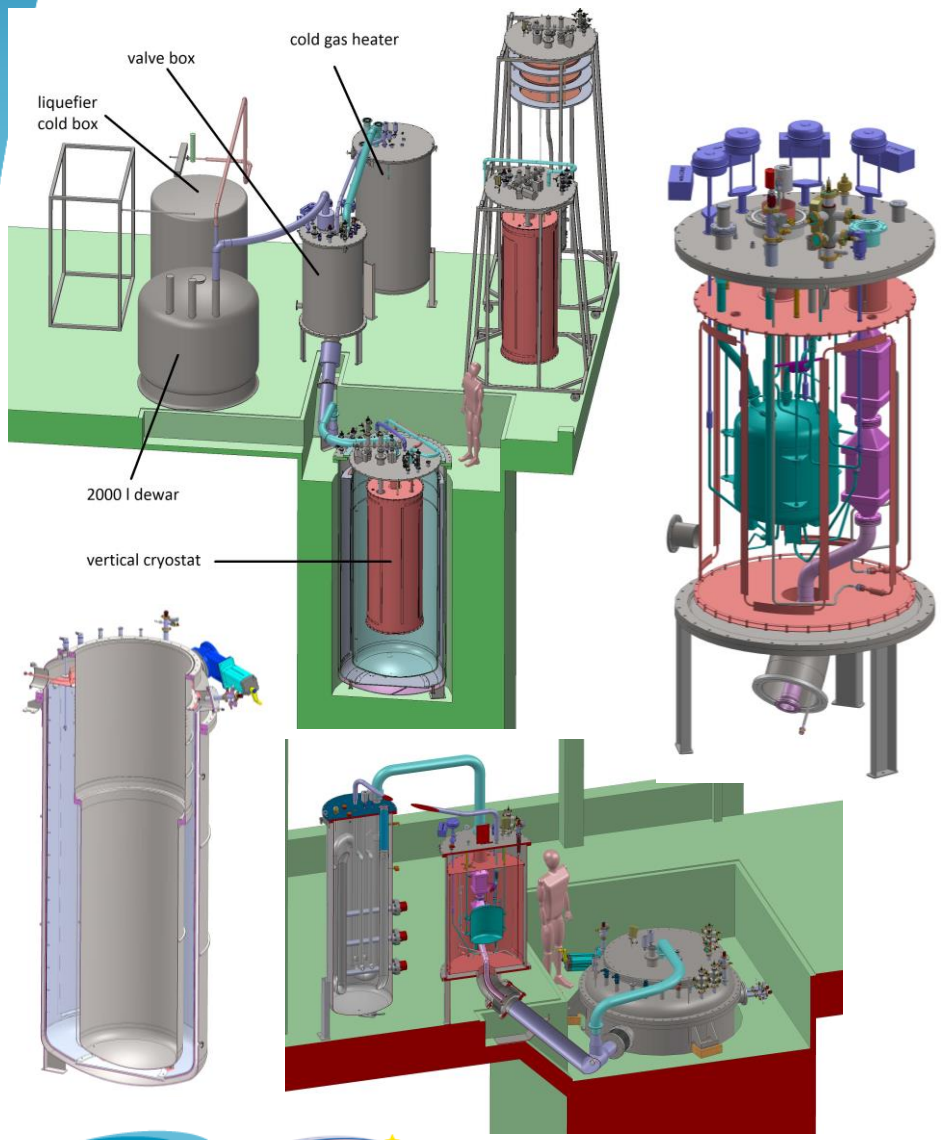




HNOSS: Horizontal Nugget for Operation of Superconducting Systems

- Main Vacuum Vessel
  - 3240 x ø1200mm inner volume
  - “beam” axis at 1600mm
- Valve box (on top of main vessel)
  - distribute cryogens
  - 4K and 2K pots, JT-valve, heat exchanger
  - 5K supercritical helium
- LN2 and LHe transfer lines
  - interconnection box to distribute cryogens to HNOSS and CM
- Cold gas re-heater
- Control system

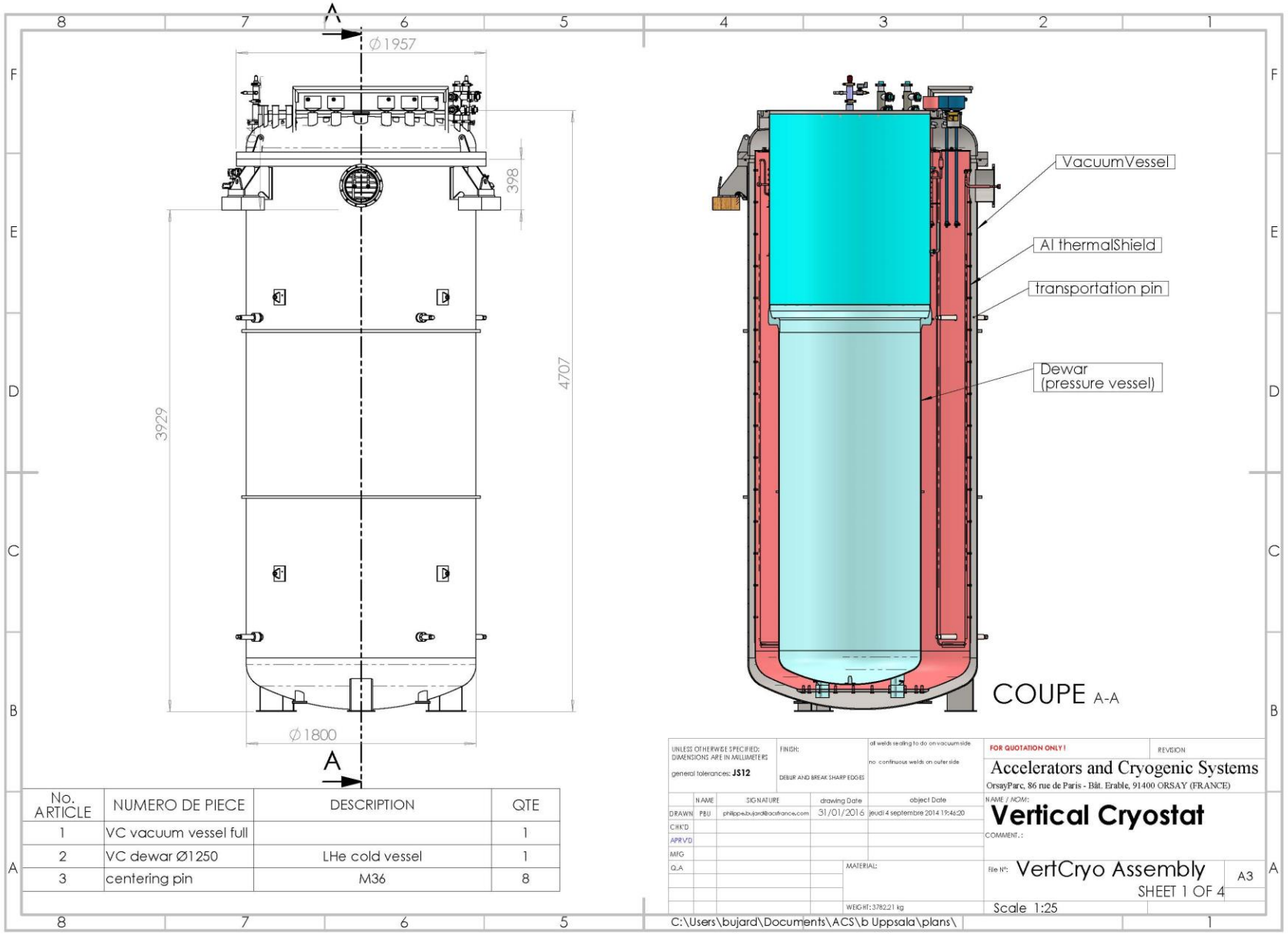
Gersemi Vertical Cryostat



Under construction

- Operation modes
  - vacuum
  - sub-atmospheric liquid bath
  - pressurized liquid bath
- Main Vacuum Vessel
  - 4436 x ø1100mm inner volume
  - 2869 mm below lambda plate
- Valve box
  - distribute cryogens
  - 4K pot, JT-valve, heat exchanger
  - 5K supercritical helium
- LN2 and LHe transfer lines
- Cold gas re-heater
- Control system

Cryostat Assembly



No. ARTICLE	NUMERO DE PIECE	DESCRIPTION	QTE
1	VC vacuum vessel full		1
2	VC dewar Ø1250	LHe cold vessel	1
3	centering pin	M36	8

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS
general tolerances: JS12
FINISH:
DEBUR AND BREAK SHARP EDGES
all welds sealing to do on vacuum side
no continuous welds on outer side
FOR QUOTATION ONLY!
REVISION

Accelerators and Cryogenic Systems
OrsayParc, 86 rue de Paris - Bât. Erable, 91400 ORSAY (FRANCE)

	NAME	SIGNATURE	drawing Date	object Date
DRAWN	PBU	philippe.bujard@acsfrance.com	31/01/2016	jeudi 4 septembre 2014 19:46:20
CHK'D				
APR'VD				
MFG				
Q.A				

MATERIAL:
WEIGHT: 3782.21 kg

NAME / NOM:
Vertical Cryostat
COMMENT.:
File N°: VertCryo Assembly
A3
SHEET 1 OF 4
Scale 1:25

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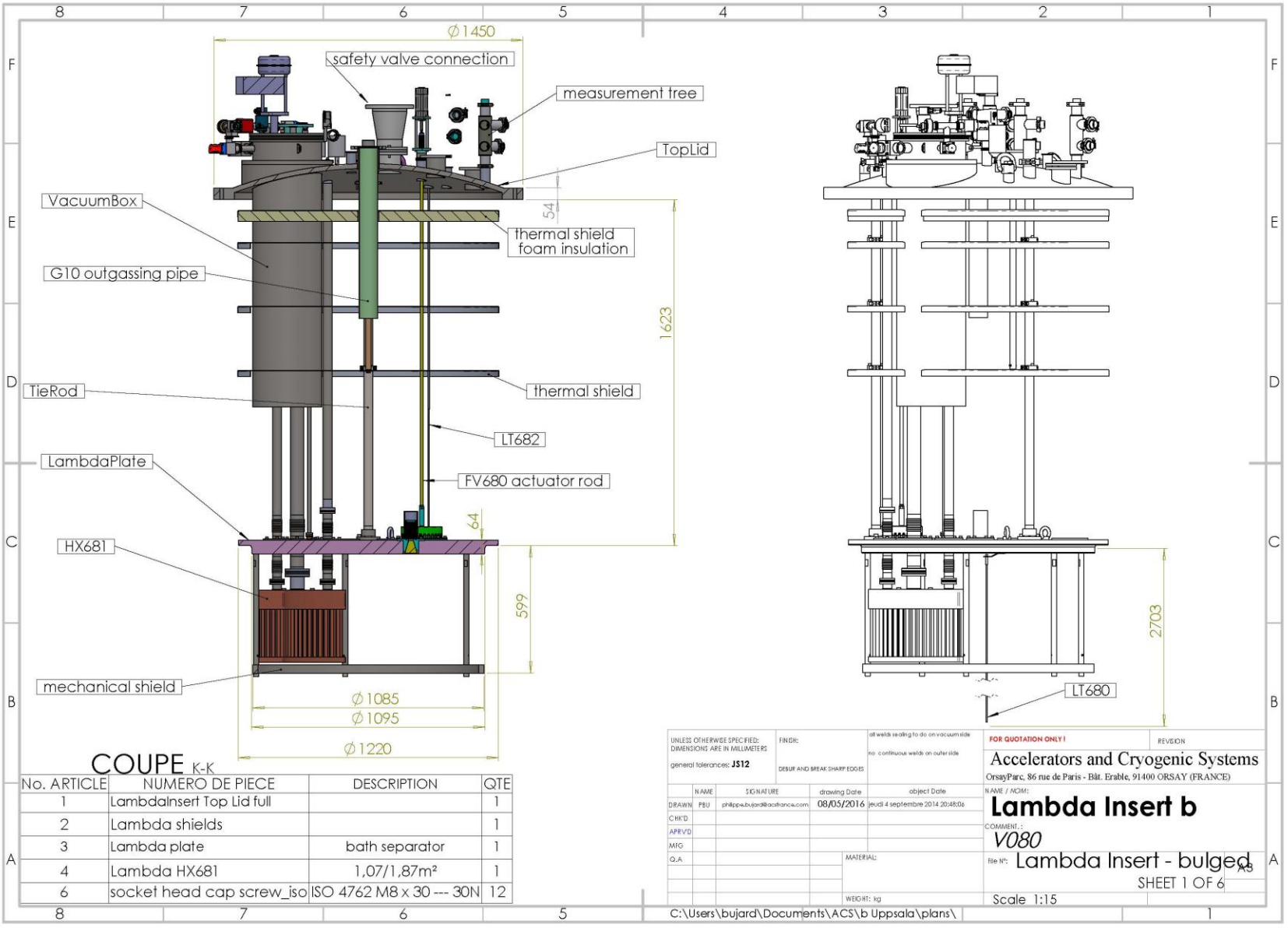
Lambda Insert



No. ARTICLE	NUMERO DE PIECE	DESCRIPTION	QTE
1	LambdaInsert Top Lid full		1
2	Lambda shields		1
3	Lambda plate	bath separator	1
4	Lambda HX681	1,07/1,87m²	1
6	socket head cap screw_iso	ISO 4762 M8 x 30 --- 30N	12

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	NAME	SIGNATURE	drawing Date	object Date
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CHK'D				
APRV'D				
MFG				
Q.A				

MATERIAL:
WEIGHT: kg

NAME / NOM:
Lambda Insert b
COMMENT.:
V080
File N°: Lambda Insert - bulged
SHEET 1 OF 6
A3
Scale 1:15

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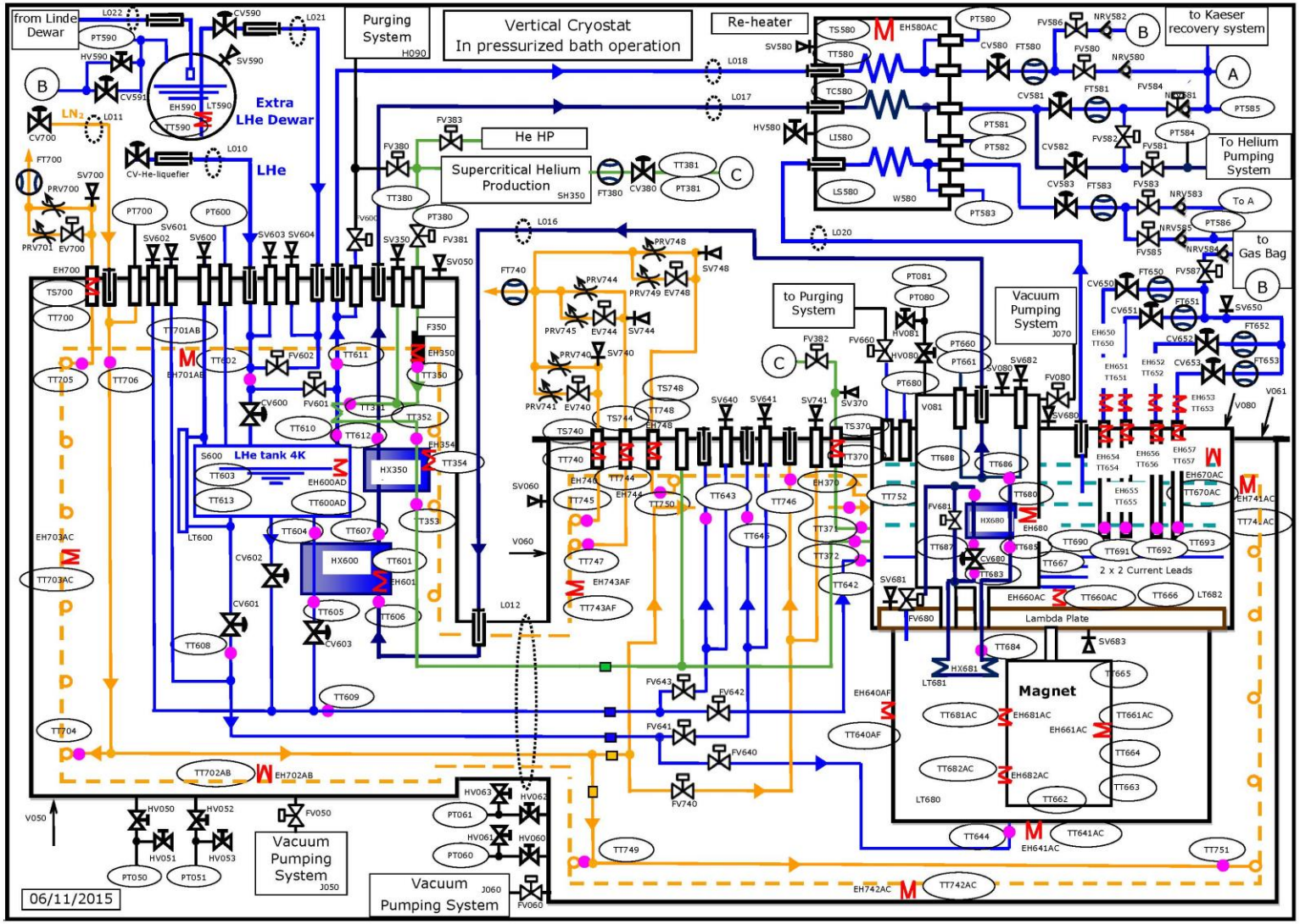
Cryogenic Operation Scheme



High Power RF Amplifiers

352 MHz, 400 kW, 3.5 ms, 14-28 Hz

- Uppsala design
- tetrode tube TH595
- prototype for ESS SRF spoke linac
- industrial manufacturing
  - Itelco-Electrosys (Orvieto, IT)
  - DB Elettronica (Padua, IT)

352 & 400 MHz, 50 kW, CW

- CERN (loan since Feb.2015)
- tetrode tube TH571b

Controls

Controls and interlock systems

- EPICS interface, data archiver
- connecting different sub-systems
  - Linde, Cryo Diffusion, Leybold
- different hardware
  - Siemens PLC, Nat.Instr. cRIO

Radiation monitoring system

- Rotem MediSmart
- 2 inside, 3 outside bunker

In-house development LLRF

- Nat. Instr. PXI and LabVIEW
- self-excited loop with digital phase control
- extended RF measurements

EPICS

Test Stand ID Card

	name	**FREIA Laboratory**
1	location	Uppsala University (Uppsala, Sweden)
	number of people working at the test stand	20 (of which 6 scientists, 4 PhD students)
2	surface of the test stand	approx. 1100 m2
3	operating temperature	1.8K to 4.2K (LN2 cooled thermal shield)
	cooling techniques	pressurized or sub-atmospheric bath, vacuum
4	cooling phases	300 - 4.2 K, 4.2 K - 1.8K
5	cooling and pumping capacity	140 l/h liquid production, 4 g/s pumping
6	shared cryogenics	yes, with horizontal cryostat test stand
7	PWC max. current, max voltage	±2 kA, ±10 V (planned, CERN design)
8	HVWL	
9	number of cryostats	1 vertical (Gersemi), 1 horizontal (HNOSS)
10	capacity of cryostats (useable, l x d)	2.8 m x 1.1 m [vert.], 3.6 m x 1.1 m [hor.]
11	handling tools	1 x 6.5 t overhead crane
12	interlock safety	NI CompactRIO, LabVIEW
13	DAQ cards and used software	NI PXI, LabView
14	quality control tools	
15	magnetic measurement capability	

This work is supported by Knut and Alice Wallenberg Foundation, Swedish Government, Uppsala University

In collaboration with

Dept. Physics and Astronomy and Dept. Engineering Sciences, Uppsala University

Accelerator and Cryogenic Systems, Orsay, France