



UPPSALA  
UNIVERSITET

# FREIA: Development work towards super-conducting accelerators

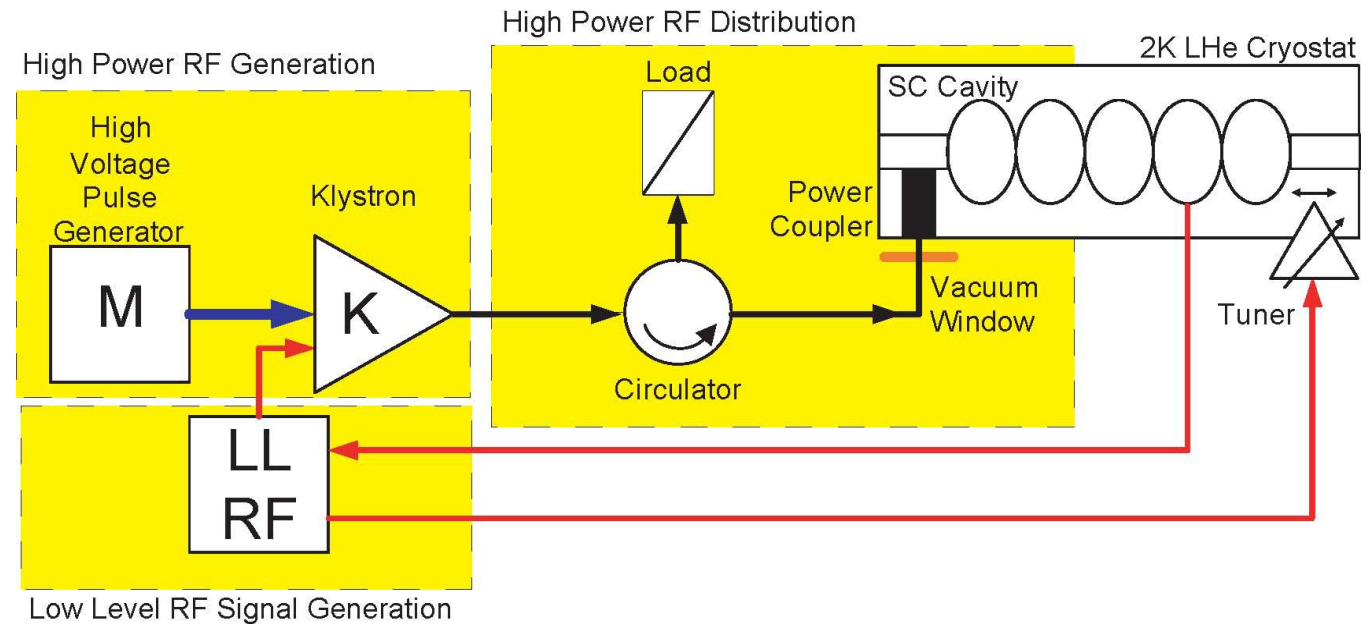
Volker Ziemann  
Institutionen for Fysik och Astronomi  
Universitet Uppsala



# Background



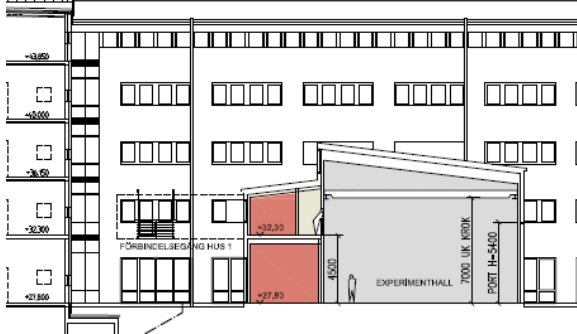
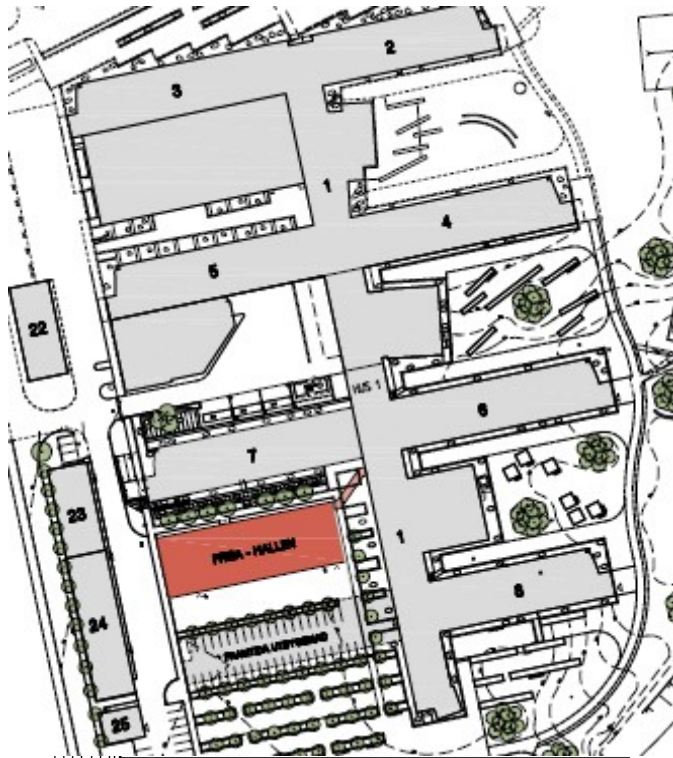
ESS suggested that we take responsibility for the radio-frequency distribution system of the ESS (~ 200 cavities at 352 and 704 MHz)



- Team: T. Ekelöf, R. Ruber, V. Ziemann, A. Rydberg
- Contract signed by UU Rektor Anders Hallberg and ESS director Colin Carlisle in July 2011

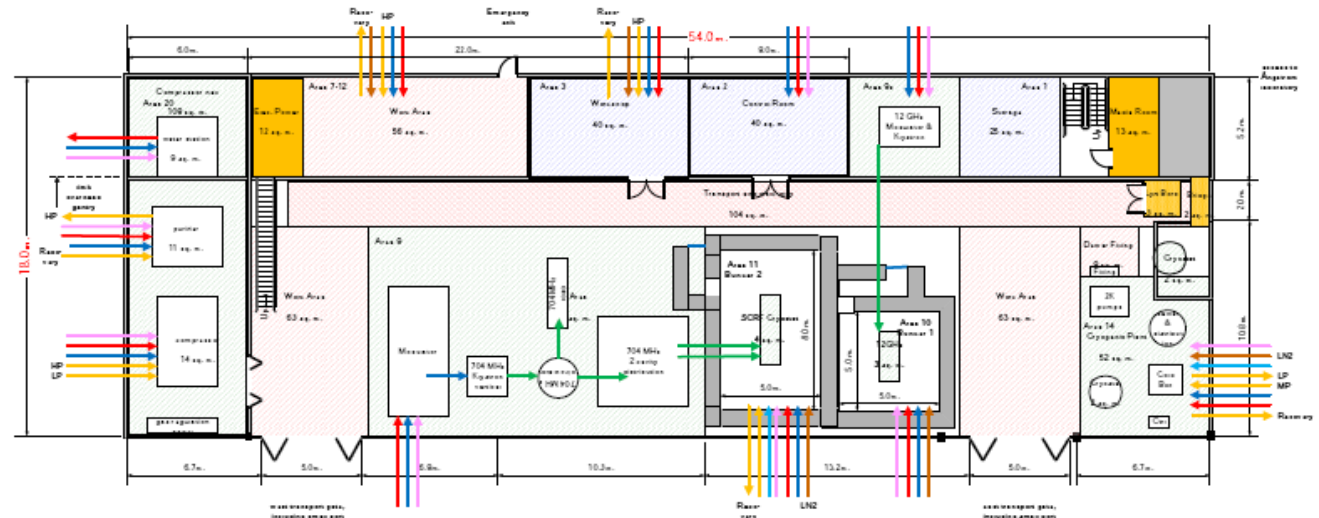


UPPSALA  
UNIVERSITET



# FREIA

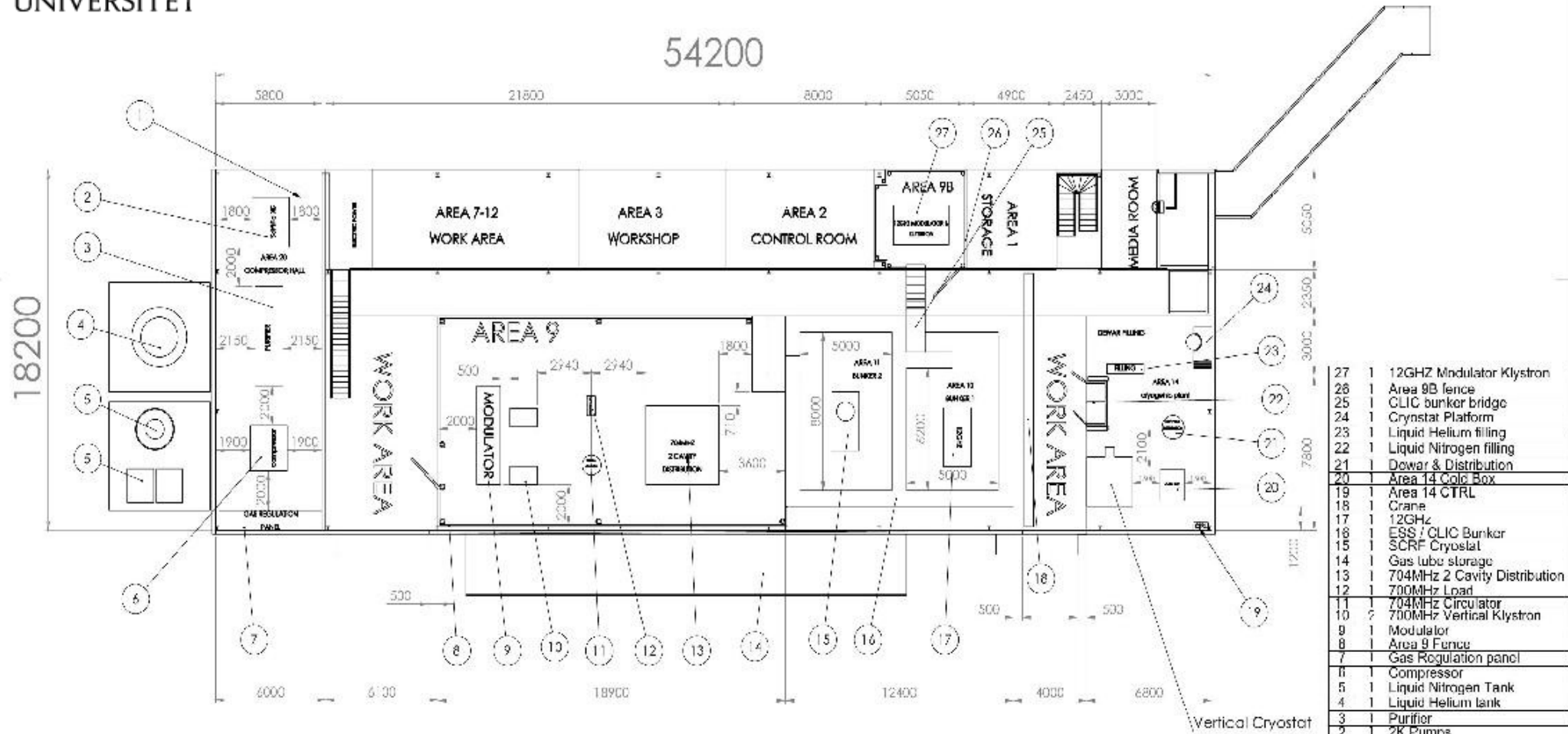
- Horizontal cryostat in bunker
- Modulator and Klystron
- Helium liquefier
- Hole for vertical cryostat





UPPSALA  
UNIVERSITET

# Inside FREIA



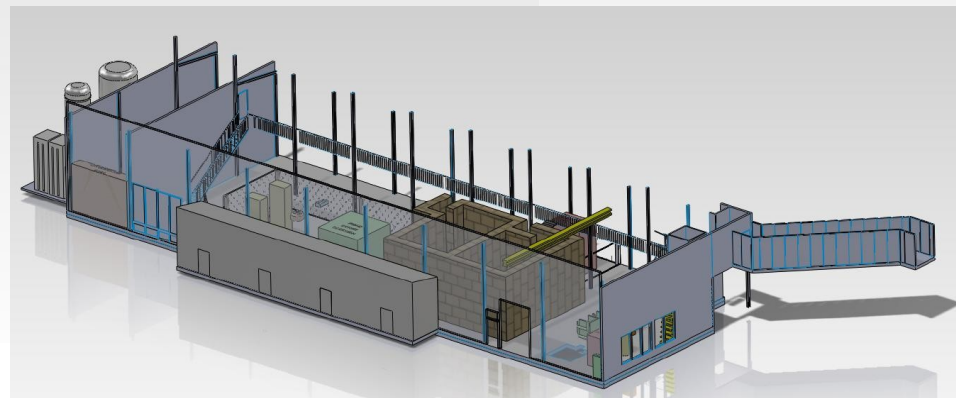
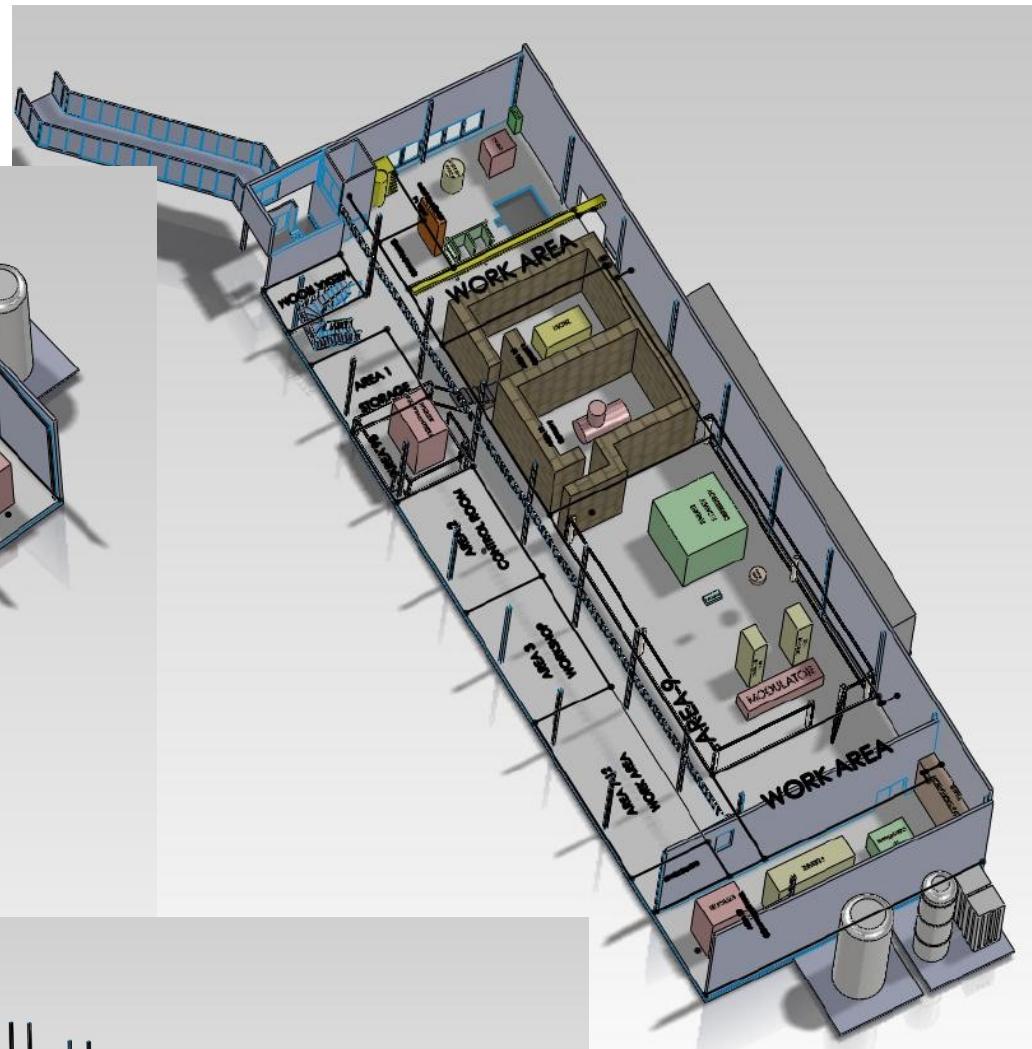
27	1	12GHZ Modulator Klystron
26	1	Area 9B fence
25	1	CLIC bunker bridge
24	1	Cryostat Platform
23	1	Liquid Helium filling
22	1	Liquid Nitrogen filling
21	1	Dewar & Distribution
20	1	Area 14 Cold Box
19	1	Area 14 CTRL
18	1	Crane
17	1	12GHz
16	1	ESS / CLIC Bunker
15	1	SCRF Cryostat
14	1	Gas tube storage
13	1	704MHz 2 Cavity Distribution
12	1	700MHz Load
11	1	704MHz Circulator
10	2	700MHz Vertical Klystron
9	1	Modulator
8	1	Area 9 Fence
7	1	Gas Regulation panel
6	1	Compressor
5	1	Liquid Nitrogen Tank
4	1	Liquid Helium tank
3	1	Purifier
2	1	ZK Pumps
1	1	FREIA Hall Assm

ALL DIMENSTIONS ARE IN (mm)

DRAWING SHOWING GROUND FLOOR

SCALE	M.N	DATE	REVISION	BY	DATE	DESCRIPTION
1:100						
				<b>FREIA HALL</b> <b>FREIA HALL MAIN ASSM</b>		
NO. 32	2002	2004.12.15	2005.01.10	2005.01.10	10.2004.01.10	1 of 1
1:100						A

# 3D impressions

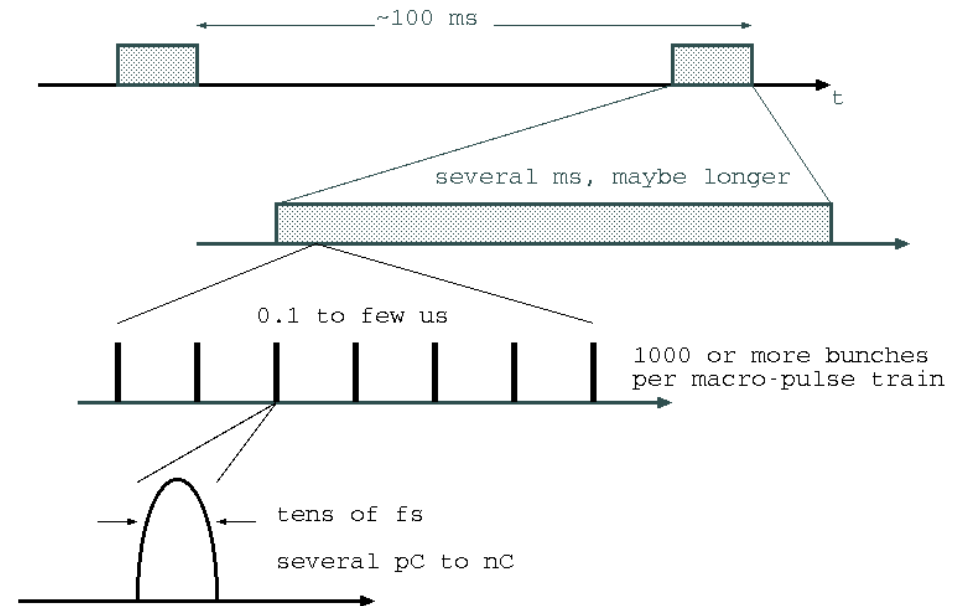


UPPSALA  
UNIVERSITET



# What's so special about a super-conducting linac?

- The time structure
- Low losses in the accelerating cavities allow for very long macro pulse duration on the order of ms...
- ...at a repetition rate of  $\sim$ Hz
- O(1000) bunches per macro-pulse with 100s of ns to  $\mu$ s spacing.
- With tens of fs bunch length an kA peak current.
  - Lots of photons



- Large bunch spacing of  $\mu$ s allows to guide bunches to different experimental areas or undulators



# Conclusion

- With FREIA we're entering the world of super-conducting RF development
  - Cryogenics
  - Power RF generation and distribution
  - RF control system
- and if we intend to use that as a base for future FEL activities it affects
  - the macro timing
  - but not the micro timing (bunch length)
  - we get loads of photons