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FREIA: Development work towards super-conducting accelerators

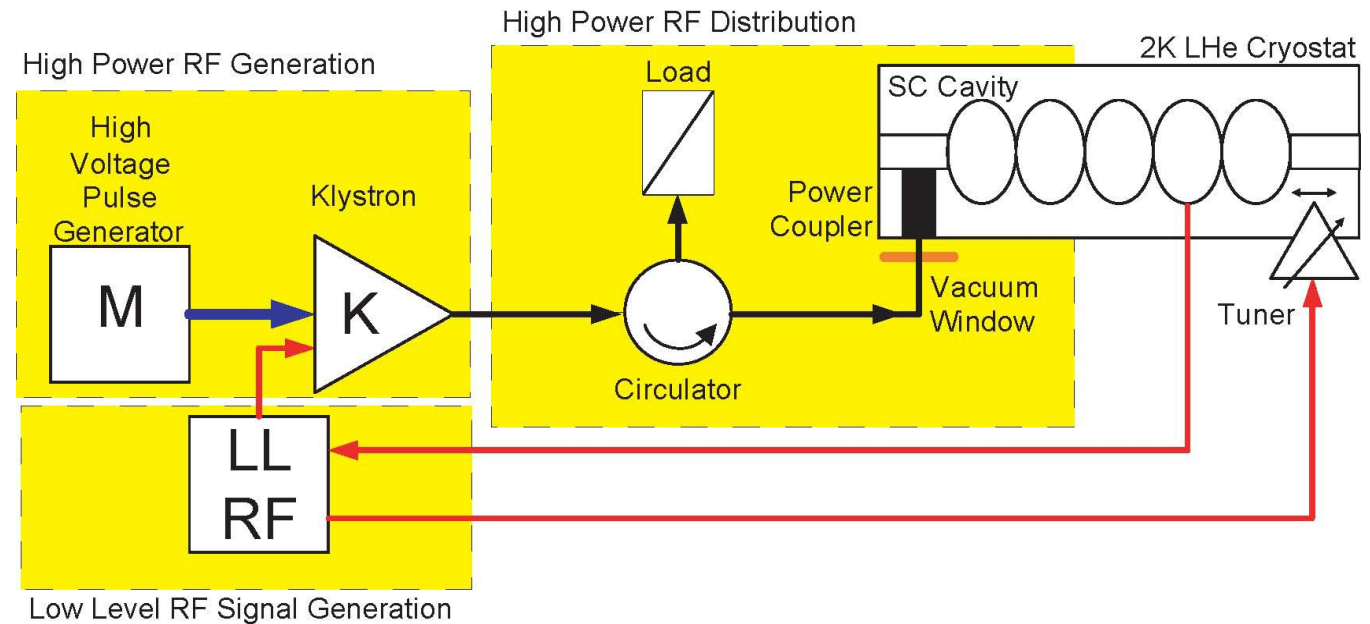
Volker Ziemann
Institutionen for Fysik och Astronomi
Universitet Uppsala



Background



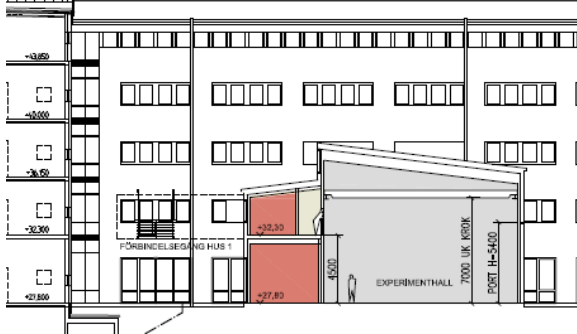
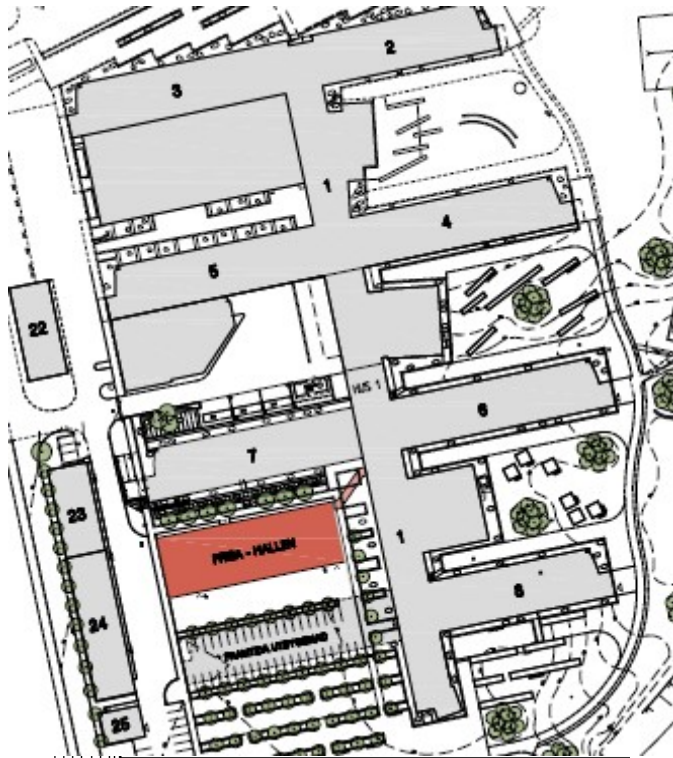
ESS suggested that we take responsibility for the radio-frequency distribution system of the ESS (~ 200 cavities at 352 and 704 MHz)



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

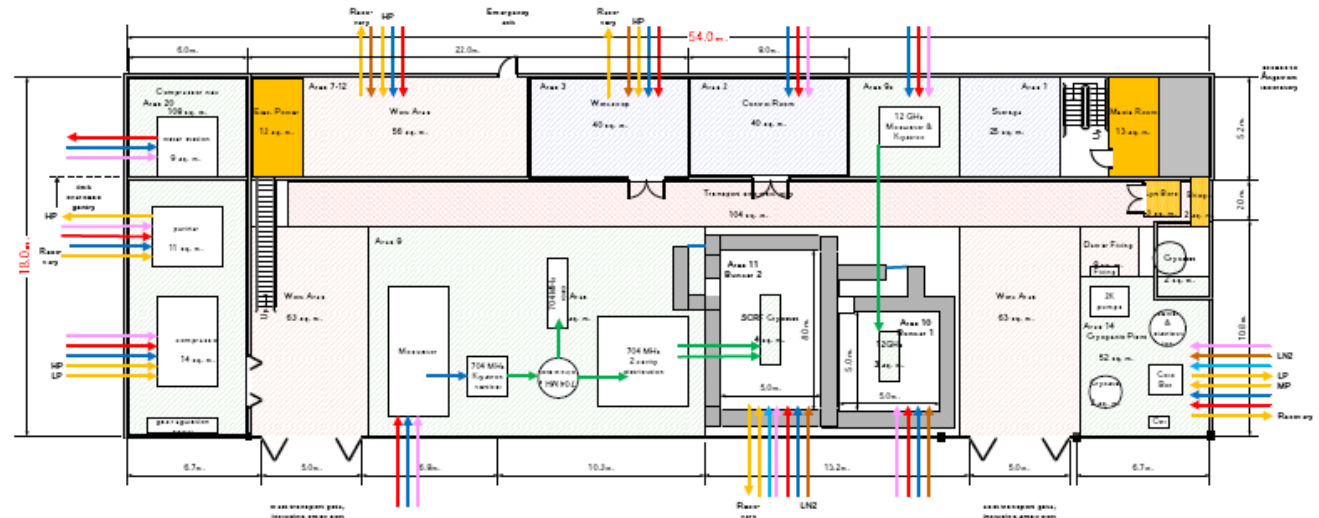


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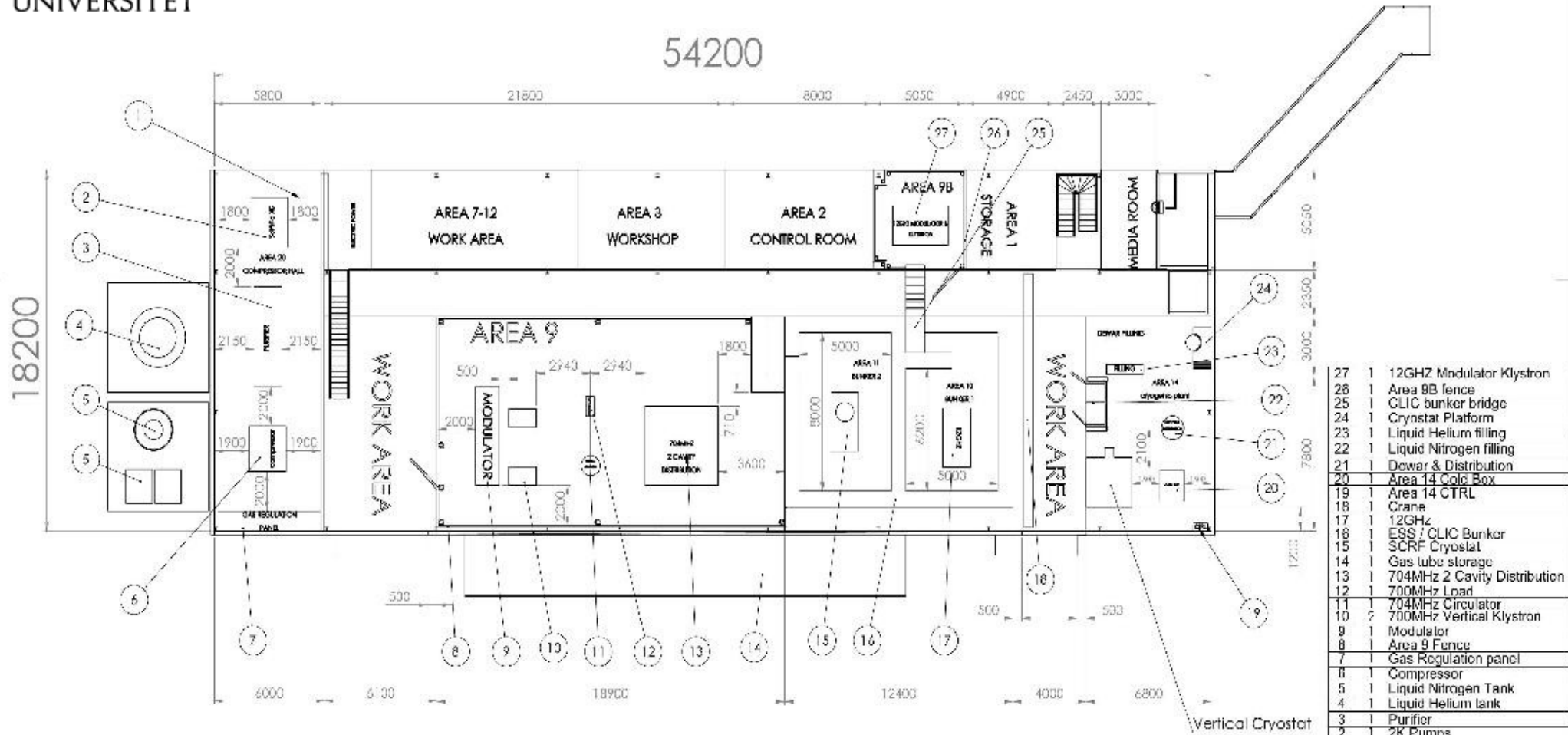
- Horizontal cryostat in bunker
- Modulator and Klystron
- Helium liquefier
- Hole for vertical cryostat





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Inside FREIA



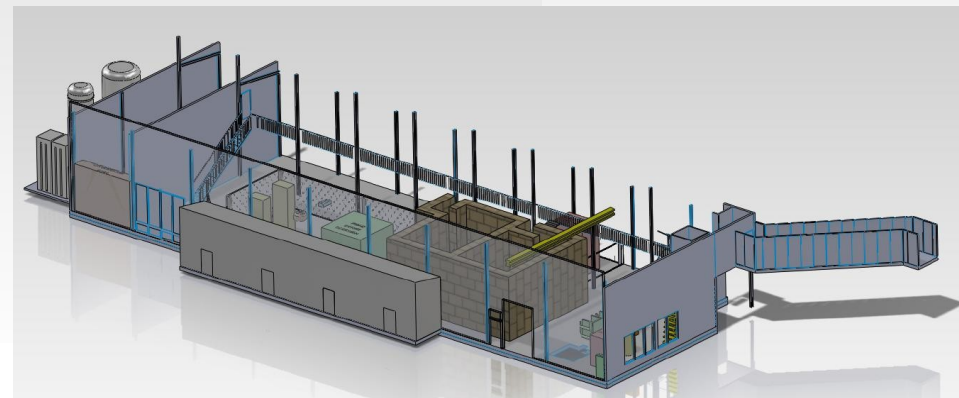
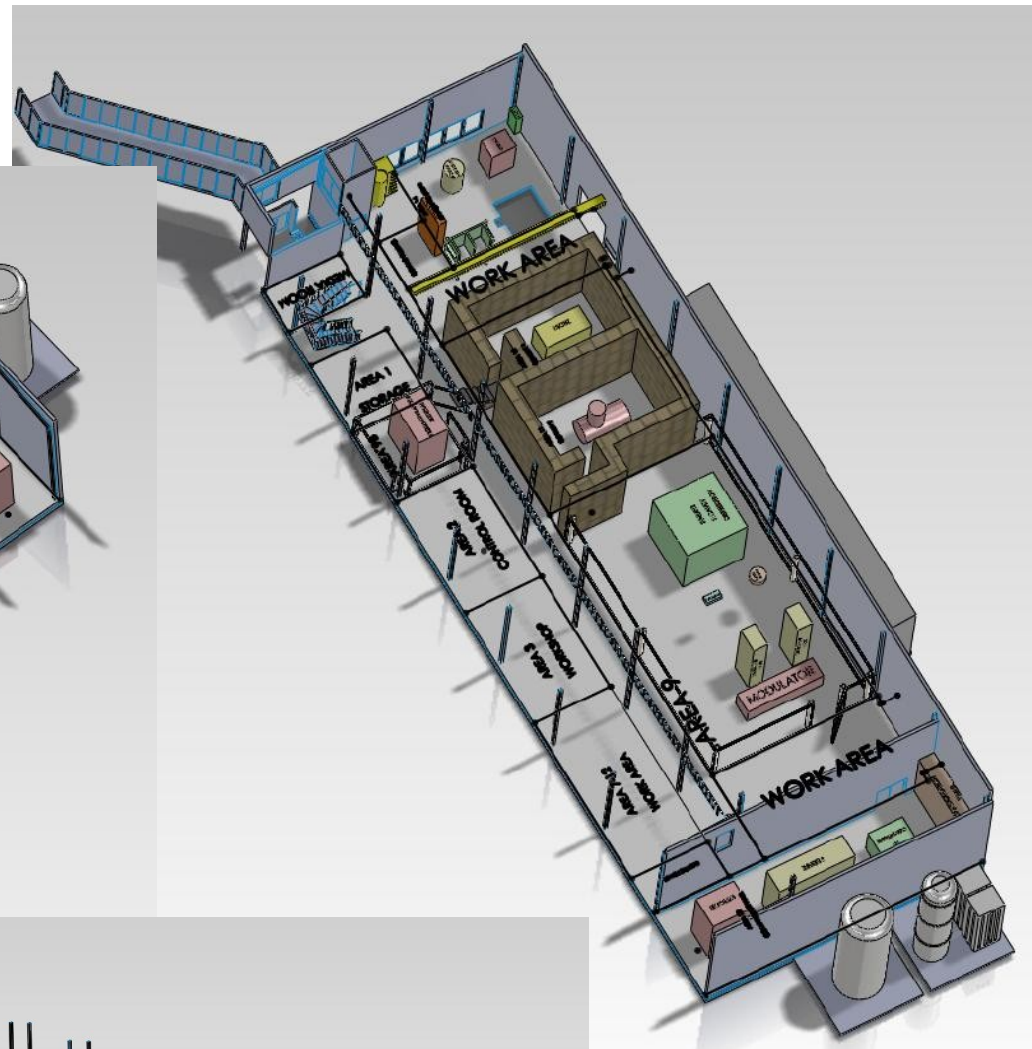
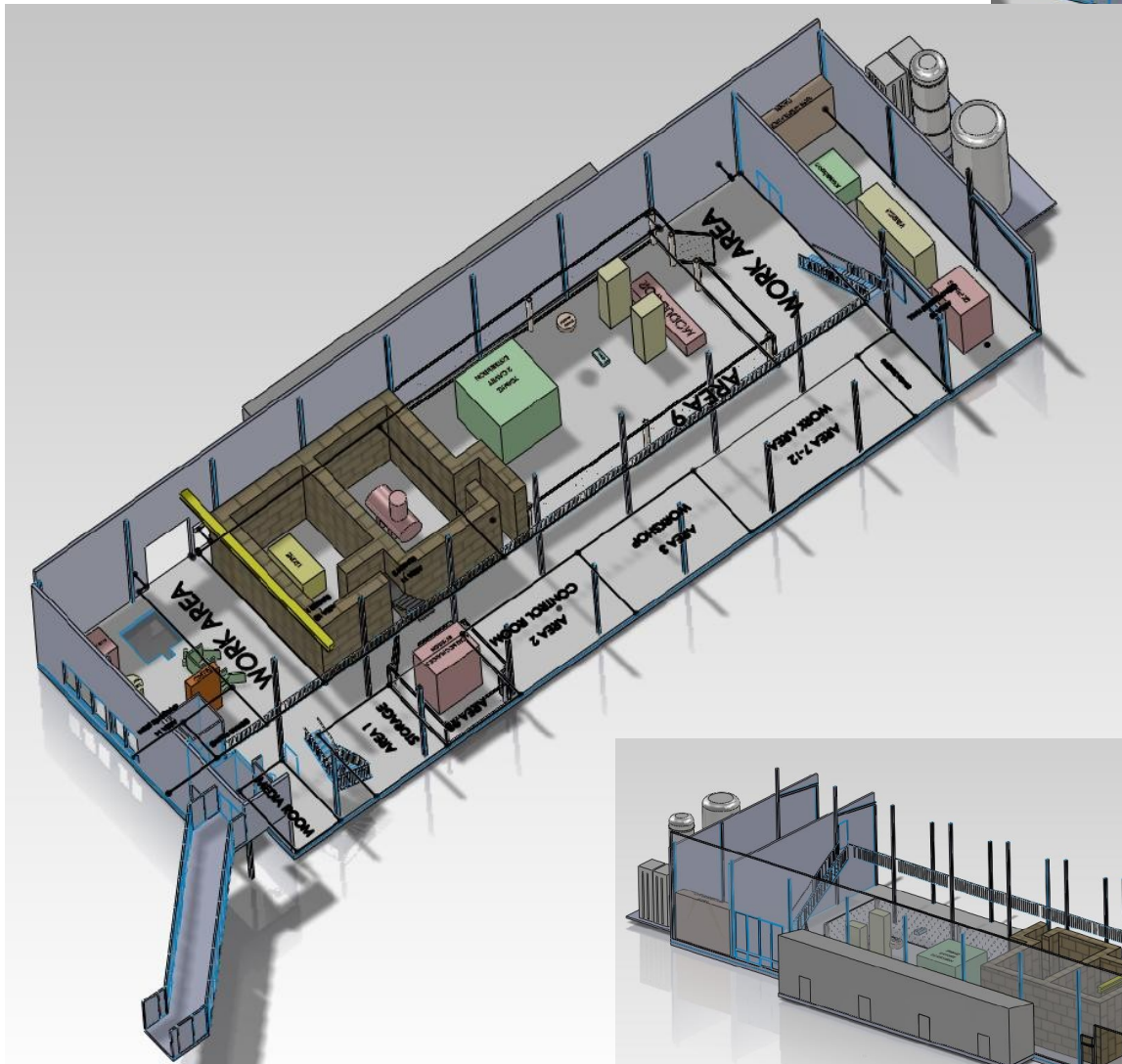
NR	QTY	DESCRIPTION
27	1	12GHZ Modulator Klystron
26	1	Area 9B fence
25	1	CLIC bunker bridge
24	1	Cryostat Platform
23	1	Liquid Helium filling
22	1	Liquid Nitrogen filling
21	1	Dewar & Distribution
20	1	Area 14 Cold Box
19	1	Area 14 CTRL
18	1	Crane
17	1	12GHz
16	1	ESS / CLIC Bunker
15	1	SCRF Cryostat
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	SCALE: V.Z/R.R	SCALE: 1:100	SCALE: 1:100
UPPSALA UNIVERSITET		CAI CONSULTING ENGINEERING ARCHITECTURE INTERIOR DESIGN	
PROJECT: FREIA HALL		PROJECT: FREIA HALL MAIN ASSM	
DRAWING NO: 111201-01		DATE: 2011-11-10	
SCALE: 1:100		SHEET: A	
TOTAL SHEETS: 1 OF 1		TOTAL SHEETS: 1 OF 1	

3D impressions

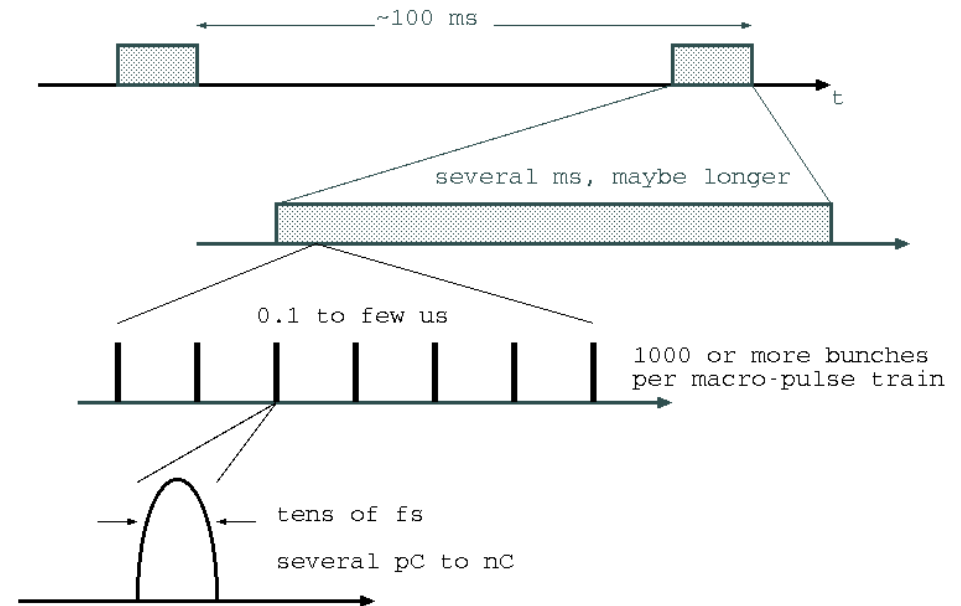


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What's so special about a super-conducting linac?

- 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 μ s spacing.
- Lots of photons
- With tens of fs bunch length an kA peak current.



- Large bunch spacing of μ 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