

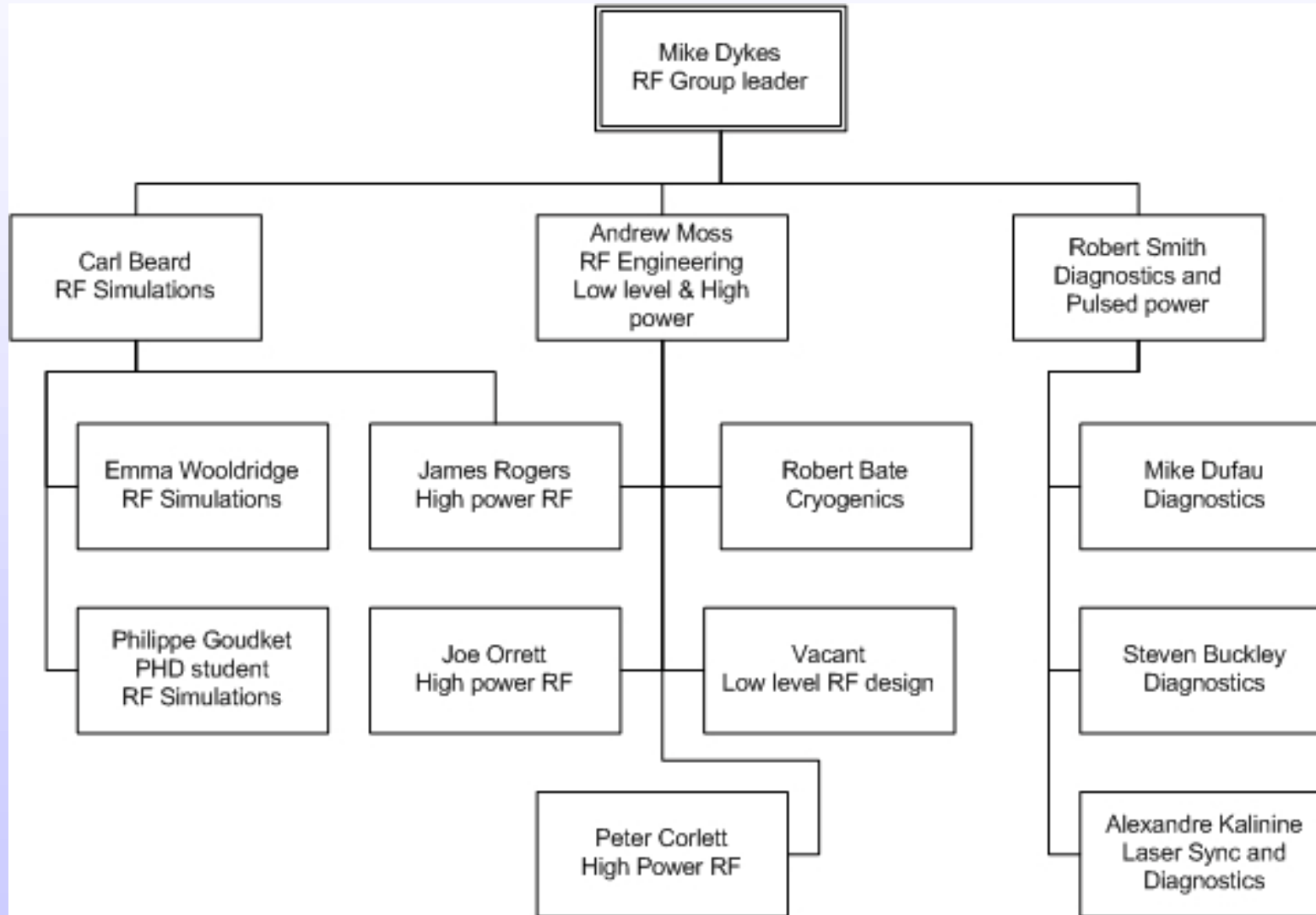
ASTeC Developments

Andrew Moss

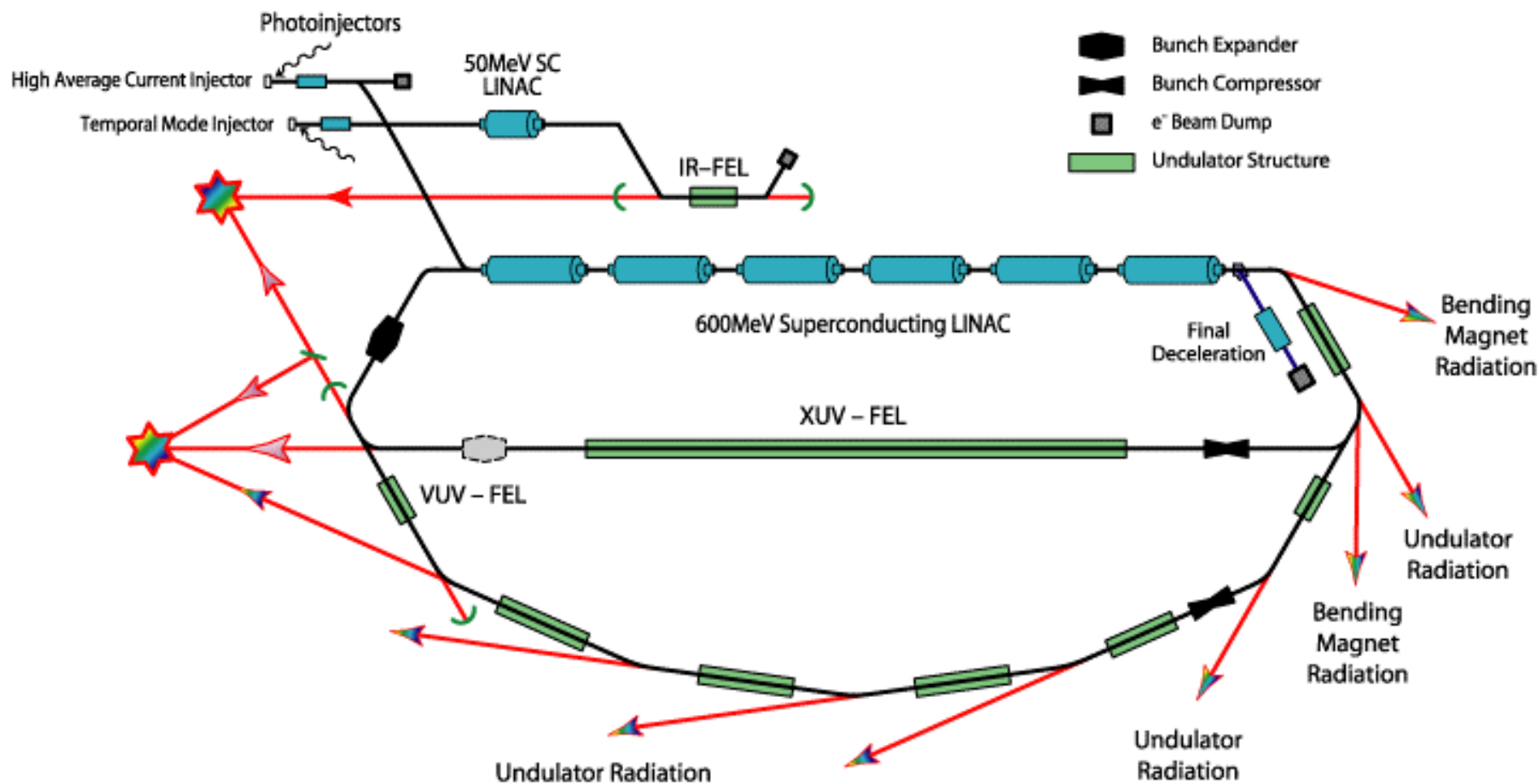
- ASTeC objectives
 - Structure of the group
- 4GLS
- The ERLP
- Timescales
- Conclusion

- All new UK accelerator projects go through ASTeC
- Still supporting the SRS and Diamond
- Linked into the TESLA collaboration
 - Beam delivery system for linear colliders
 - Damping rings
- EU cavity – Ernst
- FEL program at ELLETRA
- Main project is the 4GLS/ELRP

- Accelerator Physics (8)
- Vacuum science (5)
- Insertion devices and Magnets (7)
- RF and Beam Diagnostics (13)



- 4GLS is a uniquely flexible source of ultra-high brightness continuous and pulsed radiation
- IR to XUV parts of the spectrum.
- Combining ERL (energy recovery linac) and FEL (free electron laser) technology.
- ERL enables very high brightness short pulse radiation
- FEL technology allows very short, ultra-high brightness pulses from IR-, VUV- and XUV-FELs



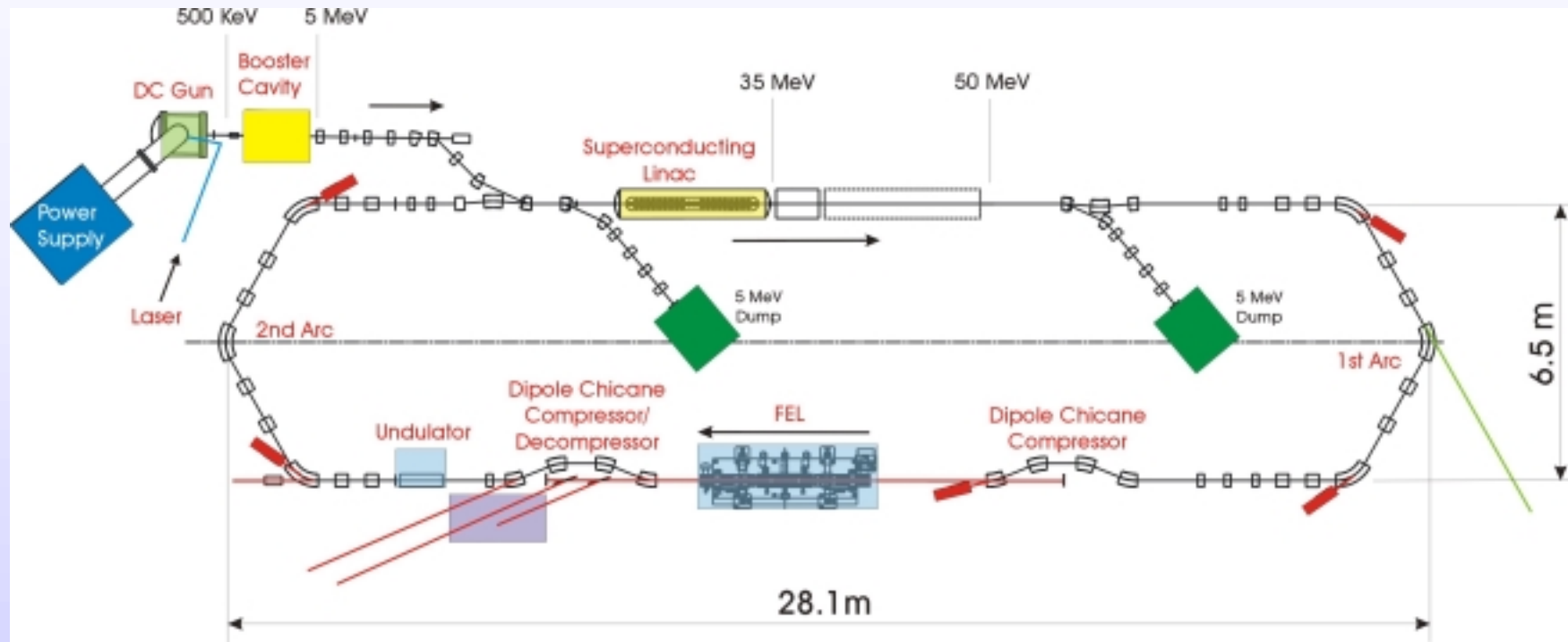


- Machine size 220M

- 2005/6 Design study complete
- Project to be implemented by 2008/9
- Beam 2007
- Project to be realised within a budget of £113 million, running cost £9.1 m

- To be built over the next 3 years
- Aims: To enable the development of core skills and to gain ‘hands on’ experience to meet the 4GLS challenge.
 - high current, high brightness photoinjectors
 - superconducting linac technology
 - FEL and spontaneous source operation together
 - coherent synchrotron radiation
 - synchronisation of photon sources
- Produce a detailed design for 4GLS
- Will not be a user facility-would be nice !

Injector Energy	~ 5 MeV
Beam energy	~ 50 MeV
Linac RF Frequency	1.3 GHz
Linac Repetition Rate	~ 10 Hz
Bunch charge	~ 80 pC
Bunch length	~ 0.5 ps (at FEL)
Energy spread	$\sim 0.2\%$ (at FEL)
Off-Crest Phase	9 degrees
Required R_{56}	0.257 m
Required RF Voltage	45.56 MV

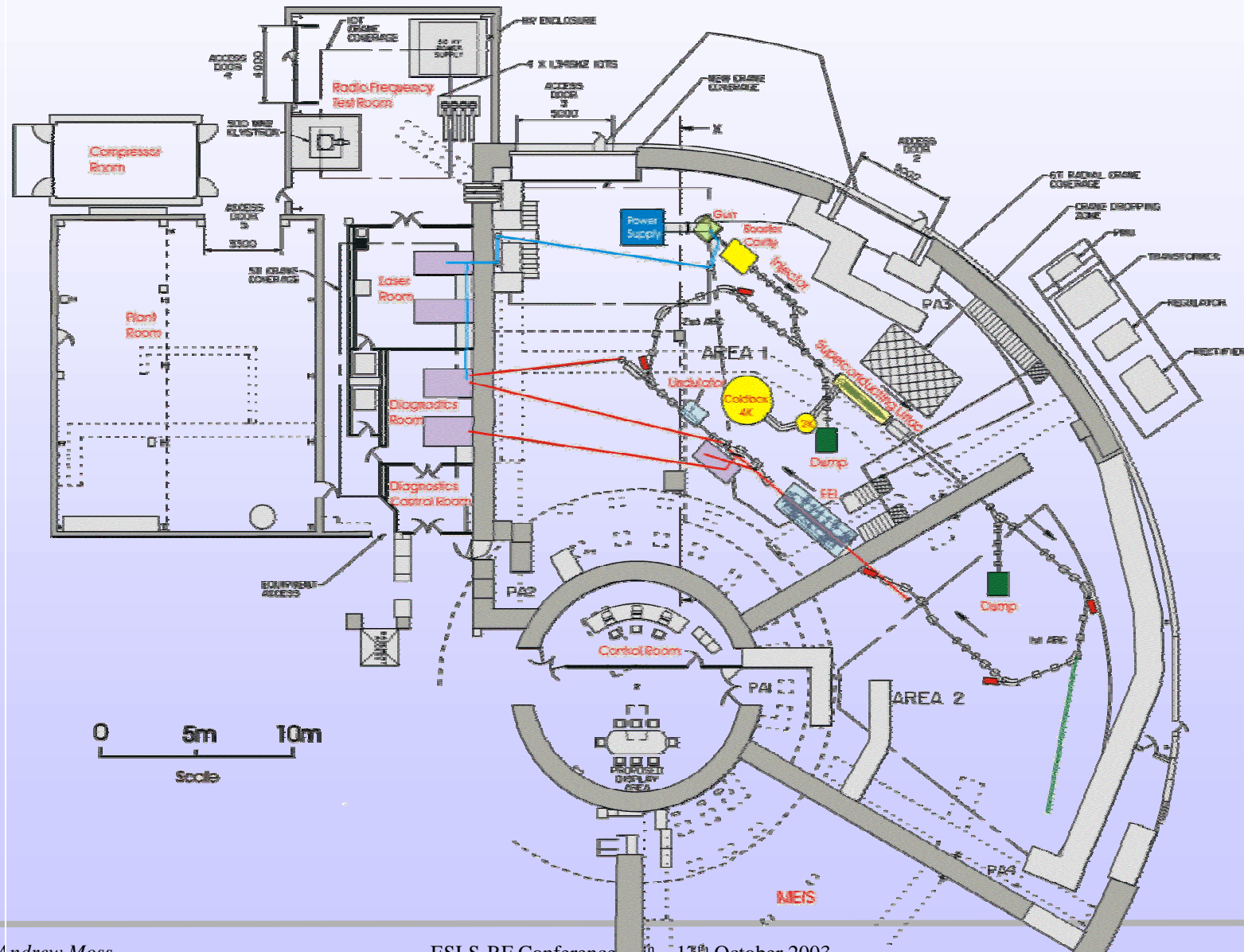


- Moderate beam energy, 35~50 MeV
- Moderate beam current <1mA
- Reasonably short bunch length ~0.5ps
- Expected return energy spread >2%
- Machine energy limited by radiation shielding of existing building

Work progressing in all areas of the ERLP design

- Photo injector gun
- Gun High Voltage 500kV DC supply
- Laser System
- Booster cavity
- RF Power Systems
- Superconducting Linac
- Cryogenic Systems

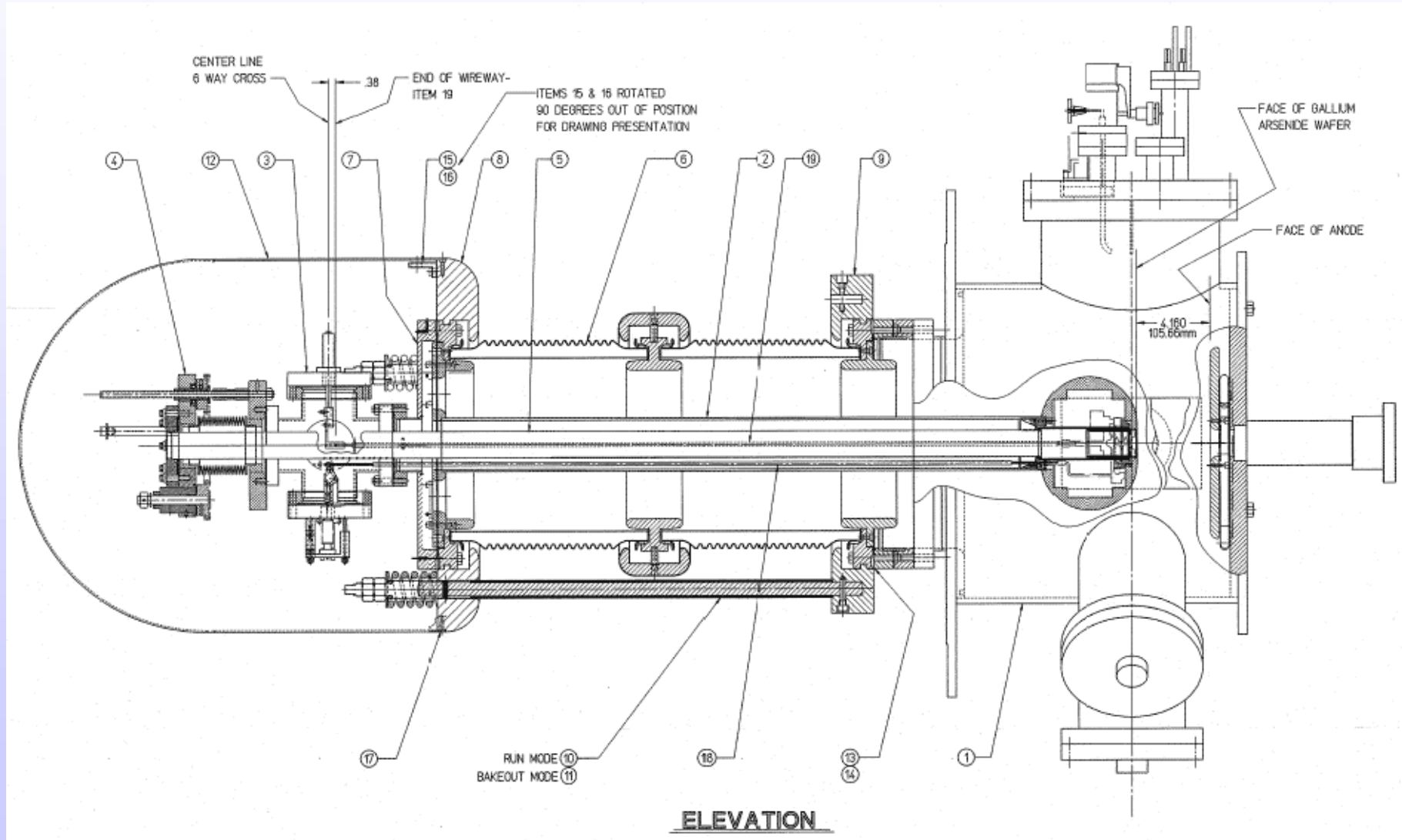
The ERLP layout



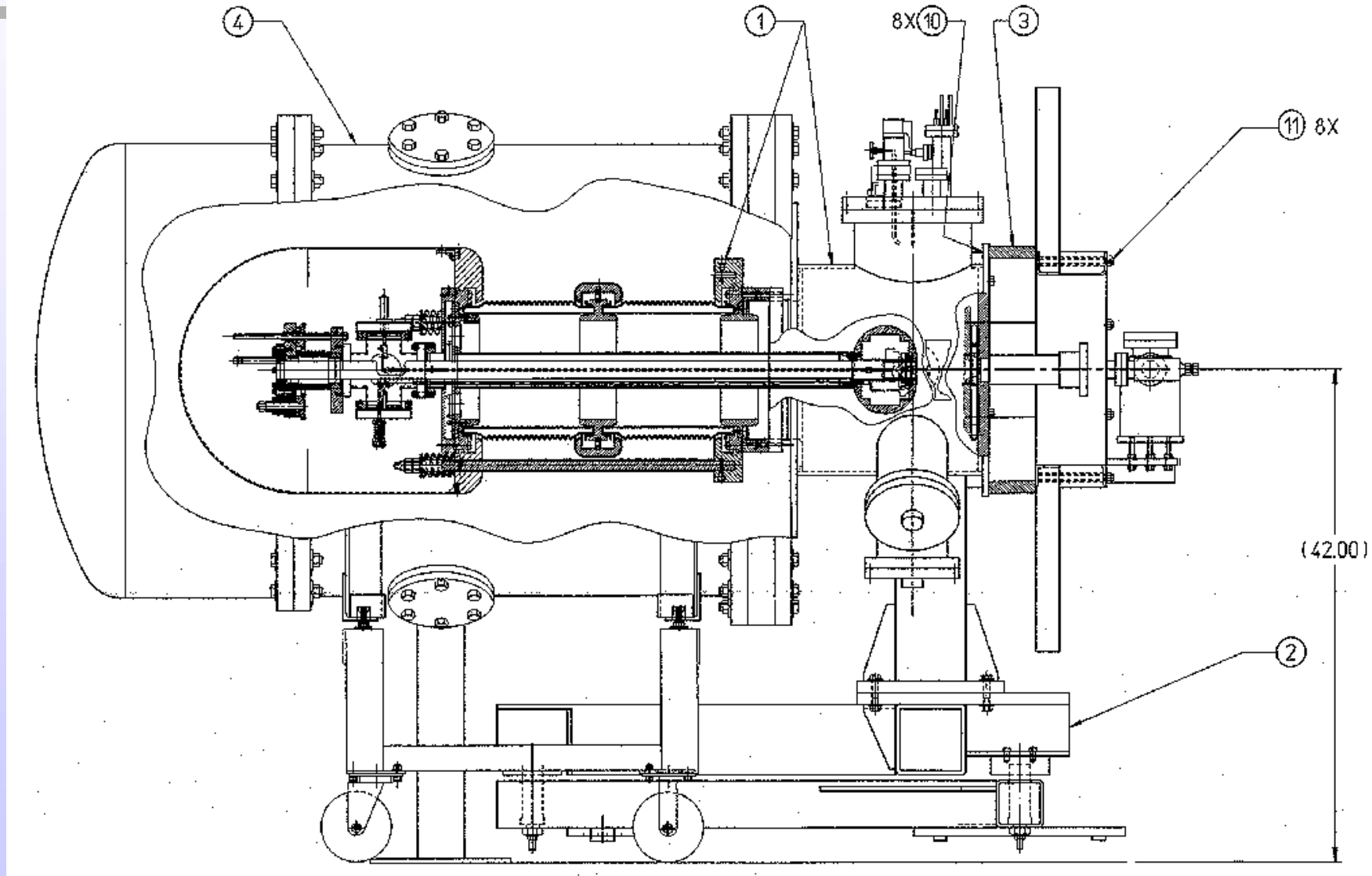


- Based Heavily on JLAB ERL Injector
- JLAB ‘M.O.U.’ in place
- All interesting parts are being built in house
- 500kV DC photo-cathode gun
- GaAs Cathode choice

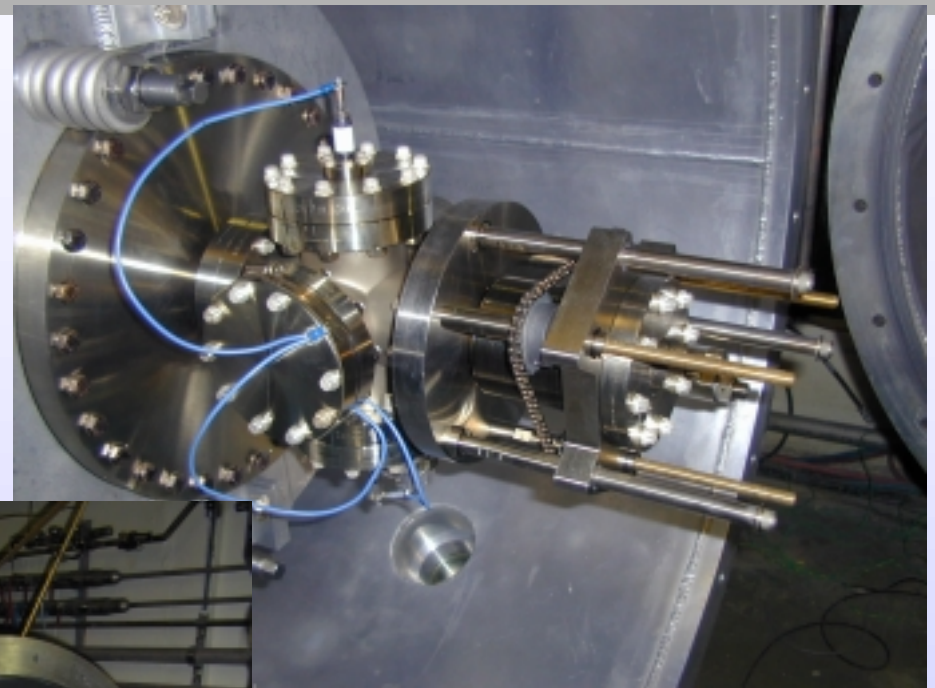
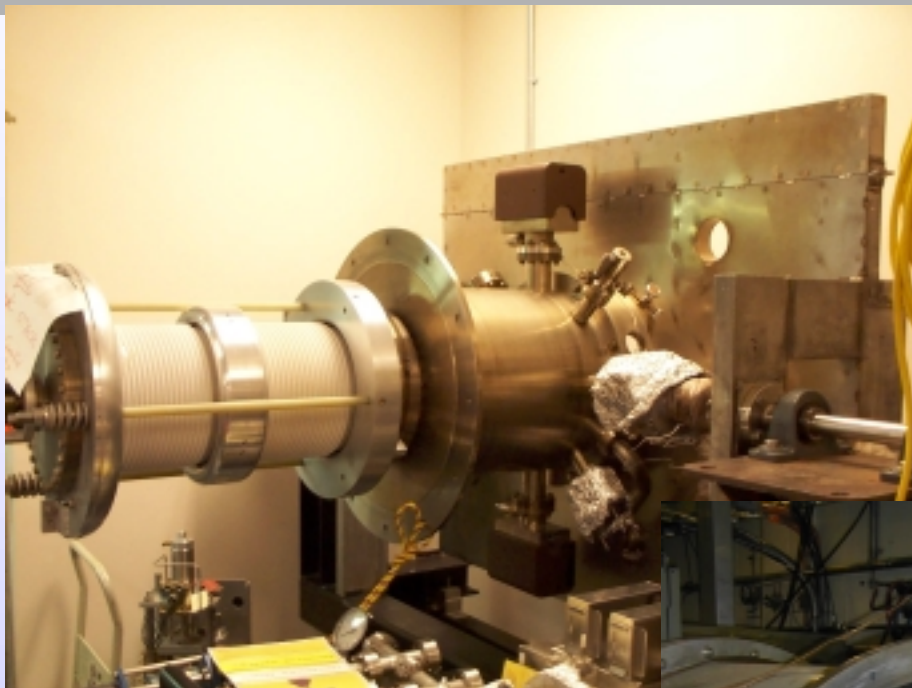
The Photo-injector gun

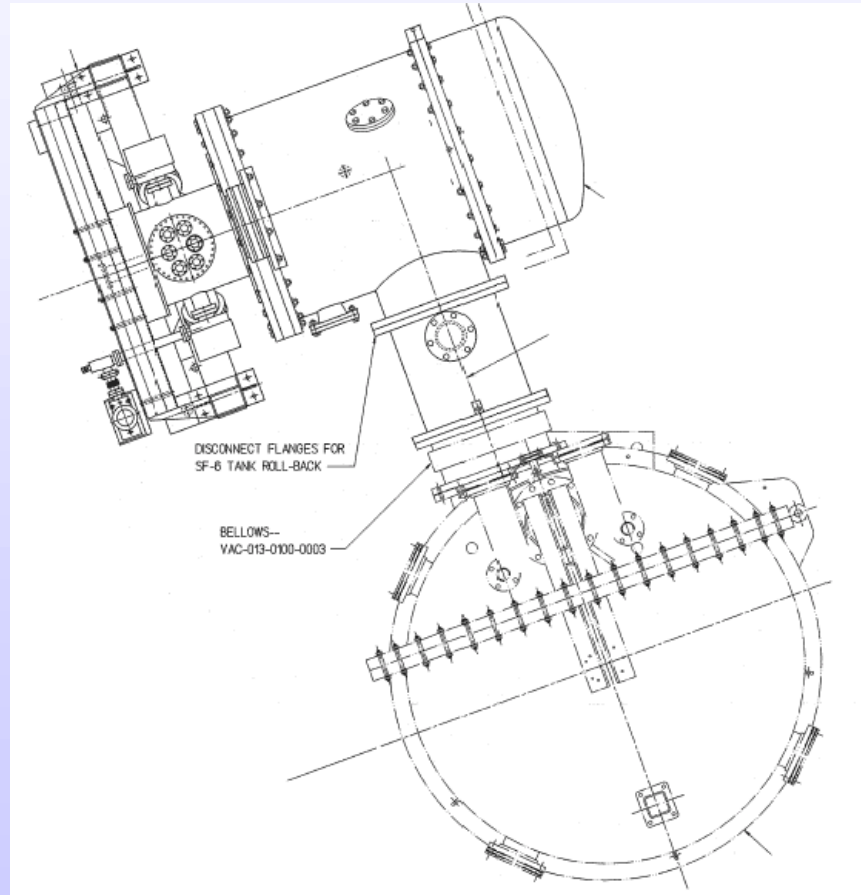


The Gun and SF6 enclosure



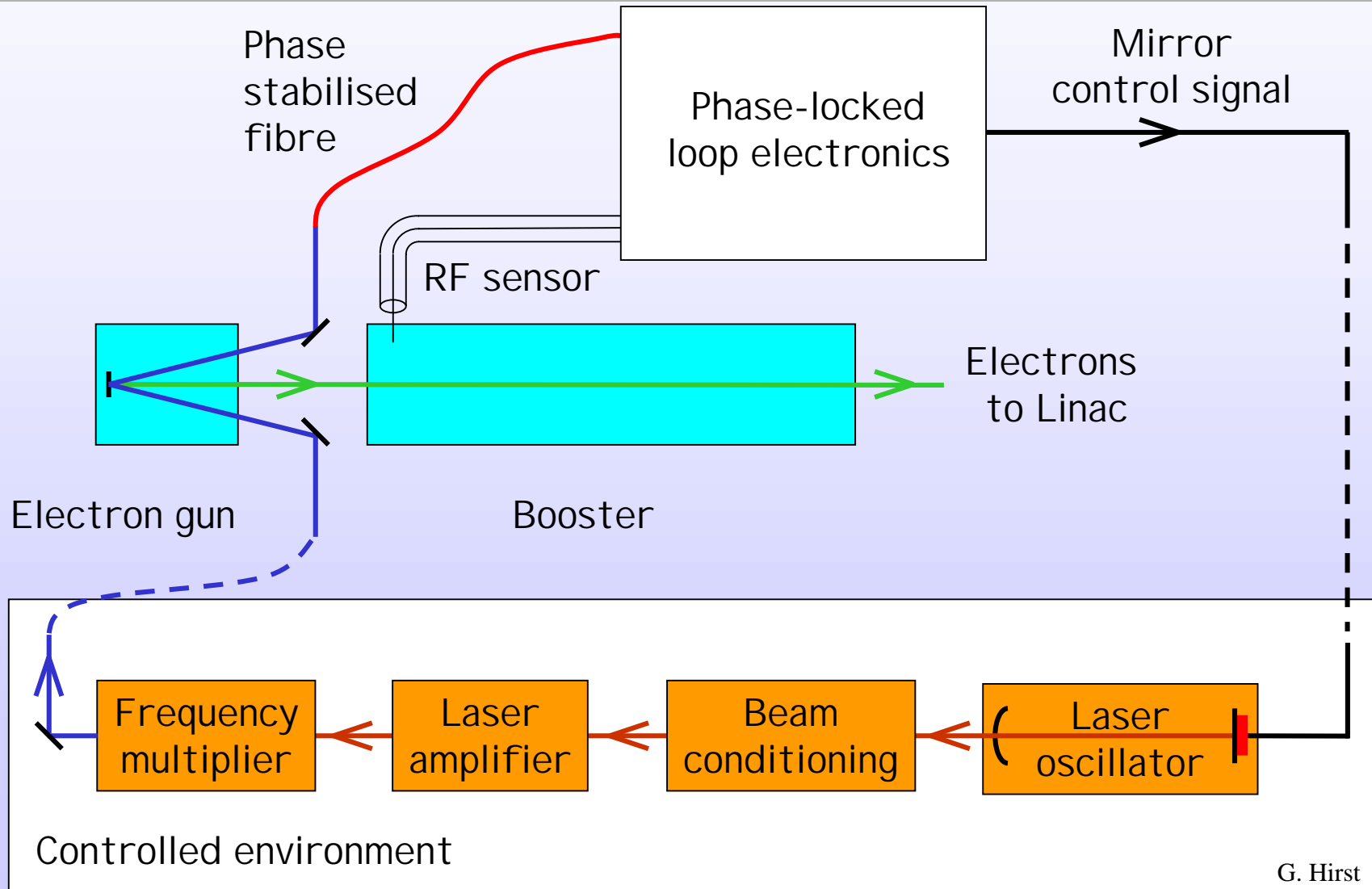
Gun pictures



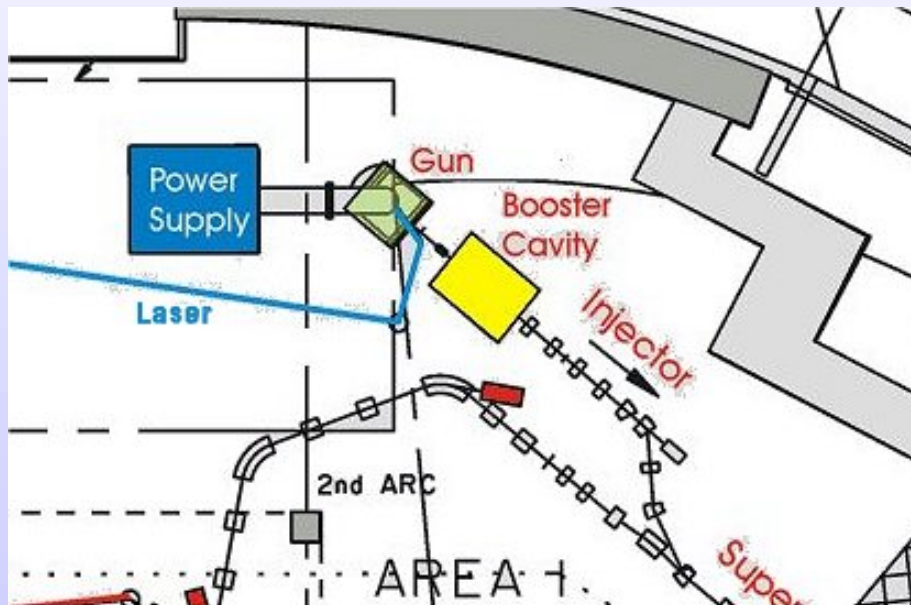


- Commercial 500kV 8mA DC Power Supply
- Contract placed with Glassman Europe.
- Power supply and gun enveloped by 0.8Bar SF6 environment

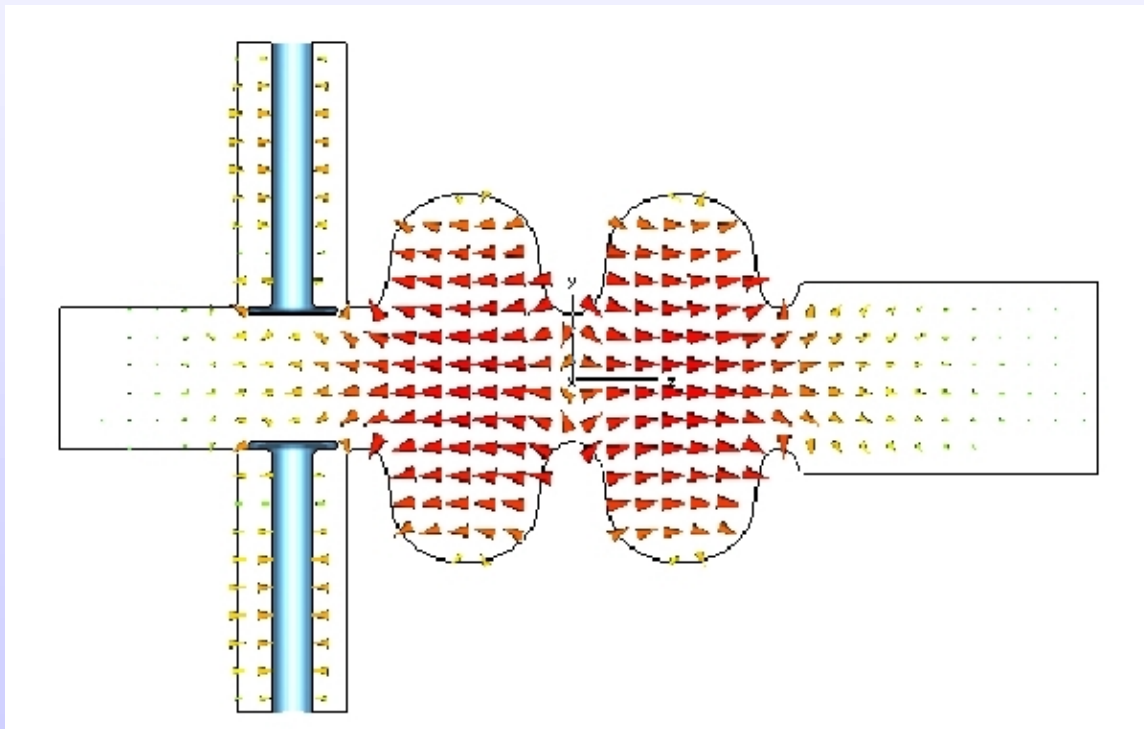




- Wavelength: 1.05 μm , multiplied to 0.53 μm /0.26 μm
- Pulse energy: 40nJ on target
- Pulse duration: 10ps FWHM
- Pulse Repetition rate: 160MHz
- Macropulse duration: 100 μs
- Duty cycle: up to 0.2%
- Timing jitter: <1ps
- Spatial profile: circular (top hat) on photocathode

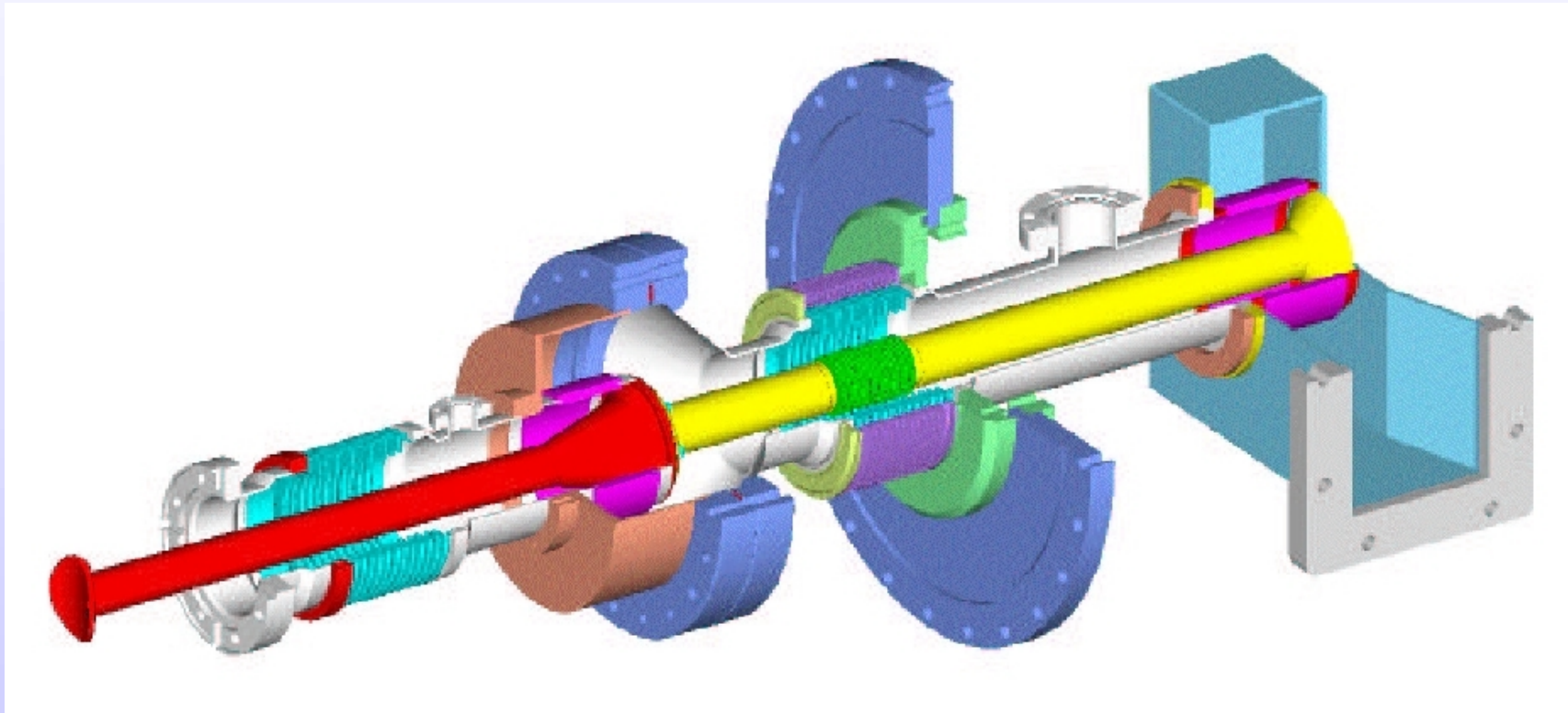


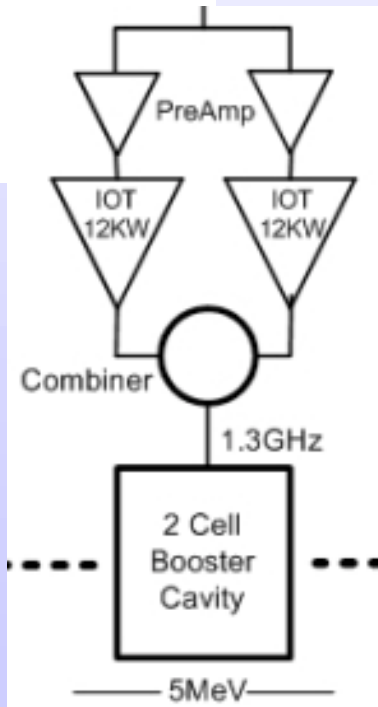
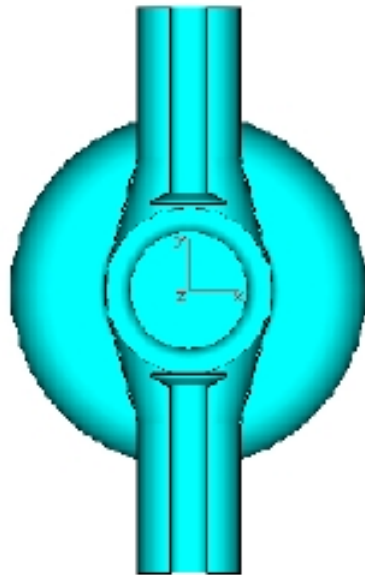
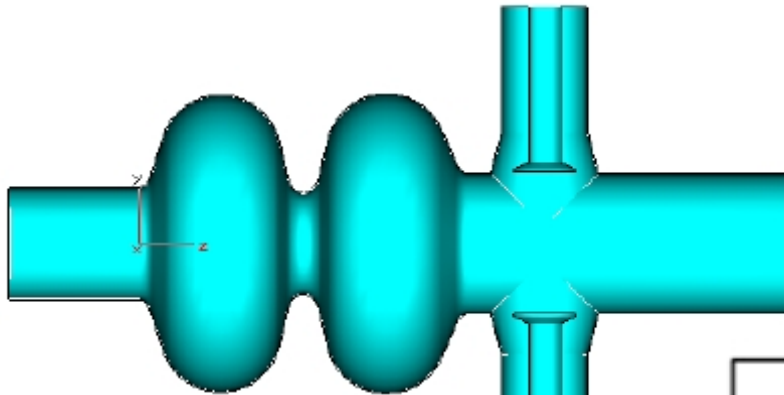
- Superconducting multi-cell cavity, boosts beam energy to 5MeV
- 1.3 GHz Freq.
- Use of Cornell design
- DL to design 200KW coupler



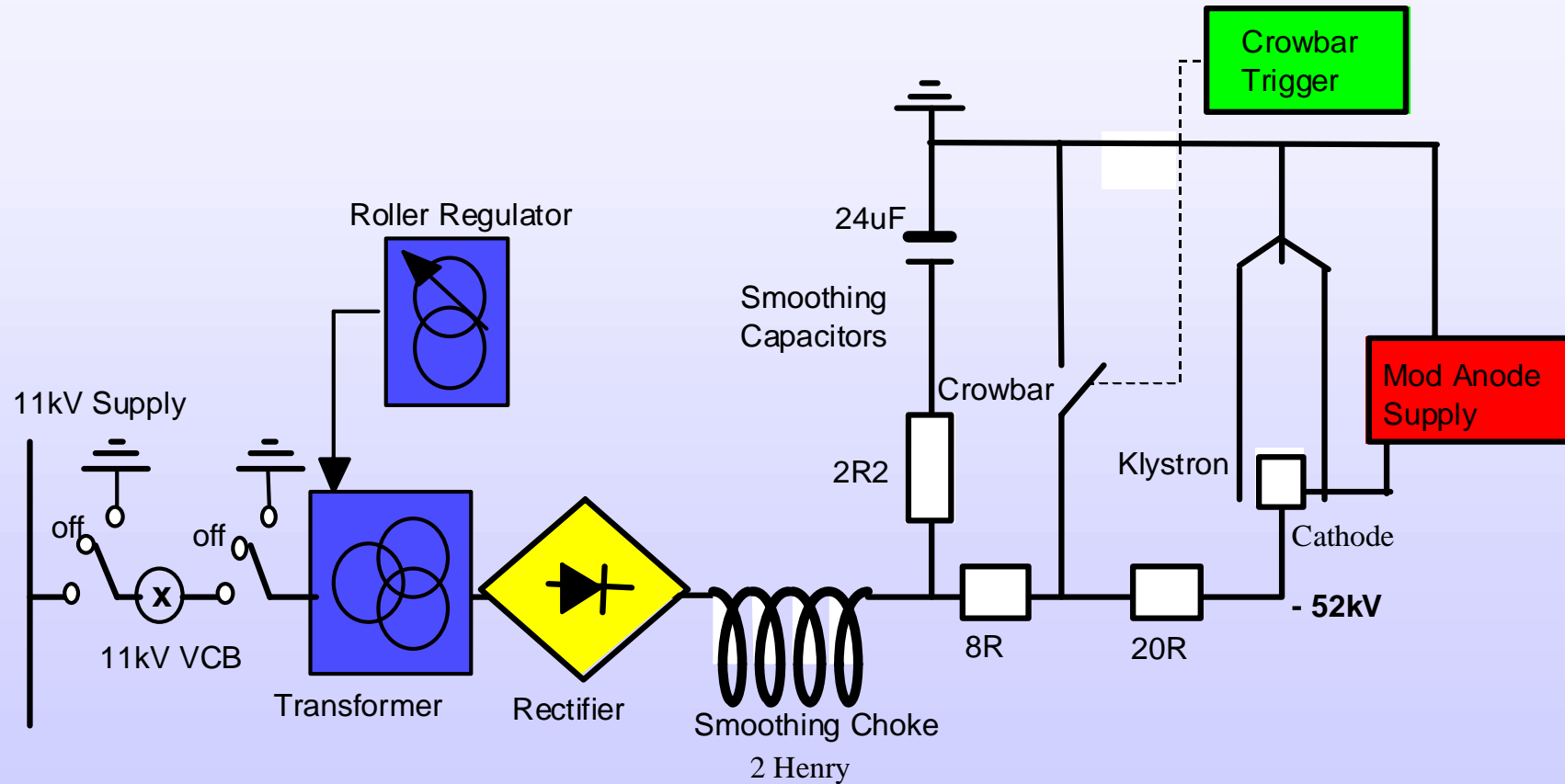
- 32KW input
- 2 couplers to prevent beam kick
- Optimised geometry to propagate dipole mode

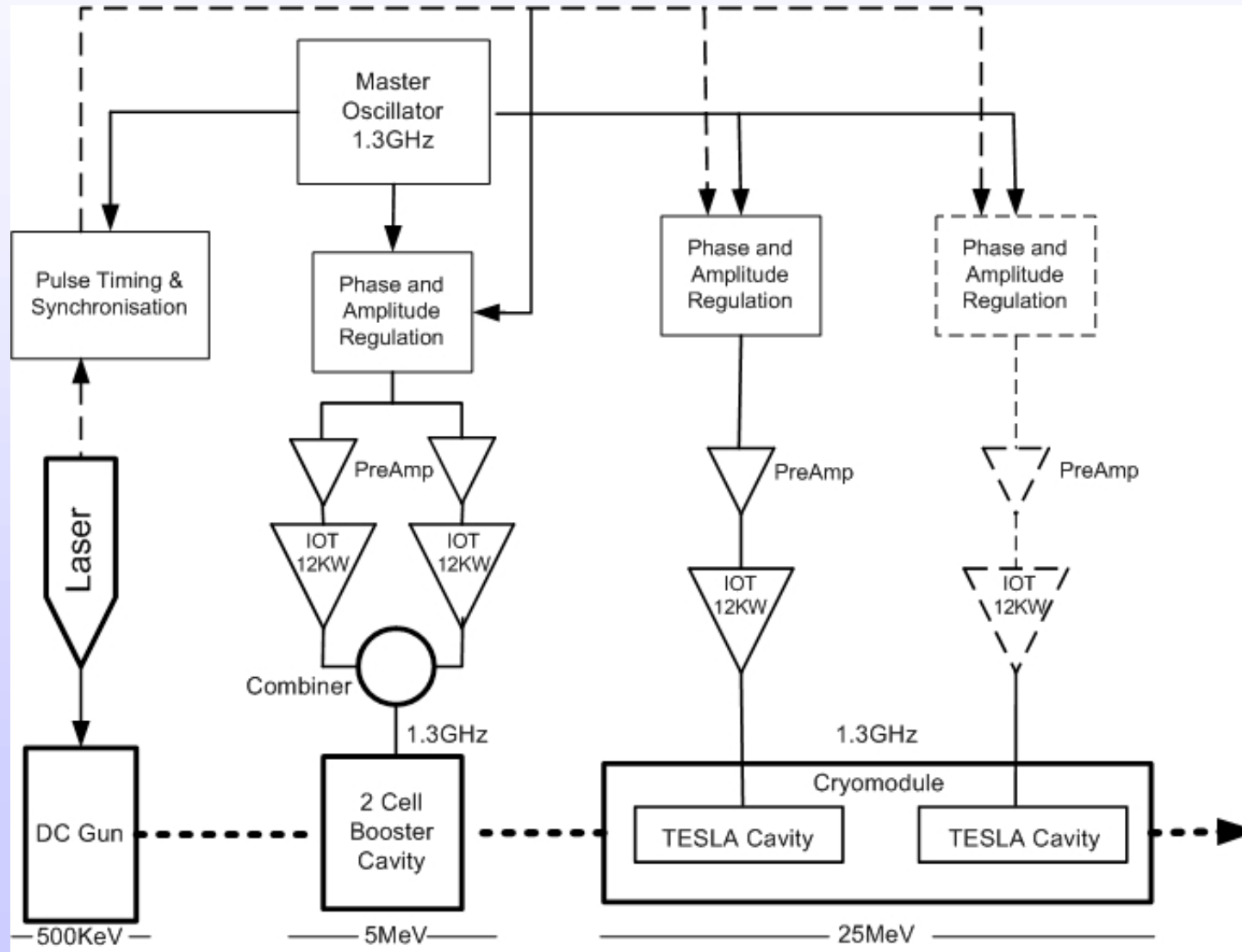
- 25W dynamic load
- 6W static load
- 2k
- 100W shield at 80 K
- Combined with Linac Cyro system
- Cryostat not know at this time



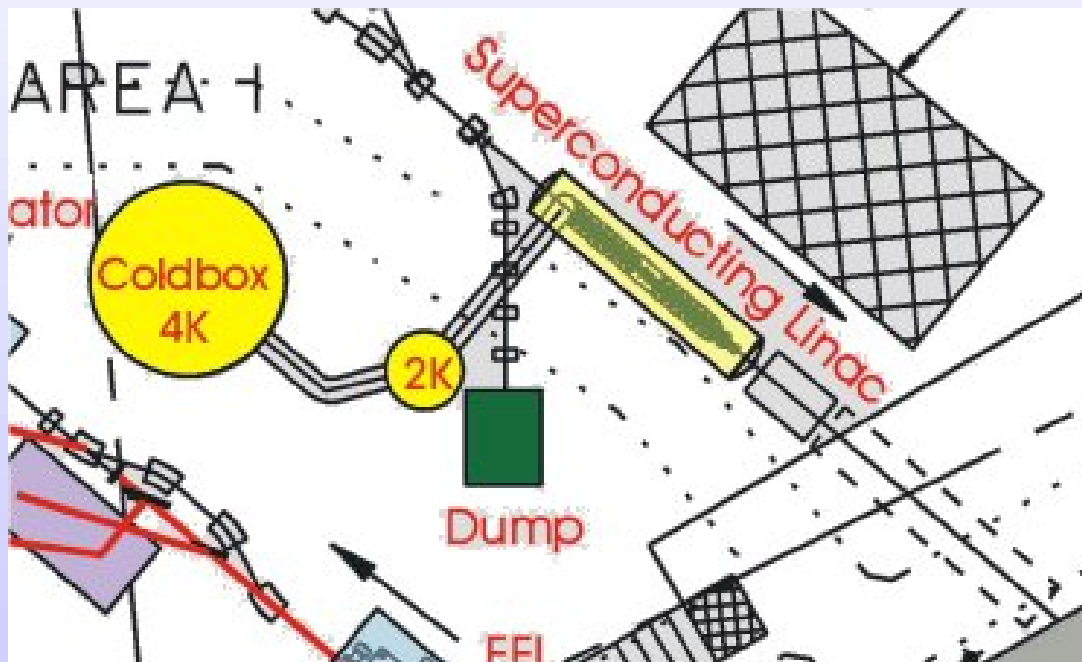


- Joe will provide more info on this
- Need 32kw for ELRP operation
- Combine 2 16KW IOTs
- Split to enter cavity
- 2 couplers to prevent beam kick + preserve phase relationship
- E2V will produce IOT for test soon

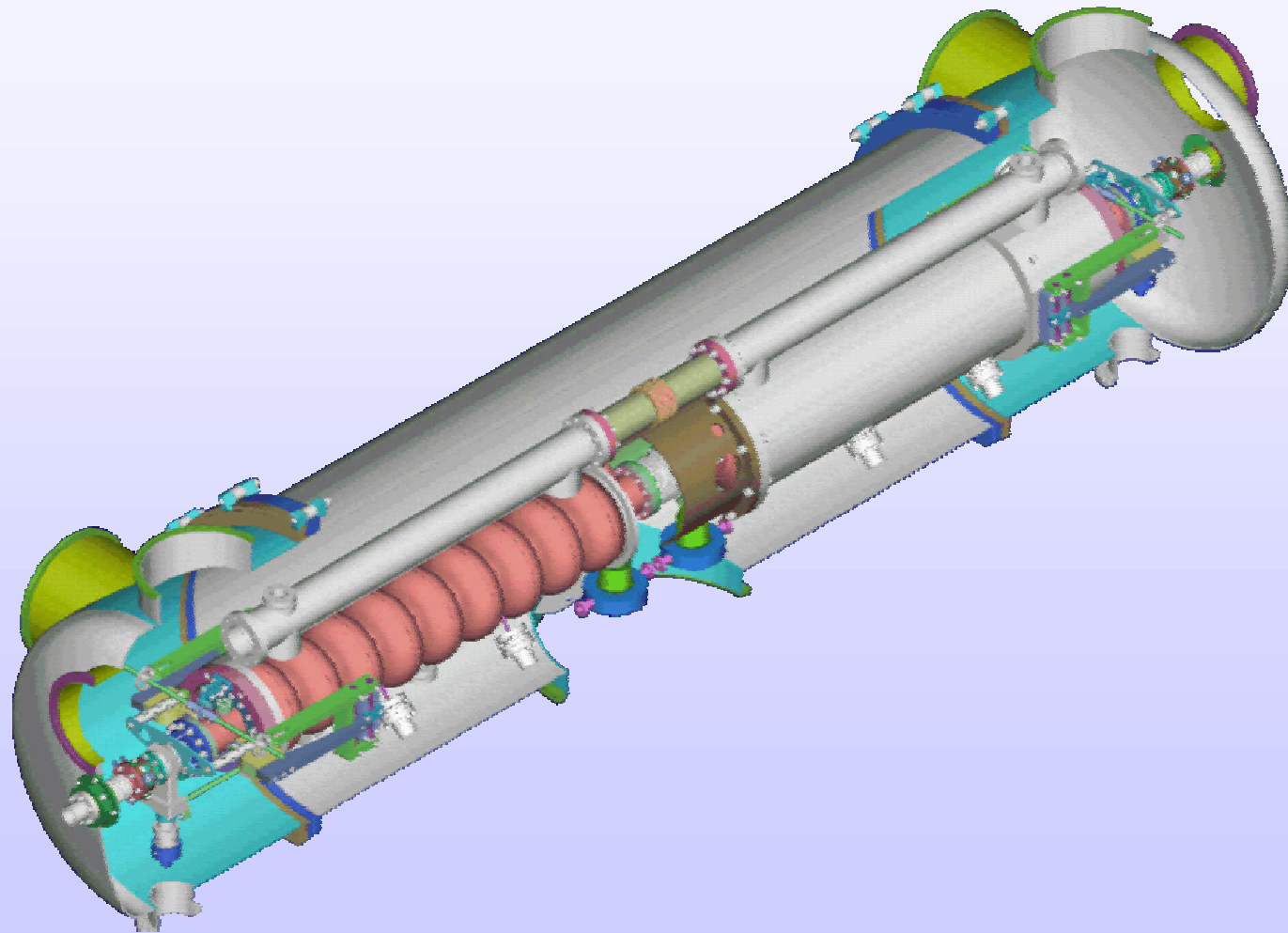


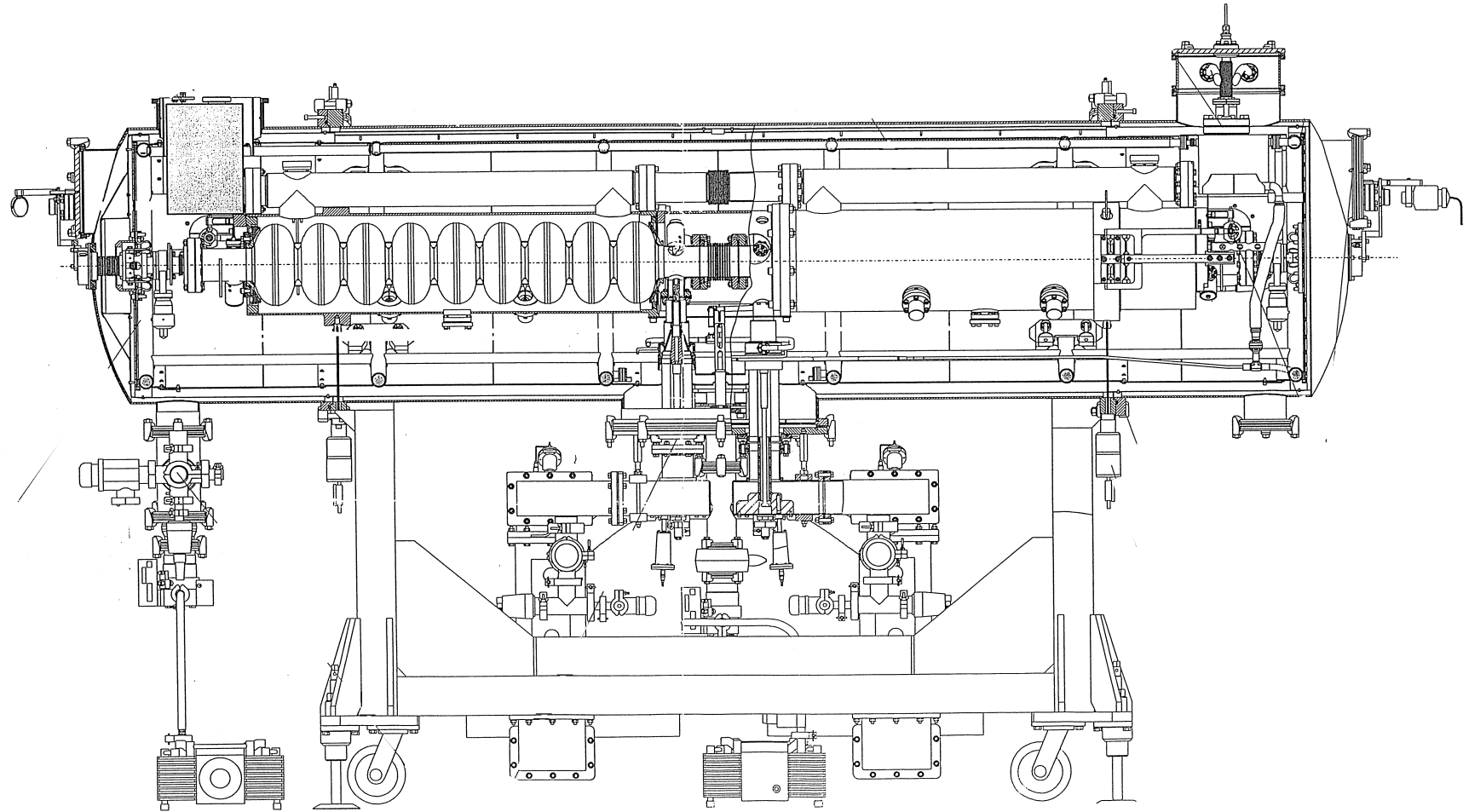


- Pulsed RF synchronised to laser system
- Pulse length 1mS at 20 Hz
- Possible trial of CW RF
- pS time scales
- A major task !
- CLF at RAL developing laser systems

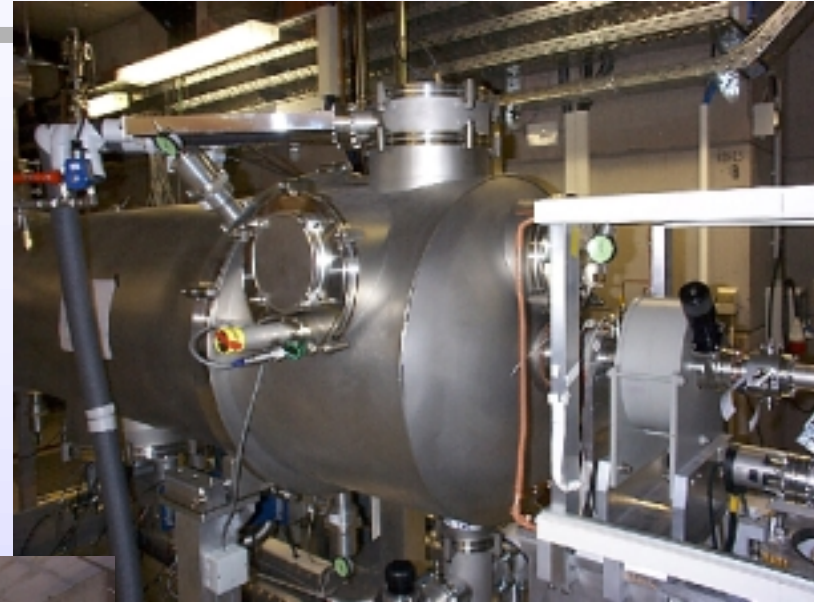
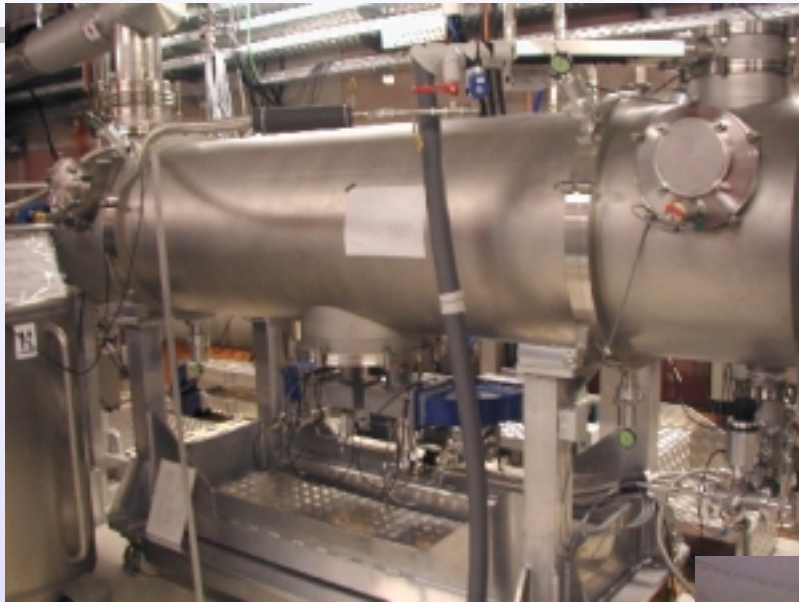


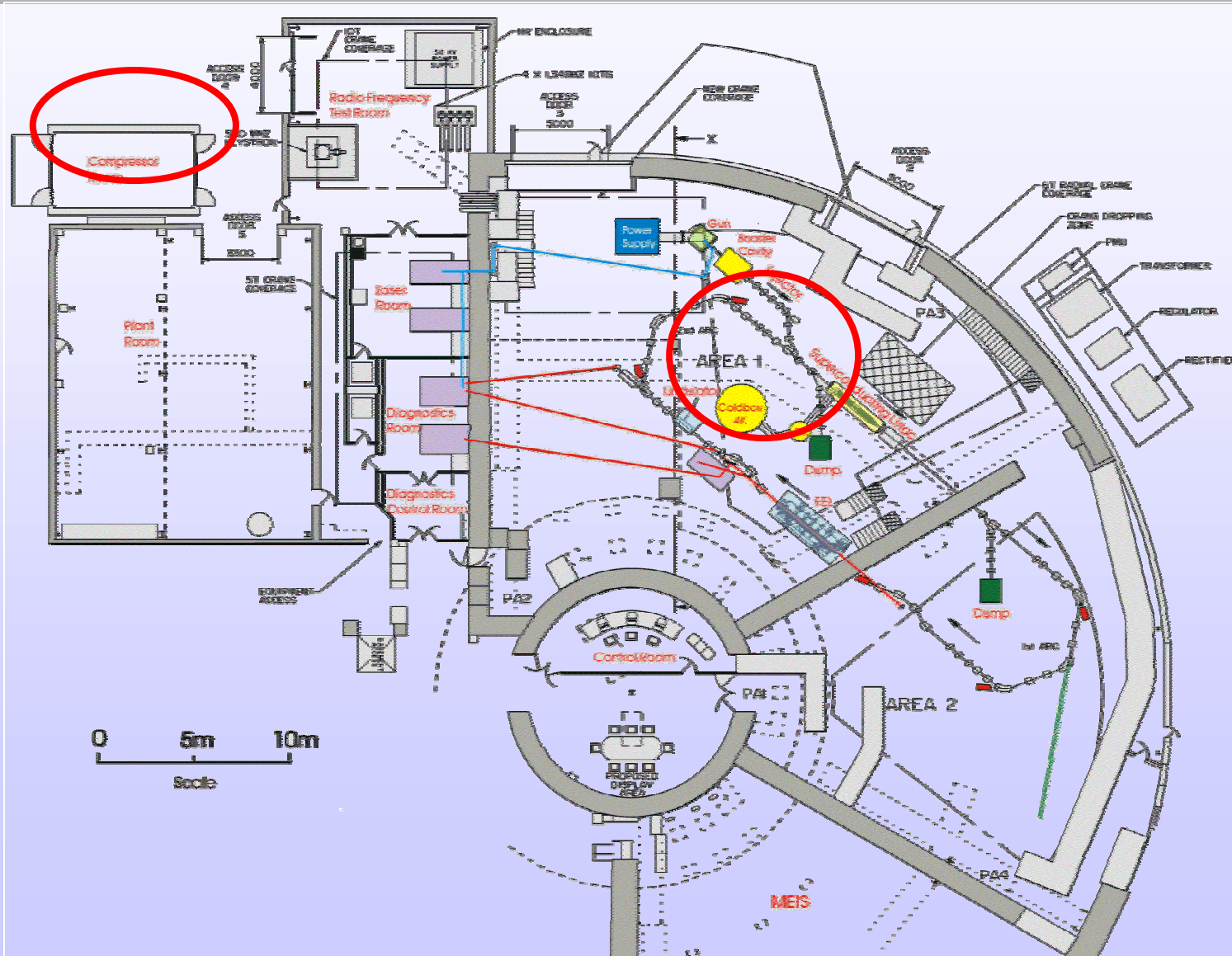
- ELBE –TESLA
- Number of cryo modules depends on individual cost
- Commercially available... 'Accel'
- Tender for module going out shortly

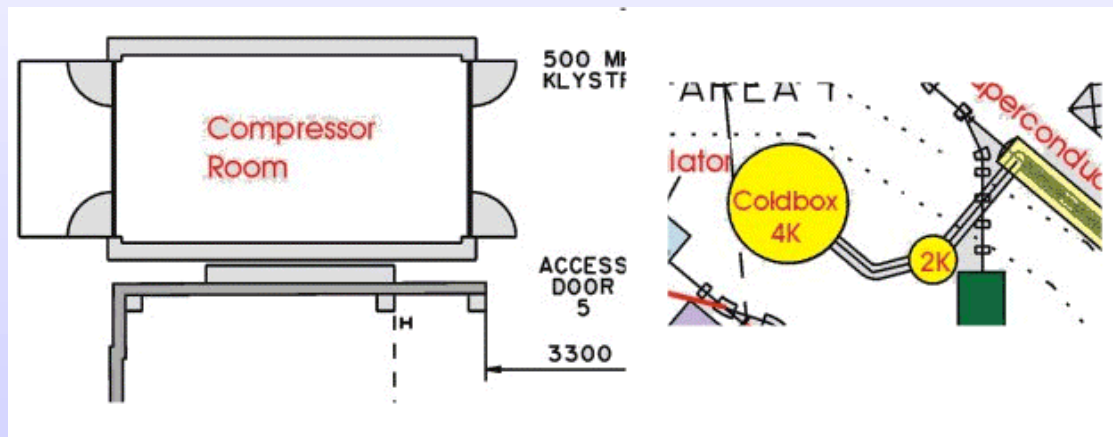




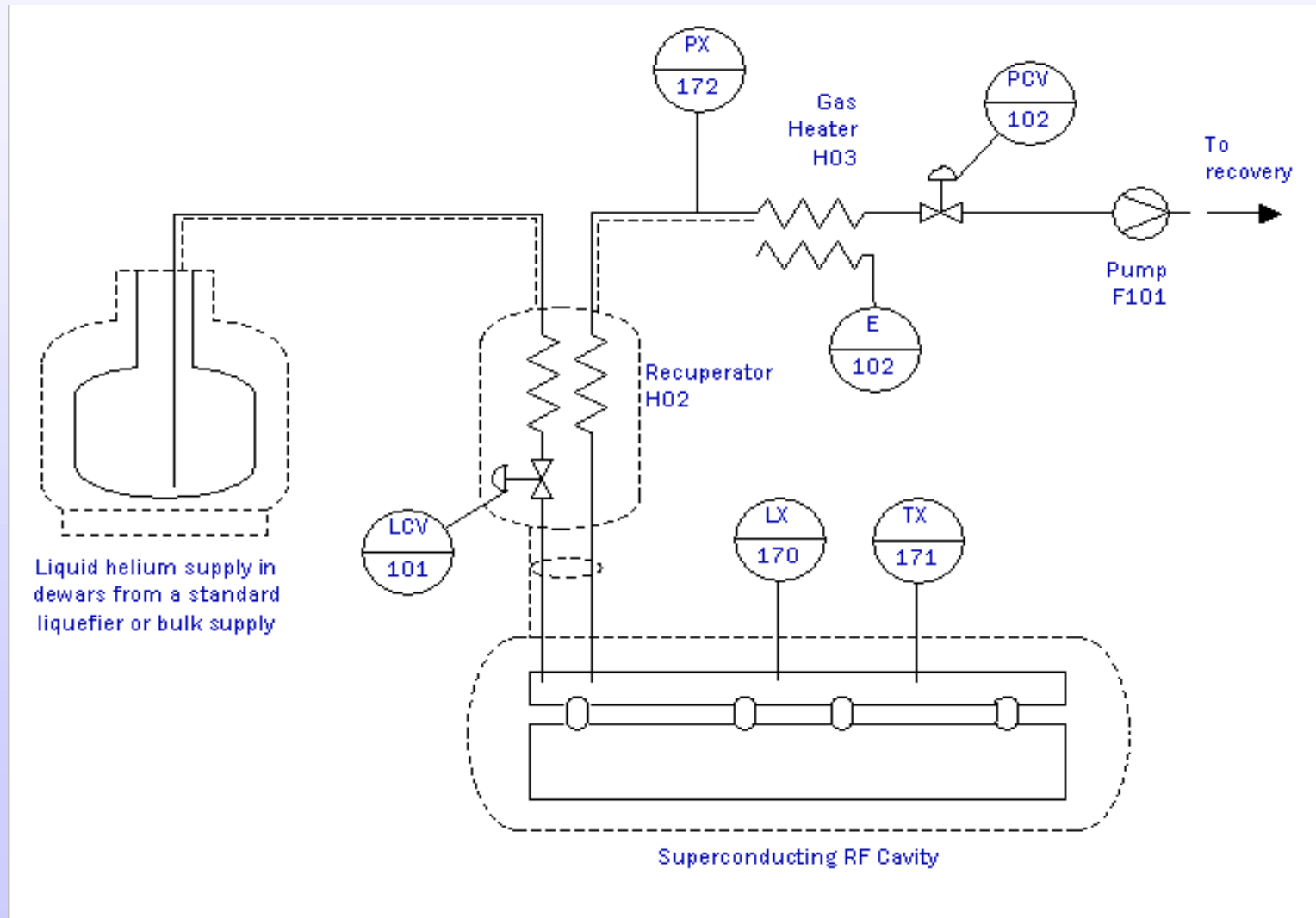
ELBE Type Cryostat with dual Tesla Linac Sections







- Choice of Helium production method
- 4K and sub-cooling 2K system
- Make 4K liquid for 24 hrs
- Pump to 2K
- Run for 5 hours/day



- Static Load = 6 Watts (24 hours/day)
- Dynamic Load = 90 Watts (4 hours/day, 5 days/week)
- Temperature = 1.8 - 2.1 k
- LHe flow = 7000 L/week
- Duration of Experiment = 46 Week

- We need a TCF20 200W fridge
- Running close to its limit
- Pulsed operation
- Tender specification has been released
10/03

- Decide cathode material 17/07/03
- Decide laser λ 17/07/03
- Booster designed 02/01/04
- Laser commissioned 30/07/04
- 1st electrons from gun 01/08/04
- Booster commissioned 30/04/05
- 1st electrons from booster 01/05/05

- Frequency decided 17/07/03
- Cryo-module decided 01/09/03
- Cryogenic system ordered 02/01/04
- RF power source ordered 02/01/04
- Cryo-module Commissioned 31/05/05
- 1st electrons accelerated 01/08/05

- Work is now progressing in several technical areas.
- Gun will be based on JLAB gun. MOU means DL has access to all JLAB gun drawings, and expertise.
- Production of components will be mainly made in house. Specialist components/services sourced from JLAB.
- 500kV power supply will be delivered 1st December
- Decisions on Linac type needed soon!
- Tender for cryo system out !
- Very aggressive project, that has to work !