Diamond RF Status

Morten Jensen

Current Status

Reminder

Linac

- 100 MeV Linac supplied by two 35 MW pulsed Klystrons
- Turn-key Contract placed with ACCEL

Booster (see A. Moss November 2002)

- 3 GeV Booster
- Extraction at 3 GeV
- Single 5-cell cavity
- IOT based RF source

Basic Storage Ring RF Parameters

	No IDs		Day 1 IDs		22 IDs	
Energy (GeV)	3		3		3	
Energy lost in dipoles (MeV/turn)	1.0		1.0		1.0	
Total losses (MeV/turn)	1.05		1.25		1.78	
Beam Current (mA)	300	500	300	500	300	500
Beam Power (kW)	315	525	375	625	534	890

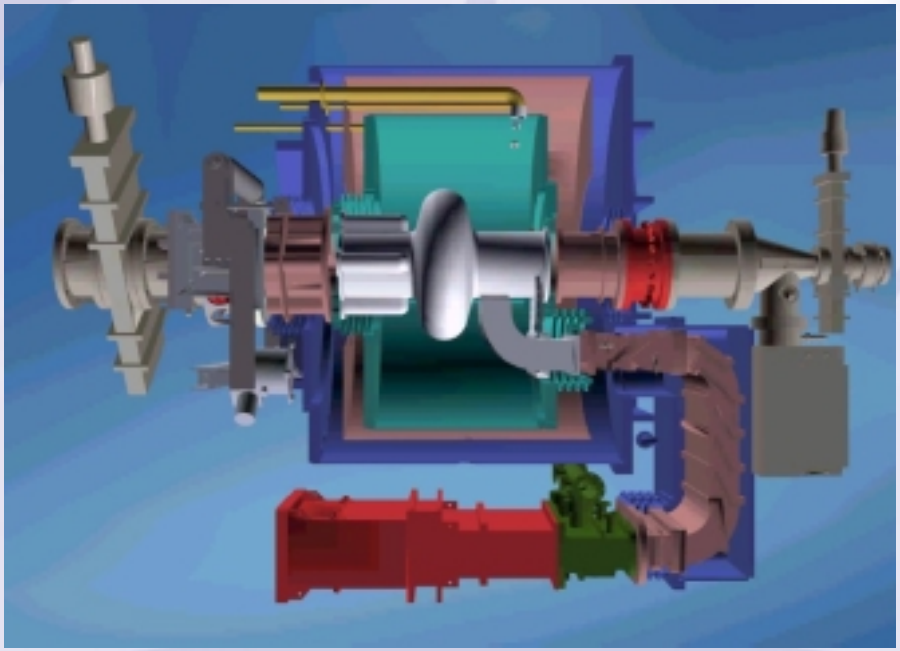
Storage Ring RF

Superconducting Cavities

Contract placed with ACCEL for two accelerating modules

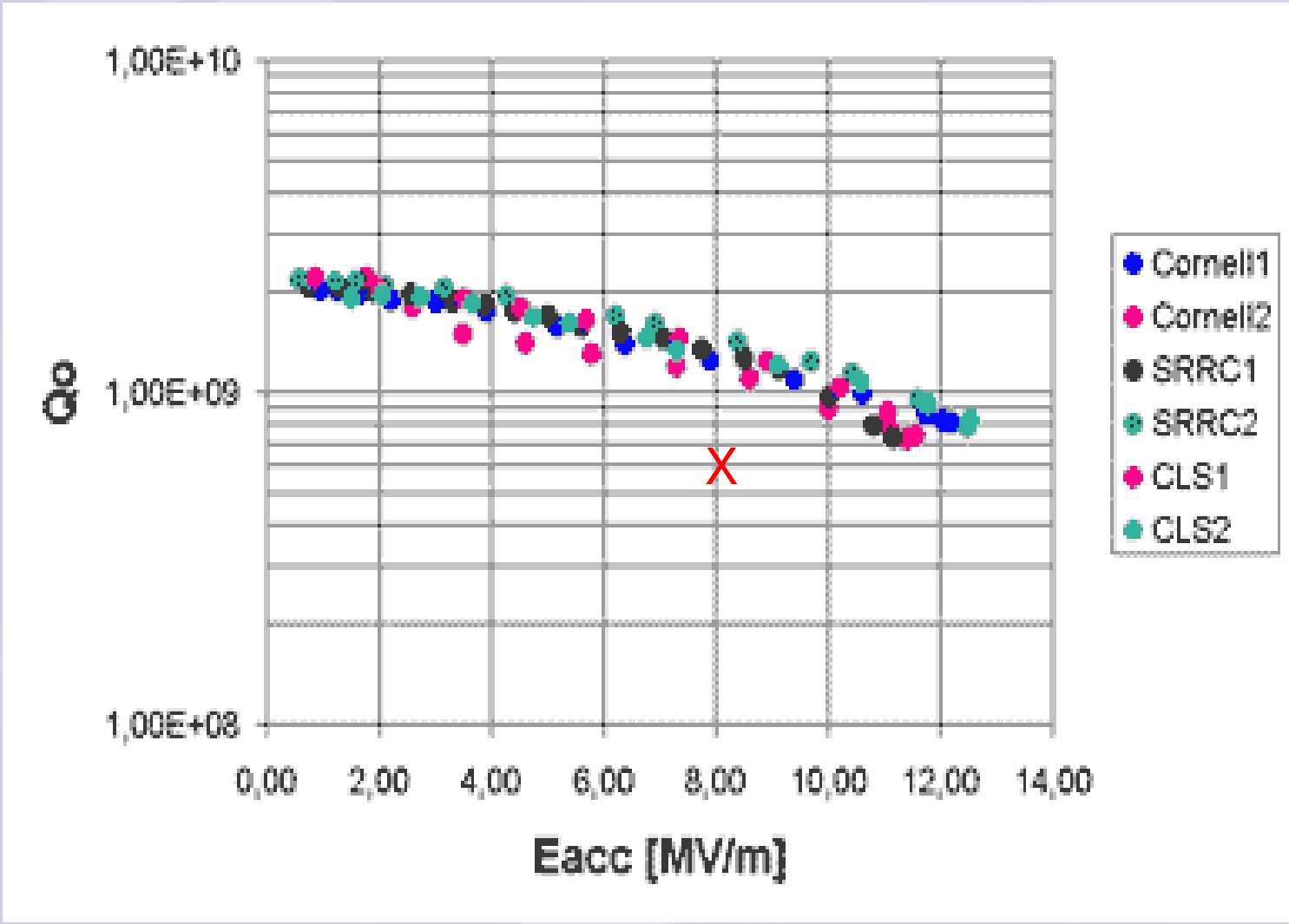
Design Review
End of November

Ready for operation by
August/September 2005



Key Parameters for each cavity

RF Frequency	499.654 MHz
Accelerating voltage	> 2 MV
Forward power	300 kW
Q_0 at 2 MV	5×10^8


1,00E+10
1,00E+09
1,00E+08
Q0
0,00
2,00
4,00
6,00
8,00
10,00
12,00
14,00
Eacc [MV/m]
X
Cornell1
Cornell2
SRRC1
SRRC2
CLS1
CLS2

Key Parameters

RF Frequency	499.654 MHz
Accelerating voltage	> 2 MV
Forward power	300 kW
Q_0 at 2 MV	5×10^8
Typical Q_{Ext} of the input coupler	$1.9 \times 10^5 \pm 0.5 \times 10^5$

Modes of Operation

Day One Operation

Number of Cavities	2	
Beam current	300	mA
Total accelerating voltage	3.3	MV
Ie voltage per cavity	1.65	MV
Q_0	5×10^8	
R_{shunt}	$89\times Q_0$	Ω

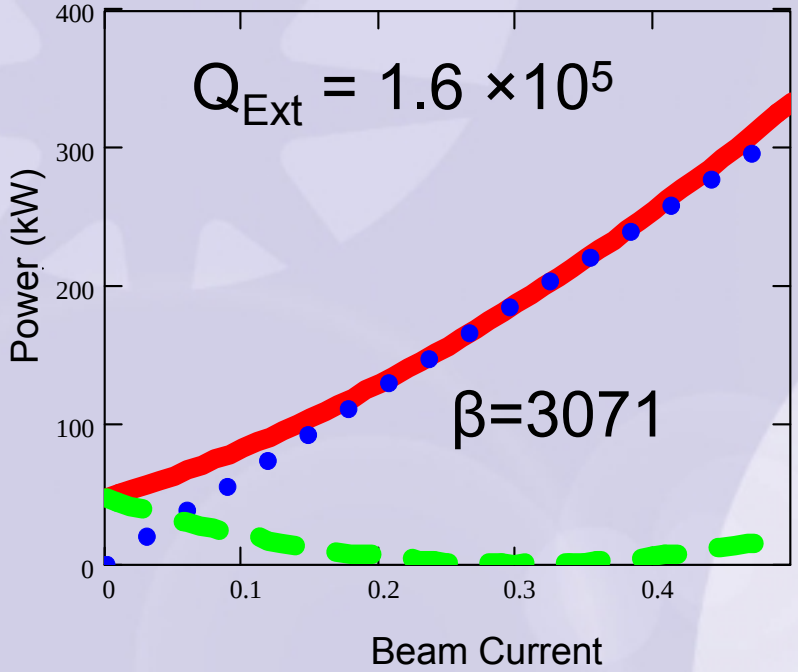
Optimum External Q for match at 300 mA

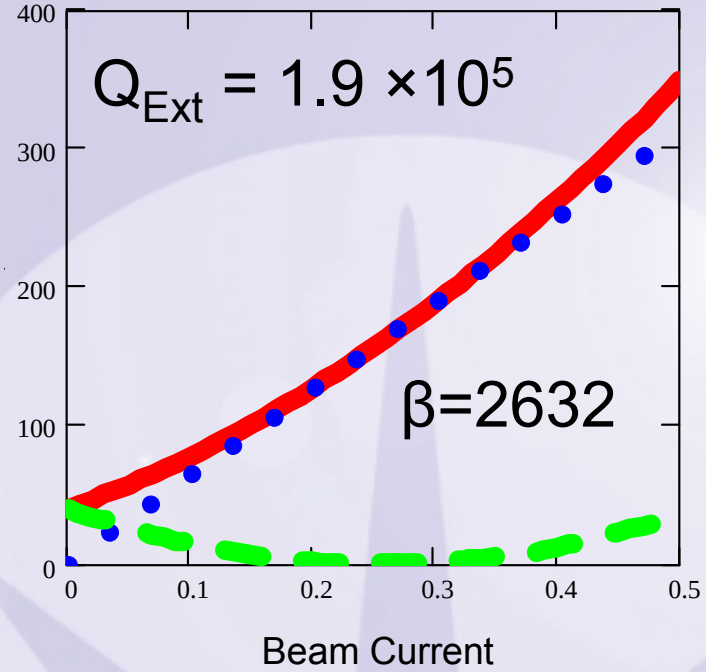
$$\mathbf{Q_{Ext} = 1.6 \times 10^5}$$

Typical External Q set on other cavities

$$\mathbf{Q_{Ext} = 1.9 \times 10^5}$$

Constant Accelerating Voltage
Setup for best match at maximum beam power (300 mA)





Verdict:

Match is reasonable at 300 mA for both

Modes of Operation

22 ID Operation

Number of Cavities	**2**	
Beam current	**300**	mA
Total accelerating voltage	**4**	MV
Ie voltage per cavity	2	MV
Q_0	5×10^8	
R_{shunt}	$89\times Q_0$ Ω	

22 ID Operation

Optimum External Q for match at 300 mA

$$Q_{Ext} = 1.7 \times 10^5$$

'Standard' External Q set on other cavities

$$Q_{Ext} = 1.9 \times 10^5$$

Verdict

Optimum Q is closer to 'standard' Q therefore whilst the power is higher at 267 kW per module the reflected power is low.

Modes of Operation

22 ID Operation

Number of Cavities	**3**	
Beam current	**500**	**mA**
Total accelerating voltage	**4**	MV
Ie voltage per cavity	1.3	MV
Q_0	5×10^8	
R_{shunt}	$89\times Q_0\ \Omega$	

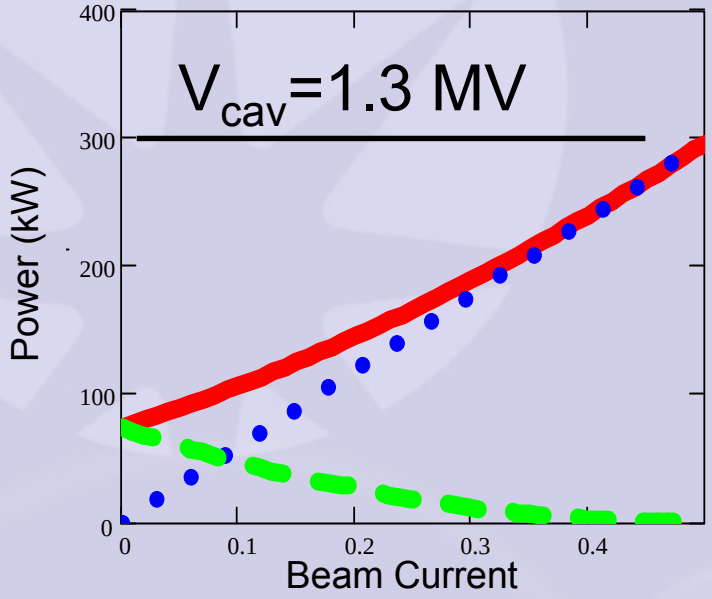
Optimum External Q for match at 300 mA

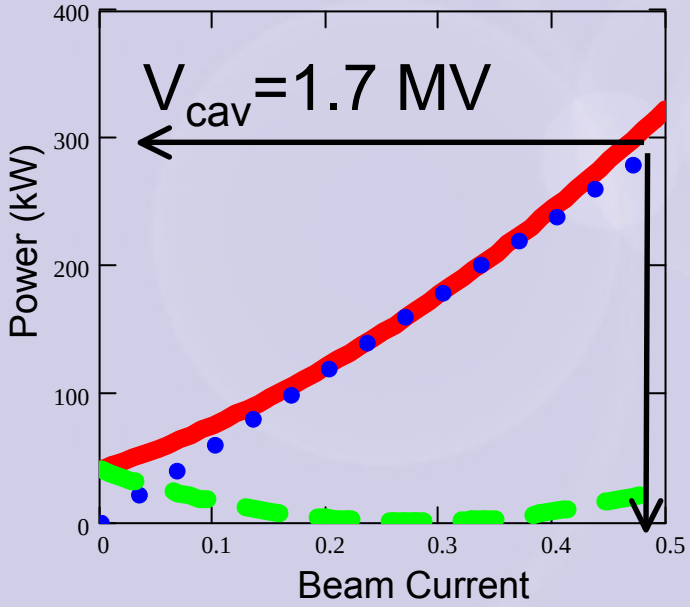
$$Q_{Ext} = 0.7 \times 10^5$$

'Standard' External Q set on other cavities

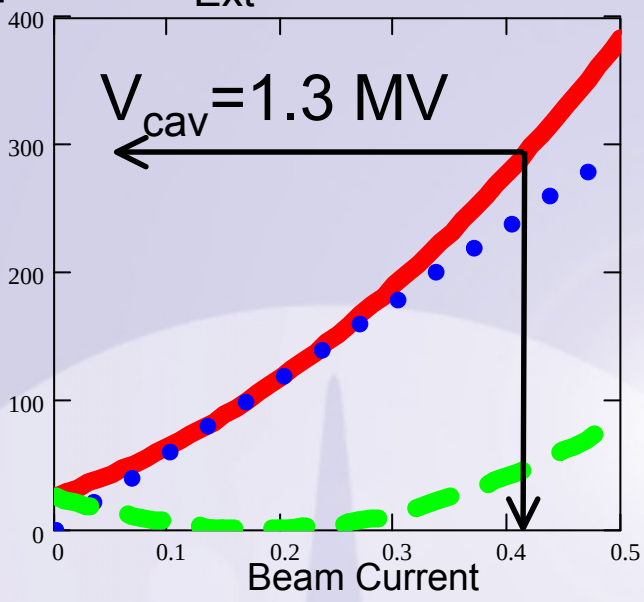
$$Q_{Ext} = 1.9 \times 10^5$$

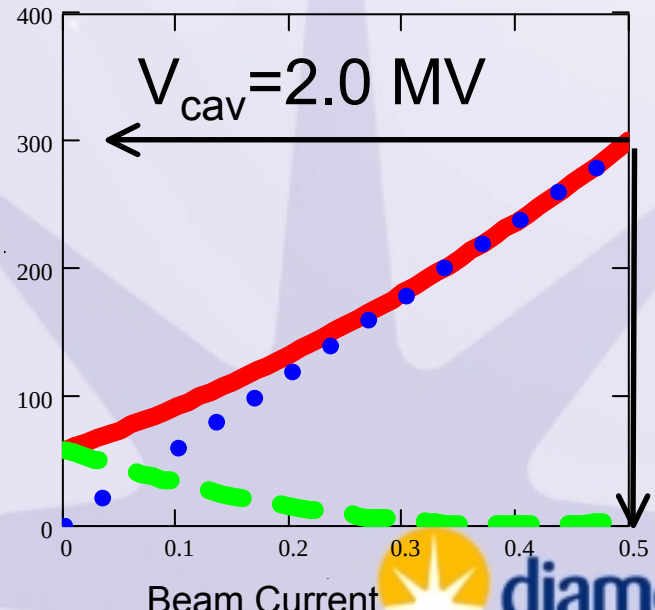
Optimum Q_{Ext} = 0.7 ×10^5





Typical Q_{Ext} = 1.9 ×10^5

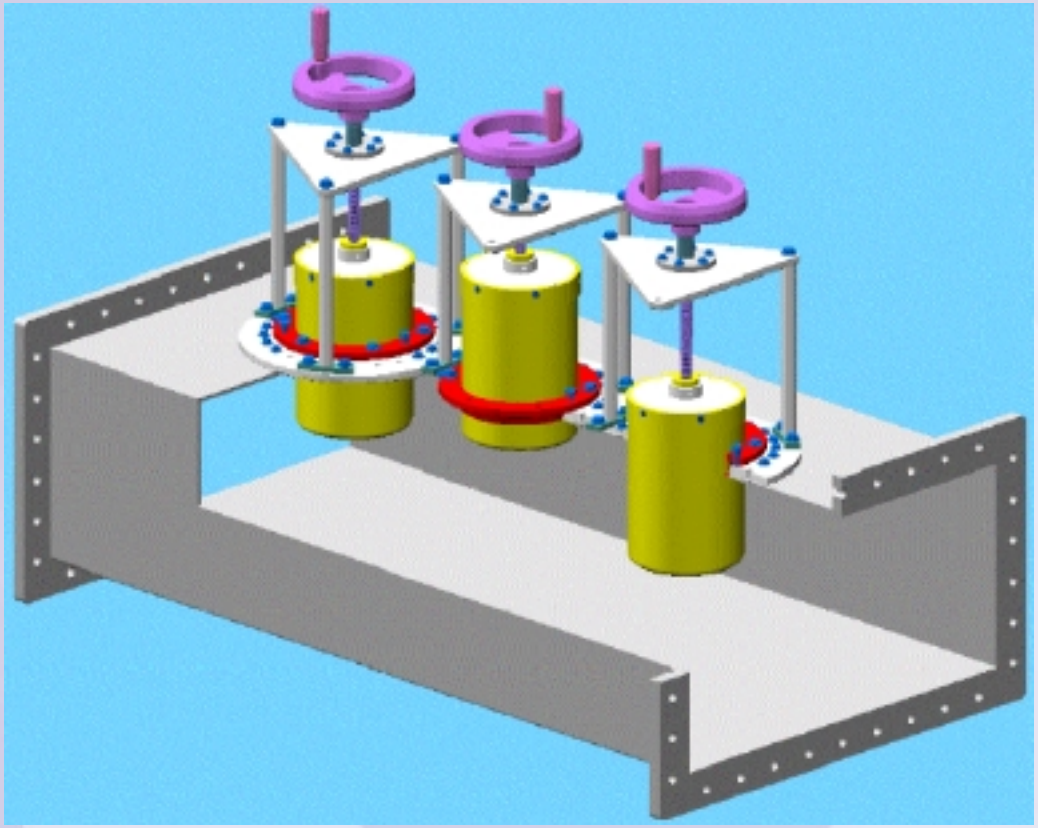




Use of three-stub tuner to match the cavity to the RF source

Matching has been achieved with a VSWR of up to 2.5.

These are currently in operation at Cornell and have been tested to 200 kW cw and 400 kW pulsed with a repetition rate of 2 Hz



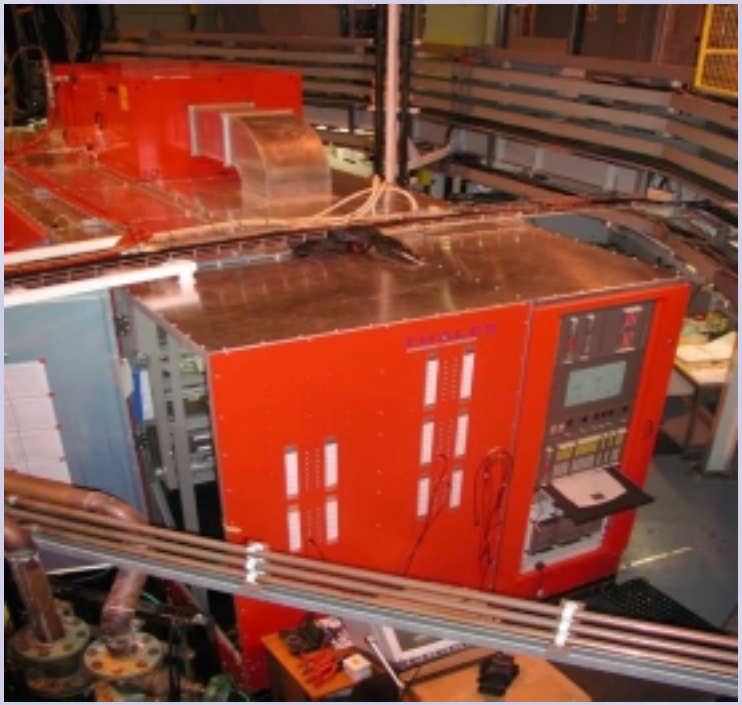
Amplifiers

Contract placed for three 300 kW turnkey RF amplifiers

Scope includes

- High Voltage Power Converters
- Filament and grid supplies
- IOTs
- EPICS Control system
- Combining system
- 300 kW circulator
- 300 kW load

High Voltage Power Converter and IOTs

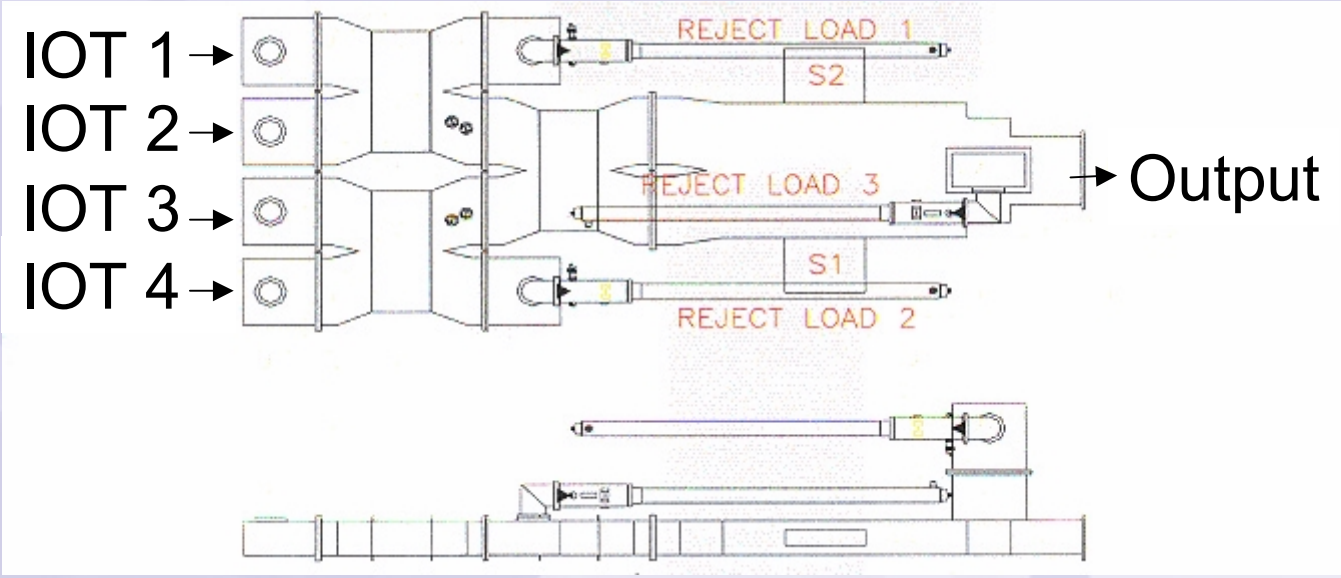


High Voltage Power Converter at SRS

IOT

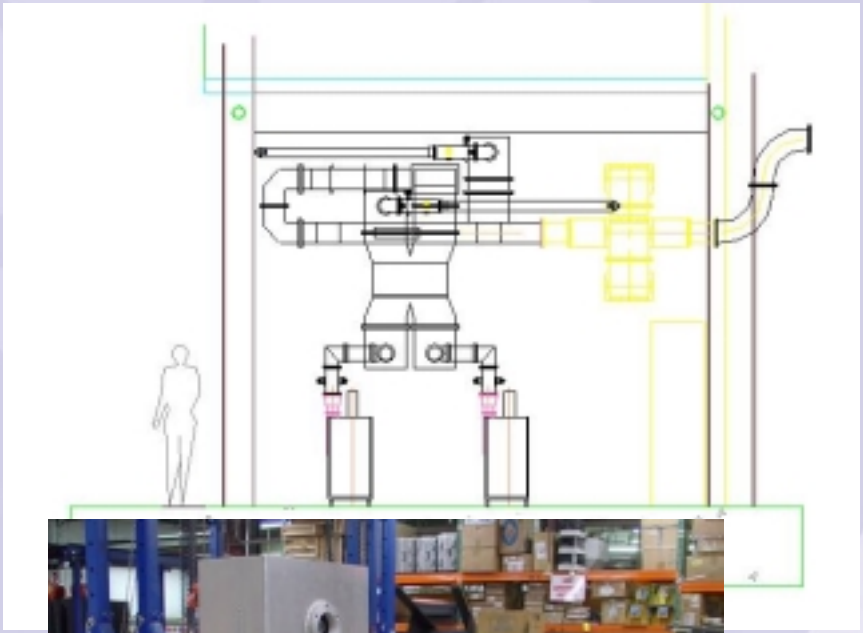
IOT in circuit

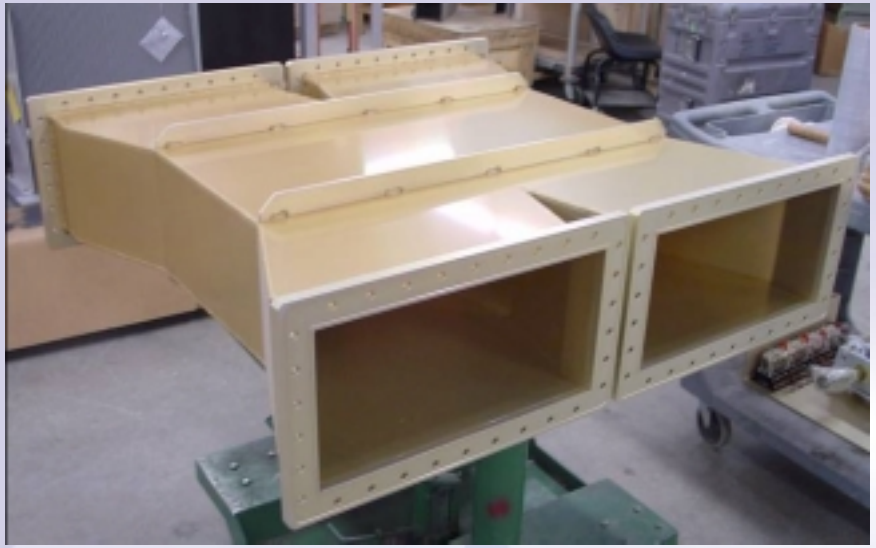
Power Combining



# of IOTs	Phase (deg)	Reject load power (kW)	Total output power (kW)
4	0	0	320
3	50	40	200
2 (pair)	90	0	160
1	90	40	40

Power Combining





Testing

Original

- Permanent installation of 300 kW Amplifier in dedicated test facility to provide High Power Test Lab
- Conditioning and test of each SC and booster cavities in test lab
- Final test in the storage ring

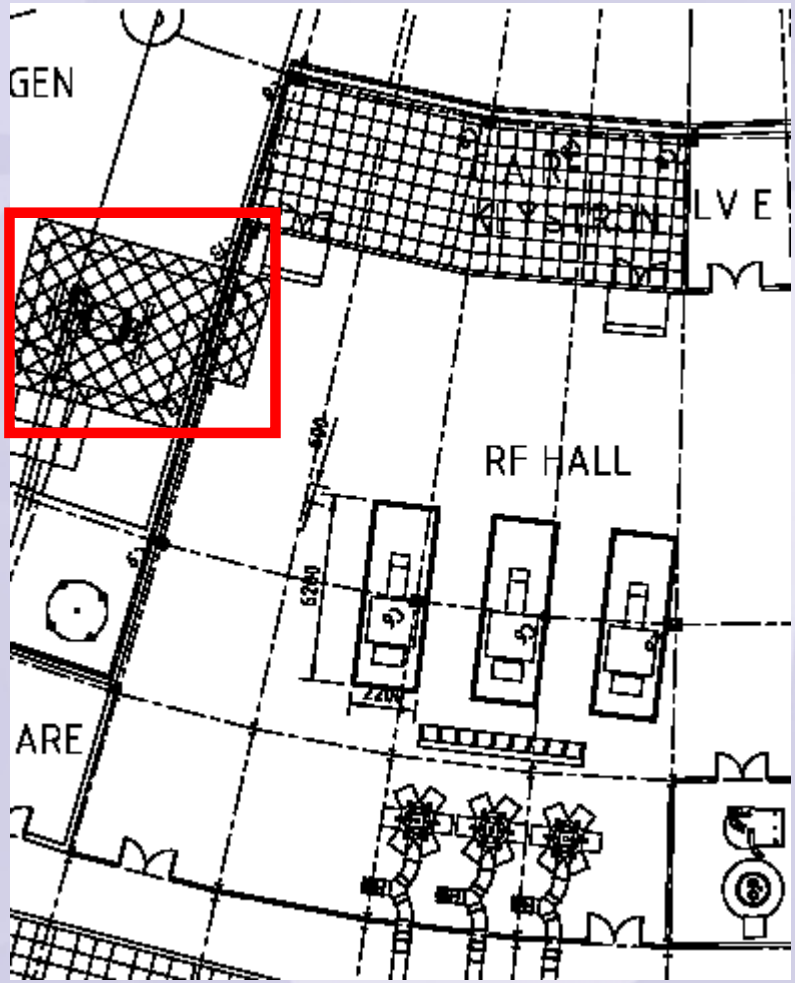
Latest

- Abandon High Power Test Lab and install in Storage Ring
- Reduced risk during transportation
- Reduced bottle neck in Test Lab
- ‘Save’ additional 300 kW amplifier

but

- Careful timing of installation and generation of Radiation Hazard

Future High Power Test Area?



What next?

Call for Tender for Cryogenic Fridge
Call for Tender for Waveguide
Design of Low Level RF system

Call for Tender for Booster Cavity
Call for Tender for Booster Amplifier