Storage Ring RF System

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Power Requirements

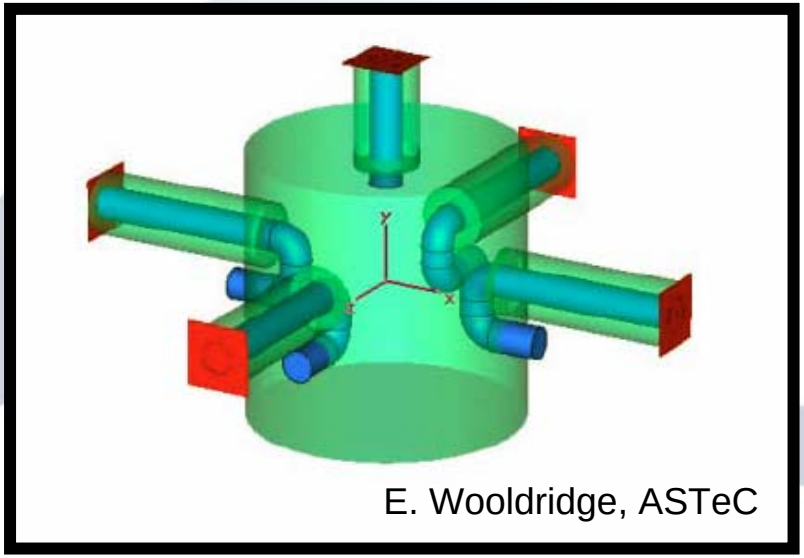
Beam current	400	mA
Bending losses	950	keV/turn
ID losses	300	keV/turn
Other losses	50	keV/turn
Total losses	1300	keV/turn
Beam power	**520**	**kW**
Energy Acceptance	**3**	**%**

Transmitter

- TWO power escenarios:
  - ~150 kW
  - ~300 kW
- THREE transmitter type escenarios
  - High Power Klystron
  - IOT combination
  - Solid State Amplifier

Transmitter

For the case of ~300 kW IOT combination, we want to produce a combiner cavity prototype:

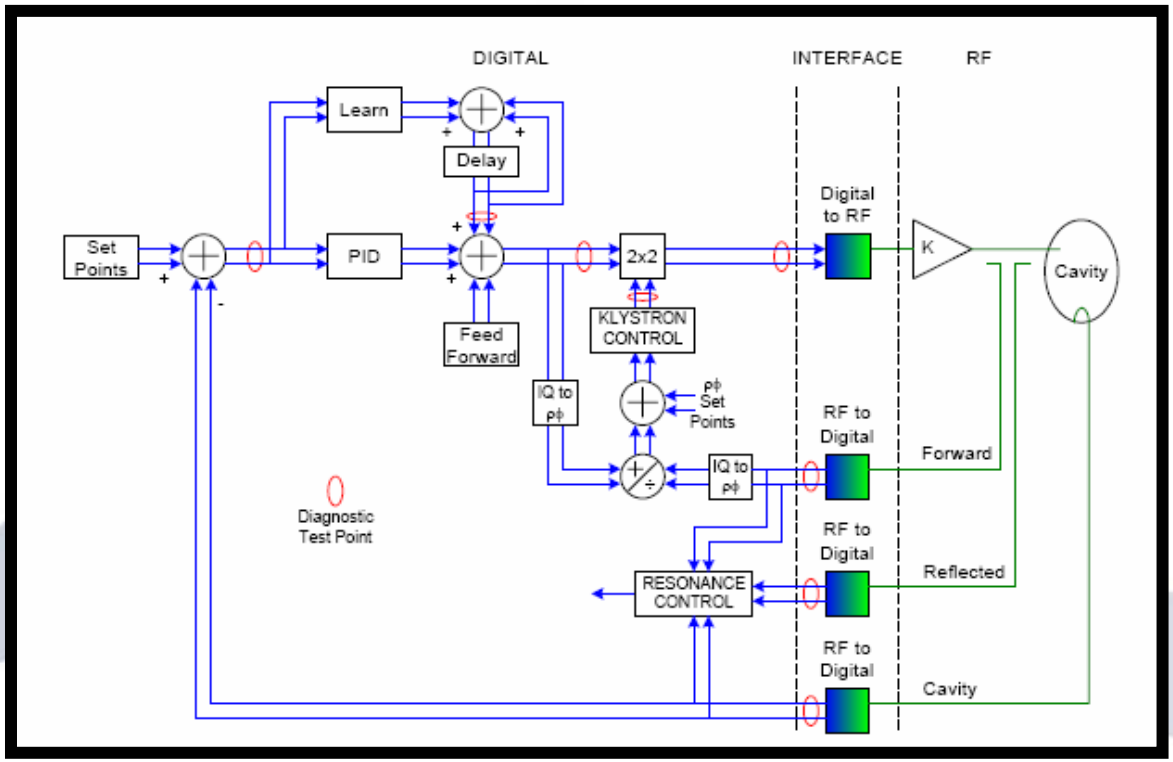


E. Wooldridge, ASTeC

Can also be used as a SSA combiner…

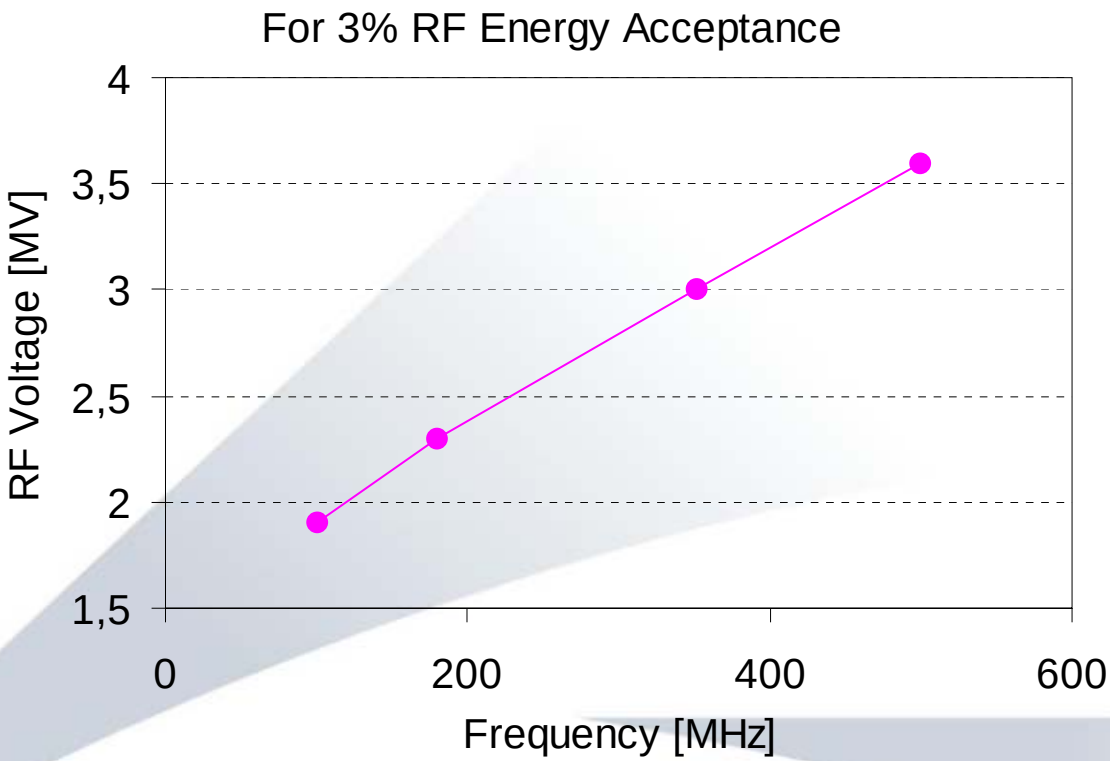
Low Level Electronics

- IQ (DE)MODULATION
  - Digital or analogue



A. Rohlev et al., CERN

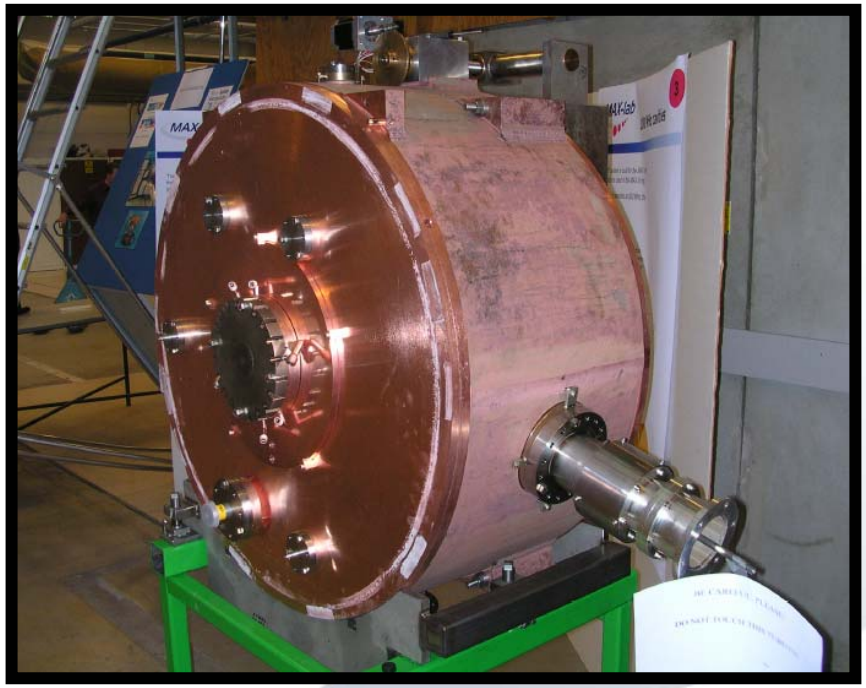
Voltage Requirements



Cavity

- NC 100 MHz MAXlab
- NC 180 MHz BNIP
- SC 352 MHz SOLEIL
- NC 500 MHz ELETTRA, UE, …
- SC 500 MHz CORNELL

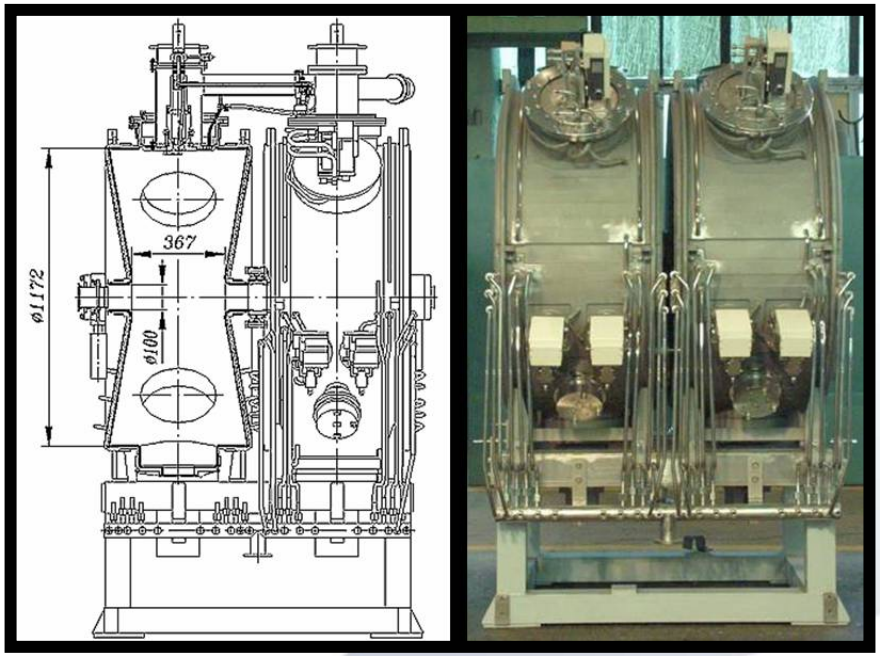
Cavity 100 MHz



Total Voltaje	2.0	MV
No Cells/IPC	10	
Type of cavity	nc	
Voltage / cell	200	kV
R_{shunt}	1,6	MΩ
Cavity power	12,5	kW
Beam power/cav	52	kW
IPC power	65	kW
Amplifier Power	80	kW
Total Power	800	kW

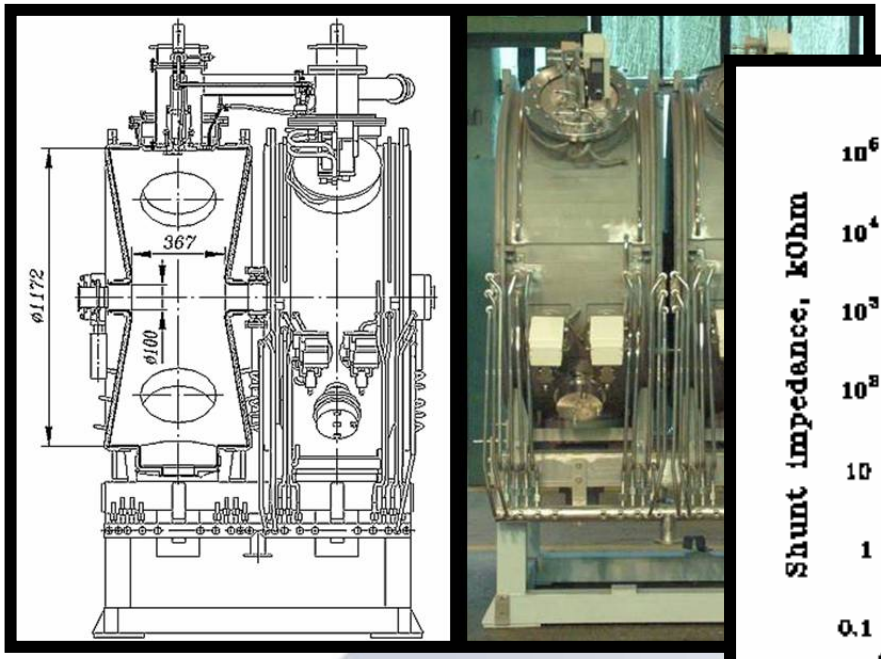
REJECTED : 10 ARE TOO MANY CAVITIES

Cavity 180 MHz



Total Voltaje	2.4	MV
No Cells/IPC	4	
Type of cavity	nc	
Voltage / cell	600	kV
R_{shunt}	4.3	MΩ
Cavity power	42	kW
Beam power/cav	130	kW
IPC power	172	kW
Amplifier Power	180	kW
Total Power	720	kW

Cavity 180 MHz



HOMs

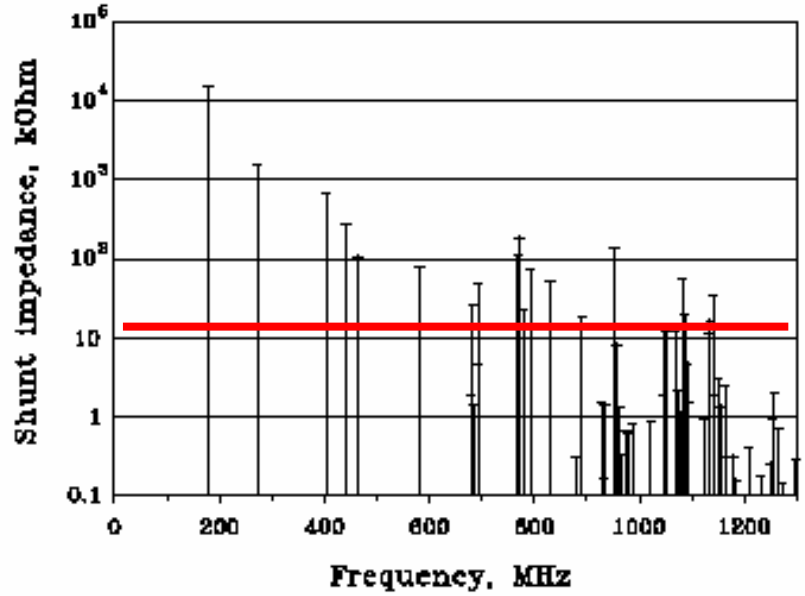
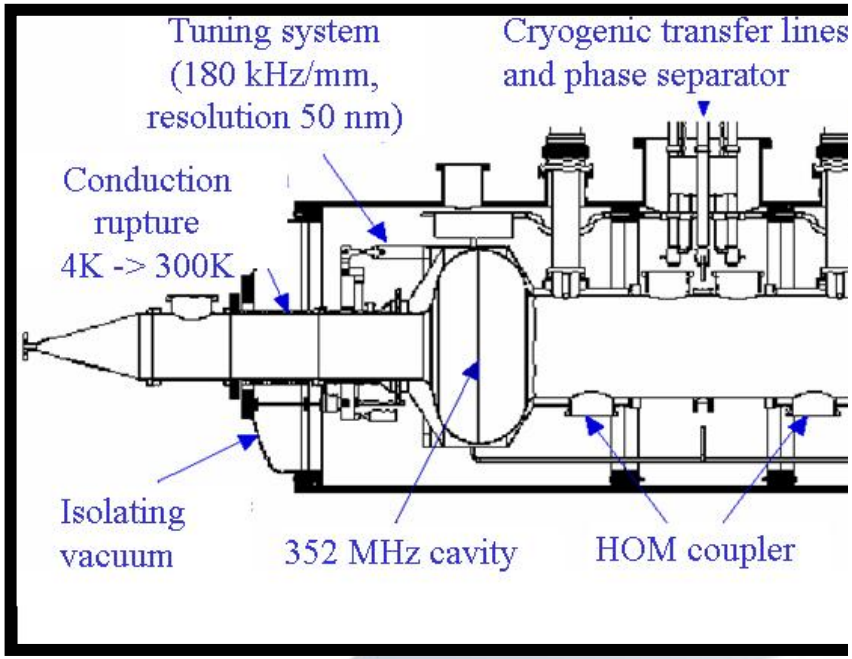


Figure 2: *Modes of a VEPP-4 cavity.*

REJECTED : TOO MANY HOMs

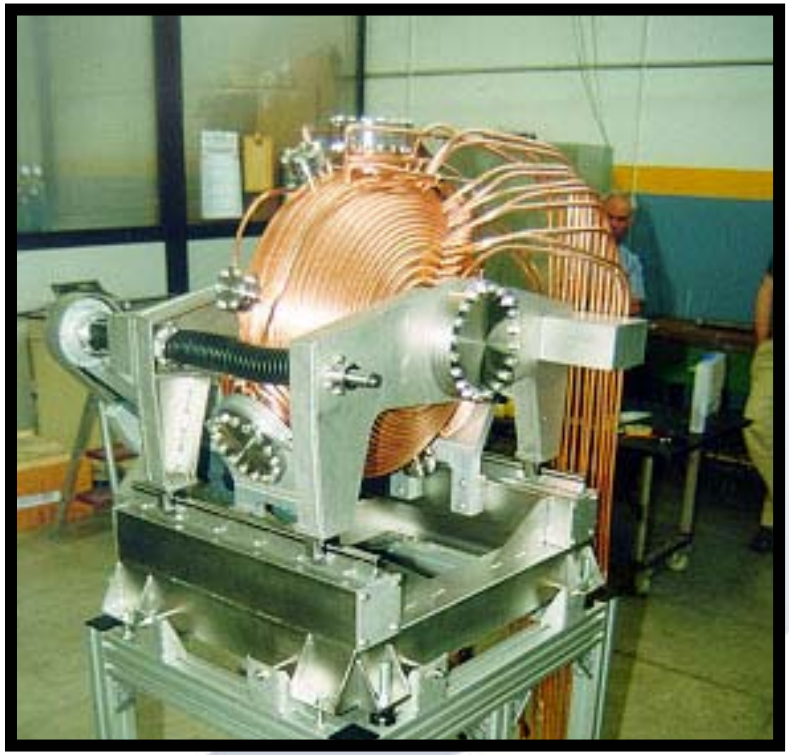
Cavity 352 MHz



Total Voltaje	3.0		MV
No Cells/IPC	2	4	
Type of cavity	sc		
Voltage / cell	1500	750	kV
R_{shunt}	4500		MΩ
Cavity power	0	0	kW
Beam power/cav	260	130	kW
IPC power	260	130	kW
Amplifier Power	300	150	kW
Total Power	600	600	kW

ON STANDBY : ONE modul is too less and TWO too much …

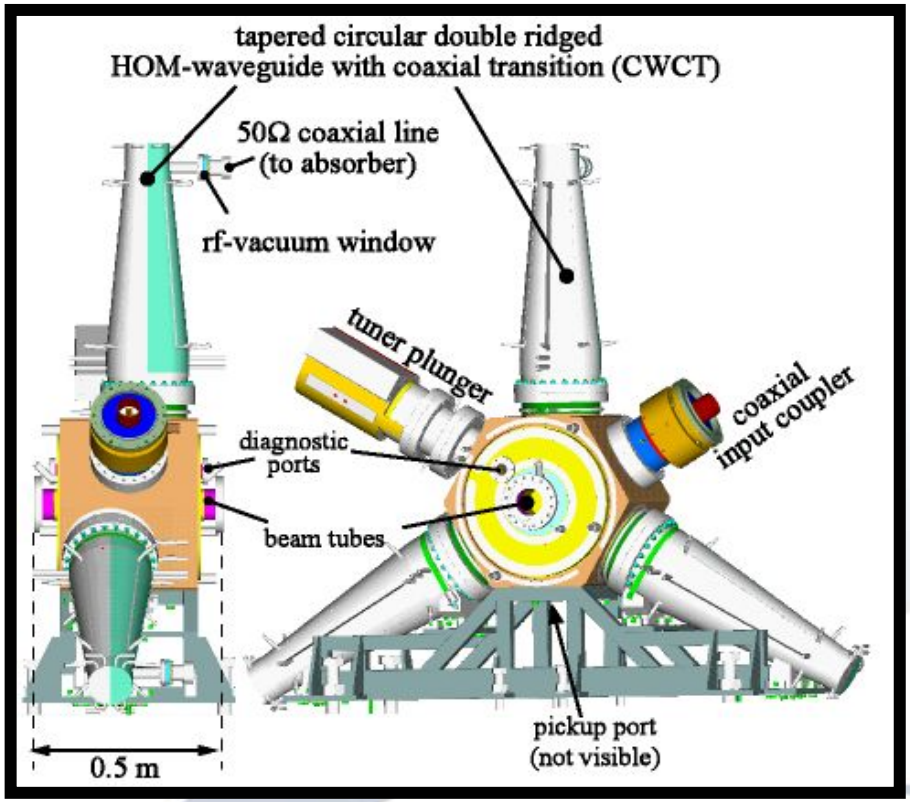
Cavity 500 MHz (1)



Total Voltaje	3.6	MV
No Cells/IPC	6	
Type of cavity	nc	
Voltage / cell	600	kV
R_{shunt}	3.4	MΩ
Cavity power	53	kW
Beam power/cav	87	kW
IPC power	140	kW
Amplifier Power	160	kW
Total Power	960	kW

1st OPTION

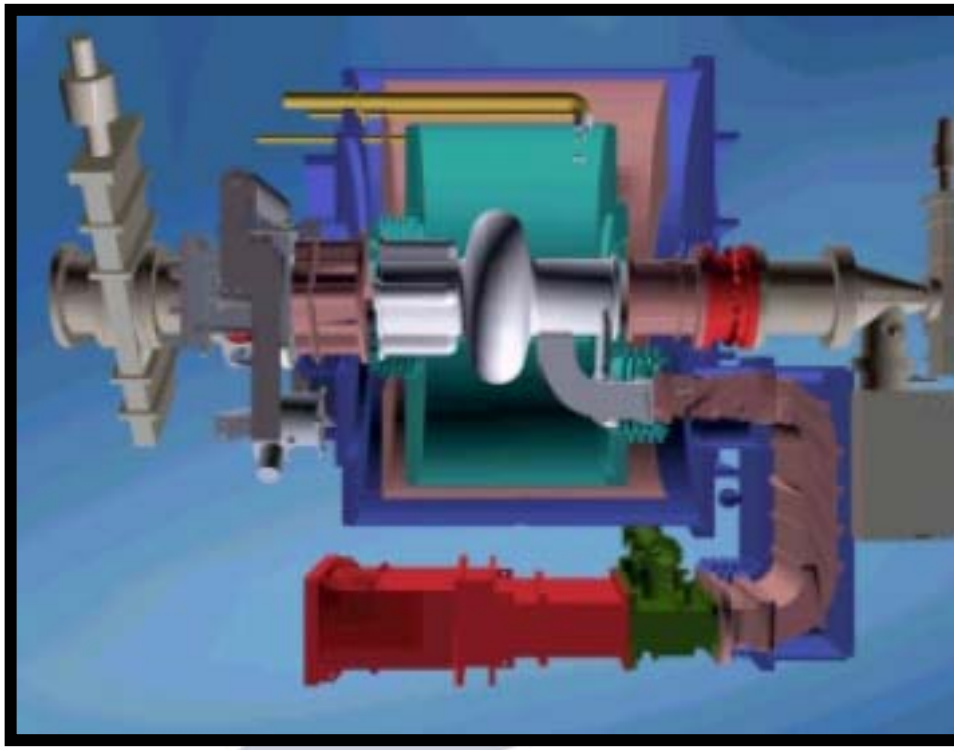
Cavity 500 MHz (2)



Total Voltaje	3.6	MV
No Cells/IPC	6	
Type of cavity	nc	
Voltage / cell	600	kV
R_{shunt}	3.0	MΩ
Cavity power	60	kW
Beam power/cav	87	kW
IPC power	147	kW
Amplifier Power	160	kW
Total Power	960	kW

2nd OPTION

Cavity 500 MHz (3)



Total Voltaje	3.6	MV
No Cells/IPC	2	
Type of cavity	sc	
Voltage / cell	1800	kV
R_{shunt}	4500	MΩ
Cavity power	0	kW
Beam power/cav	260	kW
IPC power	260	kW
Amplifier Power	300	kW
Total Power	600	kW

3rd OPTION

Cavity Comparison

	(1) ELETTRA	(2) EU	(3) CORNELL
DC POWER	2.5 MW	2.6 MW	2.1 MW
WATER COOLING	220 m^3/h	230 m^3/h	140 m^3/h
	Cavity Wall Dissipation	Cavity Wall Dissipation	Refrigerator

Cavity Comparison

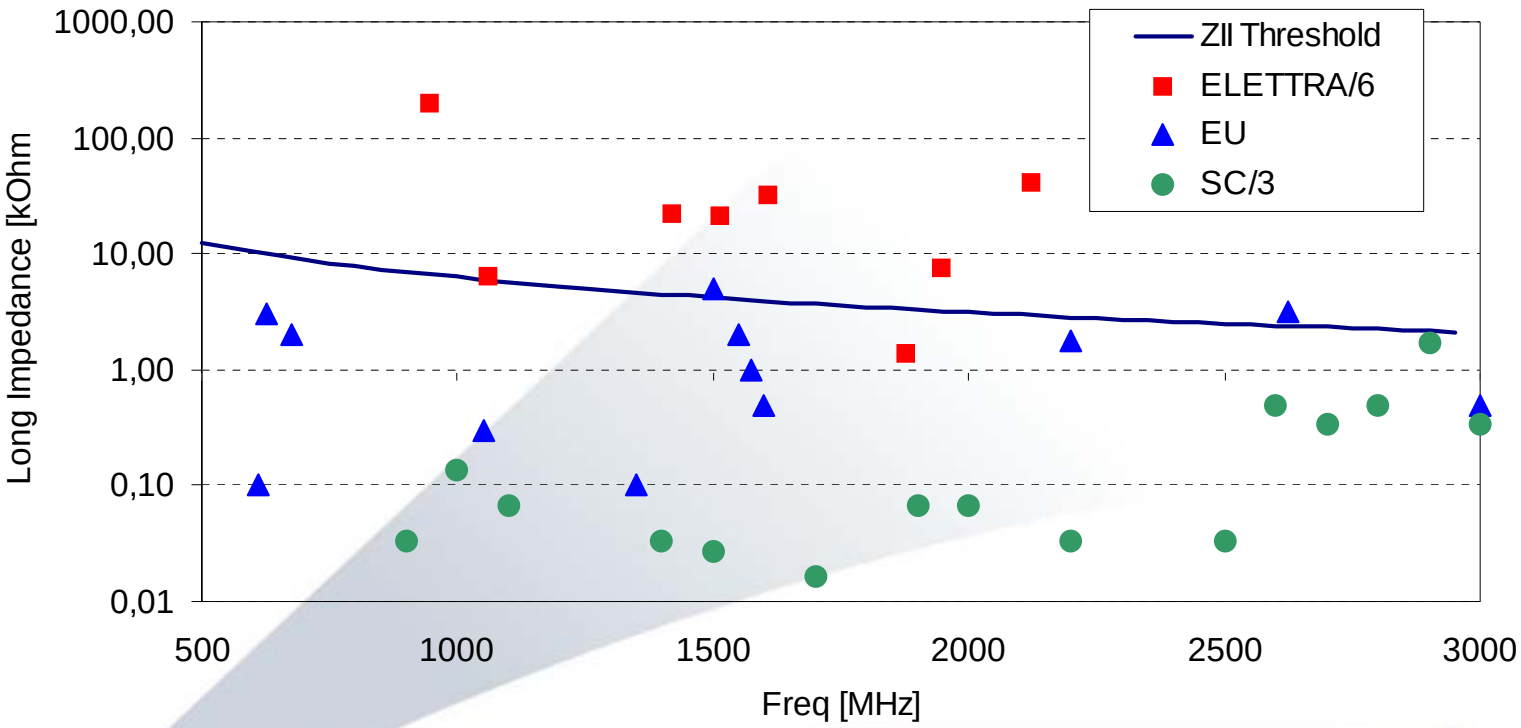
	(1) ELETTRA	(2) EU	(3) CORNELL
SPACE	2 x 2.9 m	2 x 2.9 m	2 x 3.3 m
	3 cavities in one 4 m straight	3 cavities in one 4 m straight	1 cavity in one 4 m straight
COST ESTIMATION	9.3 M€	9.9 M€	10.6 M€
	6 x 1.55 M€	6 x 1.65 M€	2 x 5.1 M€

Cavity Comparison

RUNNING COST DIFFERENCES	(1) ELETTRA	(2) EU	(3) CORNELL
INVESTMENT	-	600 k€	1300 k€
DC POWER	400 kW	500 kW	-
RUNNING (10y) (6000 h/year)	2400 k€	3000 k€	-
MAN POWER (10y) (1.5 man/year)	-	-	900 k€
OVER 10 YEARS	+300 k€	+900 k€	-

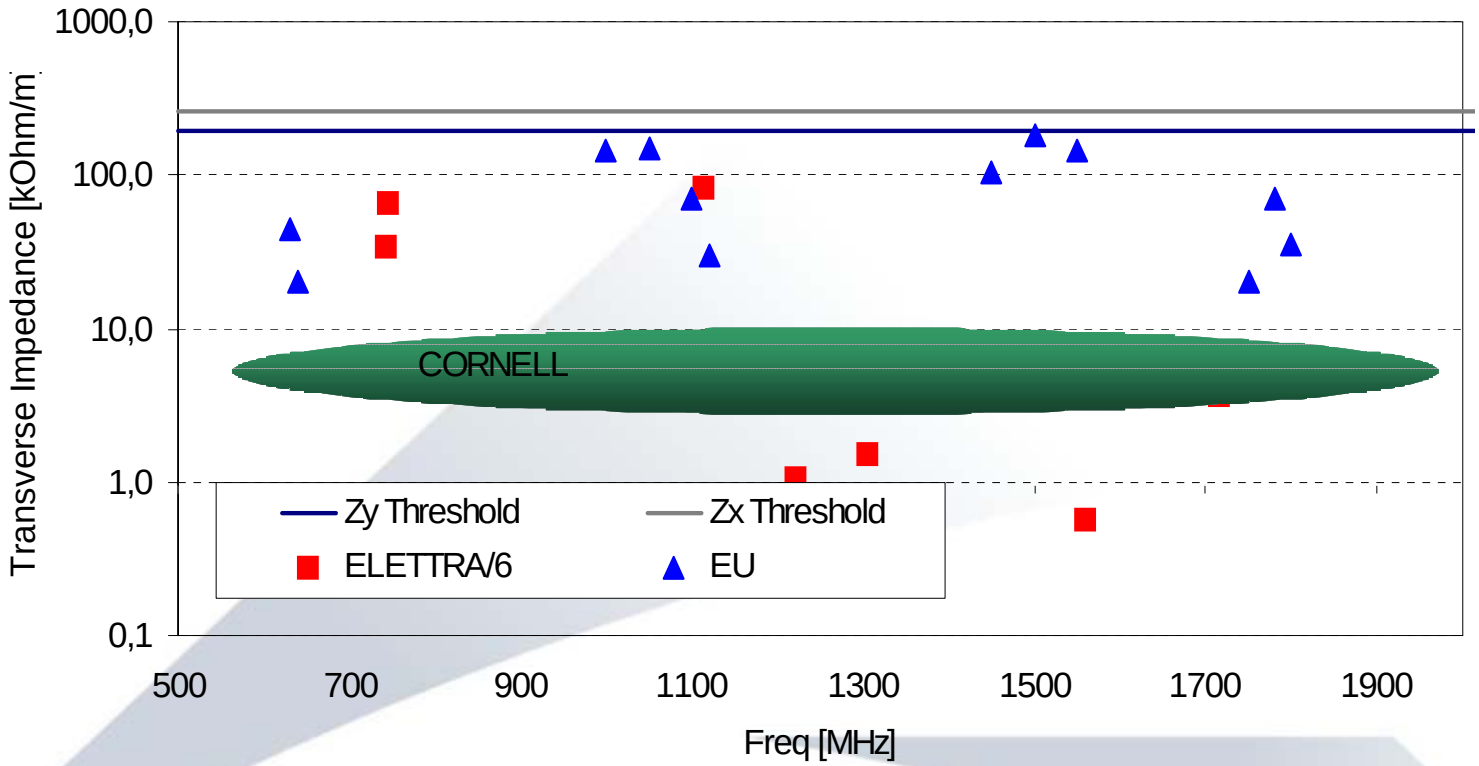
SPACE, SERVICES and COST are NOT DECISION FACTORS

Comparison: Longitudinal HOMs



Stability threshold for 400 mA

Comparison: Transverse HOMs



Stability threshold for 400 mA

HOMs comparison

(1) NC ELETTRA

Needs: SC 3rd Harmonic Cavity
Transverse Feedback

(2) NC UE

Needs: SC 3rd Harmonic Cavity

(3) SC CORNELL

Needs: None

Other Considerations

3rd Harmonic Cavity is interesting for the 3 cases to increase the Touschek lifetime

Transverse Feedback will be needed for broadband impedance instabilities in any case, but for the SC option will be simpler

SC option allows larger voltages (larger energy acceptance)

Reliability of the SC systems has to be considered

CONCLUSION