Wolfgang Anders, BESSY

HOBICAT = Horizontal Bi-Cavity Testfacility

- BESSY FEL Project
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- SC TESLA Cavities
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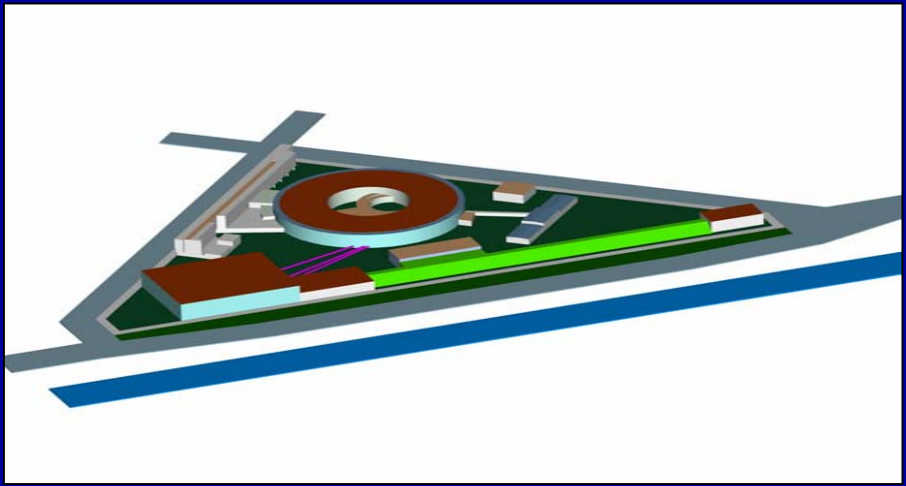
- HOBICAT RF Transmitter
- HOBICAT Test Program

BESSY FEL Project



FEL Linac Parameter

•electron energy:	2.25 GeV
•photon energy:	20 eV ... 1 keV
•pulse length:	200 fs
•bunch charge:	1 nC
•rep. rate (start):	1 kHz
•bunch train:	25 bunches
•rep.rate (final):	625 kHz/1.25 MHz

RF Parameter

frequency:	1300 MHz
accellerator gradient:	15 MV/m
operating mode:	cw
length of cavity:	1.04 m
number of cavities:	144
number of transmitters:	144
number of cryostats:	18
cavities per cryostat:	8
total energy:	2.25 GeV

parameters under evaluation	
operating temperature:	1.8 K
loaded Q value:	7E7
unloaded Q value at 2 K:	1E10
total cryogenic losses:	3.3kW@1.8K
pressure stability of LHe:	0.1 mbar
power of transmitter:	8 kW cw
type of transmitter:	IOT or solid state

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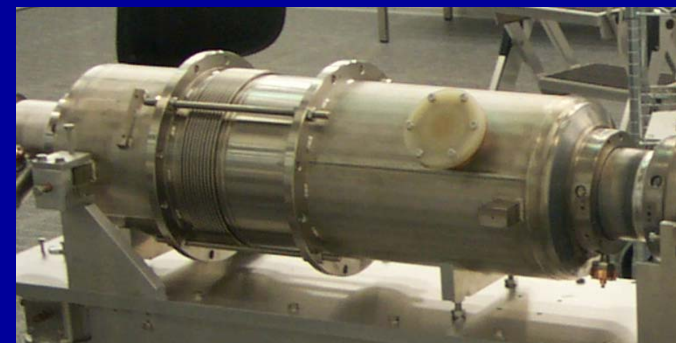
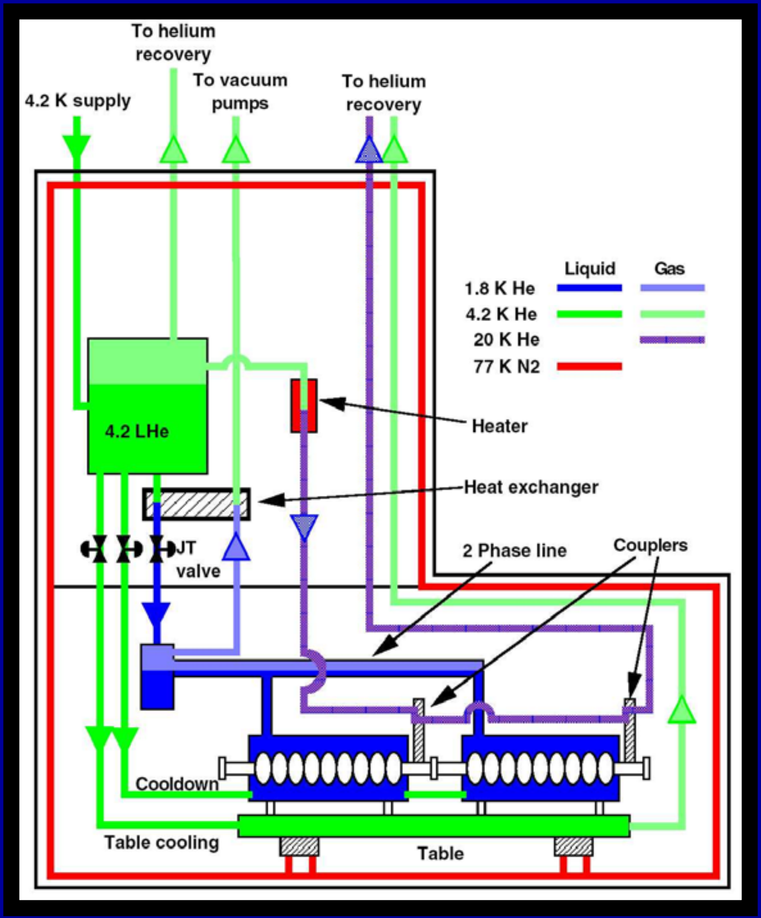
SC TESLA Cavities

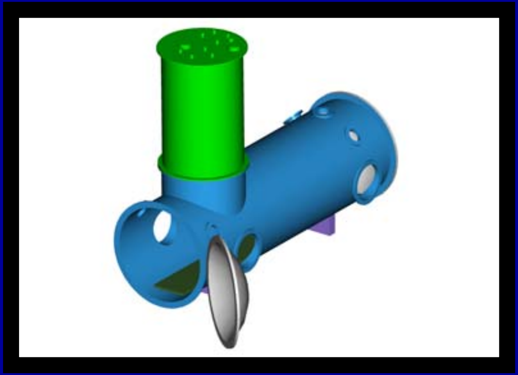


Differences to TESLA

Parameter	TESLA	BESSY FEL	Unit
operation mode	pulsed 5/10 Hz	cw	
acceleration field gradient	23.4	15	MV/m
cryogenic loads per cavity	0.8	24	W
beam current	in pulse 7.8	0.025	mA
beam loading per cavity	190 000	390	W
Q_{ext} of input coupler	$2.5\ 10^6$	$6.5\ 10^7$	
Q_{ext} dominated by	beam	microphonics	
bandwidth of cavity	520	20	Hz FWHM

HOBICAT Test Cryostat





Parameter	Value	Unit
Mechanical parameters		
Useable interior length	3,50	m
Number of TESLA cavities	2	
Useable interior diameter	1,10	m
Total height	3,2	m
Main cooling loop		
Temperature	1,8	K
Cooling capacity	80	W
Mass flow	4	g/s
Temperatures of the secondary loops		
Table cooling loop	4,5	K
Cavity fill loop	4,5	K
Coupler cooling	20	K
Heat shield	77	K
Vacuum pumps		
Suction pressure	14	mbar
Pumping speed	6400	m^3/h
Mains power	110	kW
RF Power Source		
Frequency	1300	MHz
Power	8	kW
Operating mode	cw	

klystron ⇔ IOT ⇔ solid state amplifier			
parameter	klystron	IOT	solid state
operation mode	class A	class B	class B
efficiency full power	50%	65%	30%
efficiency noisy power	**12%**	**65%**	**30%**
case of failure	total switch off	total switch off	reduced power
power supply	15 kV	22 kV	33 V
price at 8 kW cw	slightly lower	slightly lower	slightly higher
lifetime	30 000 h	30 000 h	slow death
price for replacement	same	same	same

HOBICAT

RF Transmitter

Solid State Amplifier

- frequency: 1300 MHz
- power: 1 kW cw
- status: in house

Tube Amplifier

- frequency: 1300 MHz
- power: 8 kW cw
- tube: IOT or klystron
- status: call for tender for the tube soon
- transmitter: will be build in house

HOBICAT Test Program

- CW operation and RF control of TESLA cavities at high loaded *Q*
- Causes and impact of microphonics
- Methods to reduce microphonics
- Increase pressure stability of the helium bath
- Fast piezo tuning to diminish the impact of microphonics
- Determination of the optimal input-coupling strength for the BESSY FEL cavities
- Stable cryogenic operation of TESLA cavities with high CW dynamic losses
- CW operation of the input coupler at high average power
- Determination of the optimal cavity bath temperature