

# Present status of the Rossendorf Superconducting RF Photo injector development

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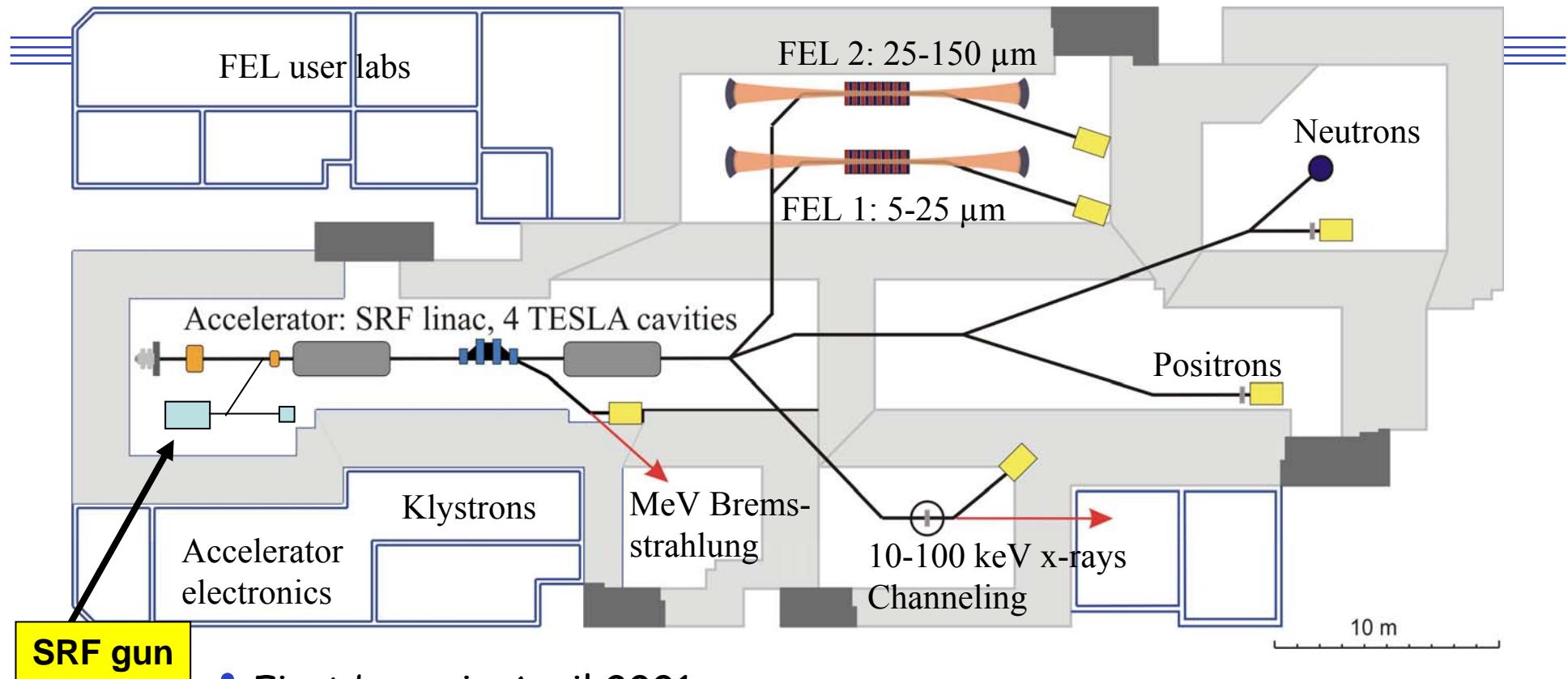
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Radiation Source ELBE  
J. Teichert

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# The radiation source ELBE – 40 MeV, 1 mA, cw linac



- First beam in April 2001
- Nuclear physics experiments are running since January 2002
- Channeling radiation since September 2003
- FEL 1 since May 2004
- FEL 2, neutron & positron beamlines planned for 2006



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# Rossendorf SRF Photo Gun Parameters

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## Normal-conducting cathode inside SC cavity

Cavity:	Niobium 3+½ cell (TESLA Geometry) Choke filter
Operation:	T = 1.8 K
HF frequency:	1.3 GHz
HF power:	10 kW
Electron energy:	9.5 MeV
Average current:	1 mA
Cathode:	Cs <sub>2</sub> Te thermally insulated, LN <sub>2</sub> cooled
Laser:	262 nm, 1W

# Rossendorf SRF Photo Gun Parameters

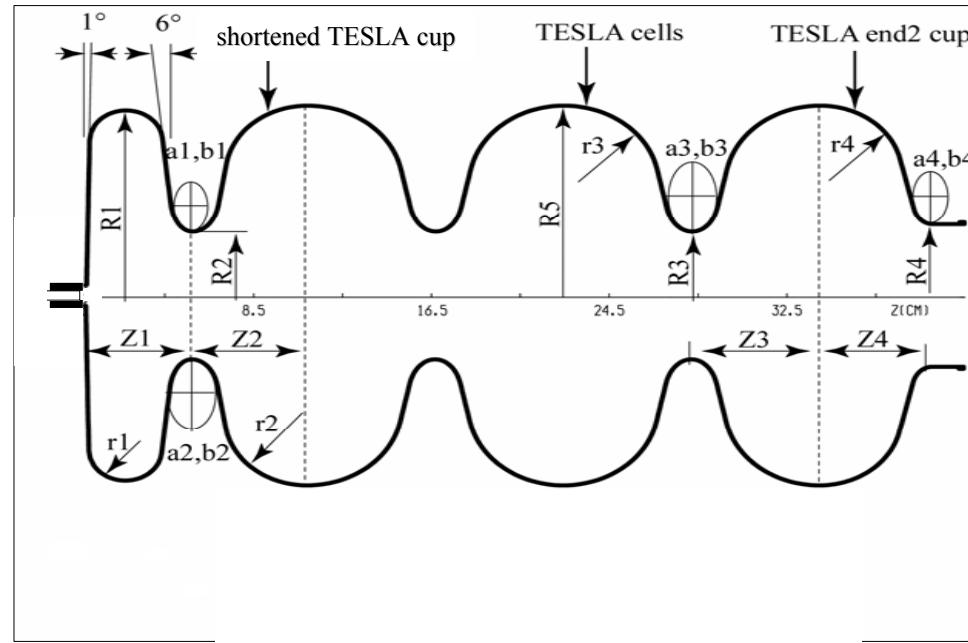
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## Planned Operation Modes and Beam Parameters

	ELBE	High Charge	BESSY-FEL
Pulse Frequency	13 MHz	$\leq$ 1 MHz	1 kHz
Bunch Charge	77 pC	1 nC	2.5 nC
Bunch Length (FWHM)	5 ps	20 ps	50 ps
Peak Current	15.4 A	50 A	125 A
Average Current	1.0 mA	$\leq$ 1 mA	2.5 $\mu$ A
Norm trans. Emittance <sub>N</sub> (rms)	1.5 $\mu$ m	2.5 $\mu$ m	3 $\mu$ m

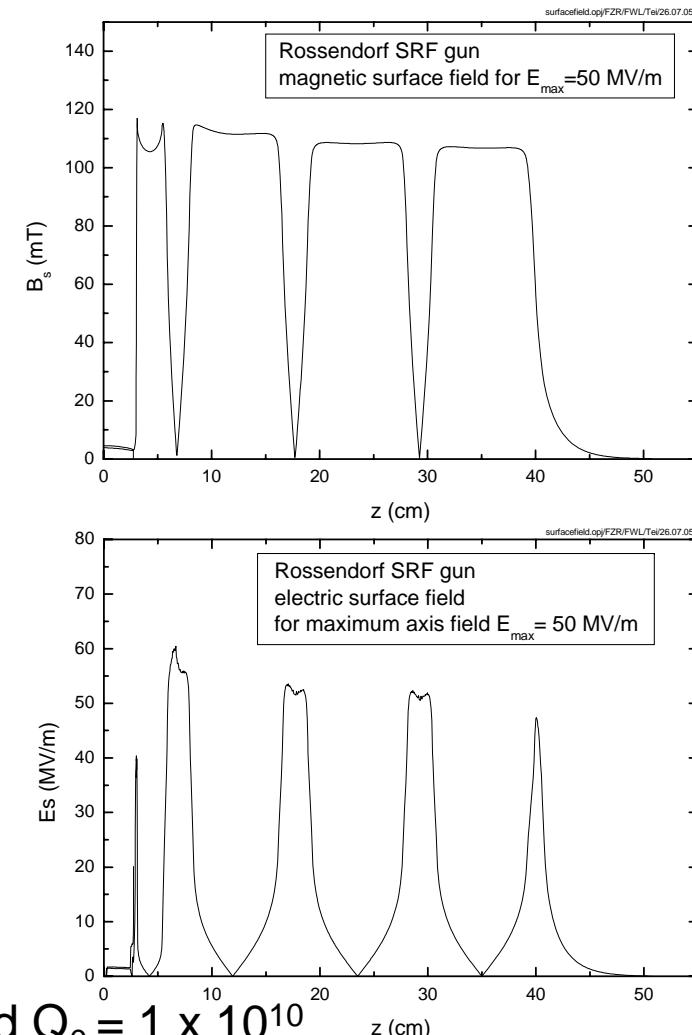


# Rossendorf SRF Photogun – 3 ½ Cell Cavity Design



1. 3 GHz, 10 kW  
optimized half cell & 3 TESLA cells  
 $E_{z,\max} = 50 \text{ MV/m}$  (TESLA cells)  
 $= 32 \text{ MV/m}$  (1/2 cell)

TESLA 500 specification, i.e.  $E_{acc} = 25 \text{ MV/m}$  and  $Q_0 = 1 \times 10^{10}$



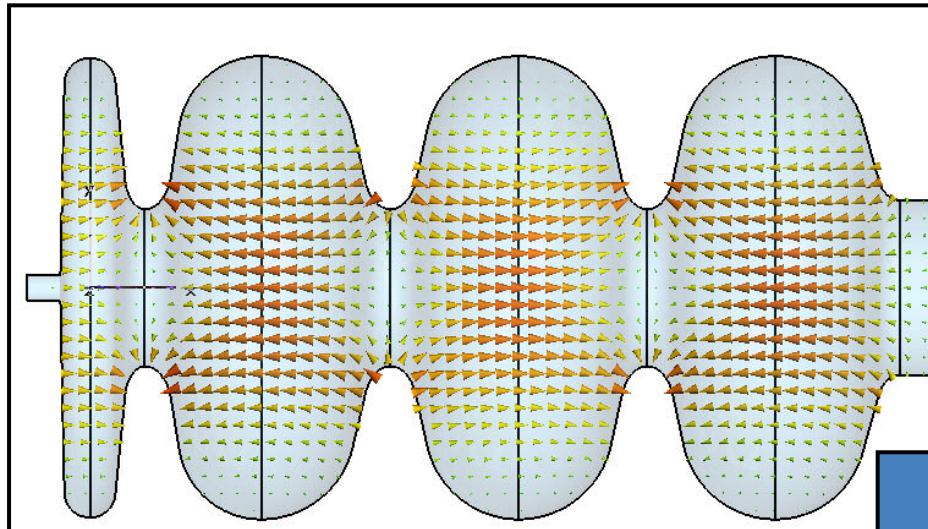
# Rossendorf SRF Gun - 3½ Cell Niobium Cavity

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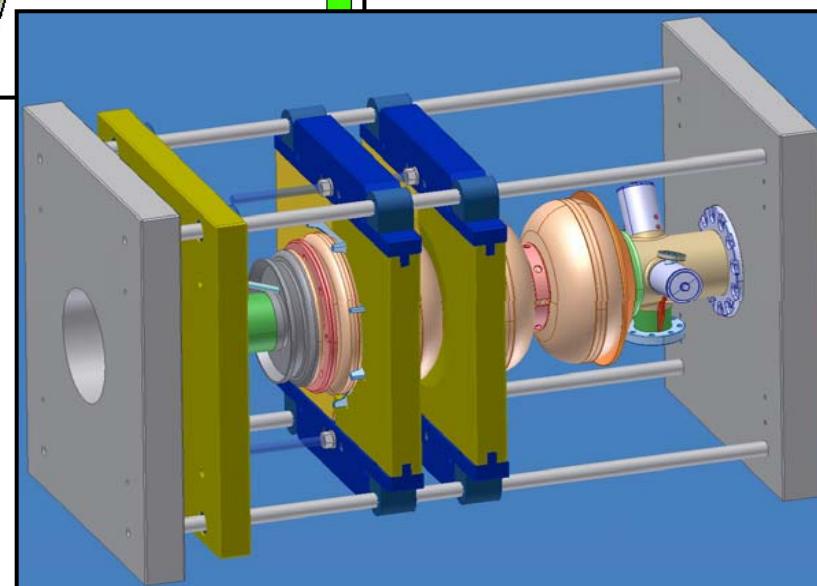
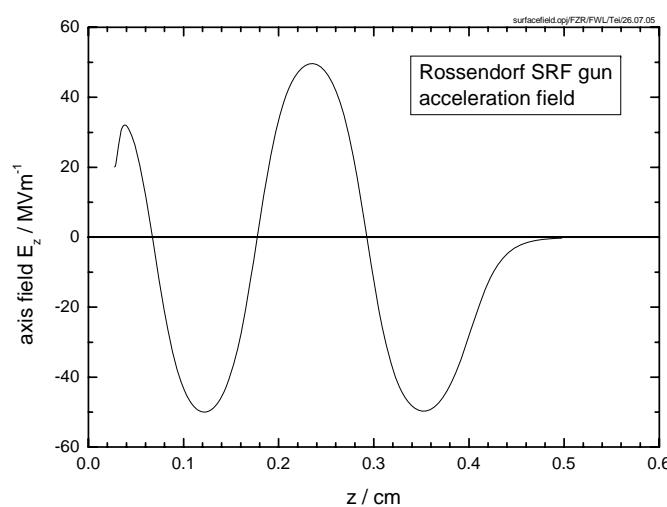
Niobium RRR 300 (RRR 40)  
total length:  
cell diameter:  
NbTi flanges  
3 TESLA shape cells  
cathode half-cell with 12 mm hole  
beam tube:  
flange for 10 kW power coupler  
2 HOM couplers (TESLA type)  
1 pick-up  
cathode side:  
choke filter with pick-up  
two tuners:  
half-cell tuner  
TESLA cells tuner



# Rossendorf SRF Gun – Cavity warm tuning

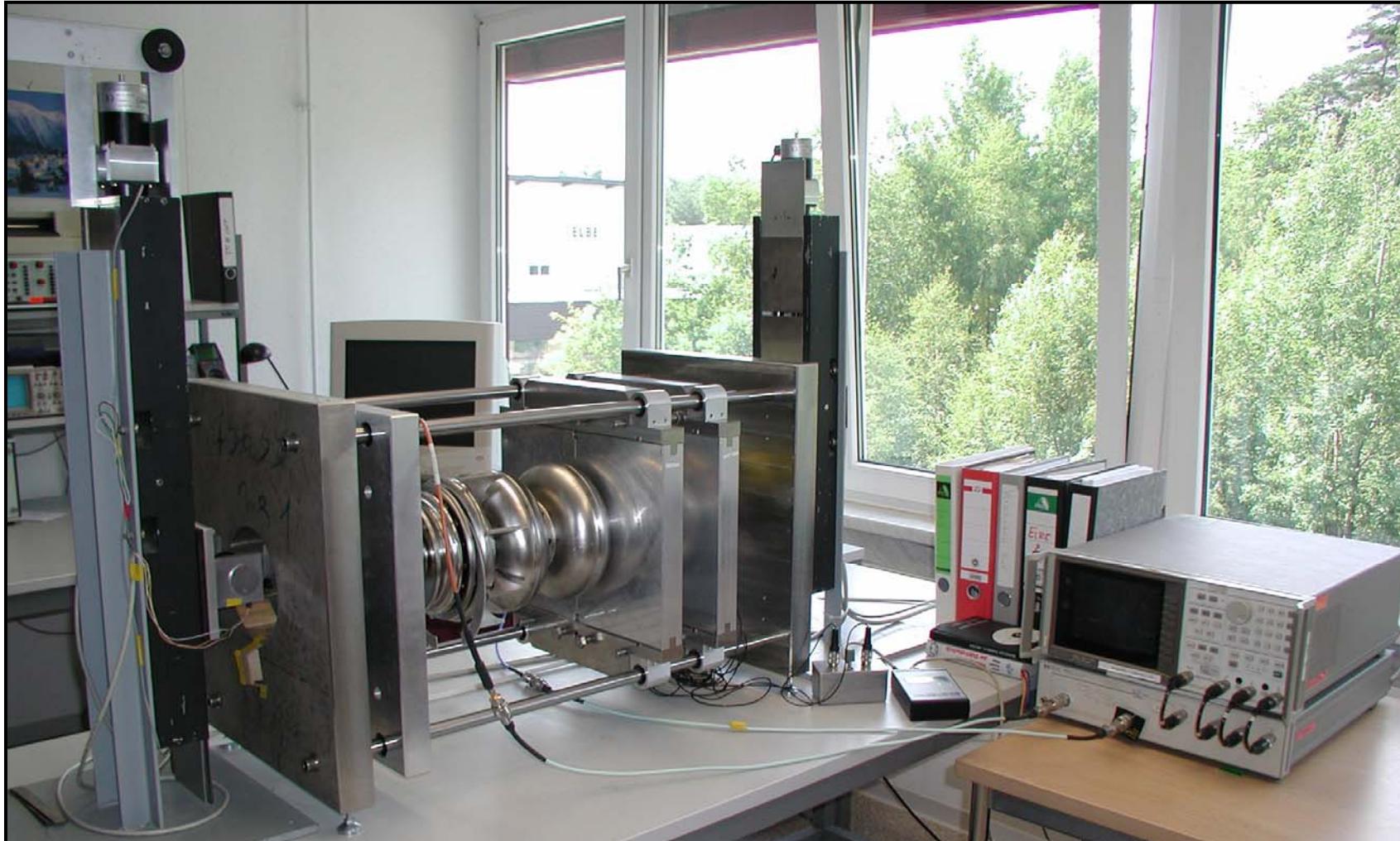


for “field flatness” tuning  
a bead-pull machine and  
a warm tuning apparatus was built



# Rossendorf SRF Gun – Cavity warm tuning

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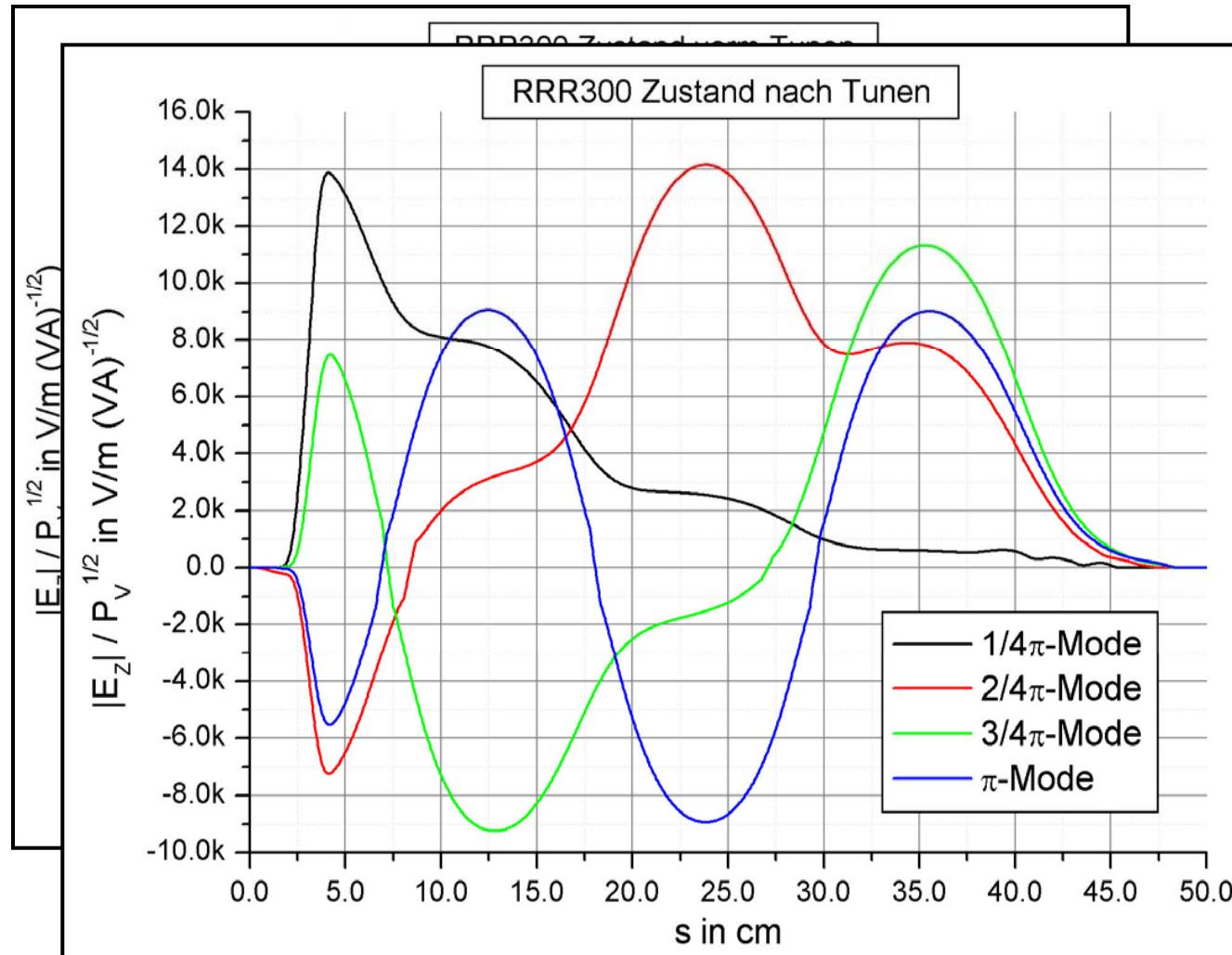
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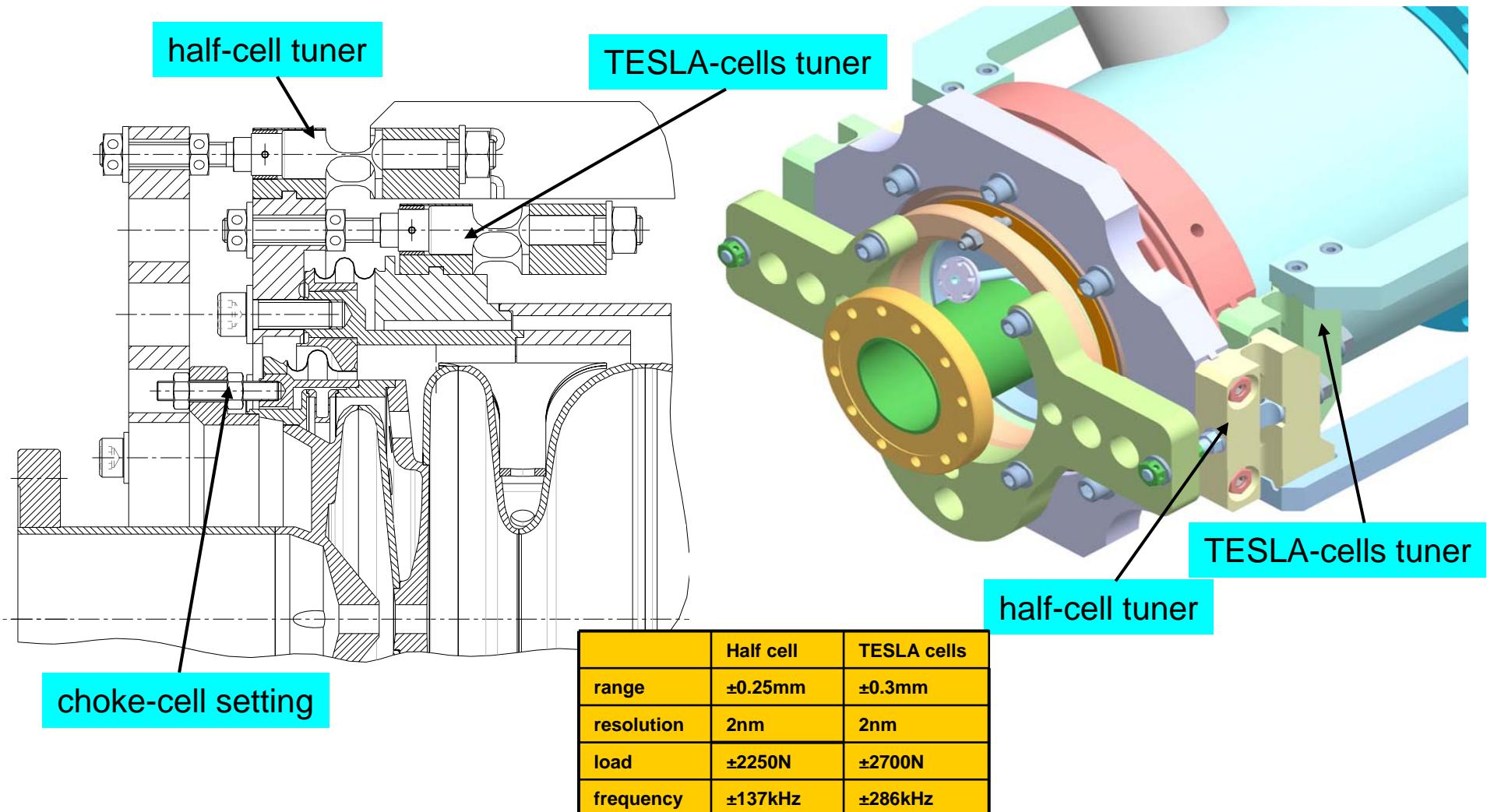
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# Rossendorf SRF Gun – Cavity warm tuning



# Rossendorf 3½ Cell SRF Gun - Tuning System



# Rossendorf 3½ Cell SRF Gun - Tuning System

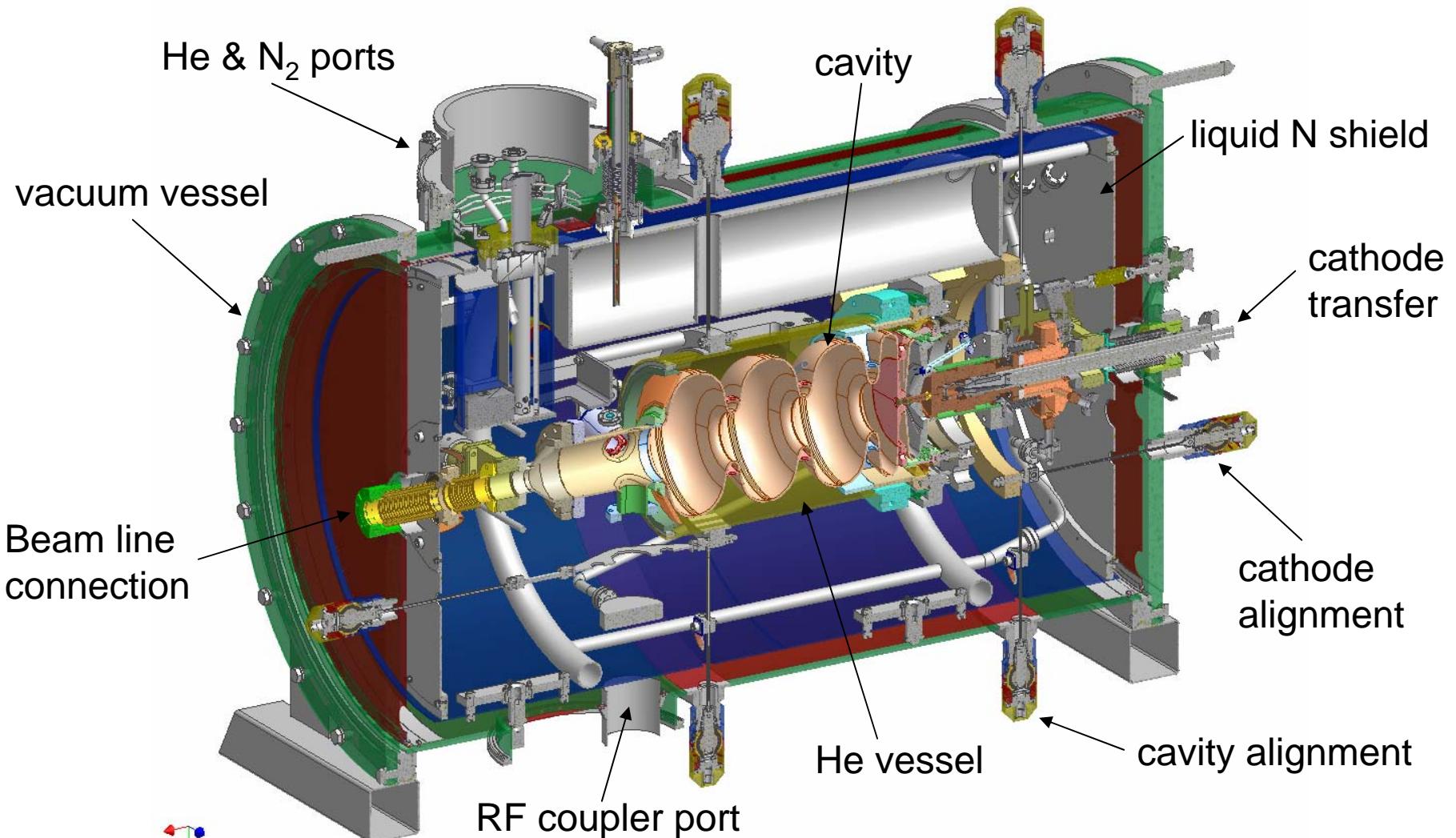
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Tuner test bench  
Operation at cryogenic temperature (liquid N<sub>2</sub>)  
Cavity is simulated by a spring



# Rossendorf 3½ Cell SRF Gun – Cryomodule design

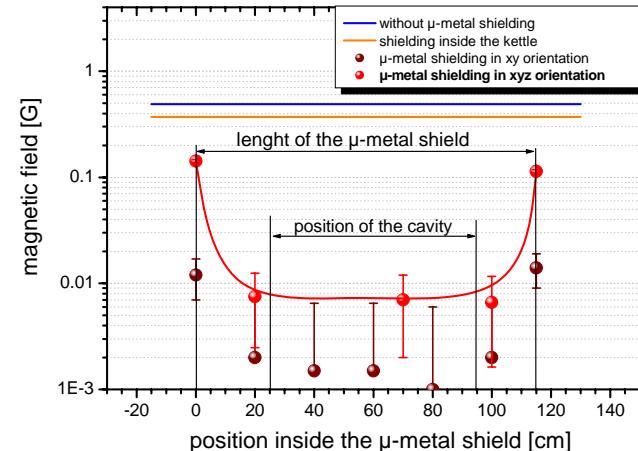


# Rossendorf 3½ Cell SRF Gun – Cryomodule

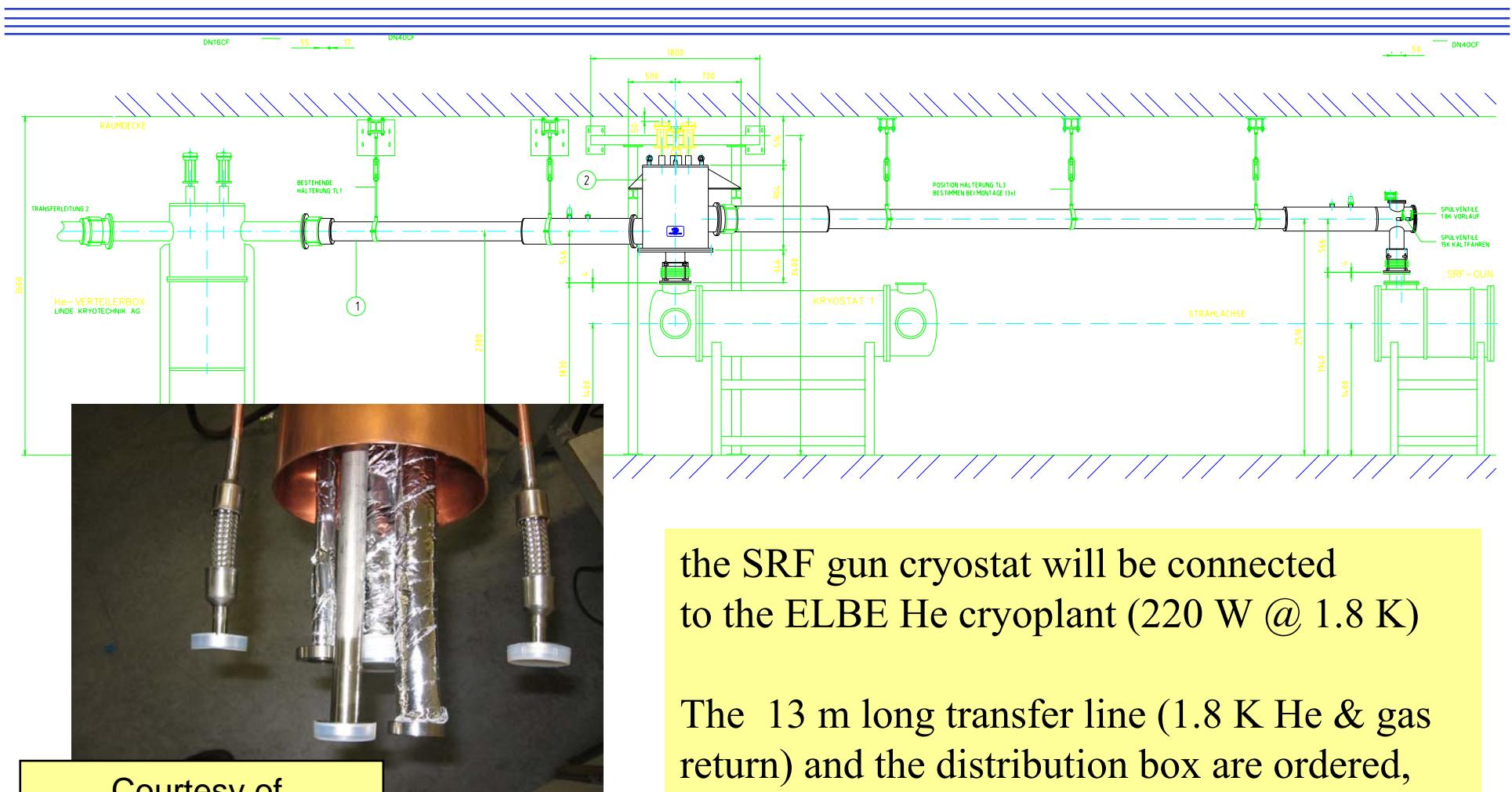


Main parts have been delivered:

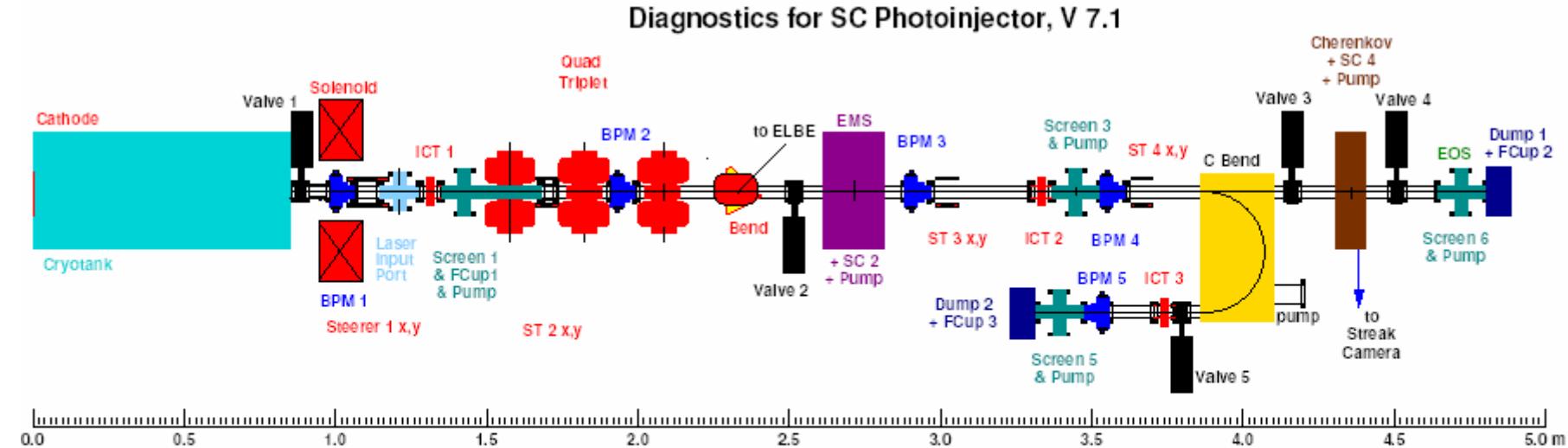
- vacuum vessel
- magnetic shield
- liquid N<sub>2</sub> shield



# Helium Transfer Line and Distribution Box



# Rossendorf 3½ Cell SRF Gun – Diagnostic Beamline



Current: Faraday cups & ICTs  
Energy & energy spread: C bent magnet  
Transverse emittance: slit mask  
Bunch length: Cherenkov radiator + streak camera  
electro-optical sampling

Courtesy of  
Dirk Lipka, BESSY



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