TESLA SRF Modules

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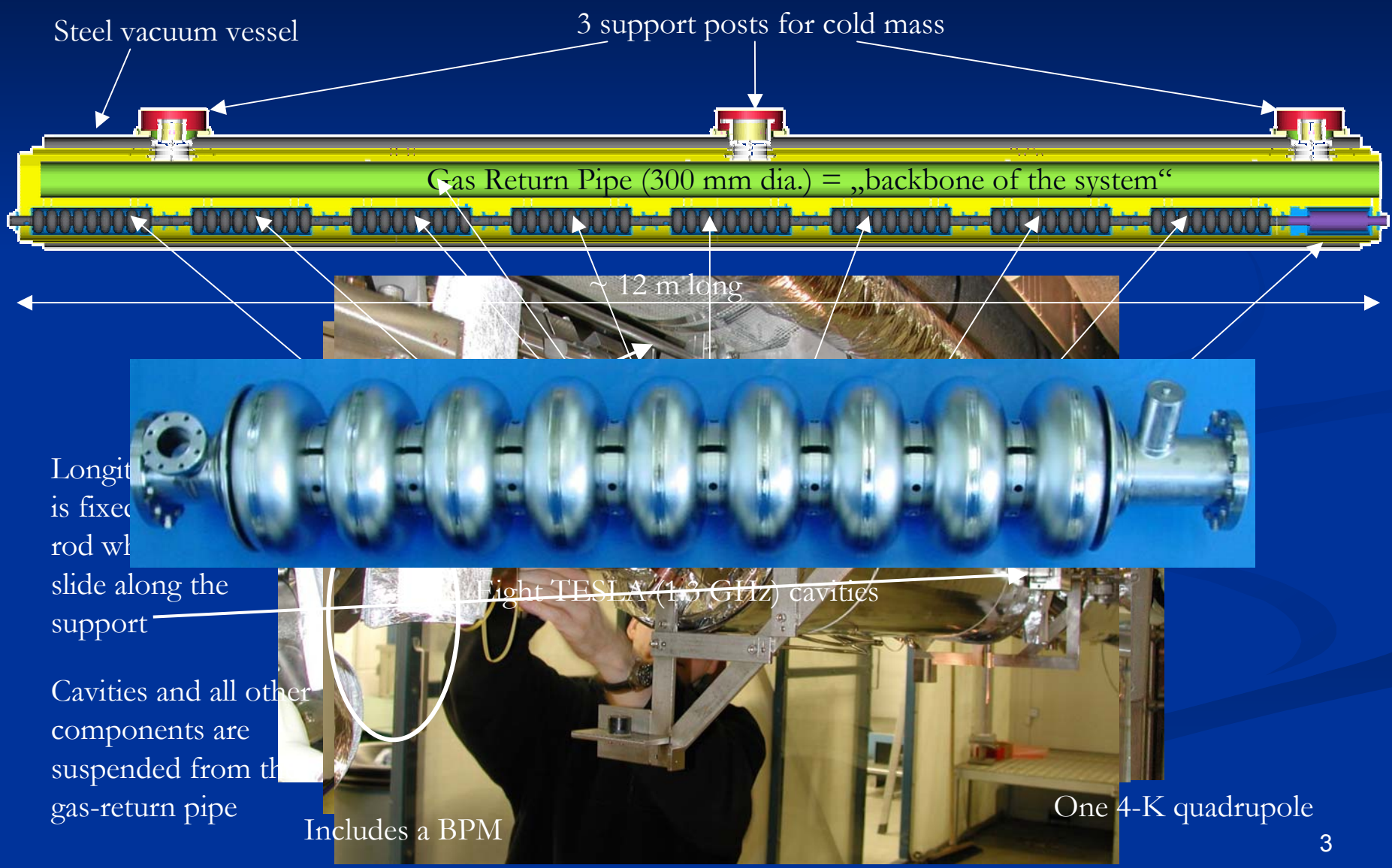
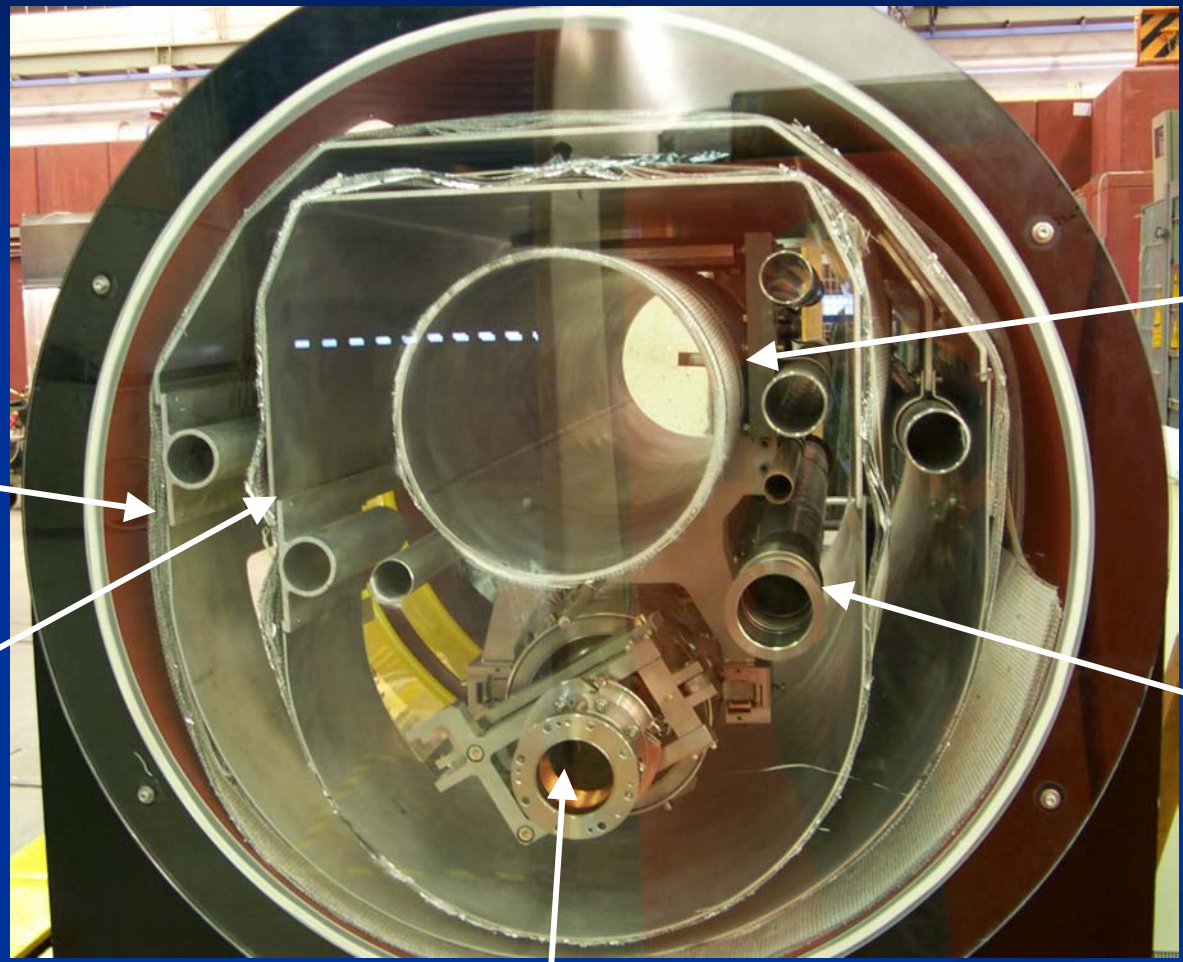
„TESLA“ Modules

- Several versions of „TESLA“ Modules
  - 1st generation: not used
  - 2nd generation: installed at VUV-FEL
  - 3rd generation: installed at VUV-FEL ← Will concentrate on this
  - XFEL, redesign of type 3 currently under way

TTF Module

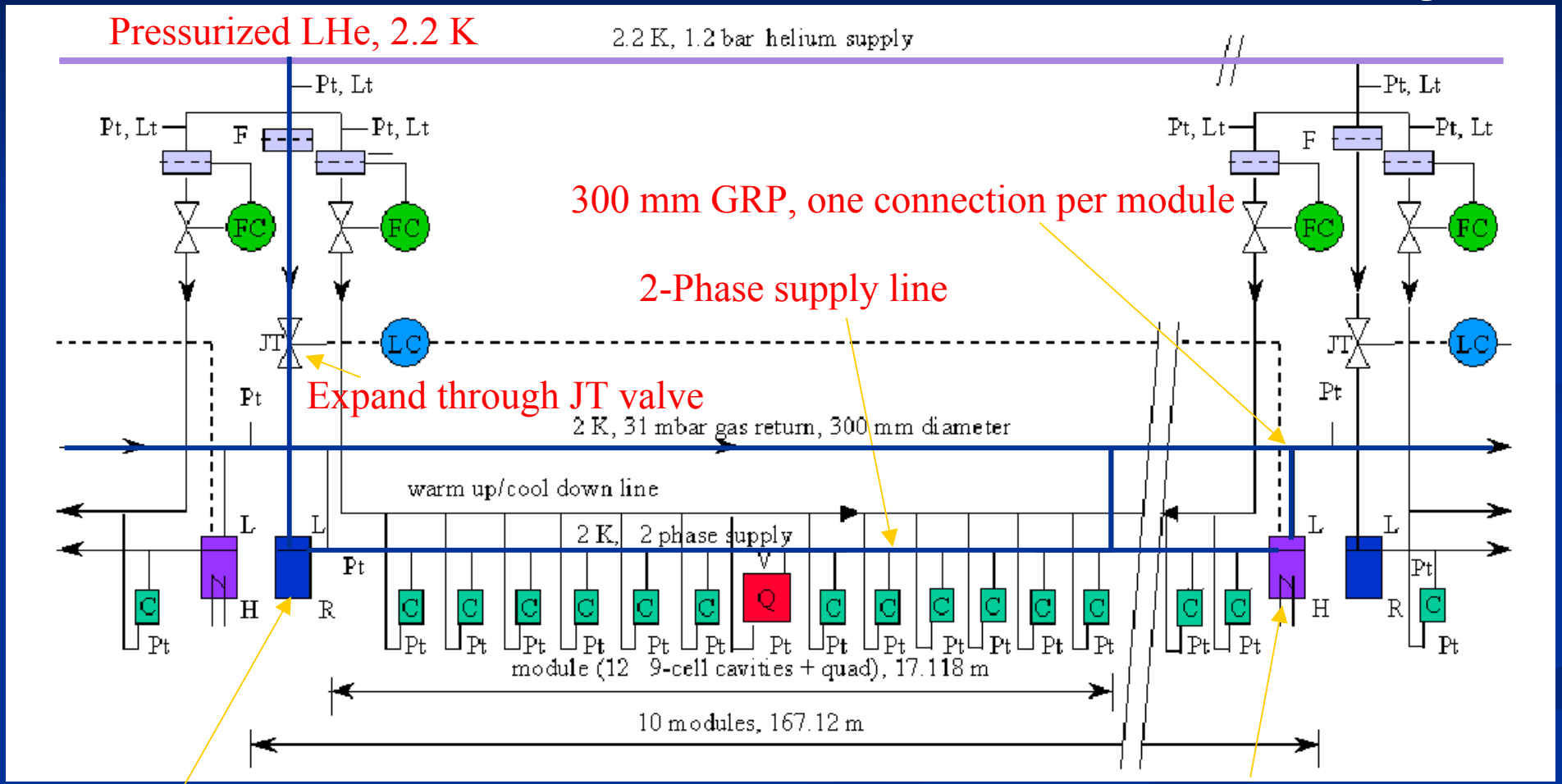

Steel vacuum vessel
3 support posts for cold mass
Gas Return Pipe (300 mm dia.) = „backbone of the system“
~ 12 m long
Longit
is fixe
rod wh
slide along the
support
Eight TESLA (1.3 GHz) cavities
Cavities and all other
components are
suspended from th
gas-return pipe
Includes a BPM
One 4-K quadrupole

TESLA Cryostat



Cryogenics of TESLA Modules

10 Modules/String

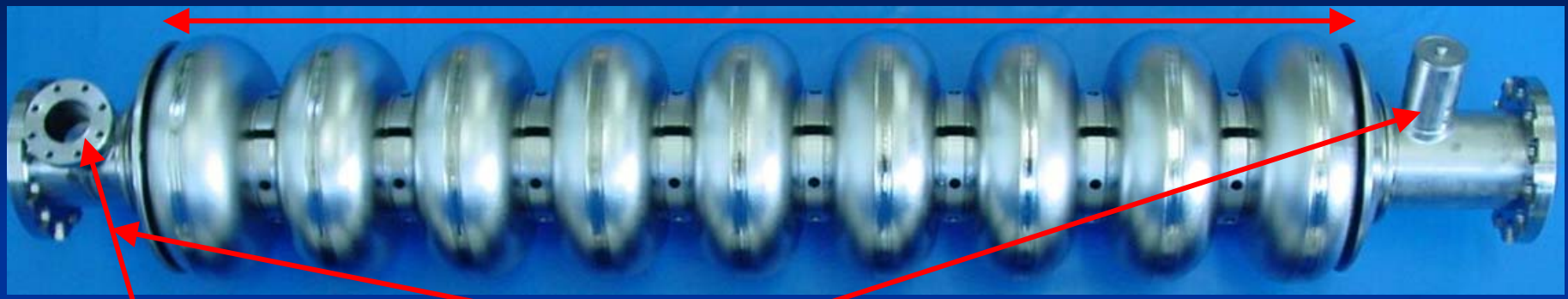


Phase separator

Level-controlled reservoir
+ Heater

TESLA Cavity

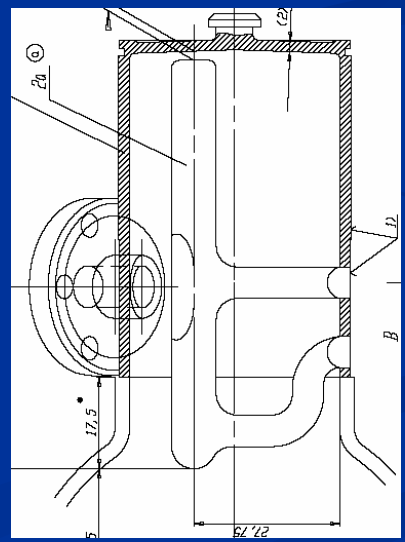
1.04 m, 9 cells

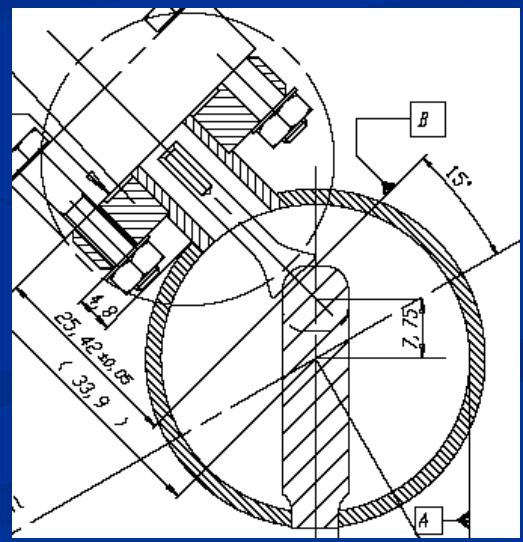


Coaxial input coupler

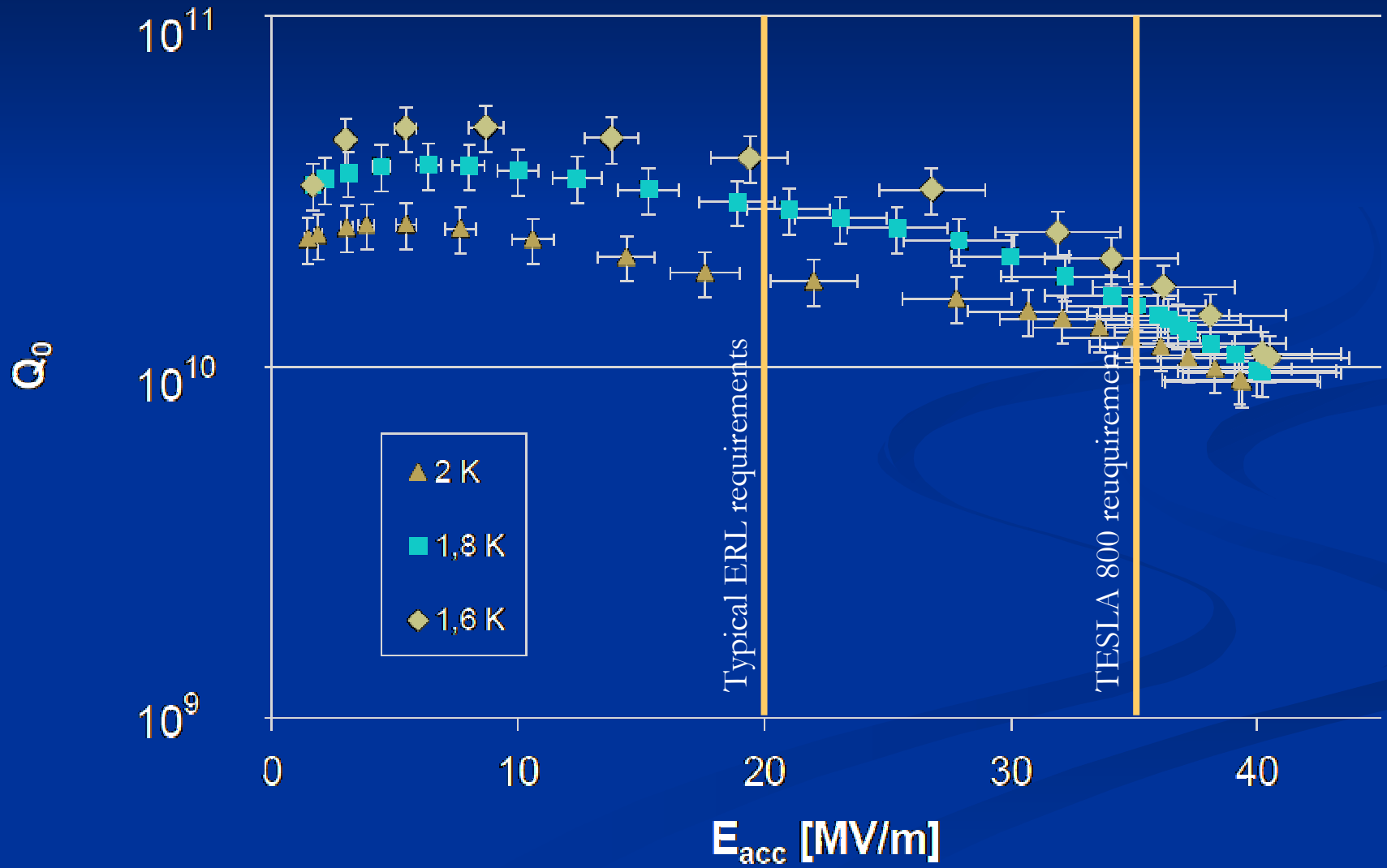
Two HOM couplers

- Based on loop couplers
- Limited frequency range, limited power handling
- Power dissipation in the pickup probe can cause quench
  - Quench field in LHe measured at about 15 – 20 MV/m

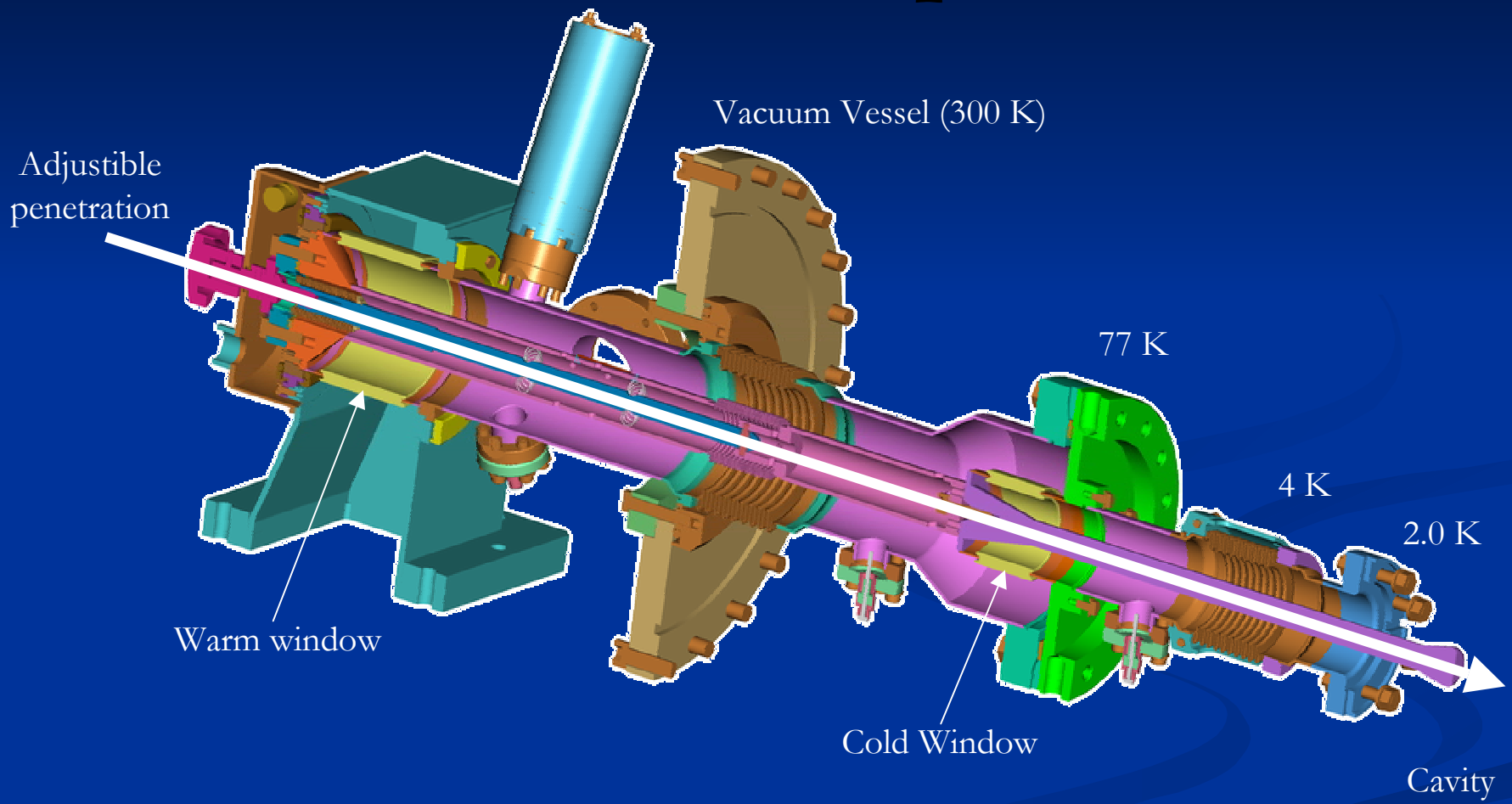




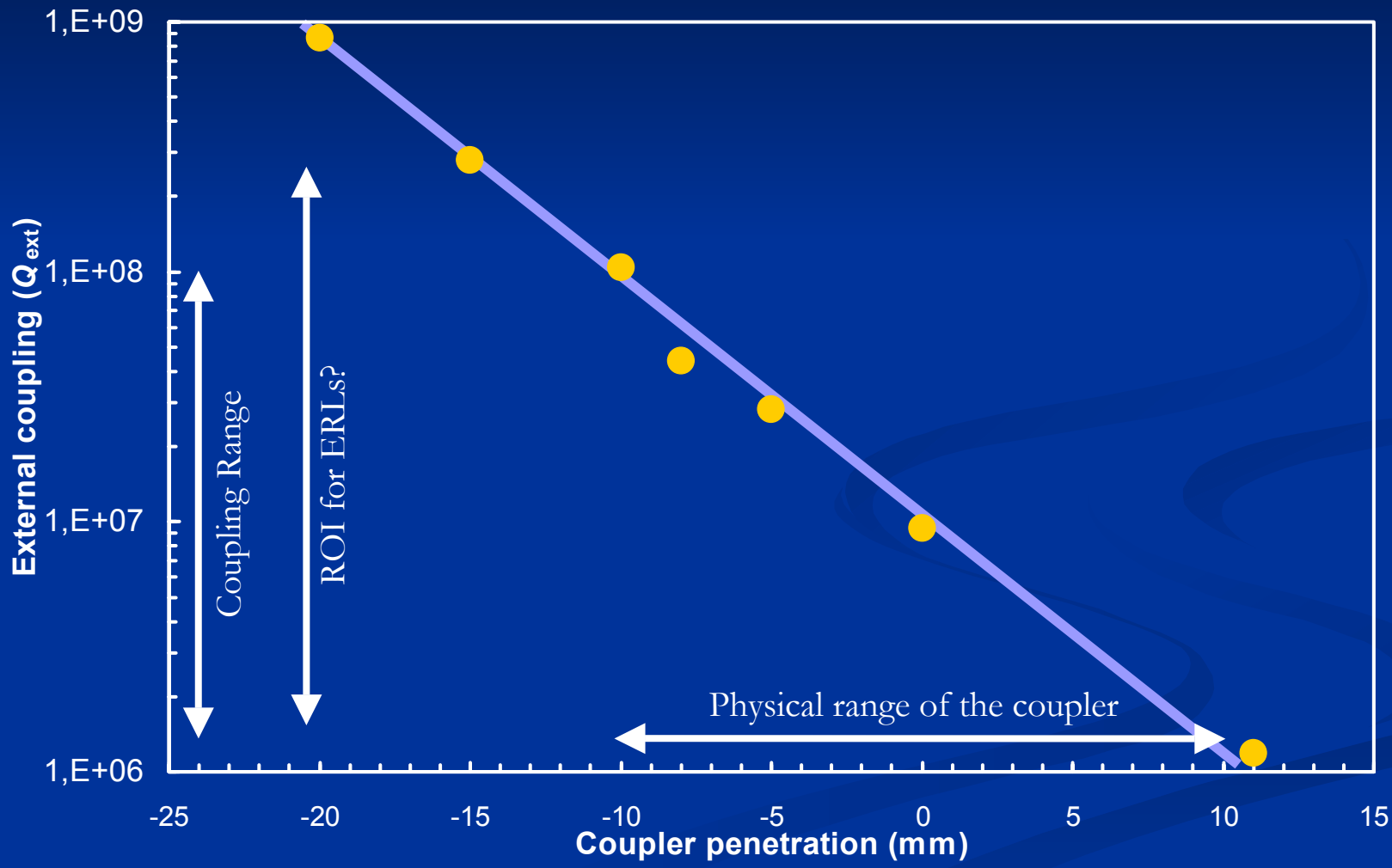
Cavity Performance



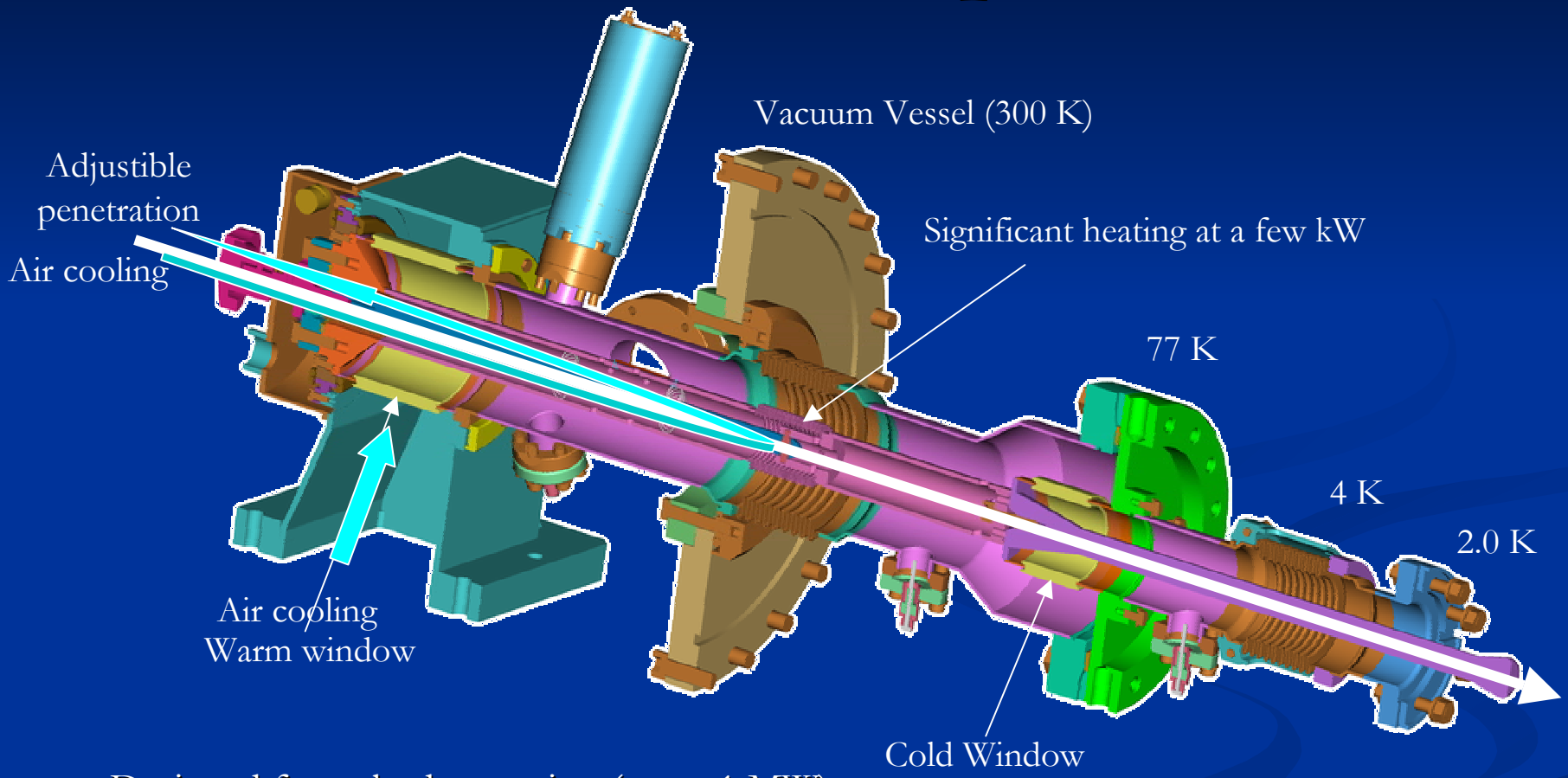
Power Coupler



Coupling Adjust



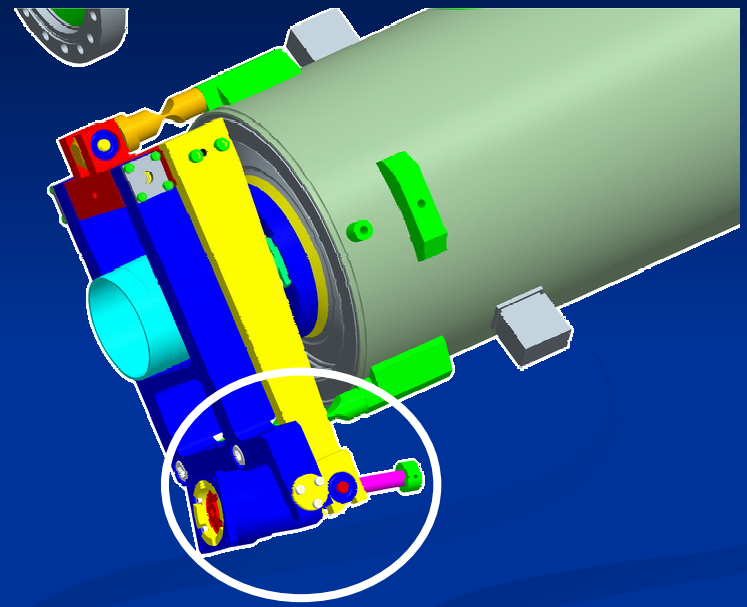
Power Coupler

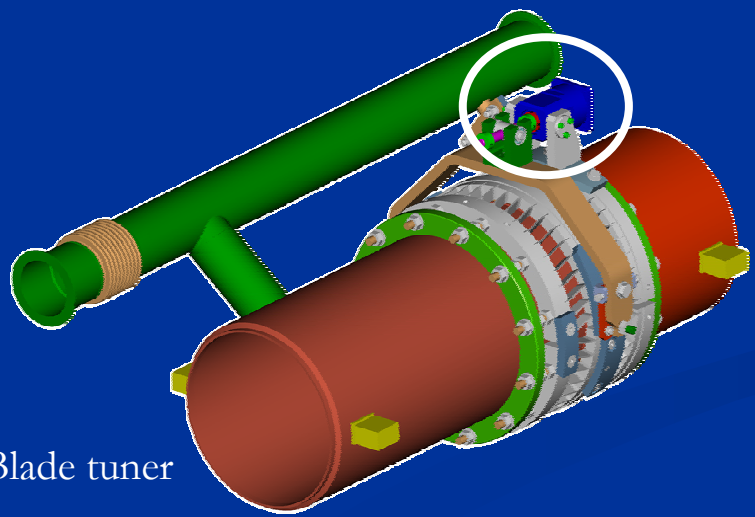


- Designed for pulsed operation (up to 1 MW)
- Average power in TTF order 1 kW
- For ERLs need SW operation → coupler limited to about 4 – 5 kW
- With additional cooling have operated this coupler at up to 8 kW SW, but redesign necessary

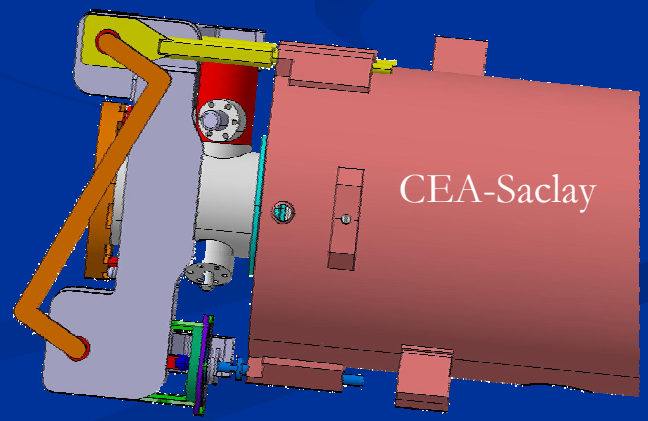
Tuner

- Two systems developed for TTF/TESLA
- Both are cold systems → reliability?
- Other, compatible but optimized designs being investigated



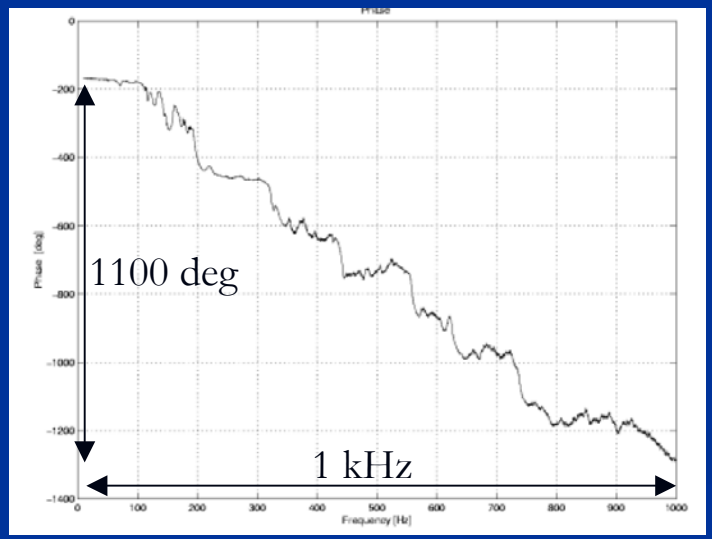


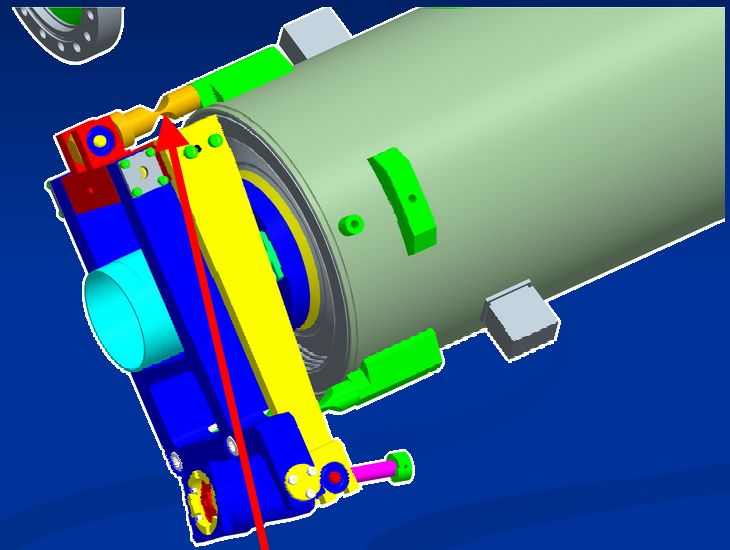
Blade tuner

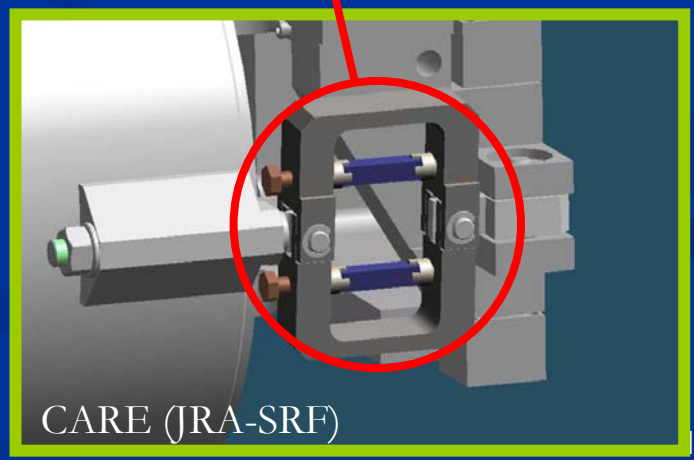


Piezo Compensation

- Existing and new tuners permit the integration of Piezo elements
- Developed to compensate Lorentz-force detuning during TESLA pulse
- Potential exists to use these to compensate microphonic detuning, *but must still be demonstrated*







Parameters & Consequences

„TESLA“ Parameters		ERL Parameters		
E_{acc}	= 35 MV/m	E_{acc}	= 20 MV/m	
I_{ave}	< 100 μA	I_{ave}	= 100 mA	Additional/different HOM couplers
I_{pk}	~ 10 mA	I_{pk}	= 100 mA	
T_{bath}	= 2 K	T_{bath}	= 1.8 K	Re-dimension cryogenic lines
Q_0	$=10^{10}$	Q_0	$=2 \times 10^{10}$	Must maintain high Q
P_{diss}	= 1 W	P_{diss}	= 20 W	
P_{pk} (RF)	= 1 MW	P_{kp} (RF)	= 20 kW	
P_{ave} (RF)	= 1.5 kW	P_{ave} (RF)	= 8 kW	→ Re-design input coupler
Q_L	$= 2 \times 10^6$	Q_L	$> 2 \times 10^7$	Re-design tuner,
BW	= 400 Hz	BW	< 65 Hz	Integrate fast tuning mechanism