



X-FEL Power Coupler Design



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Specification



Frequency	1.3 GHz
Peak power (incl. control margin)	150 kW
Repetition rate	10 Hz
Pulsed mode	500 μ sec risetime, 800 μ sec flat top with beam
Average power	1.9 kW
High Power Processing (only on module test stand)	1 MW at reduced pulse length (≤ 500 μ sec and repetition rate 1 Hz)

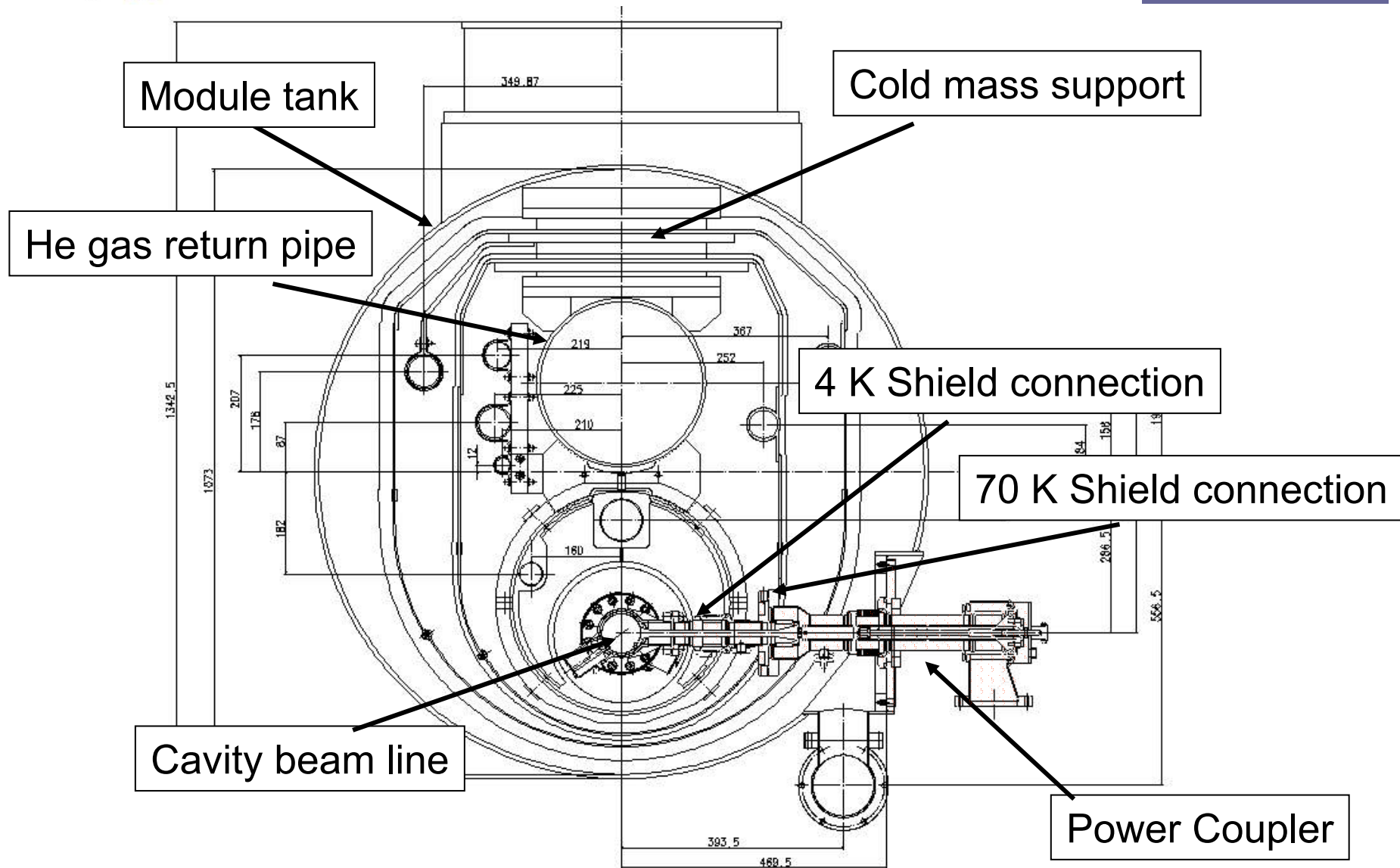


Specification cont.

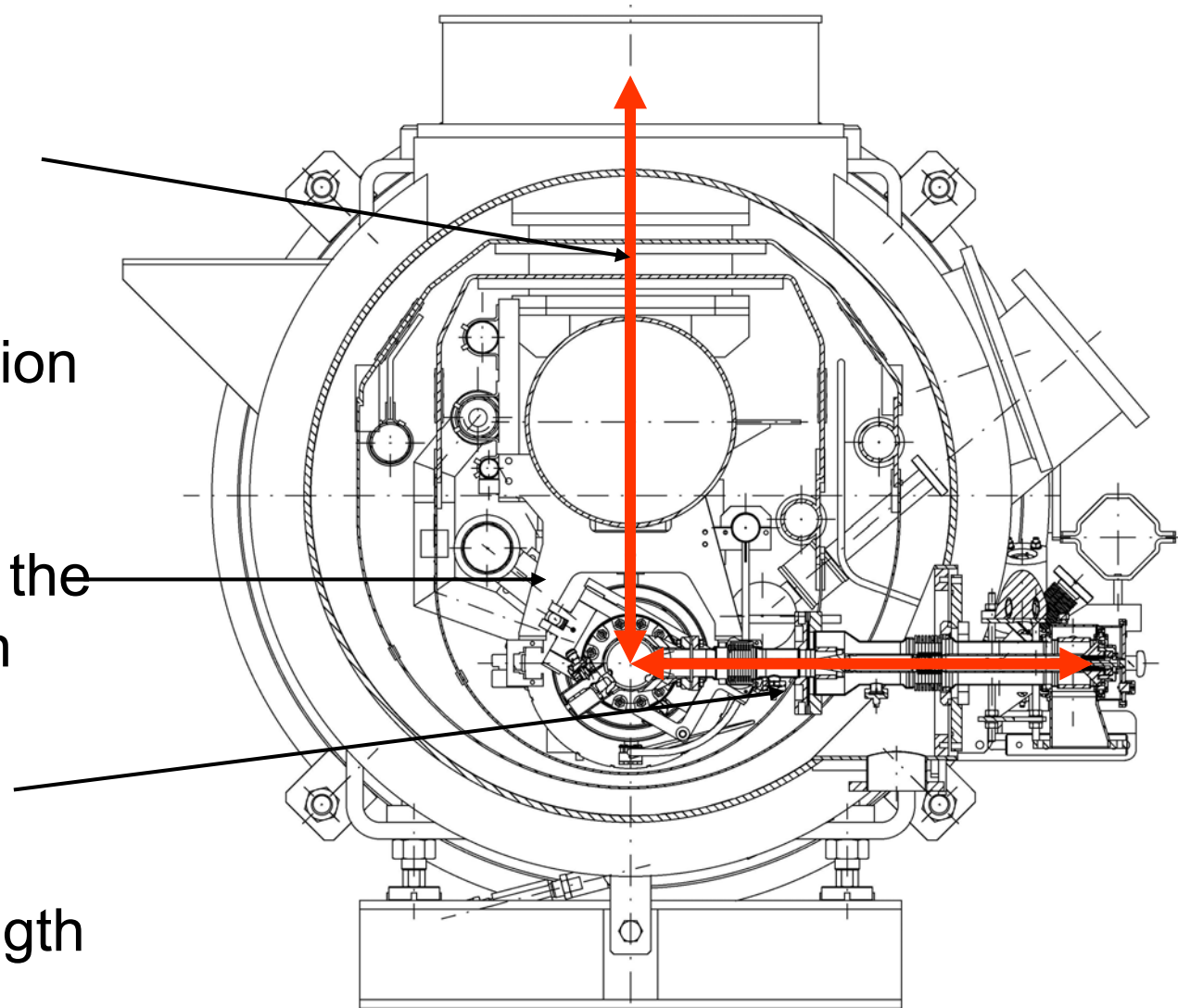


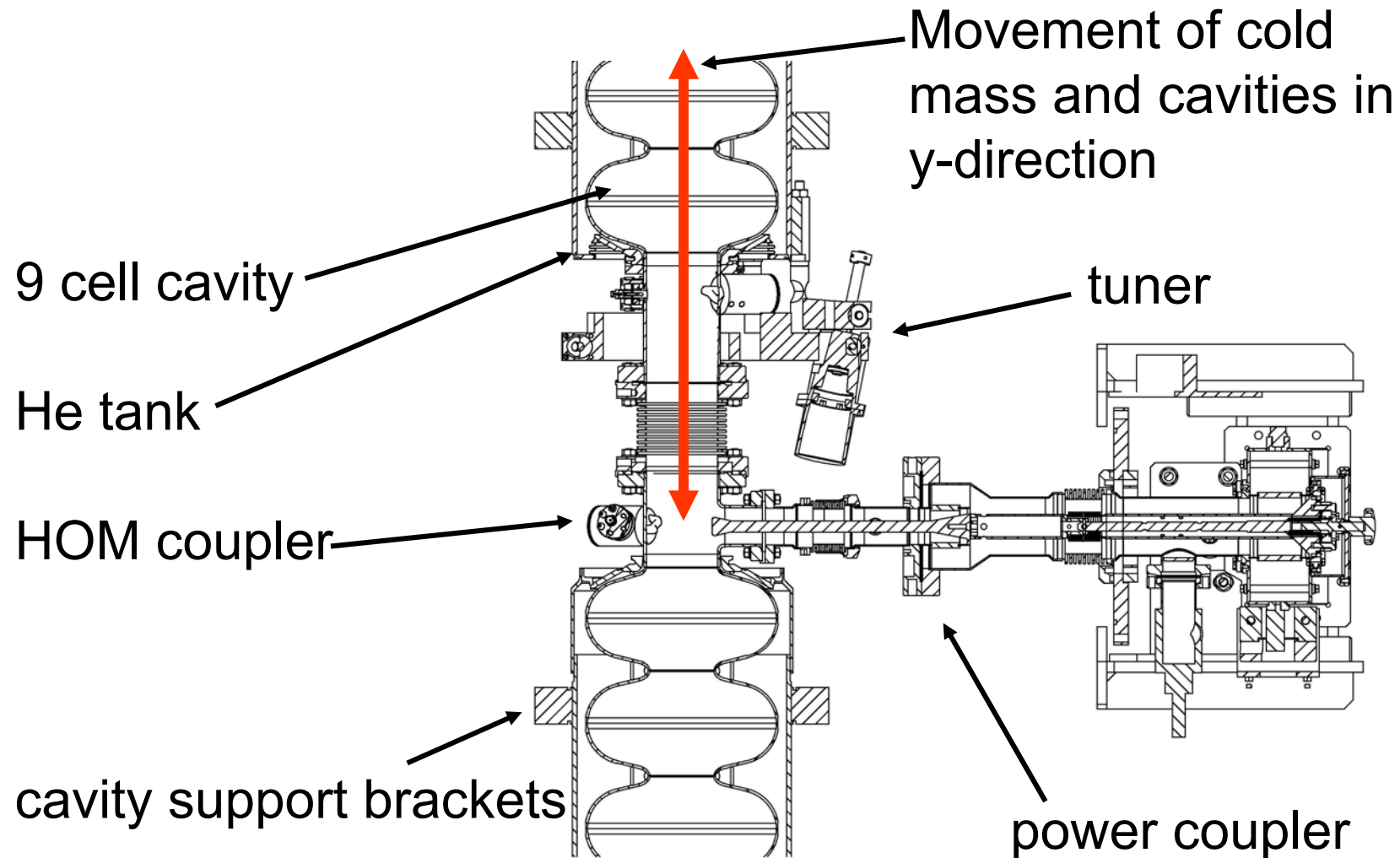
Coupling	$Q_{\text{ext}} = 10^6 - 10^7 (\pm 10 \text{ mm})$
2 K heat load	0.06 W
4 K heat load	0.5 W
70 K heat load	6 W
Lateral displacement	$\pm 2 \text{ mm}$
diagnostic	sufficient for safe operation and monitoring

Module Cross Section



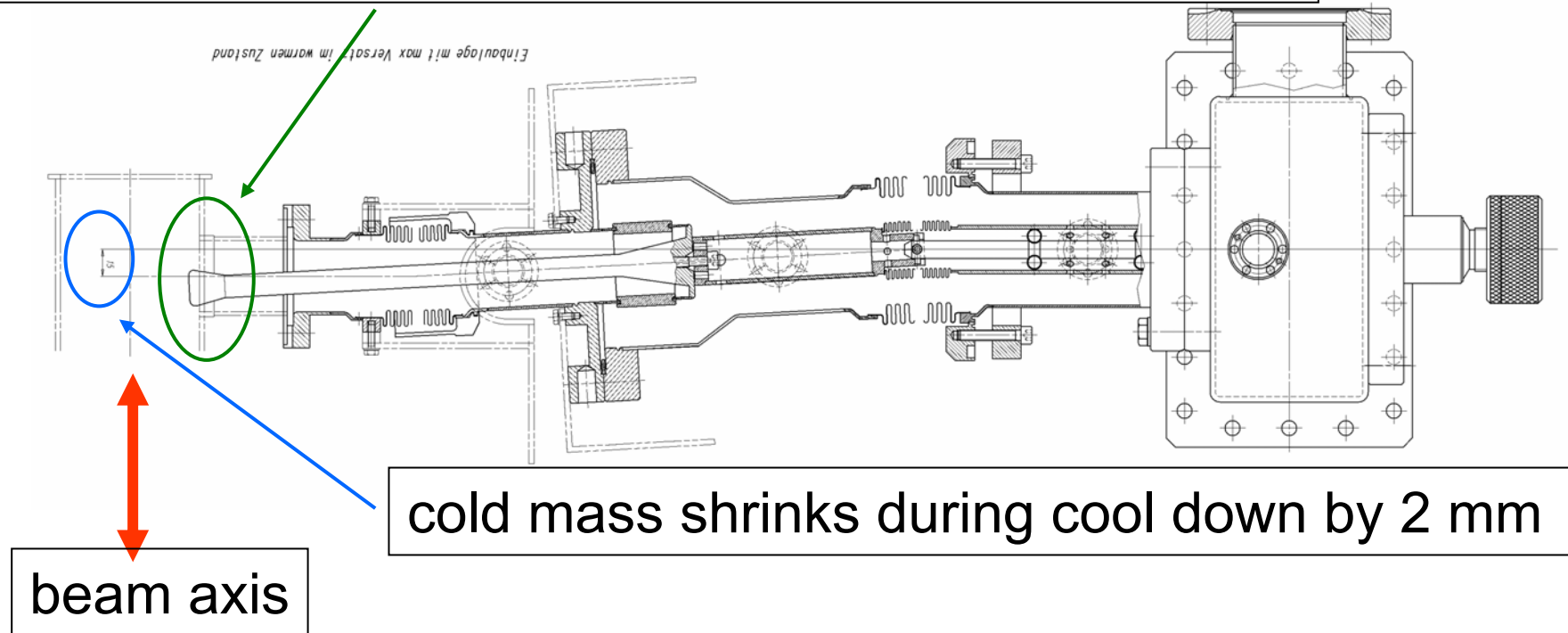
- movement of cavity during cool down in vertical direction
- cavities are supported by the SS gas return pipe
- shrinkage of coupler in length





Coupler on the module-position 1 and 8 at room temperature

distance between outer and inner conductor is small





Decided Design Criteria



- coax is easy for:
 - variable coupling
 - fabrication
 - assembly
- two windows for:
 - clean assembly of the cavity
 - save operation
- cold coax:
 - at 70 Ohm, 40 mm diameter
- warm coax:
 - at 50 Ohm, 60 mm diameter
- bias on inner conductor:
 - suppress multipacting
- flexibility:
 - bellows in the warm and cold coax
- ceramics:
 - Al_2O_3 with TiN coating
- copper plating:
 - 10/30 μm outer/inner coax
 - high thermal conductivity ($\text{RRR} \geq 30$)
 - high purity, Hydrogen free



Modularity of the Coupler

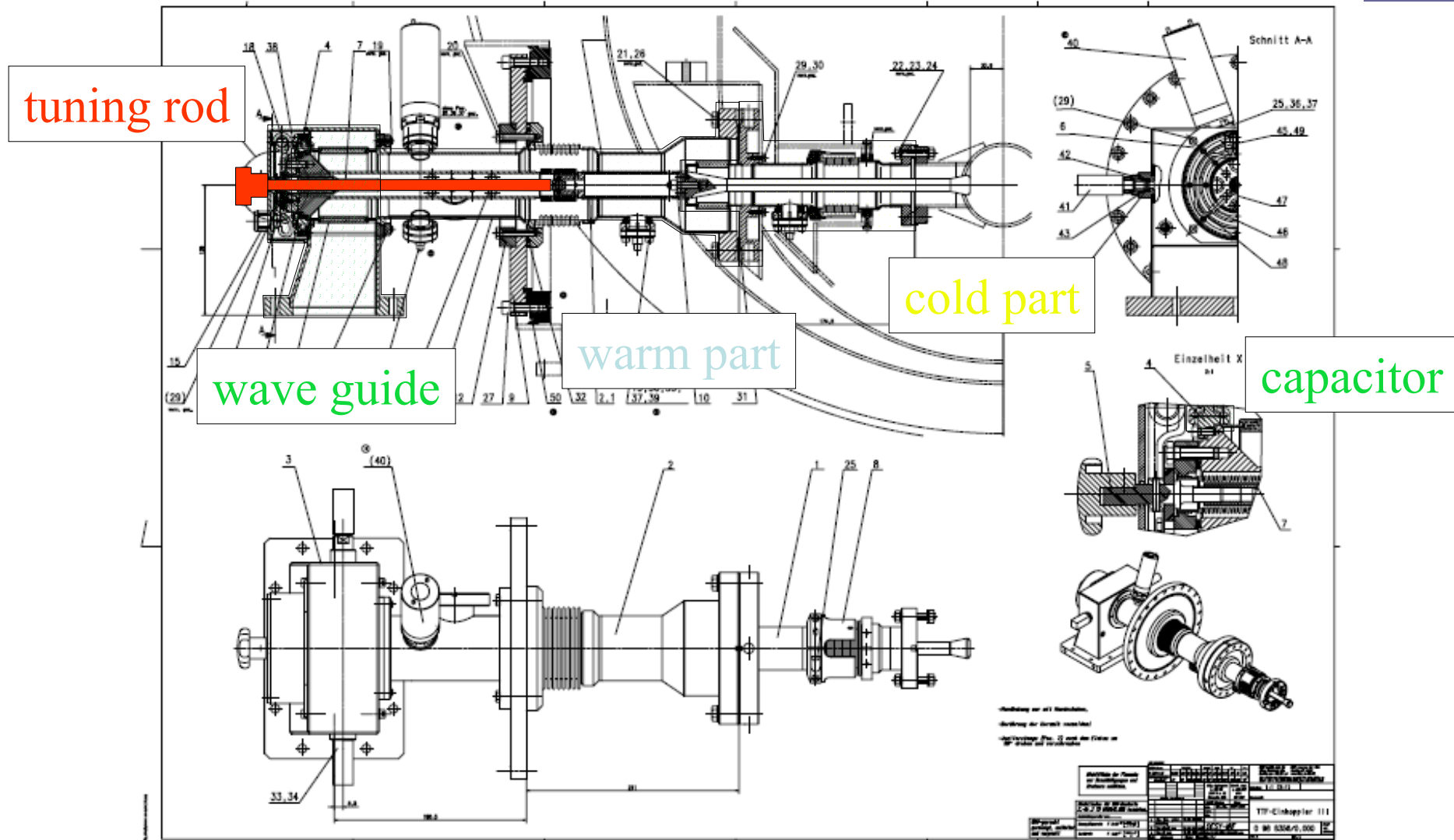


- From the requirements that we have to close the cavity vacuum in the clean room class 10 area
 - the cold window should be separated from other parts
- Not too many separate parts
- Vacuum parts separate from 'air parts'

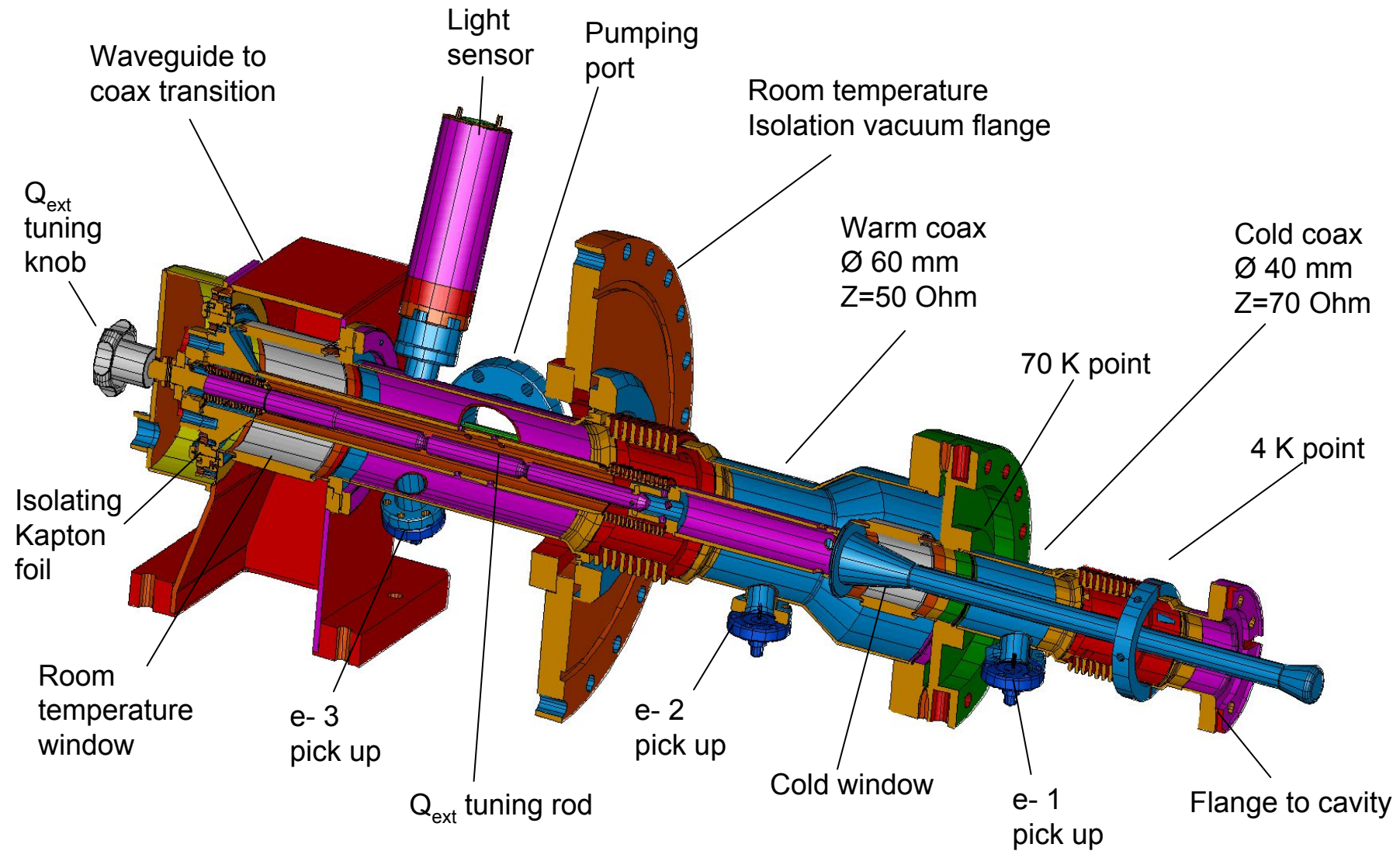
at TTF3 coupler: - cold part

- warm part
- WG
- tuning rod
- capacitor

Parts of the Coupler



The TTF 3 Coupler Design





Changes to the XFEL design



1. motorized tuning
2. simplified fabrication
3. less diagnostic
4. new electronic interlock system
5. ...
 - industrialization is on the way => next talk