DESIGN OF THE HIGH POWER INPUT COUPLER FOR CEPC MAIN RING CAVITY *

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Abstract

The main ring cavities of CEPC project are two-cell elliptical superconducting cavities operating at 650 MHz in CW mode. Each cavity equips with one high power input coupler and each coupler has to deliver at least 300 kW of CW RF power to the beam. A new coupler that employs 75 Ohm coaxial line sections, a planar ceramic disk window, a coaxial to waveguide transition and a coupling adjusting actuator has been designed. The RF design, thermal stress analysis and preliminary mechanical design of the coupler are presented below.

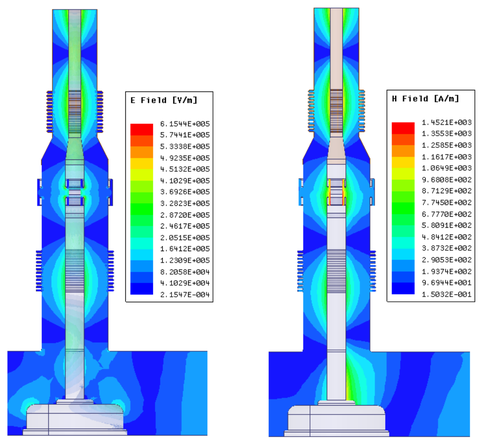
The main requirements of CEPC main ring power coupler

Parameters	Value
Frequency	650 MHz
Power	300 kW, CW, TW
Q_e	1E5 to 2E6
2 K heat loss	1 W (dynamic, 300 kW, CW, TW)
Assembly	Coupler and cavity assembled in class 10 clean room

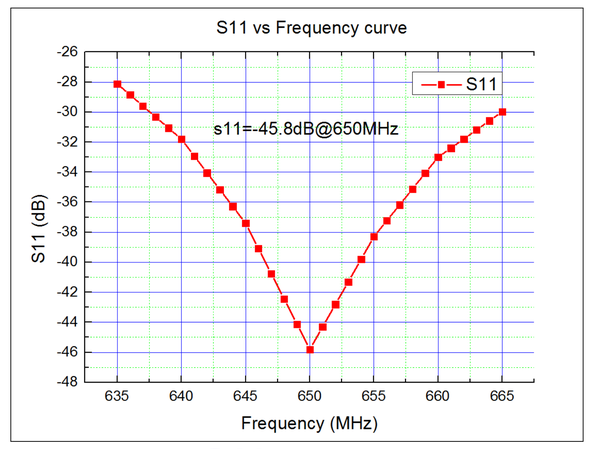
Main challenges:

- High average RF power: > 300 kW, CW, TW;
- Wide range of variable coupling: factor of 20;
- Clean assembly: coupler and cavity assembled in class 10 clean room;
- Low cryogenic heat loss: 2 K dynamic heat loss less than 1 W at 300 kW, CW, TW.

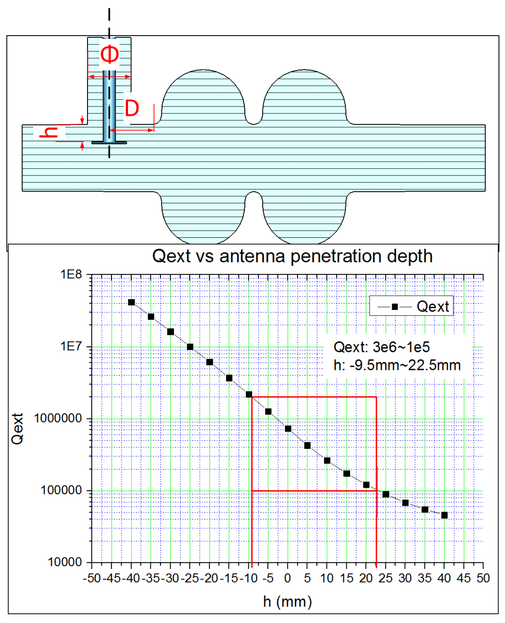
RF design



E and H field at 400kW,TW



S11 curve

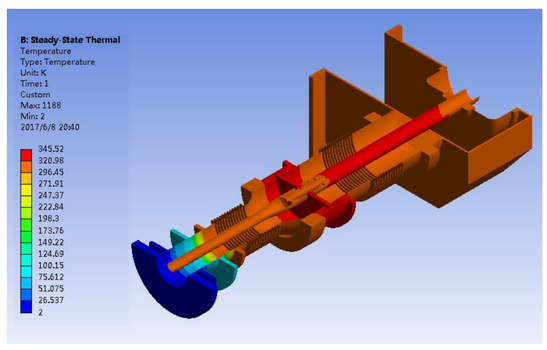


Qe-antenna tip dependence

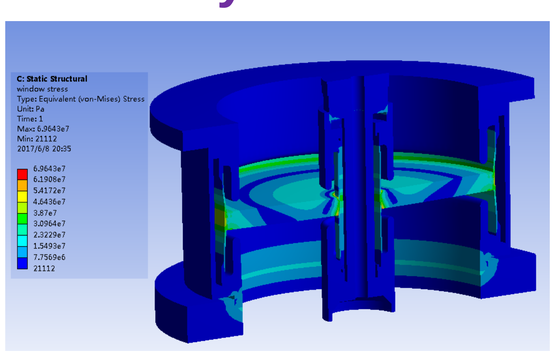
Calculated power loss (400kW, CW, TW)

Components	Power loss
Ceramic	150 W
Inner window	93 W
Outer window	21 W
Inner coaxial of vacuum part	137 W
Outer coaxial of vacuum part	66 W
Inner coaxial of air part	136 W
Outer coaxial of air part	30 W
Doorknob	102 W
Total	740 W

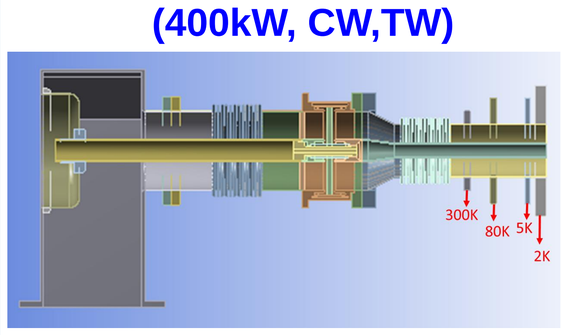
Thermal and stress analysis



Temperature (400kW, CW,TW)



Window thermal stress (400kW, CW,TW)



Thermal simulation model

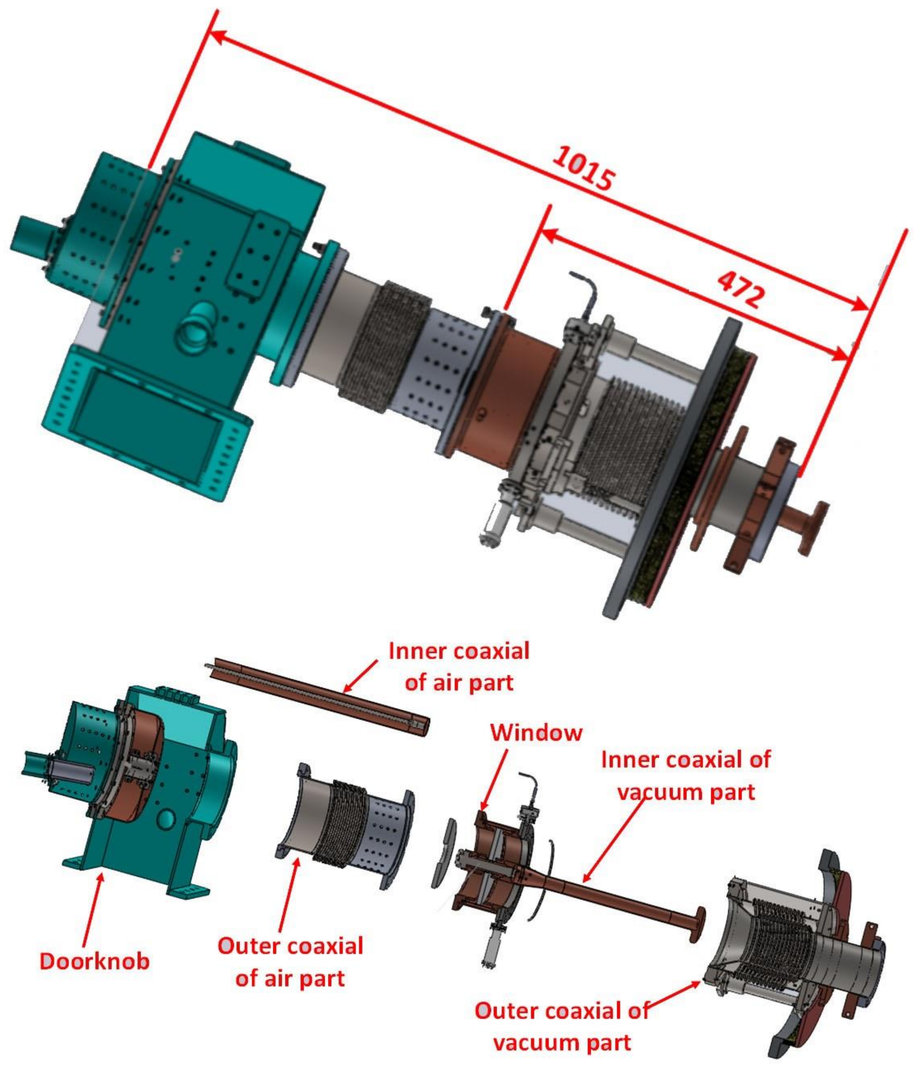
Calculated heat loss

	Static	Dynamic
2 K heat loss	0.07 W	0.77 W
5 K heat loss	3.60 W	5.46 W
80 K heat loss	22.6 W	26.6 W

Cooling scheme:

- Inner conductor of vacuum: 300K water cooling
- Inner window: 300K water cooling
- Outer window: air cooling
- Outer conductor of vacuum: thermal anchor
- Air part: air cooling

Preliminary mechanical design



The exploded view of the power coupler.

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