Input Power Coupler for NICA Injector Coaxial Half Wave SC Cavity

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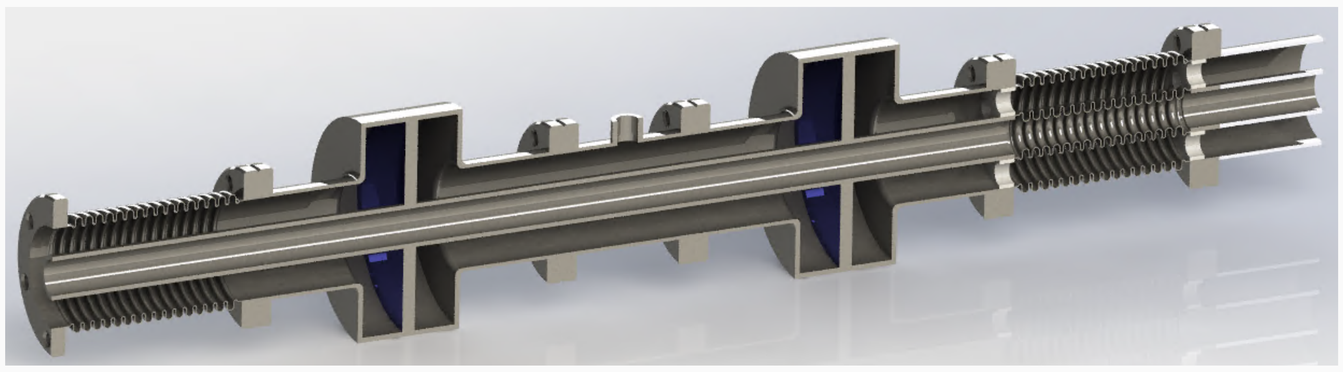
Introduction

Nuclotron-based Ion Collider fAcility (NICA) is being built in Dubna, Russian Federation. Usage of the accelerator superconducting HWR cavities for the injector part of the accelerator is considered. According to technical requirements power coupler is able to withstand 13 kW of RF average transmitting power. Additionally, coupling tuning in small range should be possible. In this paper results of the 325 MHz HWR power coupler R&D are presented and discussed.

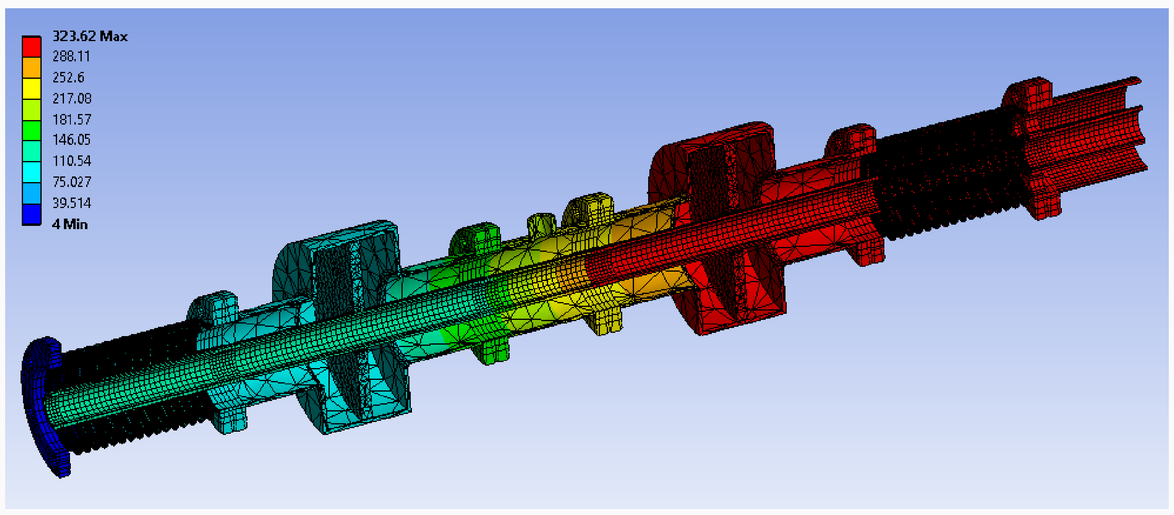
Design overview



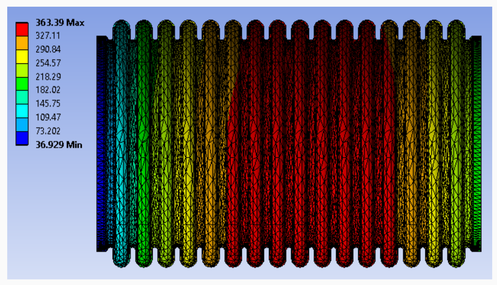
Power coupler model

Design is based on 50 Ohm coaxial transmitting line with outer diameter of 47.5 mm. Conventional two RF window design was chosen. RF windows are pillbox-shaped cavities with flat ceramic disk (96 % Al_2O_3). Cold window will operate at 80 K, warm window will be at room temperatures. Antenna movement in range ±7 mm allows tuing coupling in range of 0 to 10 mA beam current. Bellows metal thickness was chosen to be 0.4 mm. Antenna is made out of copper.

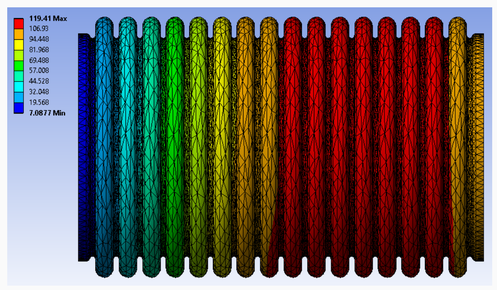
Thermal calculations



Temperature of the coupler



Steel bellows

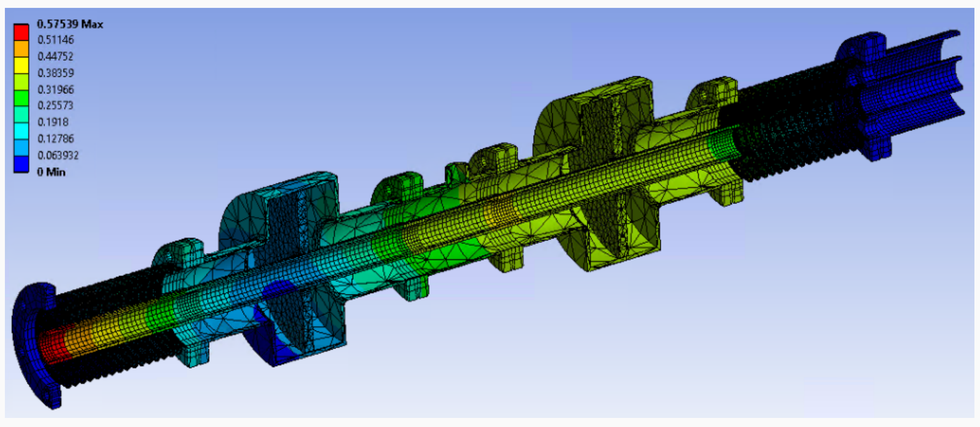


Steel bellows with copper coating

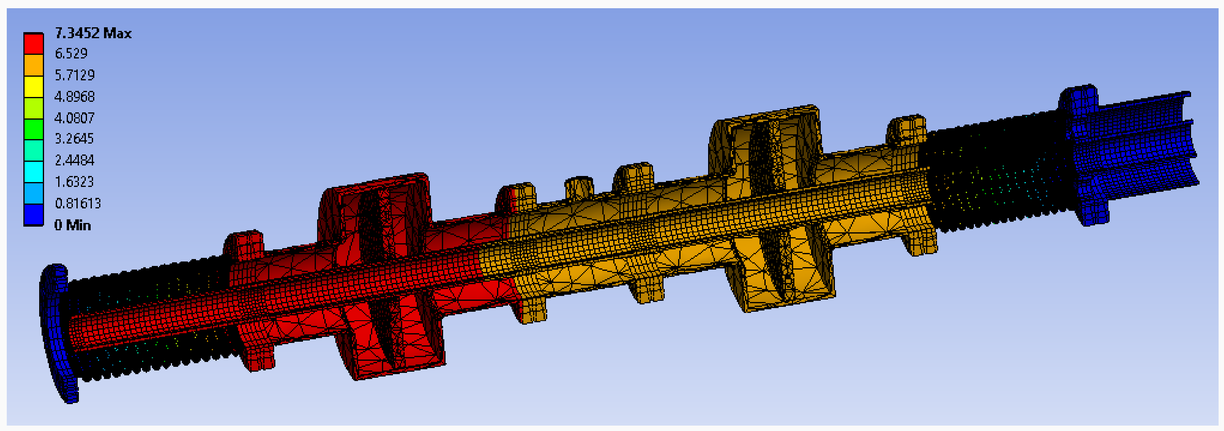
Heat loads

Type	Value, W
2 K static w/o copper	0.1
2 K static w copper	0.25
2 K dynamic w/o radiation, w/o copper	6.7
2 K dynamic w/o radiation, w copper	0.95
2 K dynamic w radiation, w/o copper	5.71
2 K dynamic w radiation, w copper	0.97
80 K static w/o copper	7.7
80 K static w copper	7.97
80 K dynamic w/o copper	54.31
80 K dynamic w copper	23.6

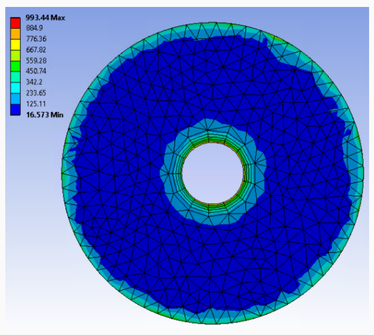
Mechanical calculaitons



Thermal deformation of the coupler



Deformaiton of the coupler under 15 kN load



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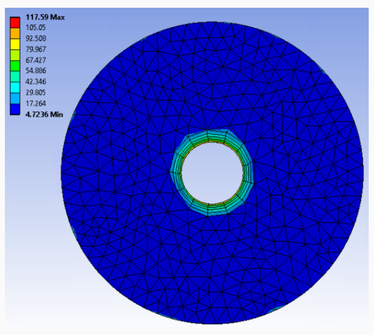

Thermal deformation of the coupler

In order to simulate a movement of the coupler, force was applied to the RF windows. It requires pulling coupler with the force of 7 kN in order to move it ±7 mm. The maximum stress to 6 mm thick ceramic disk of the warm RF window is about 120 MPa is about three times lower than ordinary Alumina strength. Cold window however appears to exceed the maximal stress. Therefore it is necessary to include a stress relief mechanism to the cold RF window. Spring-loaded double wall seems to be a resonable solution to the problem. Development of such connection is now in progress.

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