

Design of RF Power Couplers for Accelerator Cavities Using COMSOL Multiphysics®

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Abstract

High-power couplers (both coaxial and ridge waveguide type) at UHF frequencies are presently under development for the Low Energy High Intensity Proton Accelerator (LEHIPA) project and 1 GeV proton accelerator at Bhabha Atomic Research Centre. Ridge waveguide coupler transitions the WR2300 waveguide input to a smaller size ridge waveguide. An iris is used in the end wall/side wall of the waveguide to couple the RF power to accelerator cavities. These couplers are optimized for return loss of better than -30 dB at 352.2 MHz using RF module of COMSOL Multiphysics®. As the power requirement is 250 kW CW, heat transfer module is used to study the temperature profiles. Similar studies are also carried for 50 kW, 350 MHz coaxial coupler and a RF test cavity. Superconducting (SC) cavities will need SC RF couplers with detailed analysis for static and dynamic load analysis onto the 2K cryogenic system. A thermal analysis to estimate the heat load from 298 K to 2K from the coupler is also carried out. Figures below show the coupler models, return loss and temperature profile obtained from COMSOL Multiphysics. The detailed results of RF and thermal analysis will be reported in this work.

Figures used in the abstract

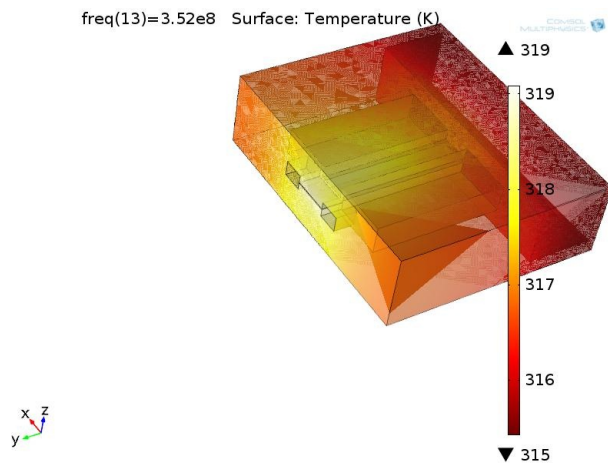


Figure 1: Temperature distribution on 250 kW, 352.2 MHz waveguide coupler with WR2300 waveguide input and ridge waveguide output.

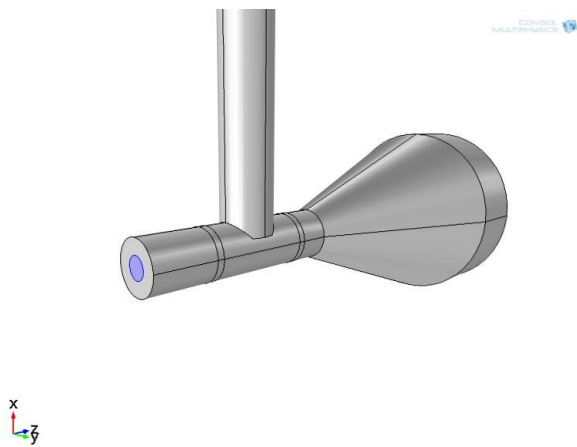


Figure 2: Model of 50 kW, 350 MHz coaxial RF power coupler.

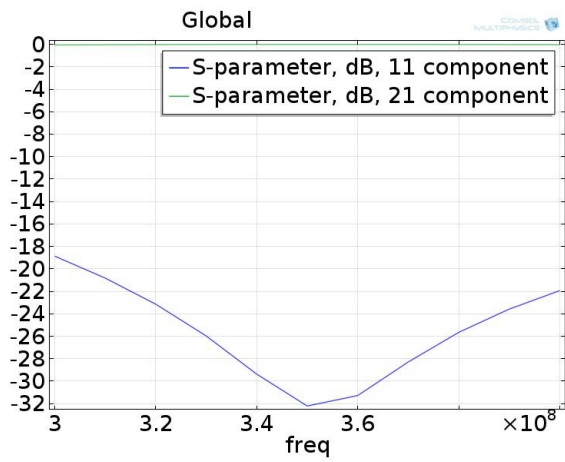


Figure 3: S parameters of coaxial coupler.

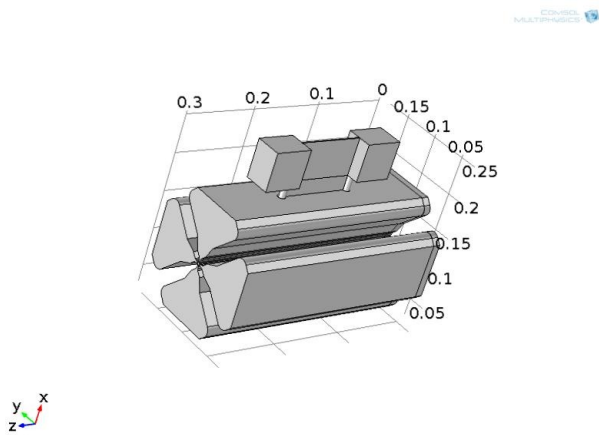


Figure 4: Model of Radio Frequency Quadrupole cavity connected to ridge waveguide by an iris for coupling simulations.