



Design and Commissioning of FRIB Multipacting Free Fundamental Power Coupler

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ENERGY

Office of
Science

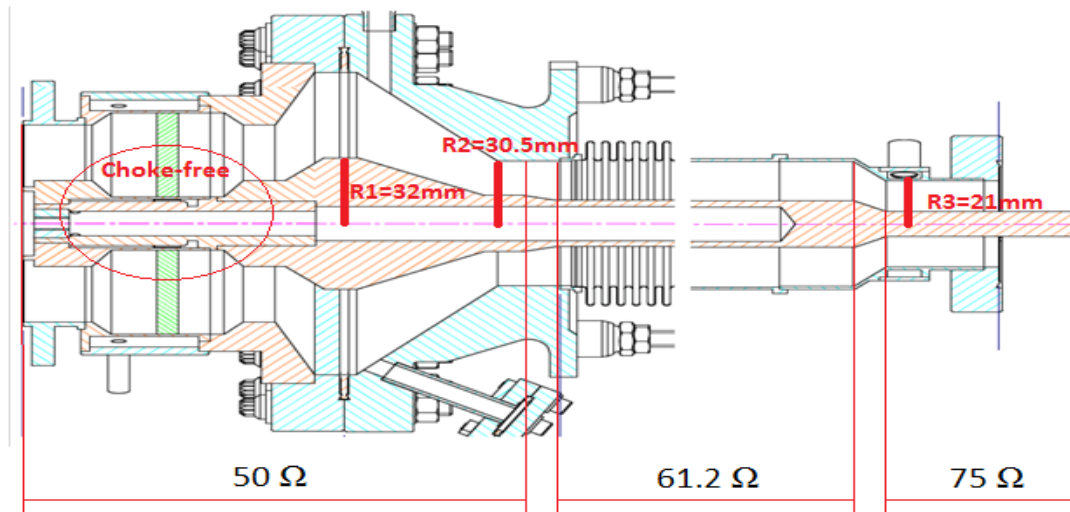
This material is based upon work supported by the U.S. Department of Energy Office of Science under Cooperative Agreement DE-SC0000661, the State of Michigan and Michigan State University. Michigan State University designs and establishes FRIB as a DOE Office of Science National User Facility in support of the mission of the Office of Nuclear Physics.

Latest Progress in the Design

A simple multipacting law for the coaxial couplers was derived as following:

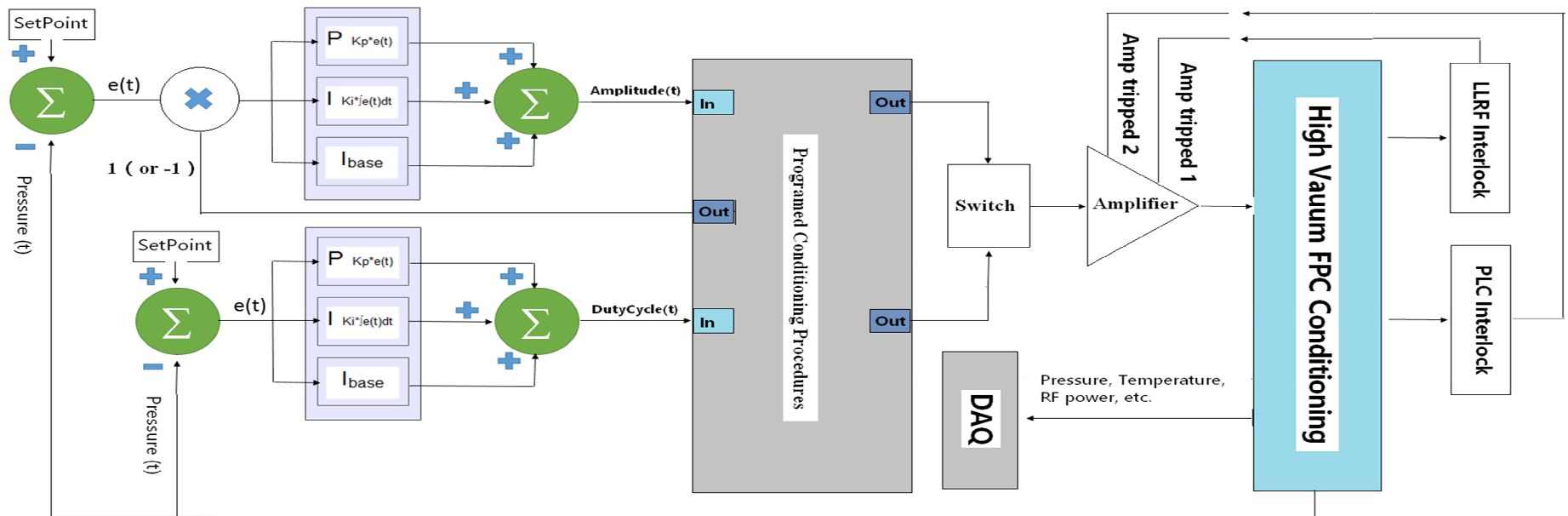
$$P_n = \frac{A\omega^4 (r_2 - r_1)^4 m^2}{(2n-1)^2 \pi \eta e^2} \left(\ln\left(\frac{r_2}{r_1}\right) \right)^{-1}$$

P_n is the RF power where multipacting turned on, r_1 and r_2 are the inner and outer conductor radius respectively, η is the wave impedance in vacuum (377 Ω), A is 1 for traveling wave and 0.25 for standing wave due to superposition theorem, e is electron charge, m is electron mass, ω is RF angular frequency, n is the order of two-point multipacting.

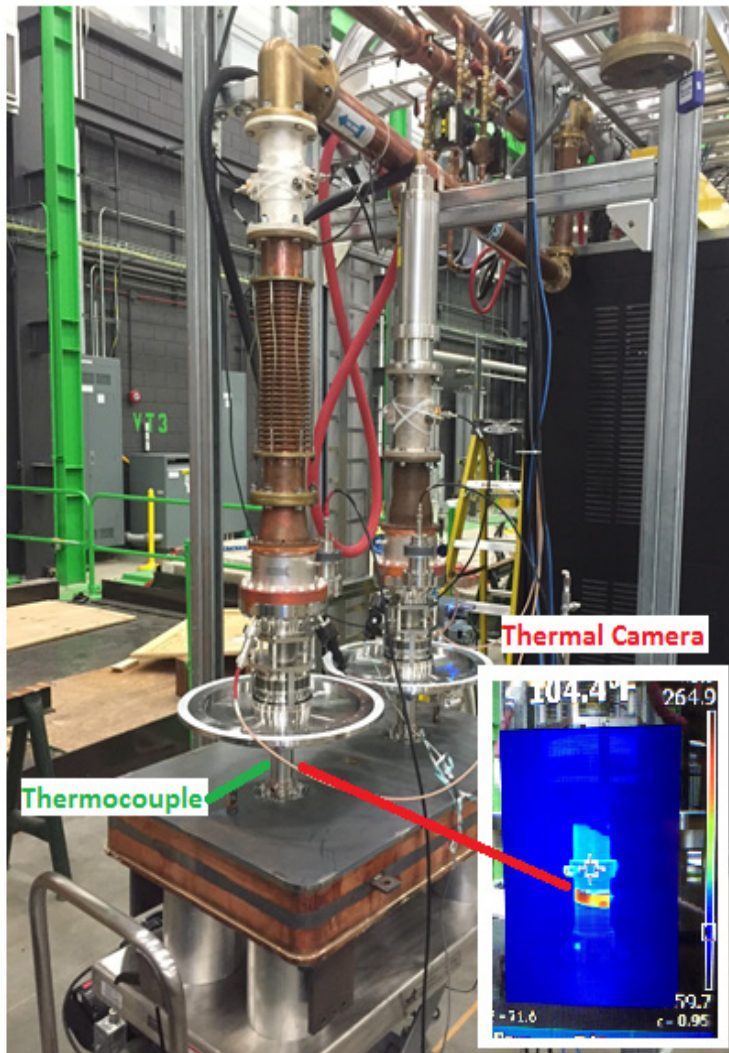


Automatic Conditioning System

An automatically conditioning system based on PI algorithm was developed to improve the conditioning efficiency and save man power. PLC and LLRF interlocks were applied in order to keep the system safe when running 24 hours without people onsite. Pico-ammeters and thermocouples were installed to monitor multipacting on the coupler.



Comparison Test between Original Couplers and Multipacting Free Couplers



The test result shows that multipacting-free design has significantly reduced conditioning time compared with original design. In the meantime, a heating problem was found during the conditioning on those ten original design couplers due to multipacting barrier. Even with long time RF conditioning (average 60 hours), more than half of these couplers still cannot overcome the heating problem.

