FERMILAB-POSTER-25-0115-AD

Booster Cavity Damper Redesign for PIP-II

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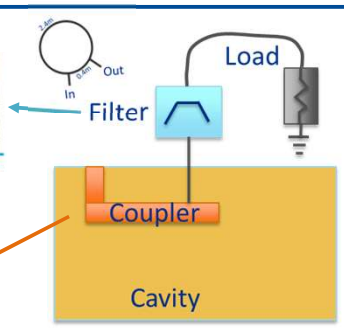
Introduction

- Under PIP-II's higher intensity, beam excitation of the Booster cavity at 105 MHz could excite the cavity's 2nd order mode, leading to beam instability.
- There's currently a Higher Order Mode (HOM) damper on the cavity at 83 MHz. If this could be extended to cover 105 MHz, the beam instability could be mitigated.

Coaxial Loop Filter

Damper Coupler



Booster Cavity Damper System Diagram

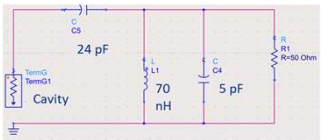
HOM Damping

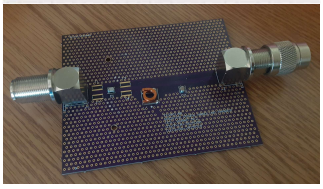
- The existing damper is composed of three parts.
  1. A coupling loop which extracts energy from the cavity
  2. A coaxial loop filter which reflects the desired fundamental mode back into the cavity while passing HOMs
  3. A dump load which burns off the unwanted HOMs.
- By replacing the filter with a wider band design, the 105 MHz mode can also be covered

Filter Redesign

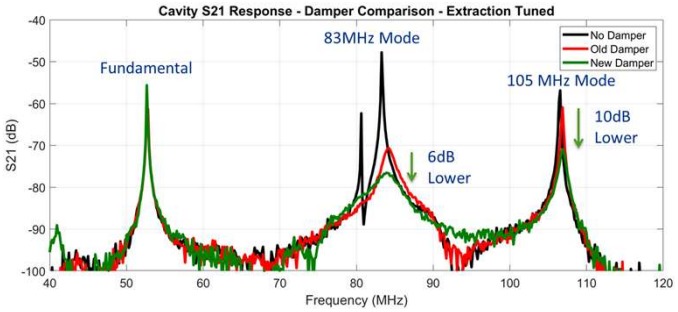
- Instead of using a cable-loop notch filter for the wider band system, a component-based PCB design was pursued instead.
- Ideally this would allow a smaller form factor for the filter while also being easier to design for the wide band

Schematic of initial design





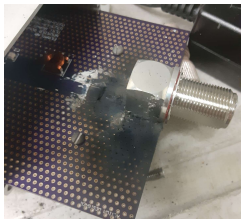
Prototype of initial design

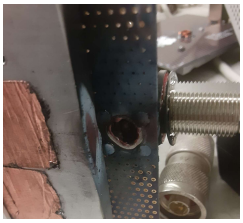


Cavity Test Results – Low Power

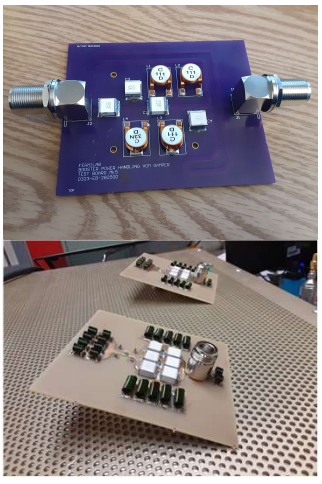
High Voltage Testing and Path Forward

- Although the filter achieved the desired damping at low power, there was a destructive arcing event at the connector during high power testing on the cavity.
- This is likely due to the filter impedance acting like an open circuit at the fundamental, causing a voltage spike on the input.
- This sparked a new design iteration to mitigate this voltage, which is awaiting testing.
- Changing to a DIN connector may also help.





Evidence of high voltage present from high power system test



New Iterations of Damper Filters for Improved Voltage Handling

This manuscript has been authored by FermiForward Discovery Group, LLC under Contract No. 89243024CSC000002 with the U.S. Department of Energy, Office of Science, Office of High Energy Physics.