Transportation Fatigue Testing of the pHB650 Power Coupler Antenna for PIP-II at FNAL

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ABSTRACT

The PIP-II Project will see international shipment of cryomodules from Europe to the United States, and as such, the shocks which can occur during shipment pose a risk to the internal components. Of particular concern is the coupler ceramic window and surrounding brazes, which will see stresses during an excitation event. Since the antenna design is new, and because of the setback failure would create, a cyclic stress test was devised for the antenna. This paper presents the experimental methods, setup, and results of the test.

INTRO / METHODS

Introduction
• Antenna will be horizontal during CM transport, can see perpendicular shocks of 5G+1G
• Antenna design is novel, having only one ceramic window separating the beamline volume from atmosphere

Methods
• Verify resonant behavior, estimate ring down time
• Estimate cycles at all shock levels experienced during transport
• Convert all shocks to an equivalent number of fully reversed displacement cycles to be applied to the antenna
• Apply cyclic displacement using an Arduino controlled tester

RESULTS & SUMMARY

RESONANCE
• Predicted: 37 Hz
• Measured: 39 Hz
• Decay: Approx. 1 sec for excitation to decay

Antenna completed 42,200 fully reversed cycles without damage. Transportation expected to occur without issue.