

LLRF System for the Fermilab PIP-II 650 MHz STC

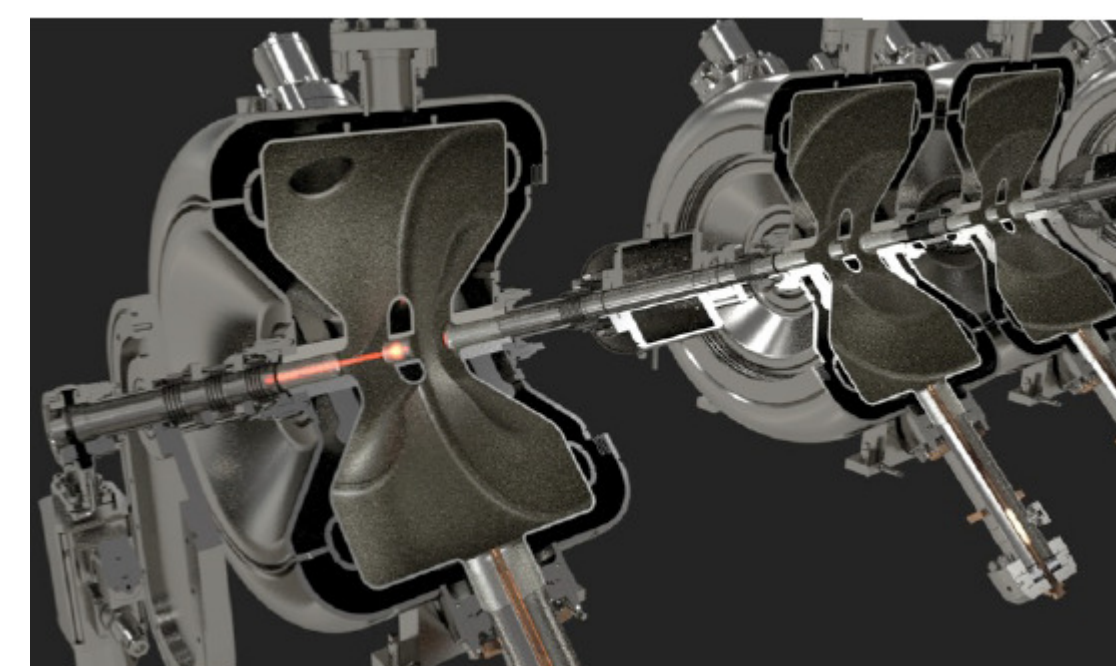
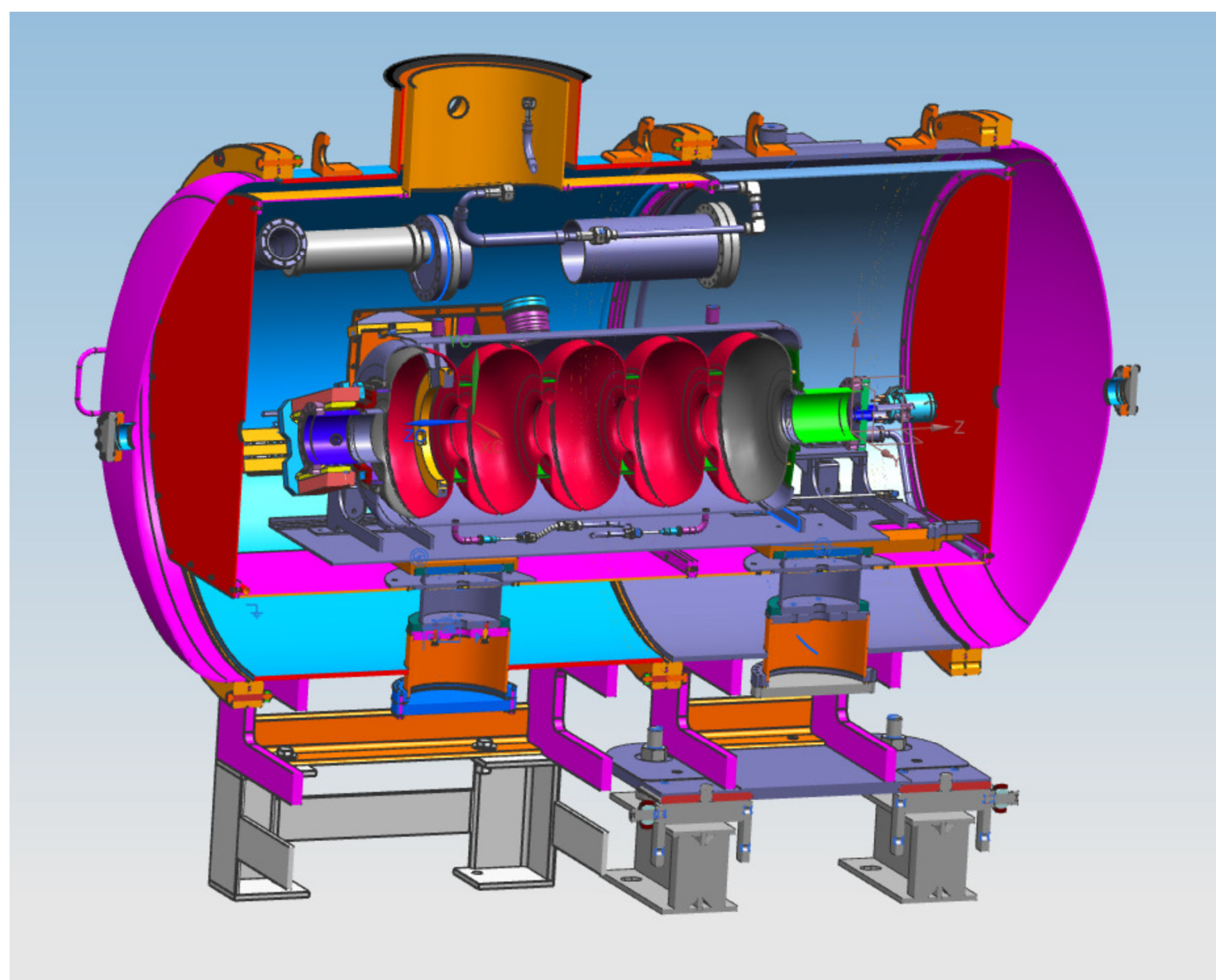
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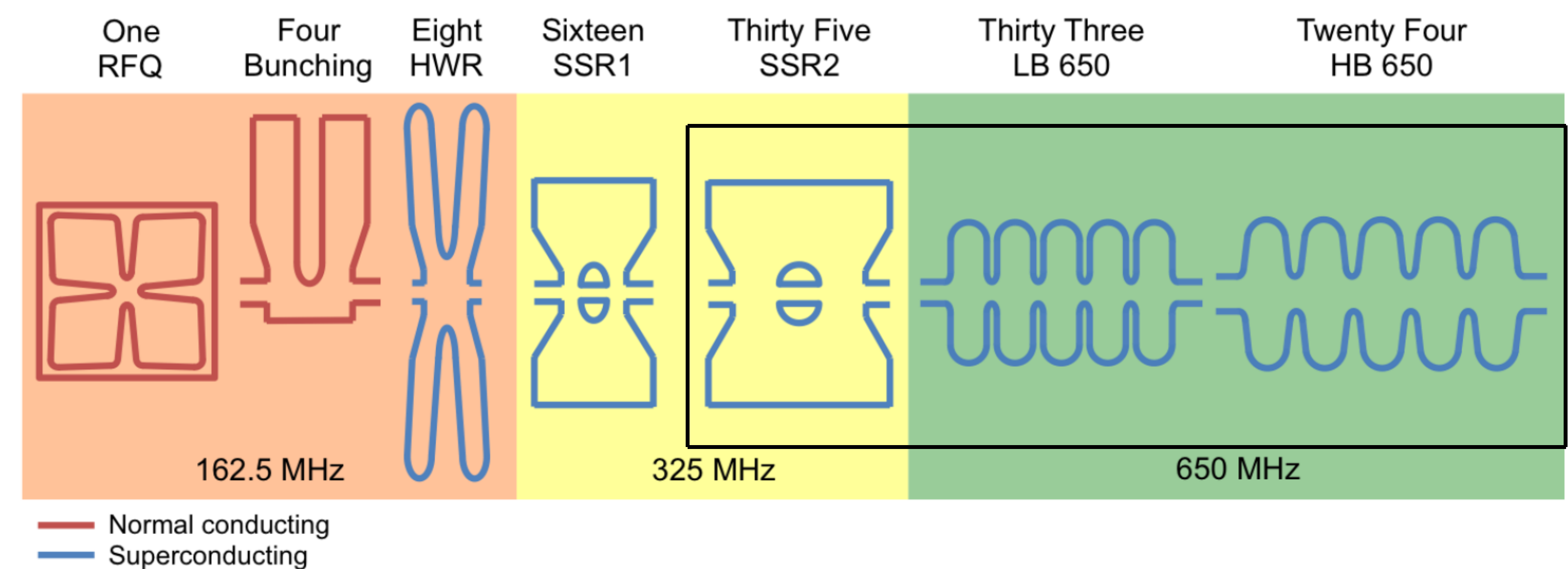
Introduction

The Spoke resonator Test Cave (STC) is being modified for testing the 325 MHz SSR2 and the 5-cell elliptical, Low Beta 650 MHz and High Beta 650 MHz cavities for the PIP-II project at Fermilab. The LLRF system for the test stand is described here. A Resonance Control system is also integrated with the LLRF system for developing microphonics control algorithms.

Test Stand with 650 MHz Cavity



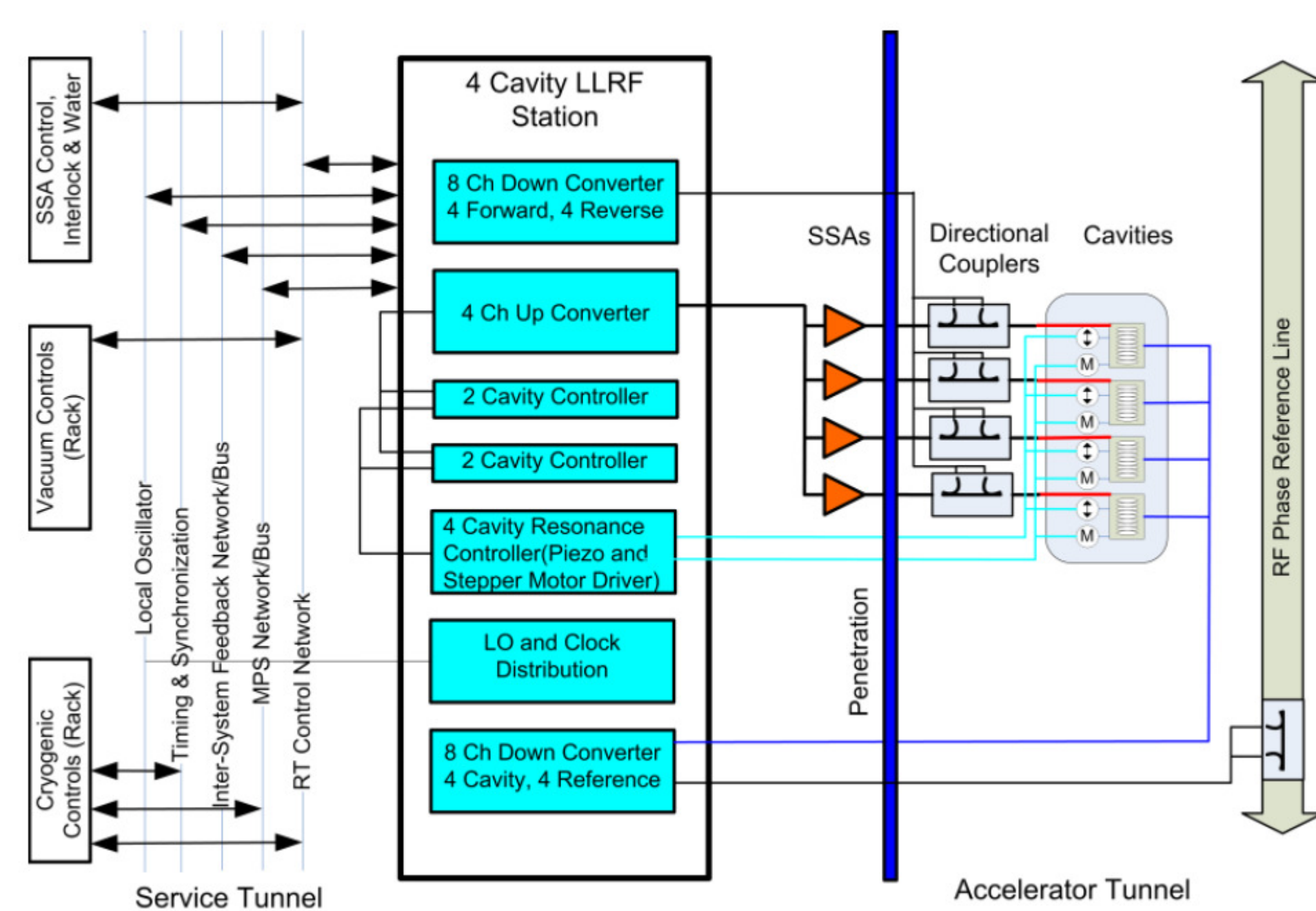
Overview of the PIP-II linac cavities



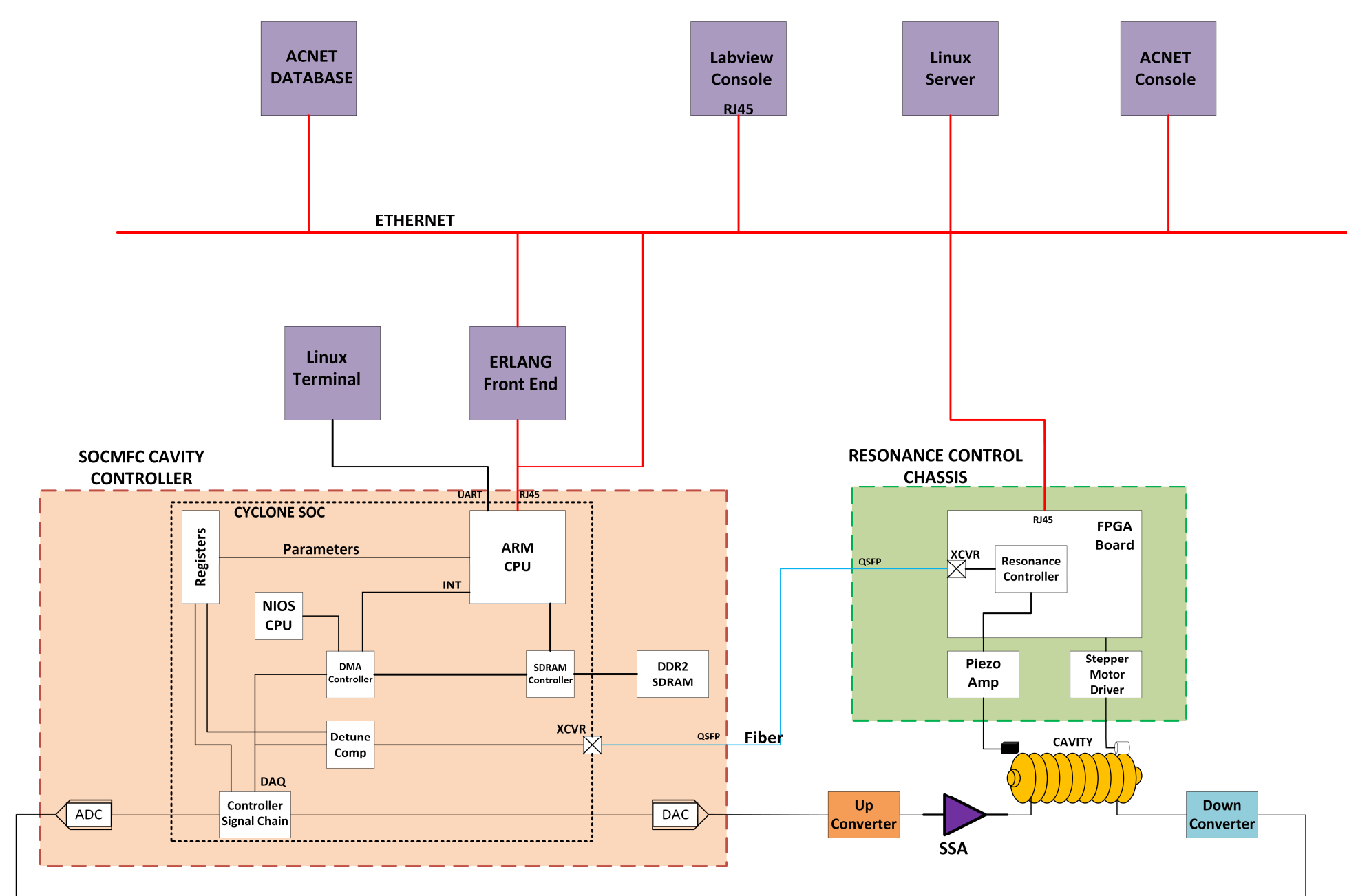
Test Station Requirements

- 650 MHz elliptical cavities will need to be qualified during horizontal test (with coupler, tuner, He vessel, magnetic shield) before cryomodule fabrication
- Testing of 325 MHz $\beta=0.22$, SSR1 and $\beta=0.47$ SSR2 cavities.
- LLRF system with RF Field control, Cavity Resonance Control, Data Acquisition system and capability to measure cavity parameters.

PIP-II LLRF Station

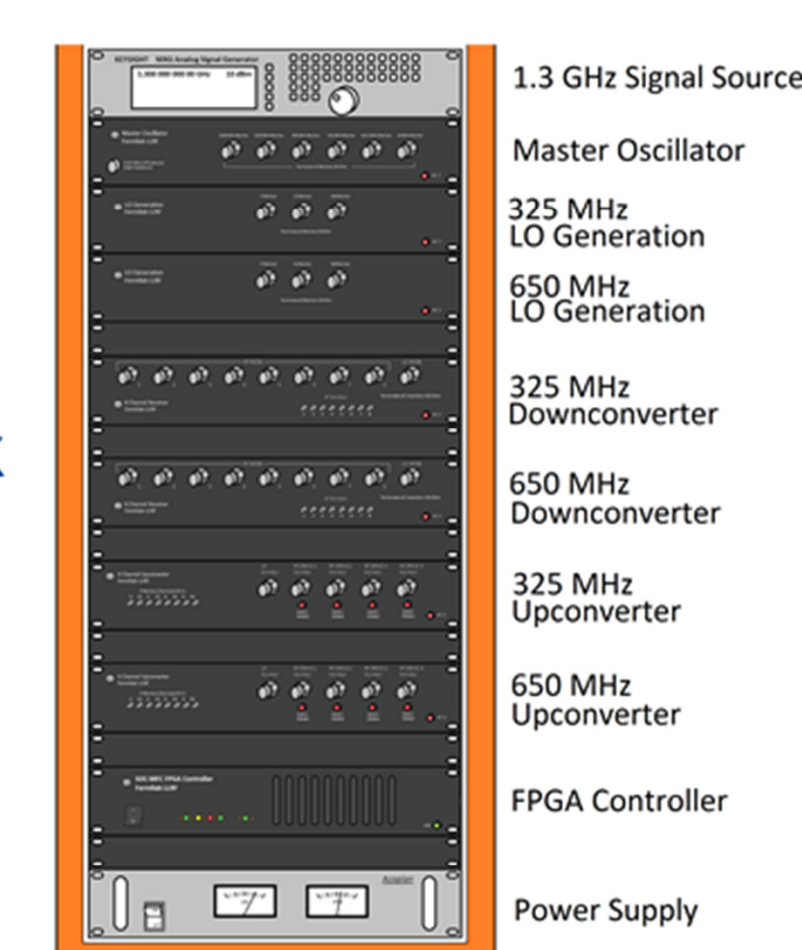


Signal Flow and Network Configuration



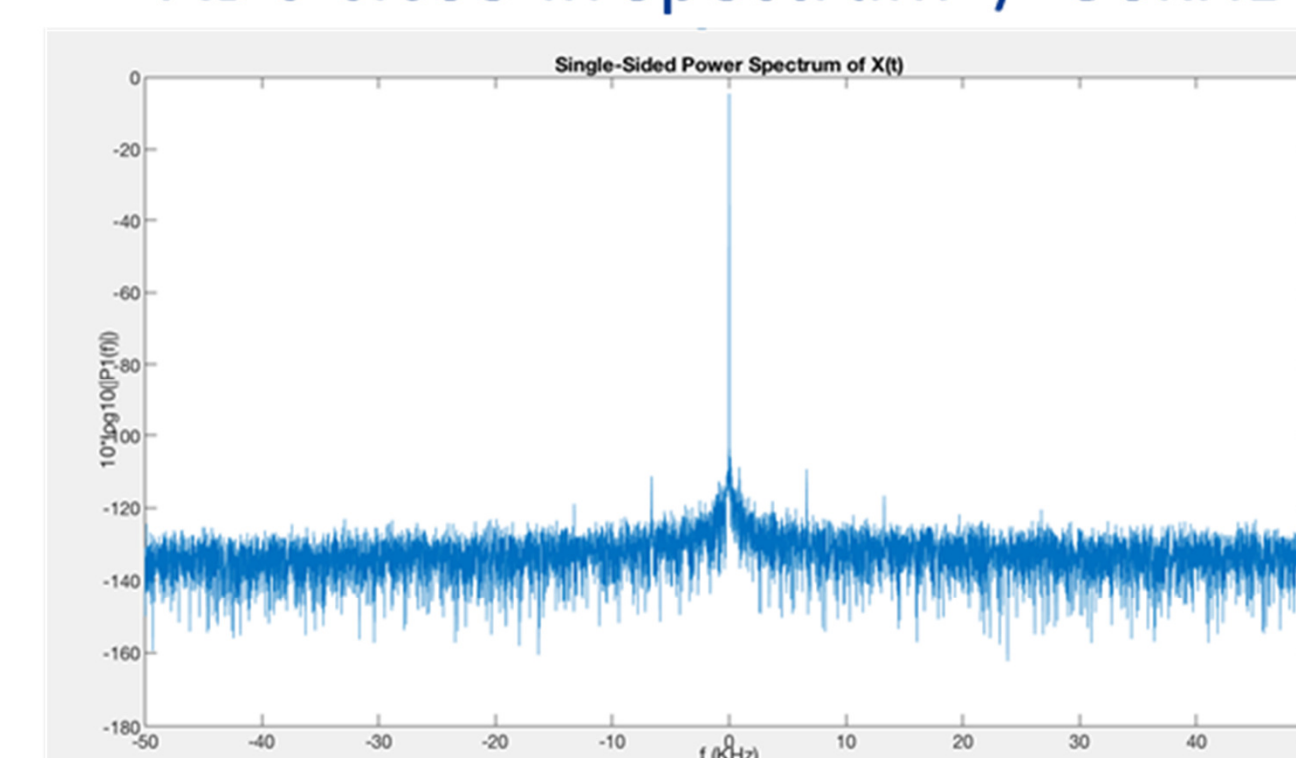
Test Stand Measurements

Test Rack

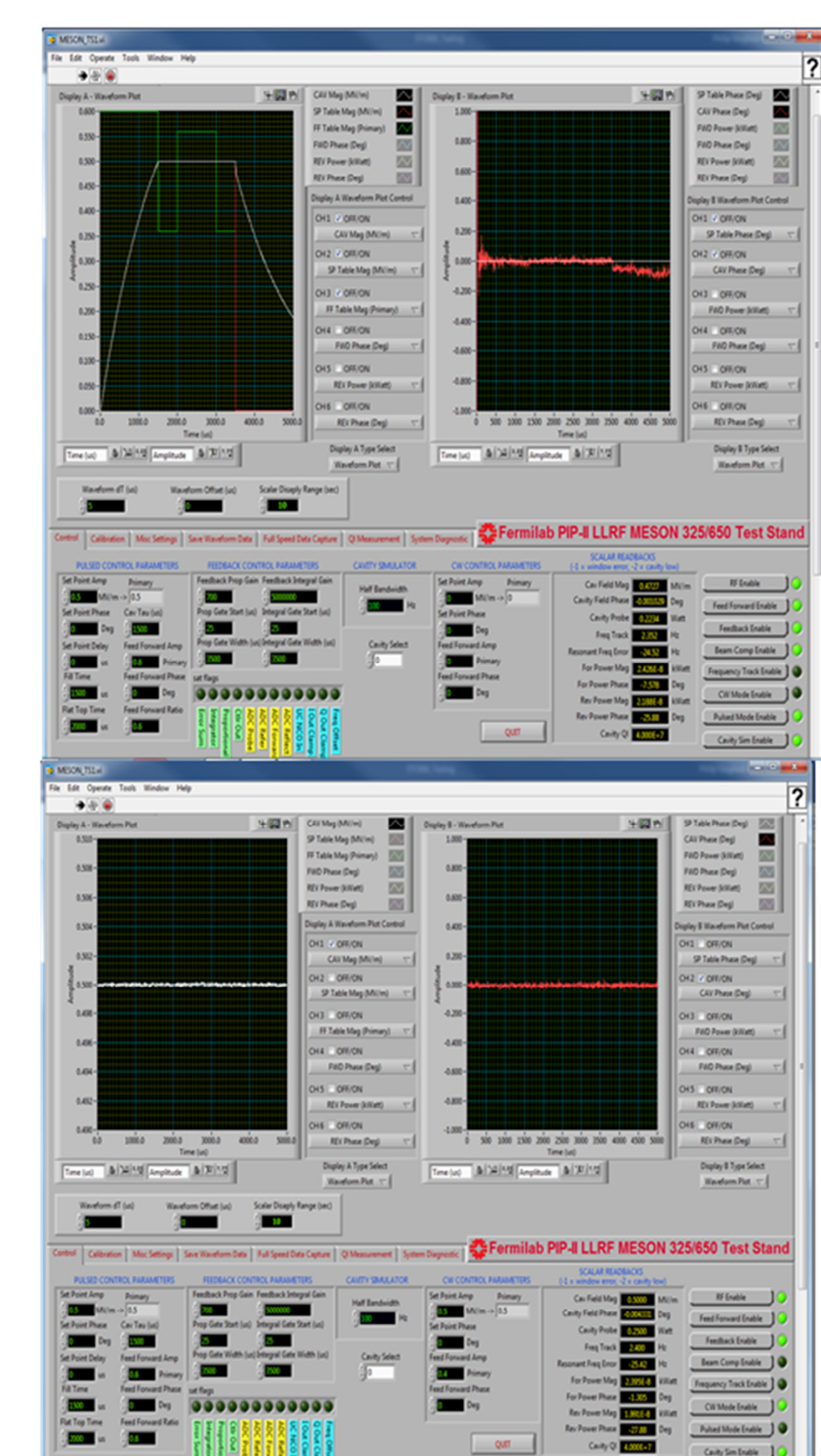


ADC Close-in Spectrum +/- 50kHz

dB FS



Pulse Mode
Feedback
With Beam
Loading
Compensation



CW
Mode with
Feedback

Summary

- System development is a collaboration between the Fermilab and LBNL LLRF teams.
- Hardware is also a mix of components developed for PIP-II as well as LCLS-II projects.
- Test stand LLRF system is ready for installation. Testing of the three different types of cavities will start with the High beta 650 MHz cavities.



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