Capture Cavity 2 Update

Testing at 4.5K

Tim Koeth
April 3rd
The CC2 Project

Capture Cavity 2 is a high gradient superconducting cavity destined to upgrade the Photoinjector to 40 MeV. This opportunity has been used for FNAL to learn the intricacies of SCRF work as well as to test FNAL facilities.

It is a collaborative effort:

- Tesla 9-Cell 1.3 GHz Cavity: DESY (33MV/m)
- Slow Tuner: Saclay & FNAL
- Cryo Vessel: IPN Orsay
- LLRF: DESY & FNAL
- Inside FNAL: AD, TD, CD
Calendar

Started Nov 2004
Approval for RF on Jan 17\textsuperscript{th} (2006)
RF into Input Coupler Jan 17\textsuperscript{th}
Coupler processing Jan 24\textsuperscript{th}
Cool down Feb 6\textsuperscript{th} (coupler still problematic)
Warm up Feb 16\textsuperscript{th}
More Coupler Processing: Feb - March
2\textsuperscript{nd} Cool Down March 13\textsuperscript{th}
CC2 Testing: Gradients, Dark Current, LLRF, Piezo & More
Warm up to begin 1.8K Installation: March 29\textsuperscript{th}
Understanding Input Coupler

We are operating at a bias of +1300 V on center conductor.
RF In CC2: Peak Gradient

Driving with a 1.38mSec (~100kW) square RF pulse: “Full Blast”

Q-loaded: 4.28E6

BLU = P-forward
YEL = P-reflected
RED = P-trans = gradient

~ 28MV/m
(any higher in gradient and cavity displays quenching)
RF In CC2: Dark Current

A Faraday Cup is installed at both ends of CC2's beam pipe.

Peak Dark Current: 50nAmps
RF In CC2: LLRF Control

Using DESY SimCon3.1 LLRF controller

BLU = P-Trans = Gradient
YEL = P-Ref
RED = P-Fwd

15MV/m
85kW
RF In CC2: LLRF Control

O’scope persistence set to 30 events:

BLU = P-Trans = Gradient
YEL = P-Ref
RED = P-Fwd

LLRF System compensated for frequency changes due to cryogenic pressure fluctuations.
RF In CC2: Piezo Fast Tuner

Lorentz force compensation with Piezo tuner
Piezo pulse: Single sine pulse; VHV=40V; F=185Hz = 5405usec; start 4140usec before cavity pulse

![Graph showing Lorentz force compensation with Piezo tuner. The graph plots Amplitude, V (from Diode) against Time, usec. The graph includes lines labeled 'Piezo=40V', 'Piezo-ON', and 'Piezo-Drive'. The graph highlights points a and b with annotations.](image_url)
Vibration Studies

The Piezo was used as a vibration sensor. The FFT above shows a dominant mechanical vibration at ~17Hz for this case. A dominant frequency of ~42Hz was observed during an earlier measurement.
Warm Up to Cool Down!

Warmed up CC2 last Wednesday (3/29) to allow Cryogenics Dept to prepare pumps for 1.8K operation.

1.8K in early May.