Fermilab MuCool Test Area Cavity Conditioning Control Using LabVIEW

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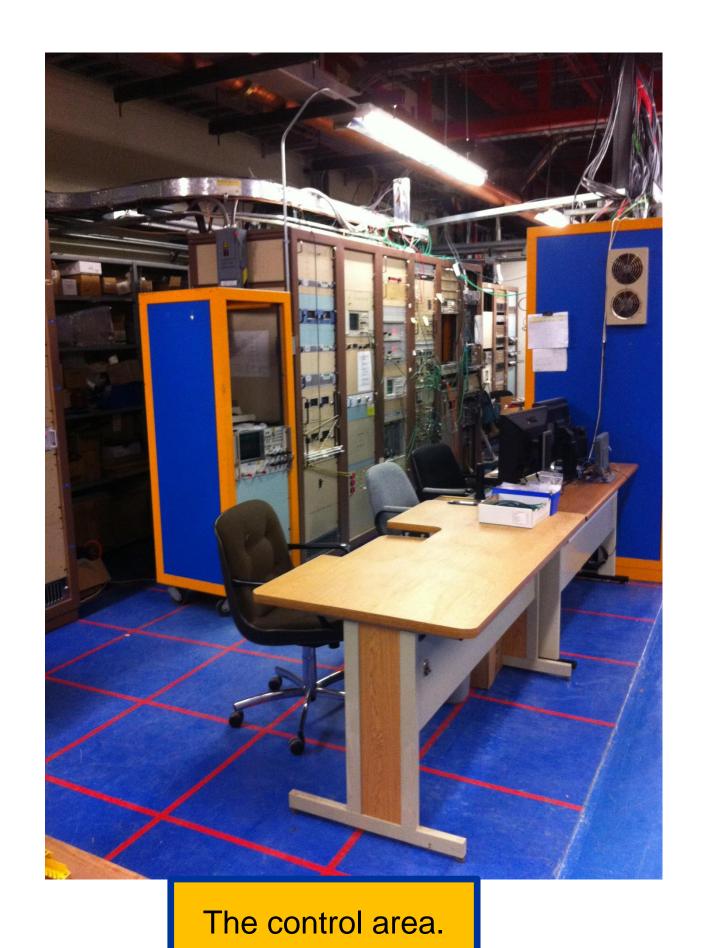Y. Torun, Illinois Institute of Technology, Chicago, IL 60616, USA

Automated RF cavity conditioning controls have been implemented in the Fermilab MuCool Test Area using National Instruments LabVIEW.
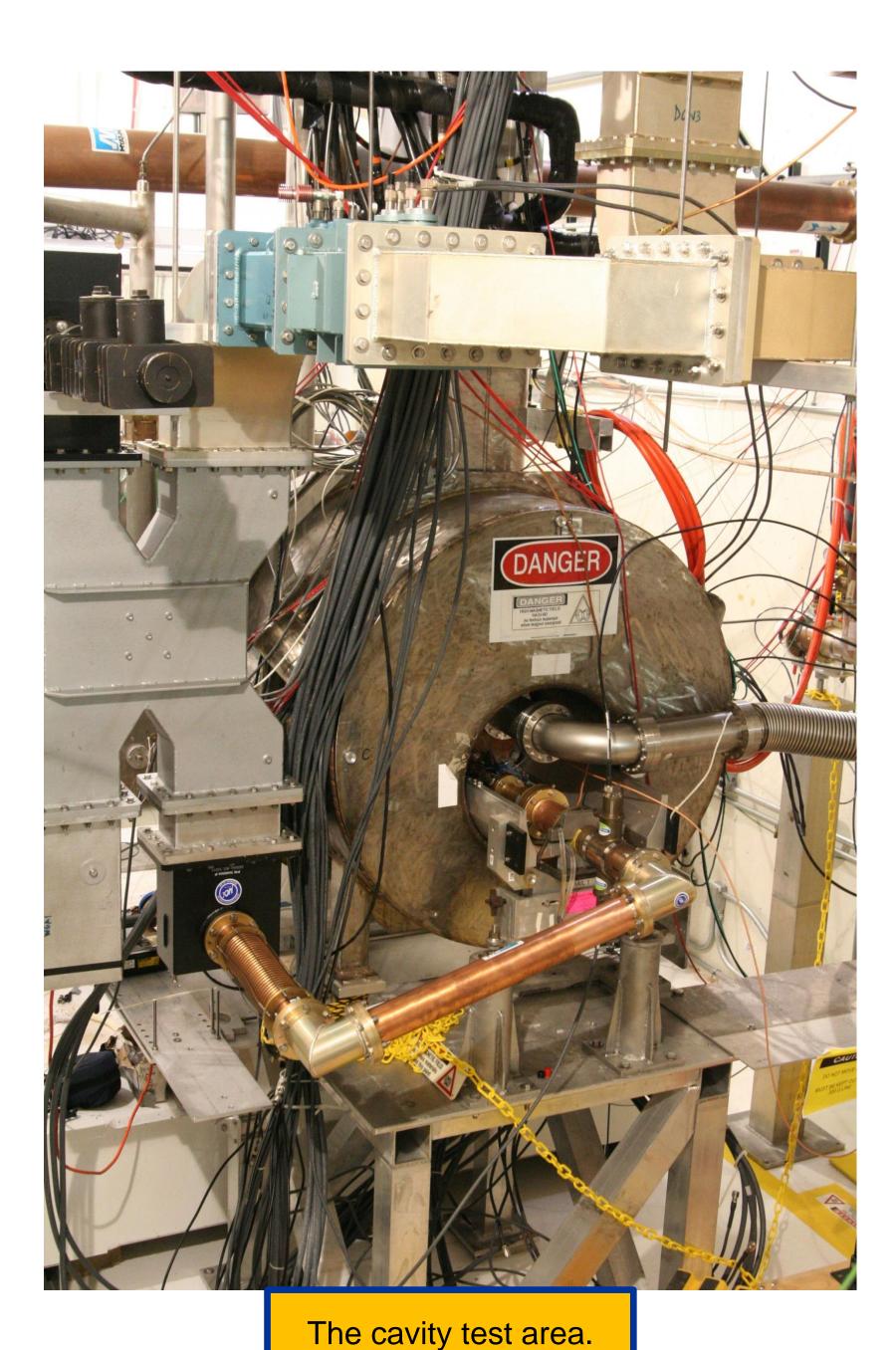
Display of RF parameters, cavity gradient and diagnostic signals are provided for real-time monitoring.

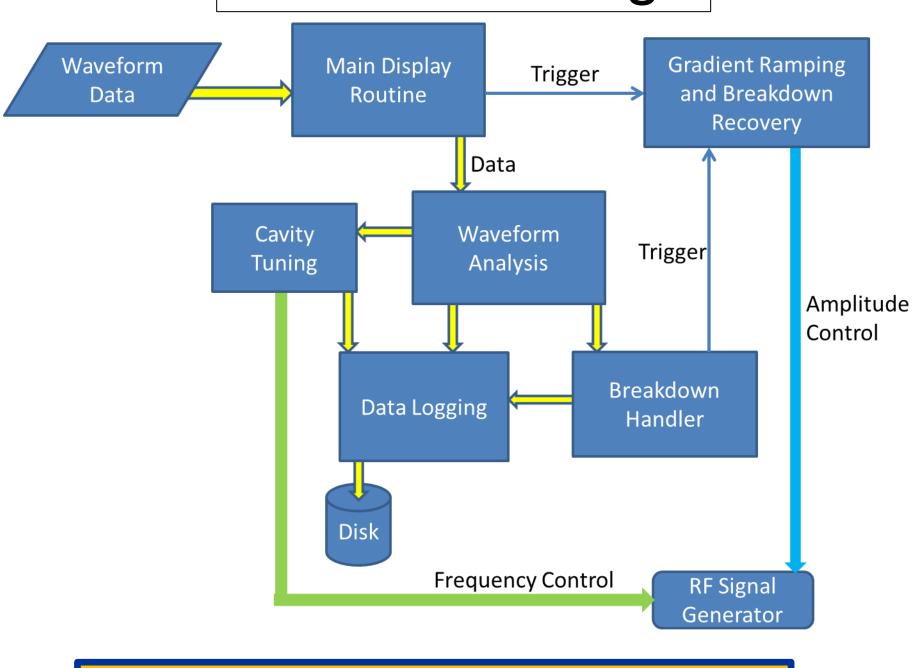Oscilloscope traces and operating parameters are logged automatically.

Gradient ramping and cavity breakdown detection allow unattended operation.

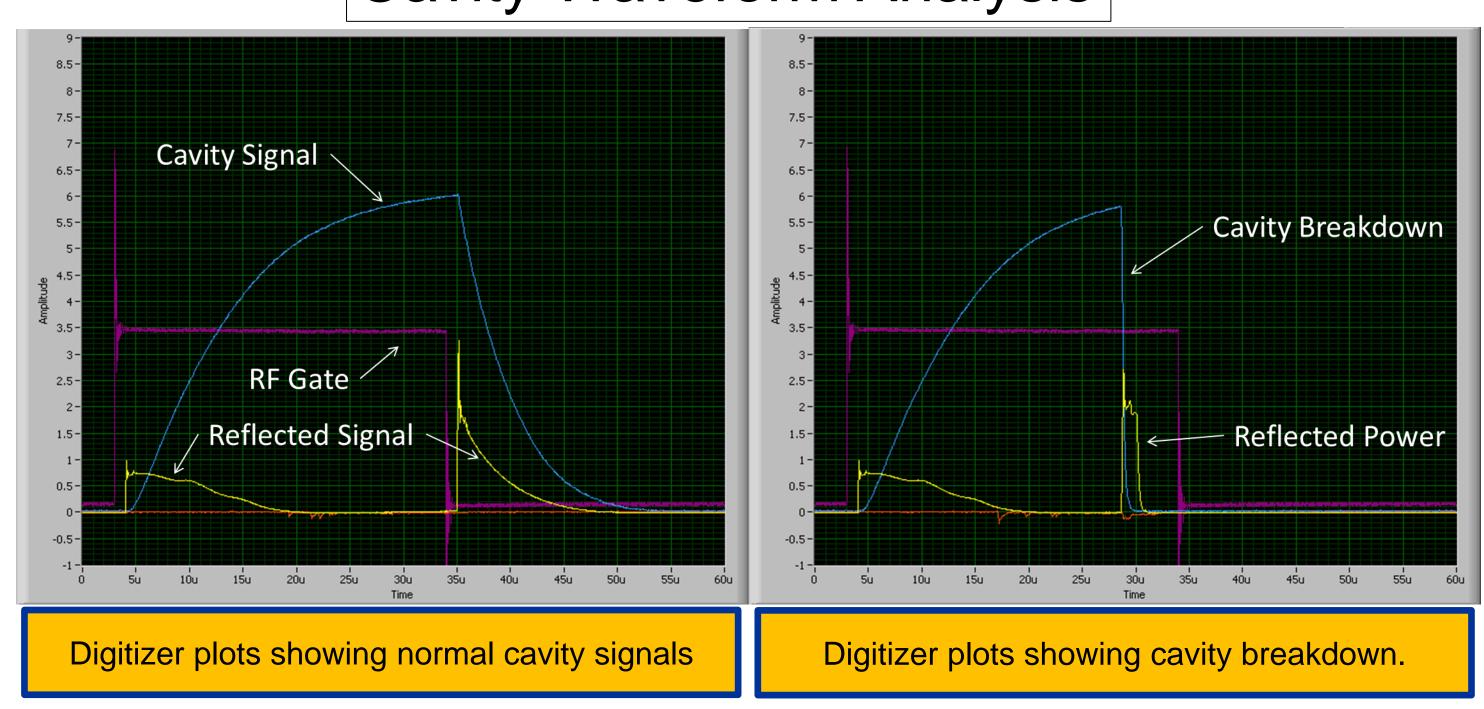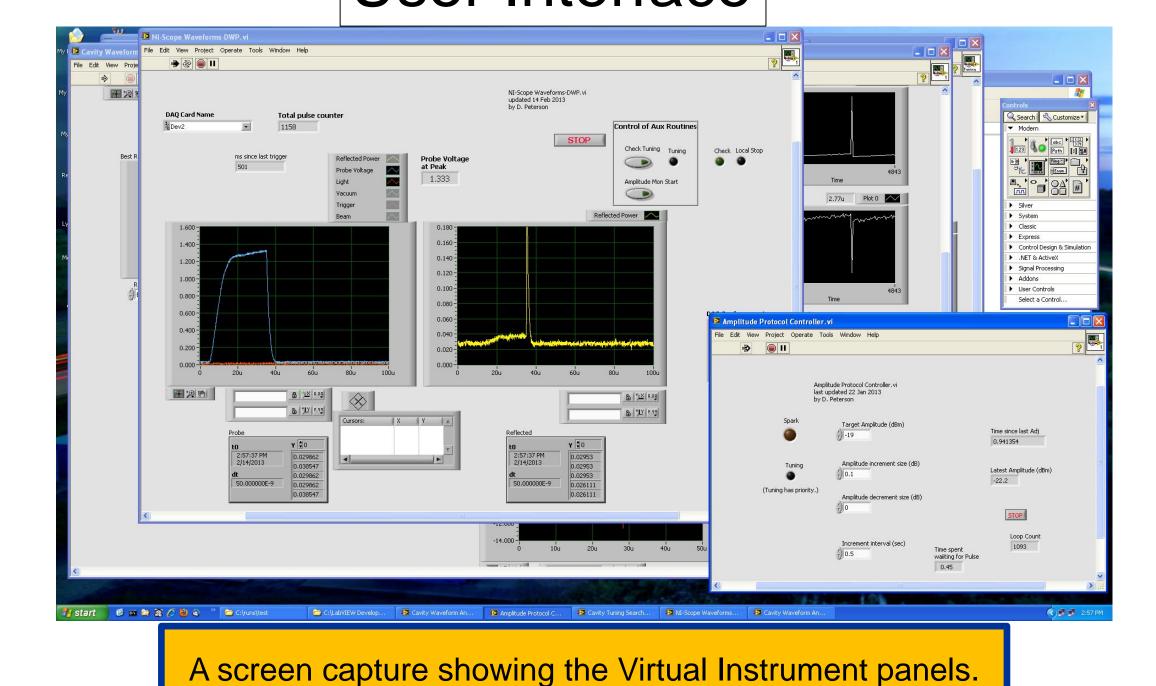Key parameters are made available to the Fermilab ACNET system for viewing by users.

The control area.

The cavity test area.

Software Design

A simplified flow chart of the program structure.

Cavity Waveform Analysis

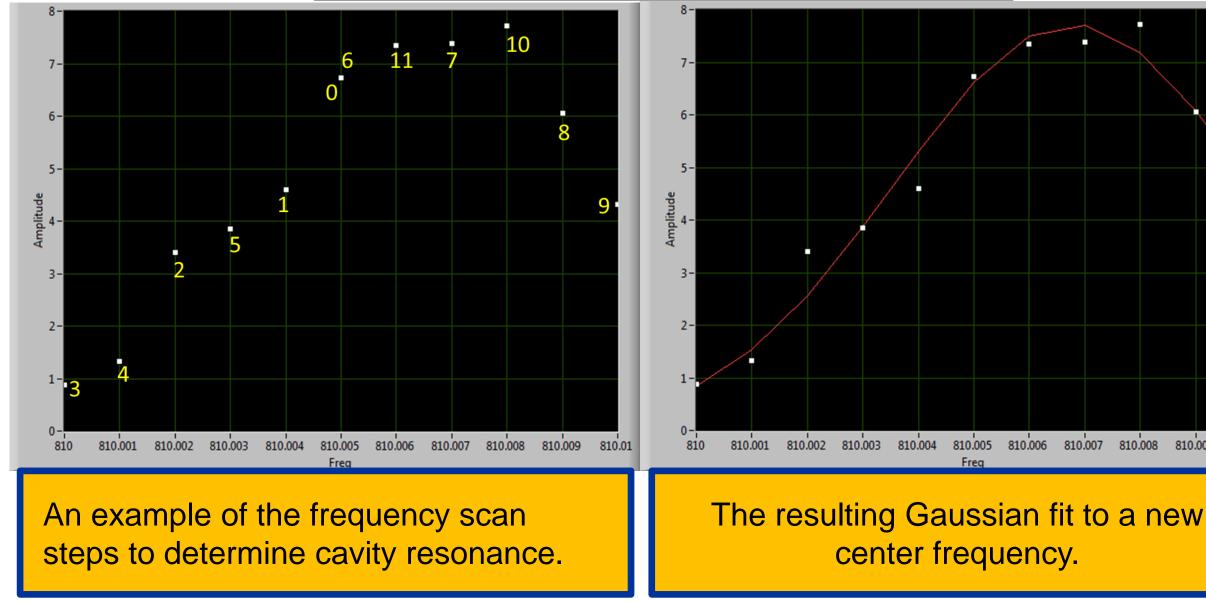Digitizer plots showing normal cavity signals.

Digitizer plots showing cavity breakdown.

User Interface

A screen capture showing the Virtual Instrument panels.

Cavity Breakdown Detection

Photo detector pulse at cavity breakdown.

Cavity Tuning Algorithm

An example of the frequency scan steps to determine cavity resonance.

The resulting Gaussian fit to a new center frequency.

Recording to Disk in a Circular Buffer

A sequence of frames from the circular buffer showing a normal pulse, a small breakdown in the tail of the next pulse and a full power breakdown during the third pulse.

Gradient Ramping and Breakdown Recovery

```
14:28:57.284, 45801, Tuning, Success
14:28:57.334, 45802, SigGen Freq, 800.560454
14:28:57.334, 45802, SigGen Ampl, -11.500000
14:29:03.563, 45864, SigGen Ampl, -11.600000
14:29:07.338, 45902, Probe Peak, 1.150167
14:29:07.338, 45902, Probe/Refl in Gate, 7.959854
14:29:07.338, 45902, Gate Start, 60
14:29:07.338, 45902, Gate End, 682
14:29:07.338, 45902, Peak Index, 582
14:29:07.338, 45902, Rise Tau, -1.209027E+0
14:29:07.338, 45902, Decay Tau, -17.215701E+0
14:29:07.338, 45902, P/R after Gate, 9.959027
14:29:07.338, 45902, Rise Slope, 72709.376049
14:29:07.338, 45902, Fall Slope, 927530.817165
14:29:07.338, 45902, Rise Dur, 12.517500E-6
14:29:07.338, 45902, Fall Dur, 981.250000E-9
14:29:07.388, 45902, Sparkl, 2, Duration, Light
14:29:11.354, 45902, SigGen Ampl, -14.600000
14:29:18.734, 45976, SigGen Ampl, -14.500000
14:29:22.480, 46013, SigGen Ampl, -14.400000
14:29:25.183, 46040, SigGen Ampl, -14.300000
14:29:31.132, 46100, SigGen Ampl, -14.200000
14:29:37.271, 46161, SigGen Ampl, -14.100000
14:29:43.339, 46222, SigGen Ampl, -14.000000
14:29:49.528, 46284, SigGen Ampl, -13.900000
14:29:55.547, 46344, SigGen Ampl, -13.800000
14:30:01.635, 46405, SigGen Ampl, -13.700000
14:30:07.814, 46467, SigGen Ampl, -13.600000
14:30:13.913, 46528, SigGen Ampl, -13.500000
14:30:20.152, 46590, SigGen Ampl, -13.400000
14:30:26.130, 46649, SigGen Ampl, -13.300000
14:30:32.209, 46710, SigGen Ampl, -13.200000
14:30:41.222, 46800, Periodic Capture
14:30:41.222, 46800, Probe Peak, 0.907000
14:30:41.222, 46800, Probe/Refl in Gate, 67.296641
14:30:41.222, 46800, Gate Start, 60
14:30:41.222, 46800, Gate End, 683
14:30:41.222, 46800, Peak Index, 661
14:30:41.222, 46800, Rise Tau, -8.889809E-6
14:30:41.222, 46800, Decay Tau, -170.369244E-3
14:30:41.222, 46800, P/R after Gate, 49.130153
14:30:41.222, 46800, Rise Slope, 52129.372214
14:30:41.222, 46800, Fall Slope, 260979.562563
14:30:41.222, 46800, Rise Dur, 13.727500E-6
14:30:41.222, 46800, Fall Dur, 2.742000E-6
14:31:00.359, 46991, Tuning, Success
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An example of a log file record of breakdown amplitude change and gradient ramping.

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