Fermi National Accelerator Laboratory

SRF2011 CHICAGO

Horizontal SRF Cavity Testing at Fermilab

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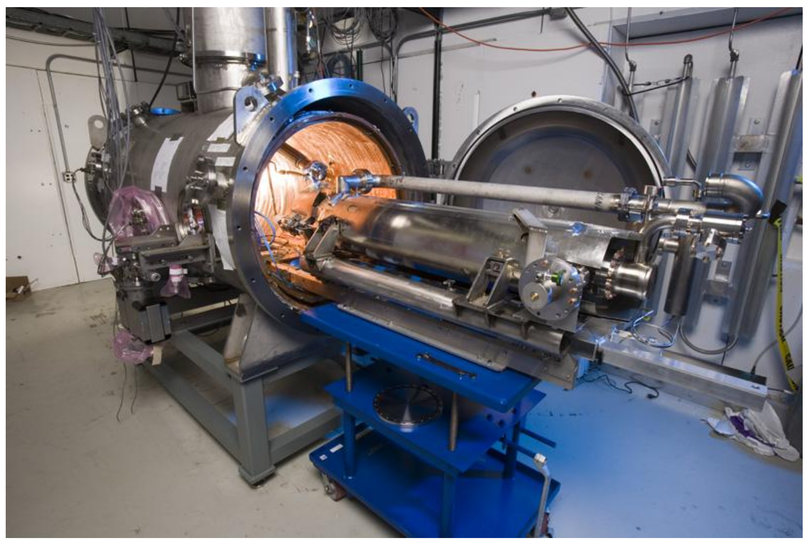
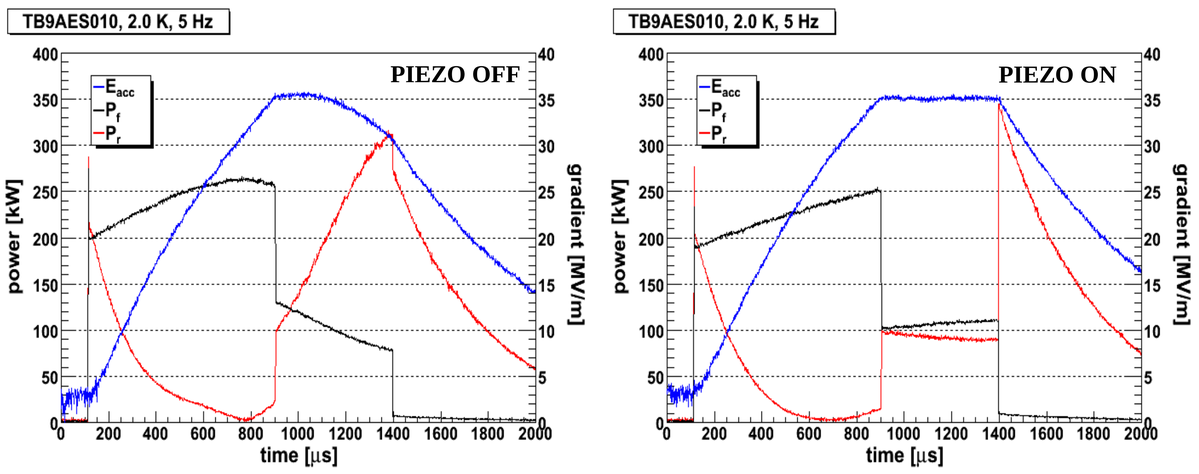
Fermilab makes use of a single-cavity test cryostat to assess the performance of dressed superconducting RF cavities using pulsed high-power RF before they are assembled into a cryomodule. Cavity performance is evaluated in terms of accelerating gradient, unloaded quality factor, and field emission. The functionality of auxiliary components such as tuners and fundamental power couplers is also verified. The latest results from extensive testing of nine-cell 1.3 GHz cavities are presented here, along with a discussion of future extensions of the horizontal test program to include 650 MHz cavities and continuous wave testing.



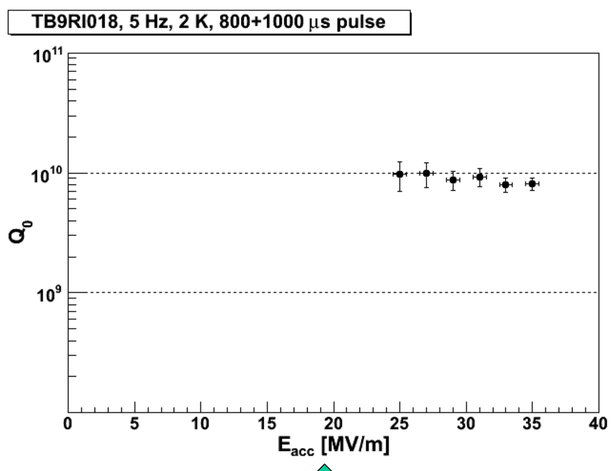
A dressed cavity ready to be installed in the Horizontal Test Cryostat.

Cavity	Max E_{acc} (MV/m)	Q_0 at max E_{acc} (x 10^{10})	Field Emission
TB9AES004	31	1.1	Little
TB9ACC013 (test 1)	>35	1.2	Heavy
TB9AES009	35	0.7	None
ACCEL8	31	1.1	None
TB9ACC013 (test 2)	20	N/A	Heavy
TB9AES010	>35	1.4	Little
TB9AES008	>35	0.9	Moderate
TB9ACC016	19	0.0055	Moderate
TB9RI029	29	0.7	Little
TB9AES007	33	0.8	Moderate
TB9RI018 (test 1)	>35	0.8	Little
TB9RI018 (test 2)	>35	N/A	Heavy
TB9RI019	>35	0.7	Little
TB9RI018 (test 3)	>35	0.4	Little
TB9RI024	34.5	0.5	Heavy
TB9RI027	>35	0.4	Little

Summary of all dressed cavity tests. TB9ACC013 and TB9ACC016 experienced failures of the copper plating in their input couplers. TB9AES007 and TB9RI024 had FE problems that are being investigated. TB9RI029 quenched early for unknown reasons. All other cavities performed as well as they did in their vertical tests.

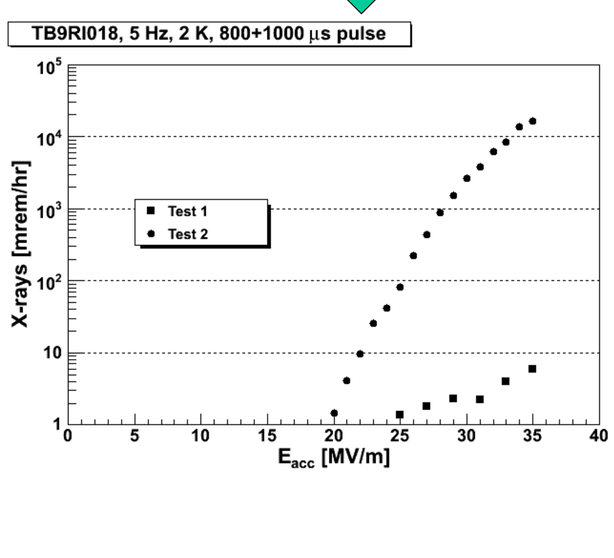


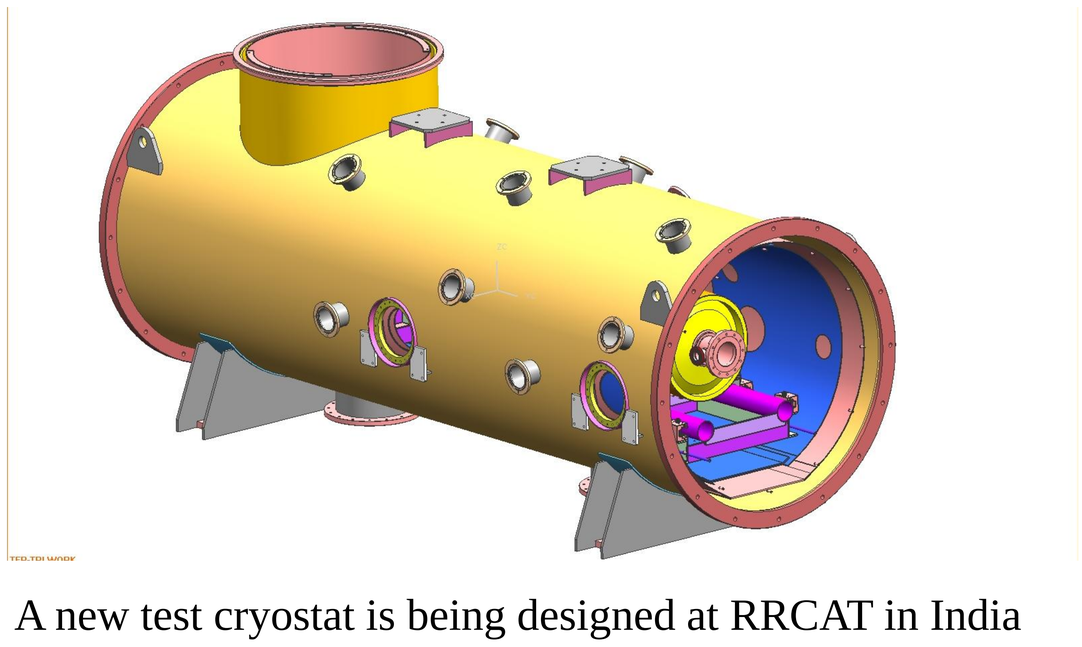
Compensation of Lorentz force detuning at 35 MV/m using fast piezoelectric tuners.



Measurements of the dynamic heat load dissipated to the cryo system are made for several different gradient points. These measurements are used to determine the cavity's unloaded quality factor Q_0.

An X-ray detector located on the "beam axis" just outside the cryostat on the cavity's input coupler end provides FE diagnostics. The plot below shows an example of a cavity exhibiting "heavy" field emission and "little" field emission.





A new test cryostat is being designed at RRCAT in India that will be long enough to house two cavities or a cavity + magnet package. The new facility (HTS2) will support tests of both 650 MHz and 1.3 GHz cavities and will be capable of both CW and pulsed testing.