Note on Vertical Test Results of Cavity NR-4

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1/15/09

Cavity NR-4, a single-cell Tesla-shape cavity manufactured by the Niowave-Roark collaboration, was tested at the Fermilab VCTF on 1/14/09. The cavity had previously undergone BCP, HPR, and assembly at Cornell, and when tested there reached a maximum gradient of 27.4 MV/m, limited by Q-drop (power). At Fermilab the cavity was ultrasonically cleaned, HPR'd for 140 minutes (on two days) and assembled at the new FNAL/ANL cavity processing facility. The sealed cavity was then transported to the A0 facility (since the pumping station at the FNAL/ANL facility has not yet been commissioned), where it was evacuated and leak checked . The cavity was then brought to IB1 and installed on the test stand, connected to the test stand vacuum system, and kept under vacuum.

The cavity was cooled down to 2.05K (25 torr) and CW measurements of Q_0 vs E performed. The cavity exhibited a soft multipacting barrier between 19-21 MV/m, which was eventually breached after ~5-10 minutes of CW RF processing. After breaching the MP barrier, the low field Q_0 (below the MP barrier) was found to have been decreased by about 5%, potentially as a result of this processing (see Figure 1). The cavity reached a maximum field of 28.7 MV/m with a Q_0 there of 1.27×10^9. The cavity performance was limited by Q-drop (power dissipation), with stronger Q-drop beginning about 20 MV/m. The ultimate cavity performance after breaching the MP barrier is shown in Figure 2. These FNAL measurement results are compared to the previous Cornell data in Figure 3. Excellent agreement is observed.

Except for a very brief burst of radiation while in the MP barrier, this cavity exhibited NO Field Emission at all during these measurements. This is in contrast to recent tests of cavities that were either re-processed or assembled at FNAL facilities. This cavity represents the first attempt to HPR and assemble a cavity at the newly commissioned joint ANL/FNAL cavity processing facility and, while this is only the first of undoubtedly many cavities that will undergo processing and testing, the FE-free performance of this cavity indicates that the facility infrastructure and water quality are presently capable of yielding clean cavity surfaces up to ~30MV/m. Additionally, the procedures, techniques, and tooling used by Genfa and Damon, who assembled the cavity, are also sufficiently robust and refined to yield excellent field emission performance. It is important, as we move forward with cavity processing at this facility, to ensure that the procedures that were followed for this cavity processing and assembly are well and accurately documented, routinely followed with a high degree of discipline, and used to train others who will engage in this activity, in order to maximize the opportunity for reproducibly good results.

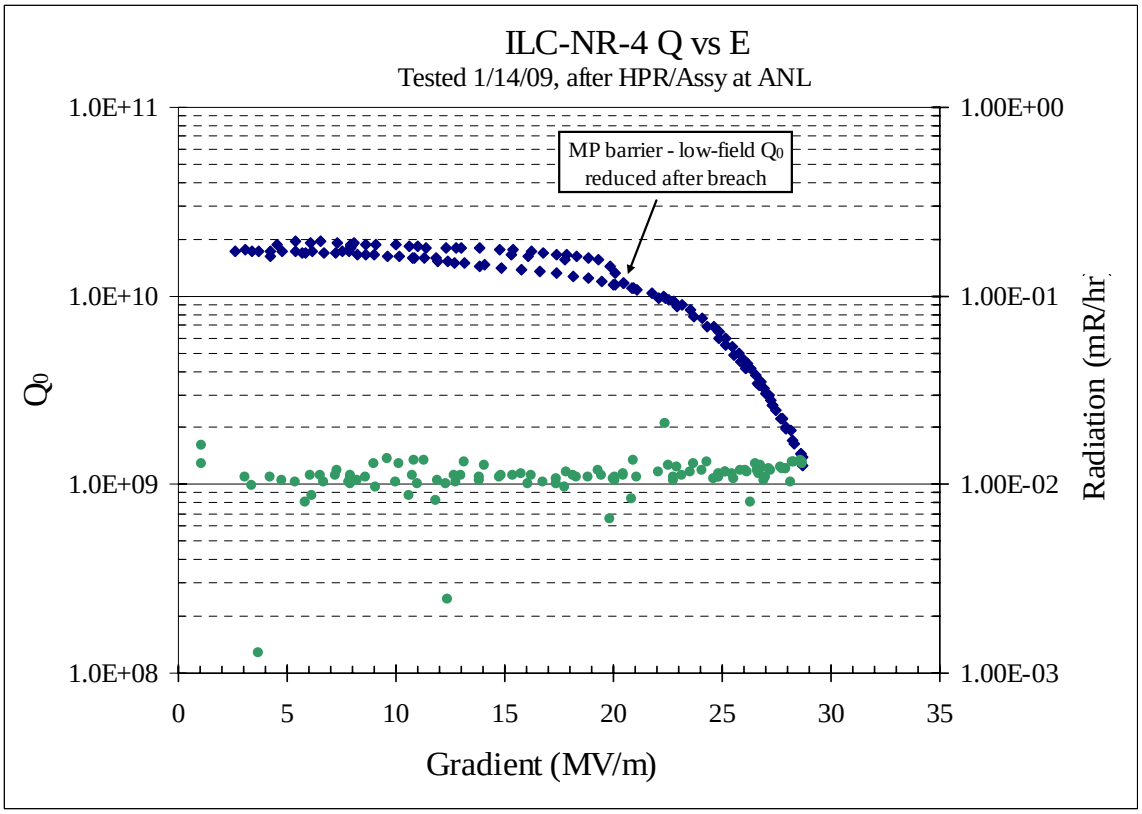

Figure 1.) Initial Q_0 vs E run at 2K.

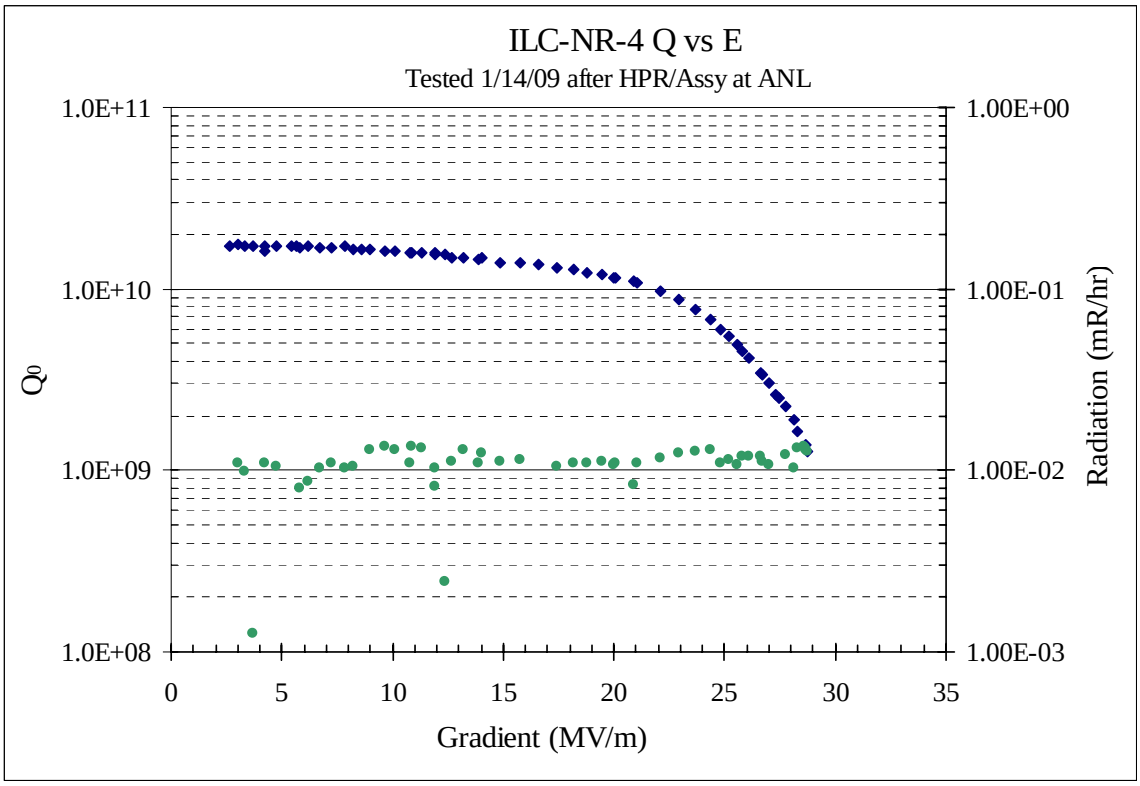

Figure 2.) Q_0 vs E at 2K, after breaching MP barrier

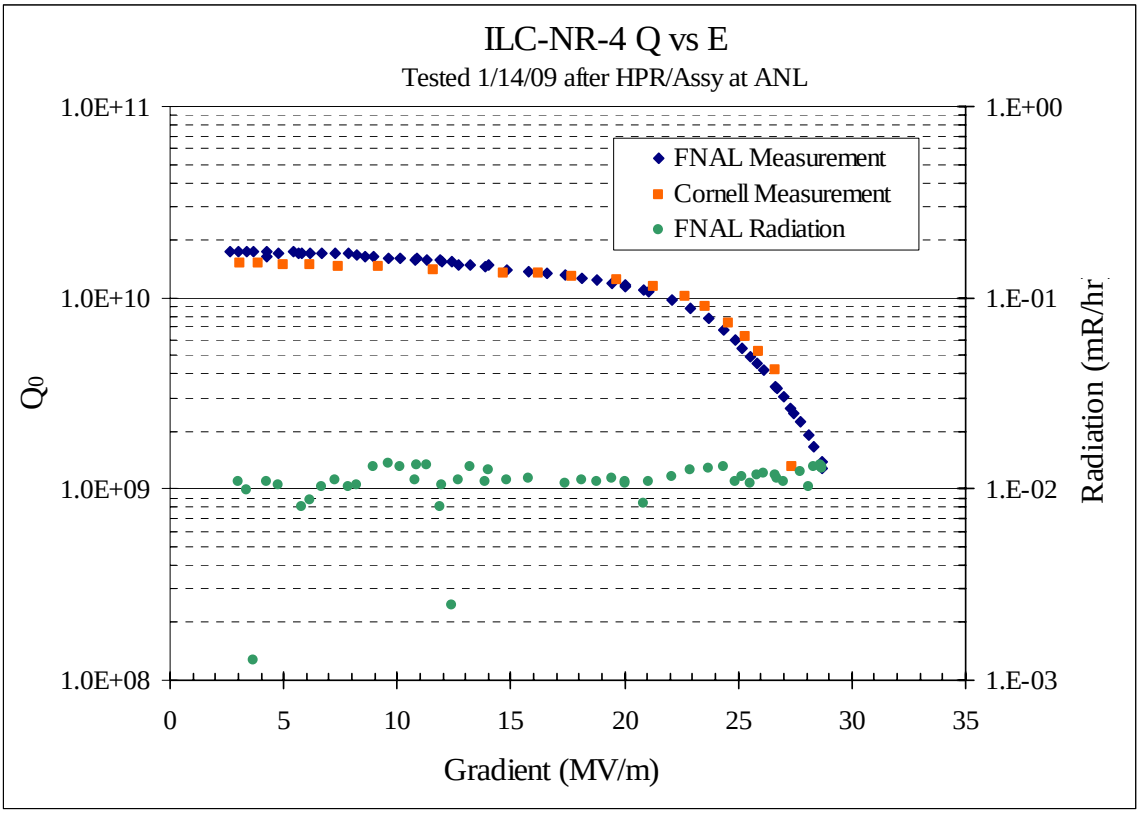

Figure 3.) Final Q_0 vs E run at 2K at FNAL, compared to Cornell data from 2008.