Note on Vertical Test Results of Cavity NR-1 – Part II

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A re-test of cavity NR-1 was completed today. The single-cell diode thermometry system and several photodiodes were added to the cavity after its initial test on 11/14/08. An attempt to re-test this cavity on 11/21 was aborted due to difficulty encountered in getting the RF system to lock onto the cavity reliably. This was traced to a loose RF connector at the cavity input coupler that may have been affected when the thermometry or photodiodes were added to the cavity, or simply due to thermal cycling. As a precautionary measure, both the input and transmitted power RF cables were replaced for this test. (As an aside, TDR and attenuation measurements on the cables removed from the top plate did not indicate any faults.)

The cavity was cooled directly to 2K and a Q_0 vs E curve taken. The cavity was limited by a FE-induced quench at 26.5MV/m (see Figure 1). Some instances of a (soft) multipacting barrier were seen at about 19-20MV/m; this barrier was breached relatively quickly. The difference between the limiting gradient in this test and the one recorded on 11/14 has been traced to an erroneous value of Kappa[†] used in the calculation of gradient. Apparently the cavity type chosen on 11/14 for the Q_0 vs E CW run was mistakenly picked as "9-cell" instead of "1-cell", so all gradient calculations performed during CW testing at 2K on 11/14 are off by a factor equal to the ratio of Kappas (3.00). When the data for 11/14 are corrected for this, they agree with the data taken on 11/26/08 (see Figure 2). The cavity performance after electropolishing has been degraded from a maximum of 28 MV/m (limited by non-FE quench or low-Q) measured after BCP at Cornell, to a maximum of 26.5MV/m, limited by FE-induced quench. While this is not as severe as first thought (when the cavity limit was thought to be 8.5MV/m), the conclusions from the earlier test remains valid. Field emission is the primary source of performance limitations for cavities processed/assembled or re-assembled at ANL/FNAL.

While Q_0 vs E data were taken at 2K, several thermometer (single-cell diode system) and photodiode scans at various cavity field levels were recorded. Data are not yet available from these runs.

[†] Kappa is defined as $(\sqrt{(R/Q)})/L_{acc}$ where R/Q is the shunt impedance (in Ω) and L_{eff} is the accelerating length (in m).

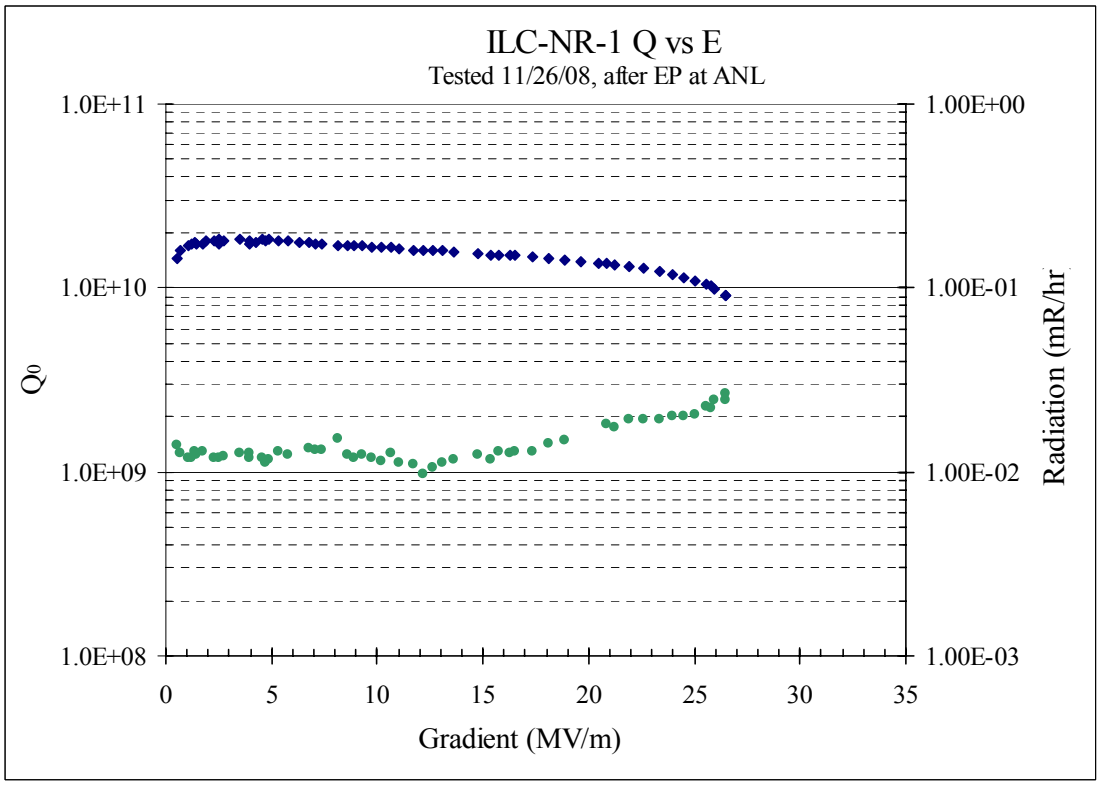

Figure 1.) Q_0 vs E at 2K.

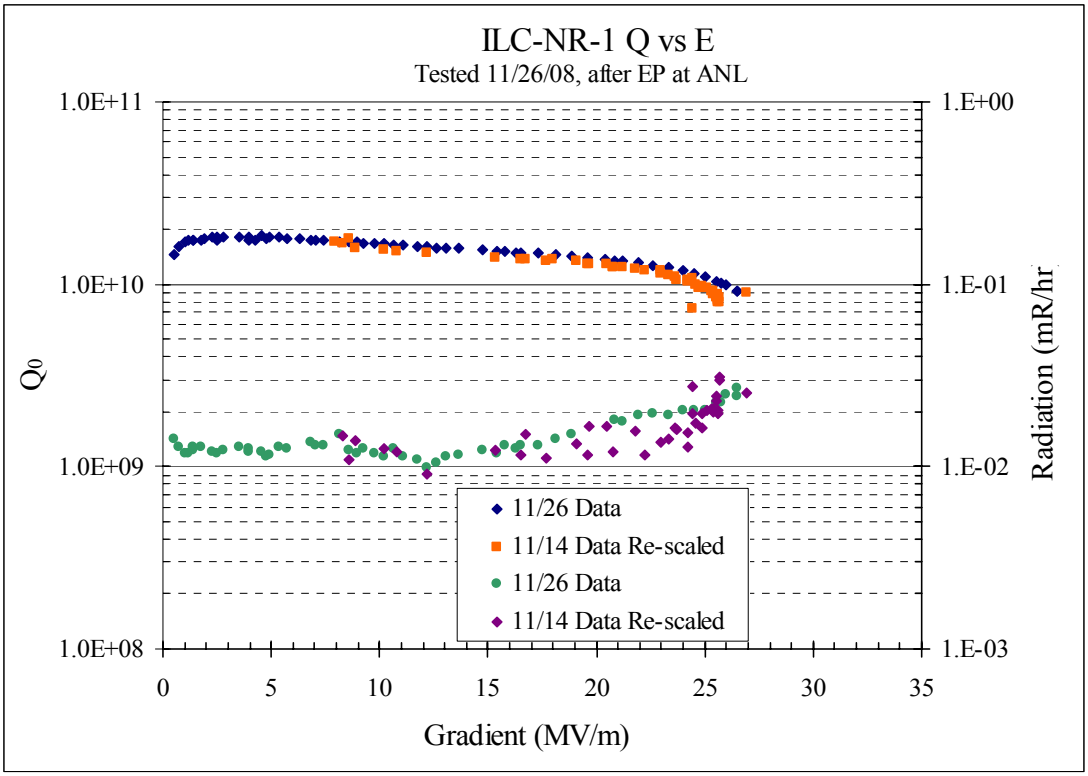

Figure 2.) Q_0 vs E at 2K, showing data from 11/16 and corrected data from 11/14.