NLC-Note 15
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Distribution: RF/Parameters

RF and Beam Loading Parameters for the NLC Detuned Structure with Damping Manifold

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Attached is a figure showing the unloaded and beam loaded gradient in the NLC detuned structure with damping manifold. The effect of the damping manifold was modeled by reducing the Q of cavities 1 through 106 by -2-l/2%, then tapering the Q linearly to -5% at the end of the structure. This corresponds to an average Q reduction of 3.1%. The effect of a uniform 3.0% reduction in Q was also calculated. The results are summarized in the table below. The parameters without damping manifold are those reported in NLC Note-4 (Rev. 1). Here $\bar{G}_0$, $\bar{G}_b$ and $\bar{G}_L$ are the unloaded, beam-induced and loaded ($\bar{G}_L = \bar{G}_0 - \bar{G}_b$) gradients averaged over the length of the section. The numbers in the table are based on $\bar{G}_0 = 50$ MV/m. The last column gives the percent change for the tapered case compared to the structure without a manifold.

RF Parameters for Three NLC Structures

	Without manifold	3% Q reduction	Taped Q reduction	Percent change
τ	0.57	.533	.535	+3.5%
$\hat{P}$/meter (MW/m)	48.81	49.48	49.42	+1.25%
p/section (MW)	87.95	89.16	89.05	+1.25%
$\bar{G}_b$ (MV/m)	12.79	12.73	12.73	-0.5%
$\bar{G}_L$ (MV/m)	37.20	37.27	37.27	+0.2%

The present NLC parameter list at 500 GeV is based on a peak rf power of 50 MW/m for a gradient of 50 MV/m. Thus there is a slight overhead of 50/49.42 = + 1.2% compared to the power actually needed. However, the cell Q's are based on the theoretical surface resistance for a perfect copper surface, as calculated by URMEL or SUPERFISH. The Q of a real copper cavity is always less than this theoretical value. We note from the above table that a 3% reduction in Q requires a 1.37% increase in peak power. Thus the 1.2% power overhead allows for a 2.6% further reduction in Q in the NLC structure due to imperfect surfaces. However, the actual Q reduction is likely to be somewhat greater.

0= 89.16 MW p0= 49.41) MW/m RO= 91.01 Rb=).86 RL= 50.58 Mohm

F= 11424.0 MHz Ib=0.743 A SL= 1.802 m VG0=0.1186 VGL= 0.0297 TF=0.1011 us tau= 0.536

VO= 90.08 Vb= 22.93 VL= 67.15 MV EAGS=49.99 EABS=12.72 EALS=37.26 MV/m

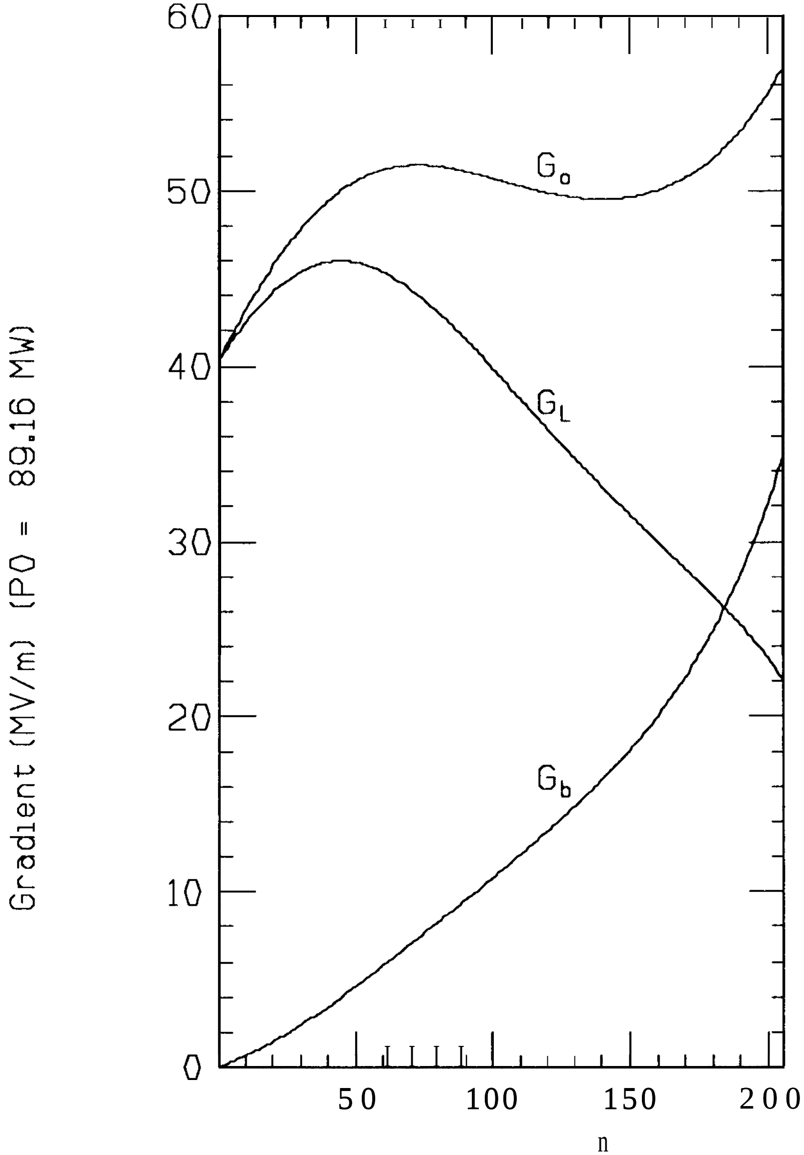

Fig. 1. Generator, beam and loaded gradients as a Function of cell number n.

DTU
NC=206

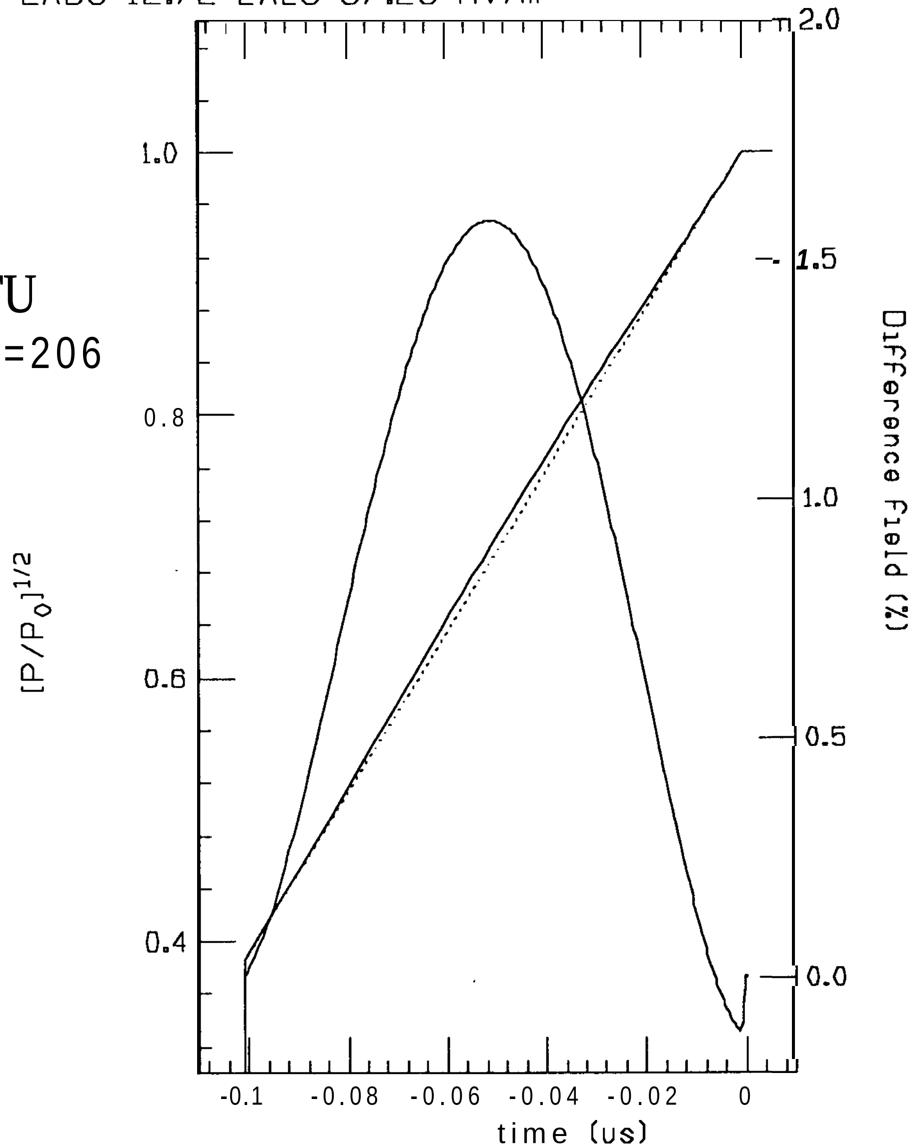

Fig. 2. Norm. input field $[P/P_0]^{1/2}$ and difference between it and a linear field (dots) vs time
Initial norm. field= 0.3850

frsh(1)= 0.970 frsh(50)= 0.970 frsh(106)= 0.970 frsh(130)= 0.969 frsh(160)= 0.962 frsh(206)= 0.951
s1= 653.1 s2= 946.0 V/pc/m T01= 0.200 T02= 0.177 us As= 0.343 Vr= 0.250