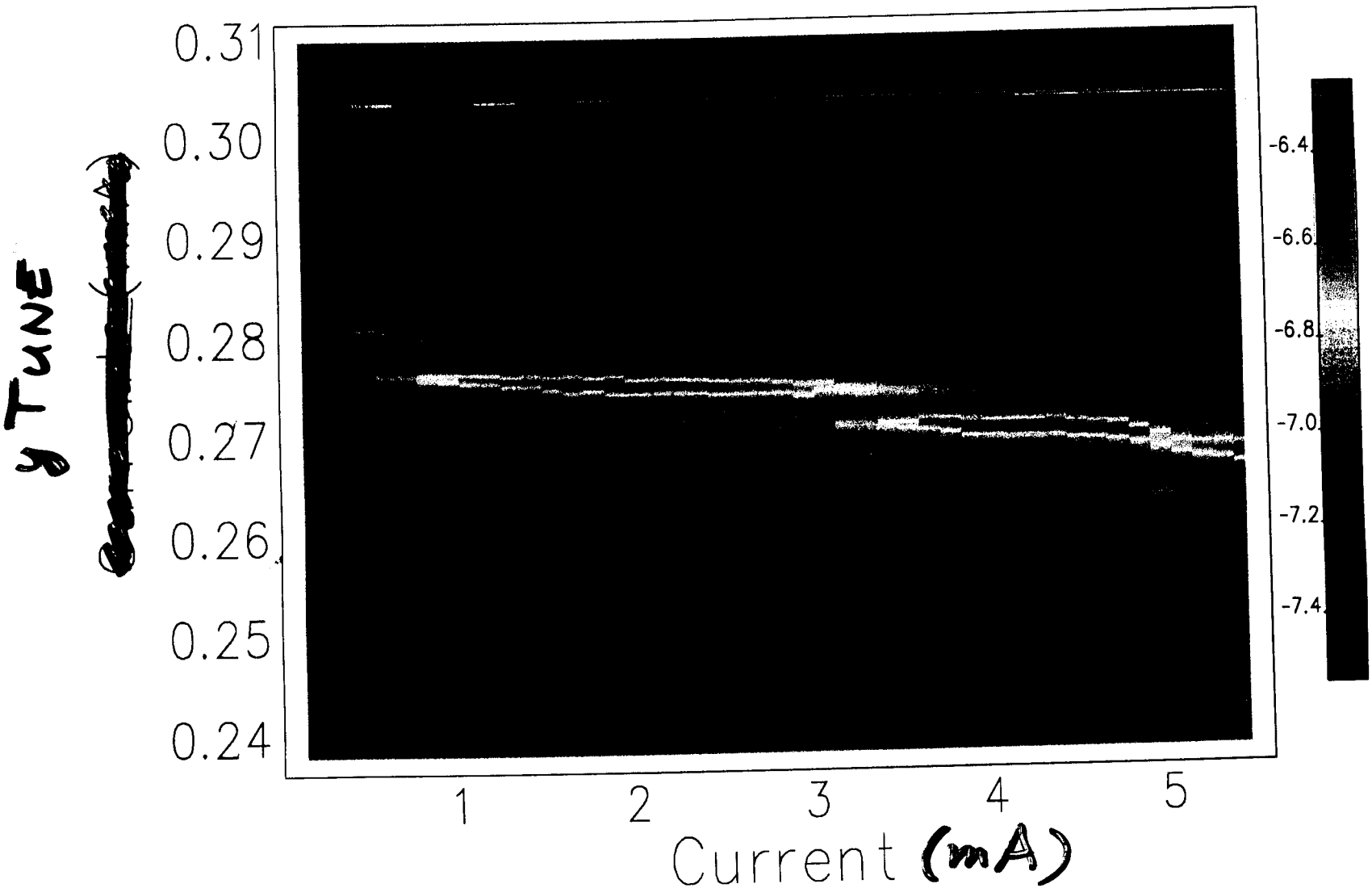
APS Measurements

Kwang-Je Kim for APS group



$\Delta\nu_y/\Delta I = -0.0026$ $\xi_x = 1.3$ $\xi_y = 3.8$

2D equivalent 5-m, small gap ID chambers

MODE-MERGING (VERTICAL)

At the nominal chromaticities, $\xi_x = 1.5$ and $\xi_y = 4$, the vertical tune is seen to cross several synchrotron sidebands as the single-bunch current is increased. The peak tune signal (max coupling) occurs:

$\nu_s = 0.007$

m = -1 at 2 mA
m = -2 at 4 mA
m = -3 (just starting to cross at current limit, 5.5 mA)

When the vertical chromaticity was lowered such that $\xi_x = 1$ and $\xi_y = 1.4$, the single bunch current limit was 1.9 mA. This is consistant with mode-merging in the vertical plane.

In simulations using a BBR model, a mode-coupling instability (between m=0 and m=-1) occurs around 4.4 mA (horizontal) and 2.2 mA (vertical). This vertical result nearly reproduces the experimental observations under low chromaticity conditions.

IMPEDANCE ESTIMATE

The vertical SR impedance was estimated three different ways. The agreement (to within 20%) suggests that Z_y is dominated by the small-gap chambers.

1. Z_y due to the small-gap chambers was determined experimentally from the change in the vertical tune slope as a function of number of chambers [Proc. of 1997 PAC, 1700]:

   53 kΩ/m per chamber
   Z_y (20 chambers) = 1.1 MΩ/m

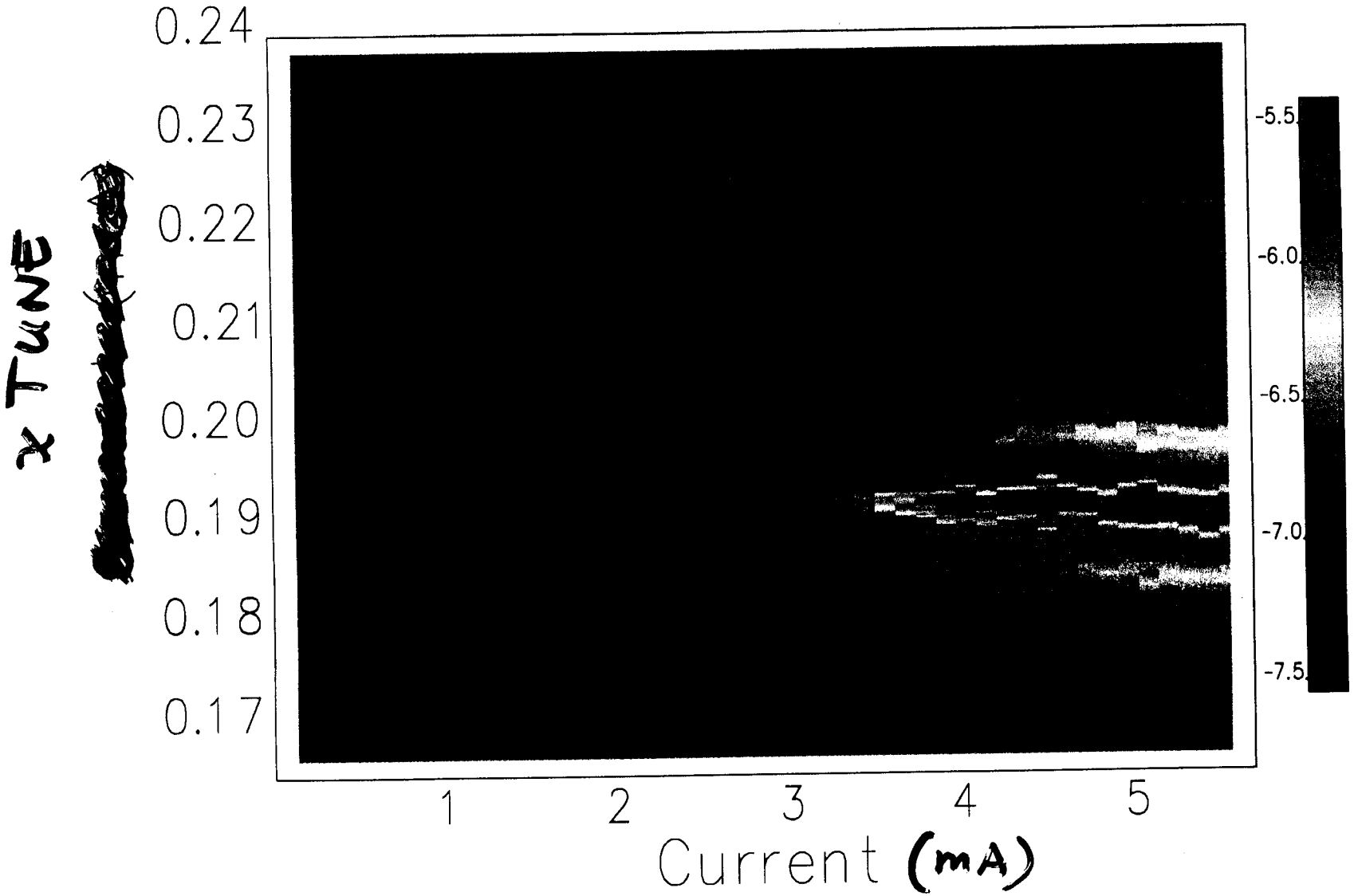
2. Simulations of a broad-band resonator (BBR) impedance model with the following parameters reproduced the measured tune slope of $\Delta\nu_y/\Delta I = -0.0026$ [Proc. of 1999 PAC, 1644]:

   f_{res} = 25 GHz (cutoff freq at <b>=4mm)
   Rs = 1.2 MΩ/m

3. The impedance due to the small-gap transitions was estimated assuming a perfectly conducting cylindrical tube of height a and angle θ [Bane and Krinsky, Proc. of 1993 PAC, 3375]

$$W_\perp = \frac{Z_0 c}{\pi a}\left(\frac{2\theta}{\pi}\right)^{1/2}\frac{1}{\sqrt{2\pi}\sigma_s}\exp\left(\frac{-s^2}{2\sigma^2}\right) = 6 \times 10^{14}\ \Omega/\text{m-s}$$

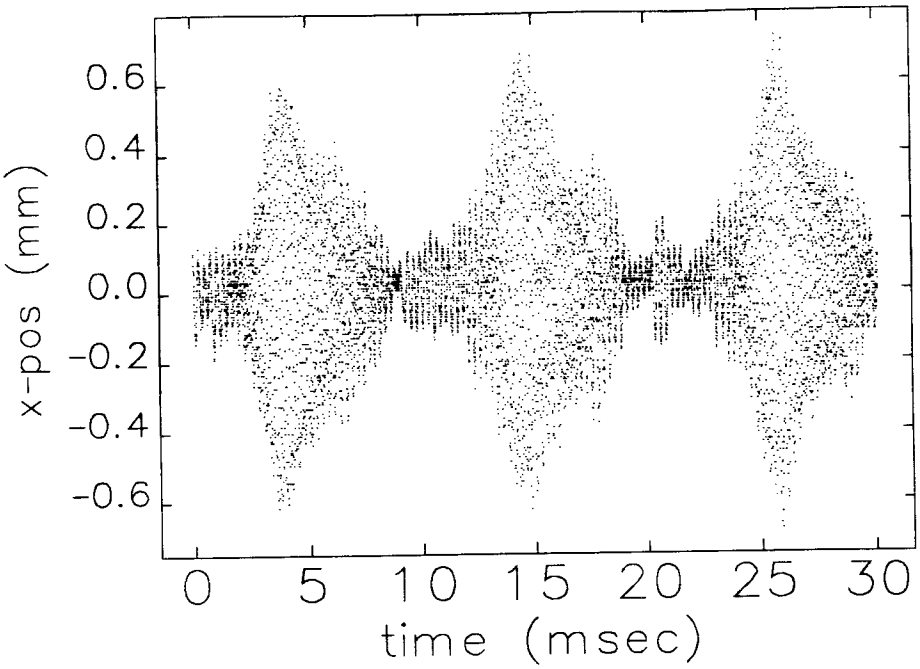
$Z_y = (\sigma_s/c)W$ = 20 kΩ/m per transition
Z_y (20 x 2/per) = 0.8 MΩ/m



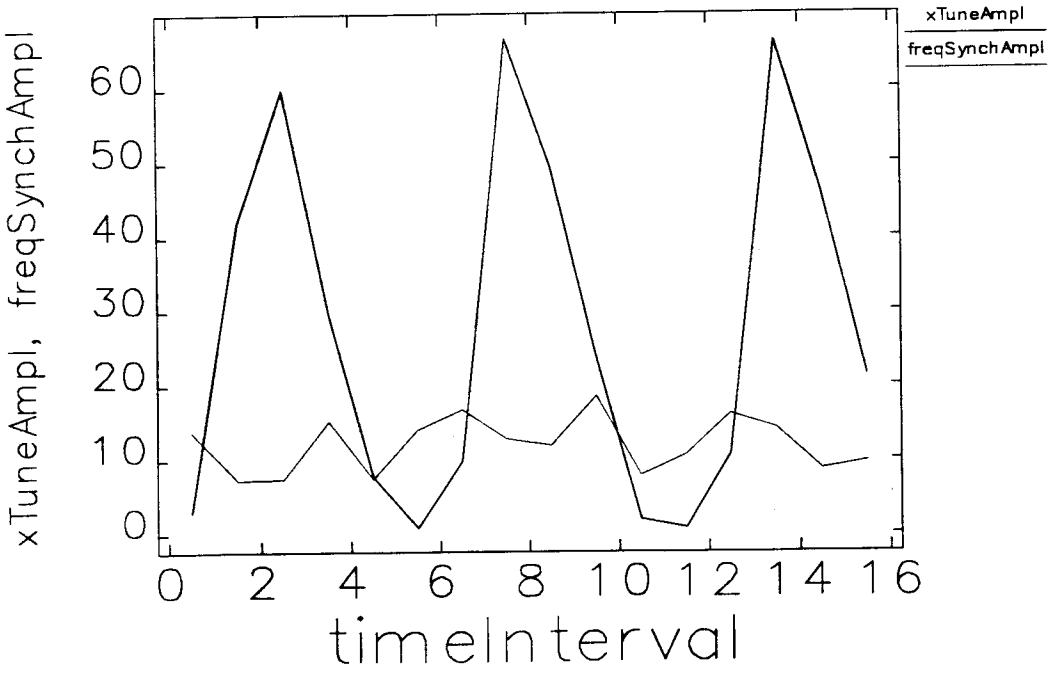
$\Delta\nu/\Delta I = -0.0008$ $\beta_x = 1.3$ $\beta_y = 3.8$

20 equivalent 5-m small-gap ED chambers

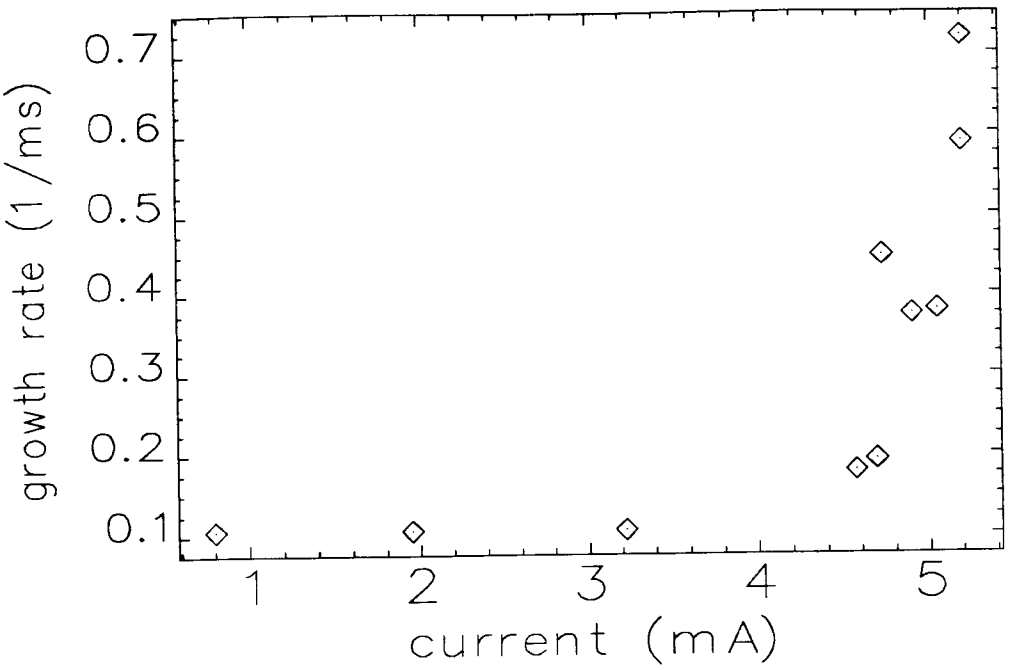
BEAM HISTORY MOMBO at HIGH DISPERSION; 5.2 mA, NOM CHROM



HORIZONTAL TUNE AND SYNCHROTRON TUNE AMPLITUDES



BURSTING MODE GROWTH RATE VS. CURRENT



BURSTING MODE GROWTH RATE VS CHROMATICITY

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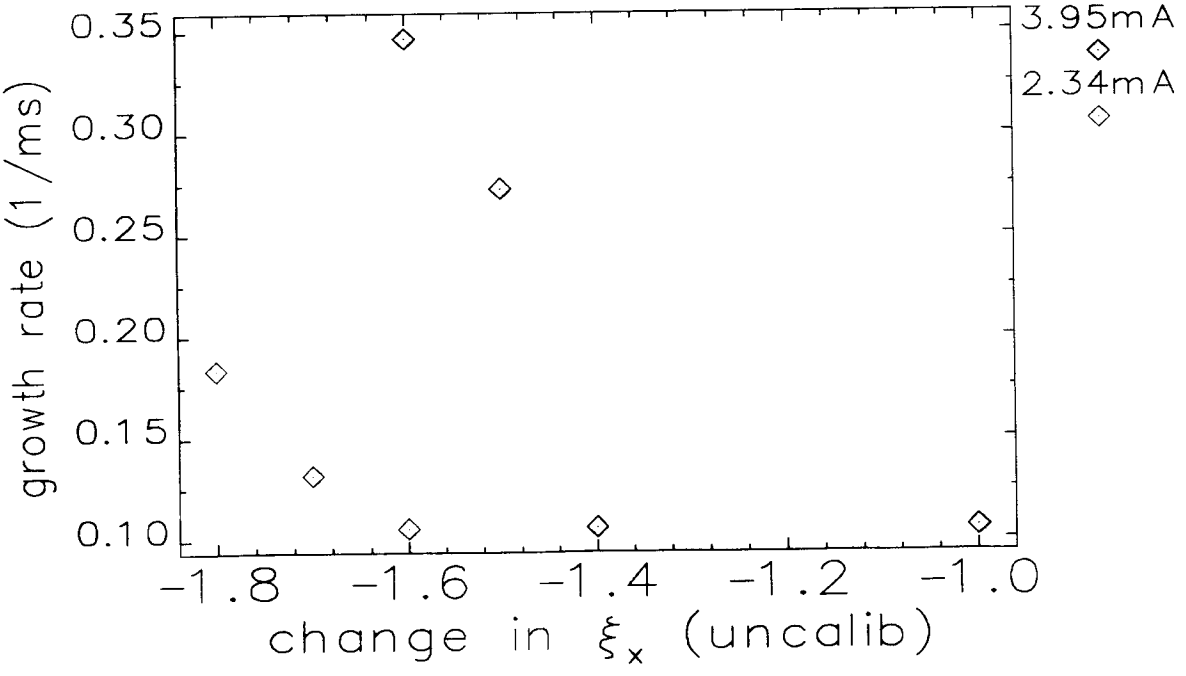
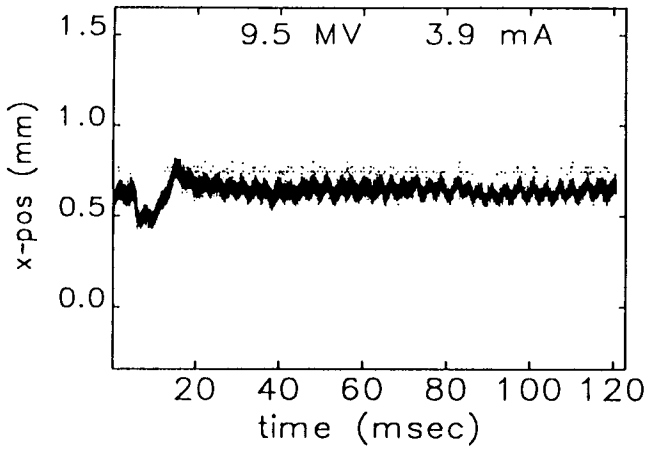
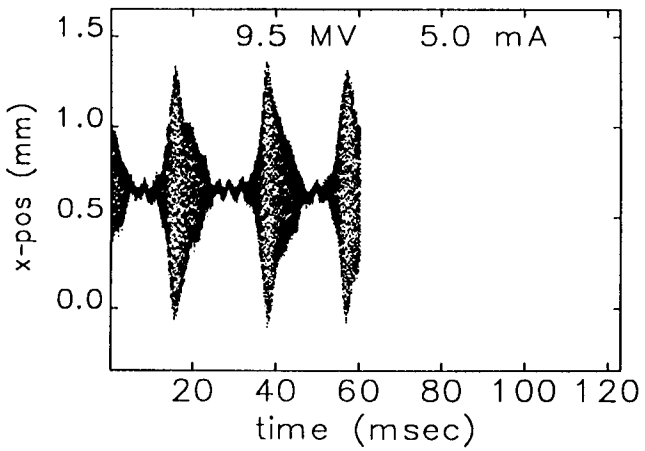


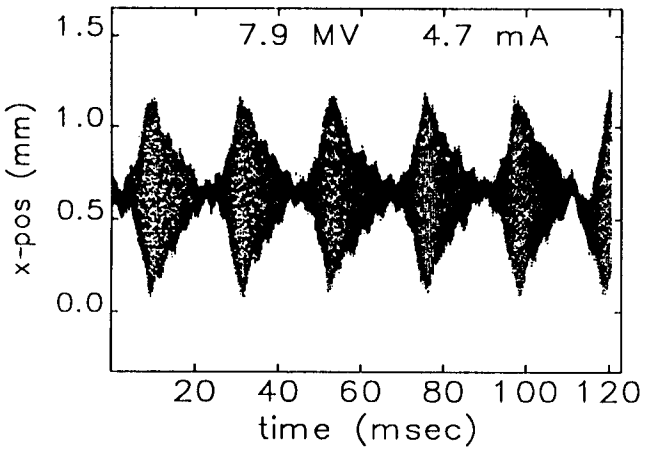
(at nominal chrom ($\xi_x = 1.5$, $\xi_y = 4$), inj current to below threshold, then reduce ξ_x; at -1.6 units, scrape down to below threshold, then reduce ξ_x again)

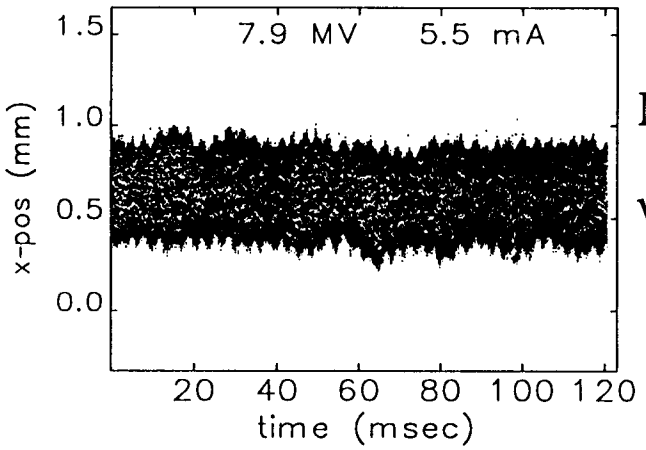




MAX

$\nu_s = 0.0073$





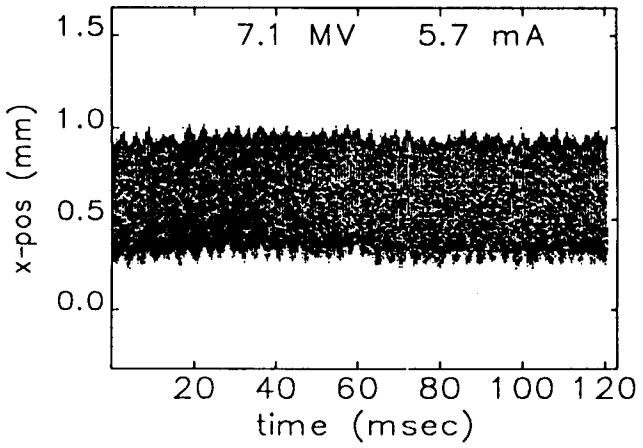
MAX

$\nu_s = 0.0062$

RF VOLTAGE

(no bursting mode)

CURRENT



MAX

$\nu_s =$ 0.0055