17TH ADVANCED BEAM DYNAMICS WORKSHOP ON
FUTURE LIGHT SOURCES

Two Color Electron Beams in Alpha Buckets

S. L. Kramer, J. B. Murphy, BNL

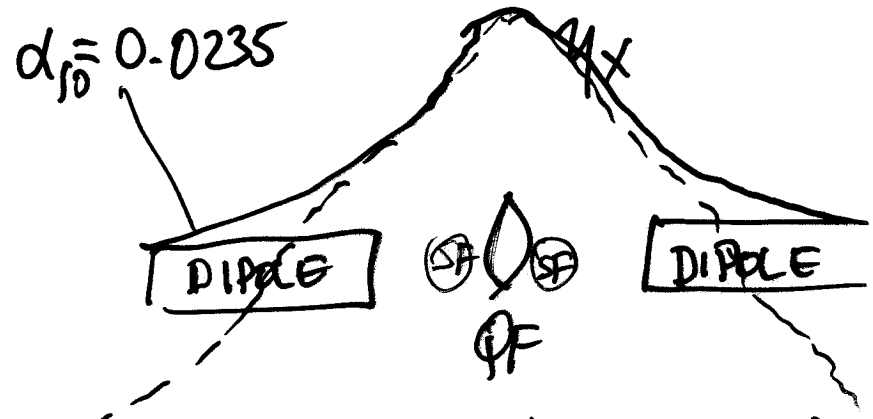
APRIL 6-9, 1999
ARGONNE NATIONAL LABORATORY, ARGONNE, IL U.S.A.

See PAC99

Two Color $\bar{e}$-Beams in α-Buckets

S.L. Kramer & J.B. Murphy
NSLS/BNL

NSLS VUV
$E = 737$ MeV
4 period DBA



$-\alpha_0 \leq \alpha_1 \leq +2\alpha_{10}$

($\frac{\alpha_{10}}{400}$ (I ~ 1 mA)
$\frac{\alpha_{10}}{225}$ (I ~ 5 mA)

QF controls $\alpha_1 = \frac{1}{C}\int \frac{\eta}{\rho} ds - \frac{1}{\gamma^2}$

SF controls: α_2

$$\alpha = \alpha_1 - \varepsilon\alpha_2 + \cdots$$

Longitudinal Phase Space Motion

Equations of Motion:

$$\dot{\varepsilon} = \frac{eV_{RF}\mathrm{Sin}[\phi + \phi_s] - U_0}{E_0 T_0}, \qquad \dot{\phi} = -\omega_{RF}(\alpha_1 - \alpha_2 \varepsilon)\varepsilon$$

Fixed Points: $\dot{\phi} = \dot{\varepsilon} = 0$ with $\mathrm{Sin}\phi_s \equiv \frac{U_0}{eV_{RF}}$

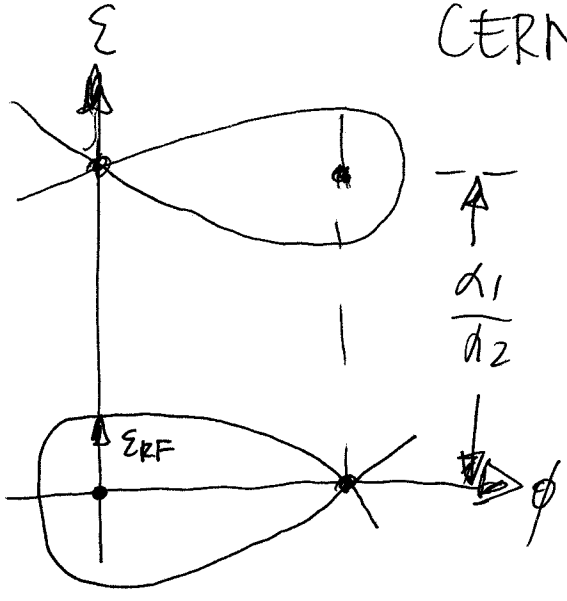
$$\dot{\varepsilon} = 0 \quad \Rightarrow \quad \phi = \begin{cases} 0 \\ \pi - 2\phi_s \end{cases},$$

$$\dot{\phi} = 0 \quad \Rightarrow \quad \varepsilon = \begin{cases} 0 \\ \alpha_1 / \alpha_2 \end{cases}.$$

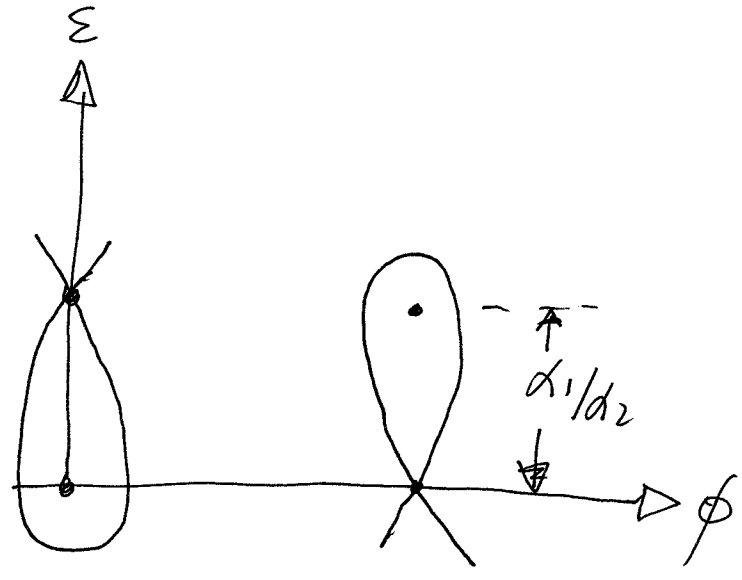
α - Buckets Near Transition

Kolomenski & Sabsovich

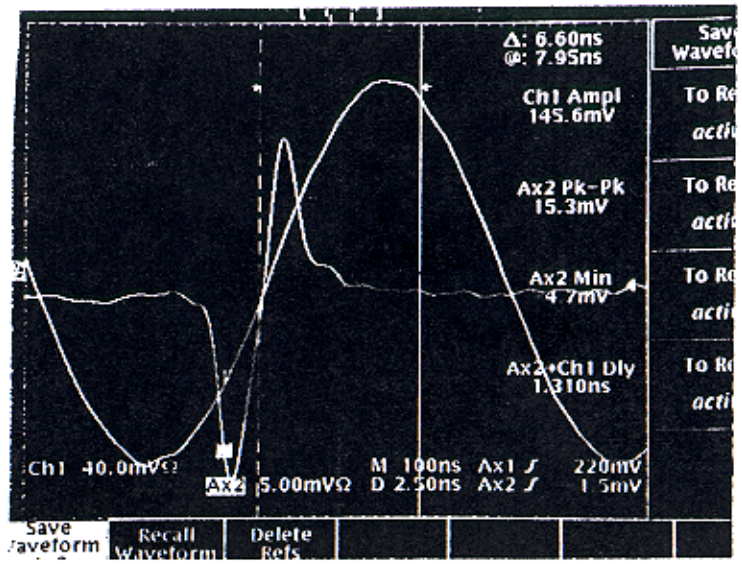
CERN Symposium 1956

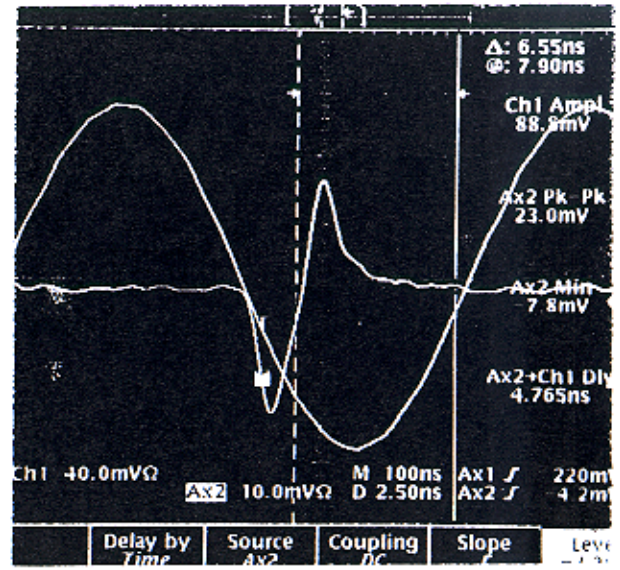


$\frac{\alpha_1}{\alpha_2} < \frac{\varepsilon_{RF}}{\sqrt{3}}$



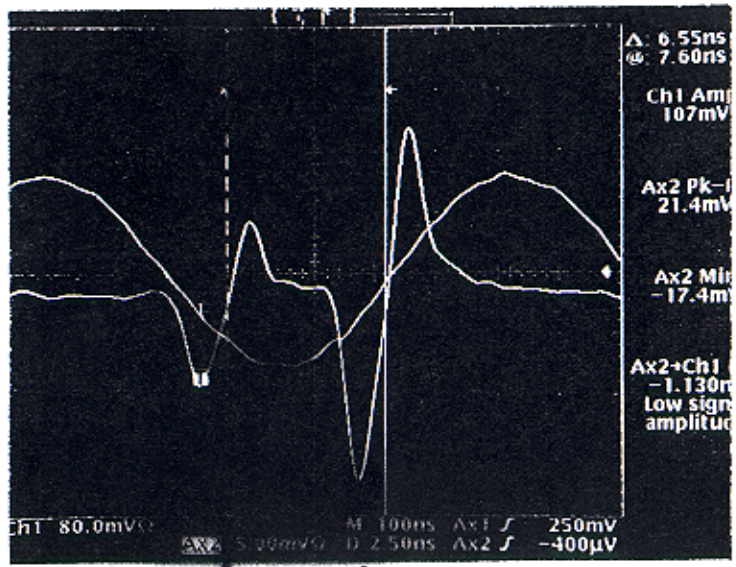
STRIPLINE SIGNAL SHOWING STORED BEAM in α-Buckets

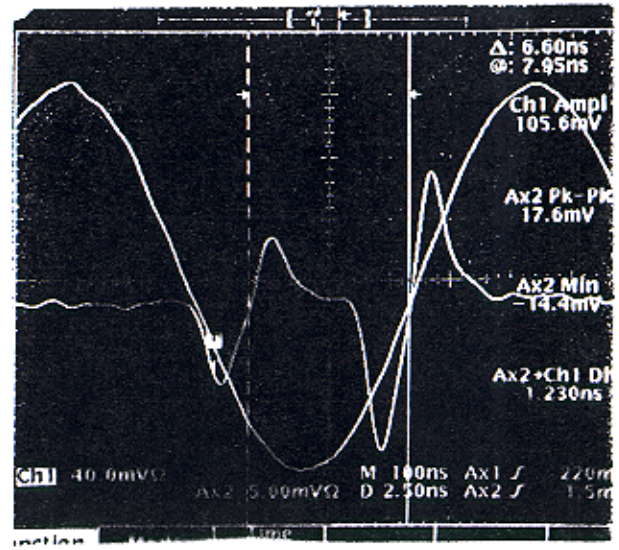




$f_{RF} = 52.88\ MHz$

$\Delta\tau_{bucket} \hat{=} 19\ ns$

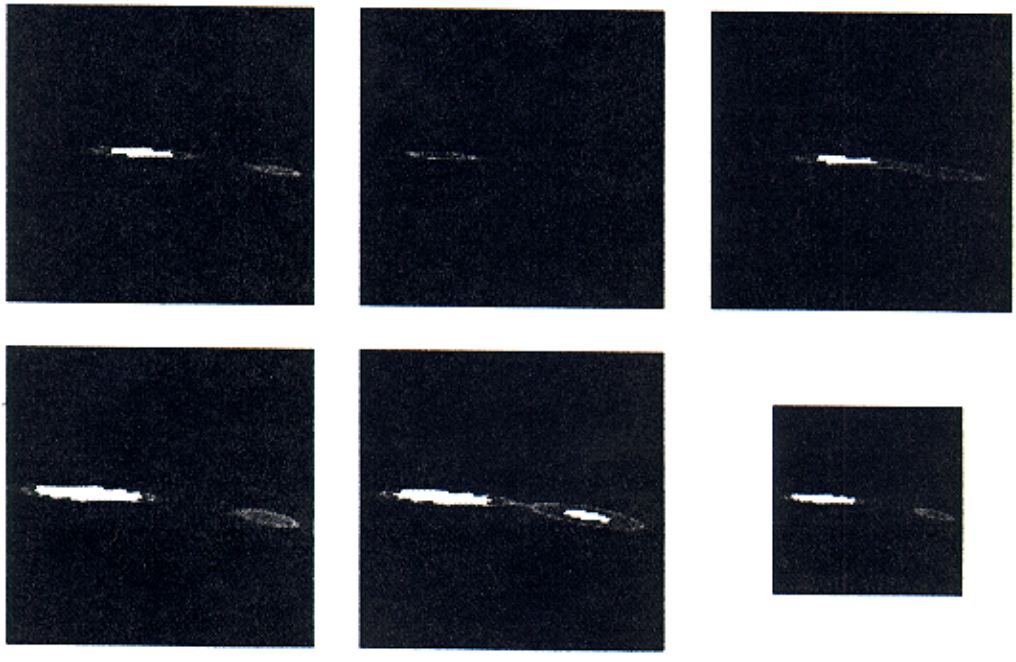




$\Delta\tau_\alpha \simeq 6.7ns$

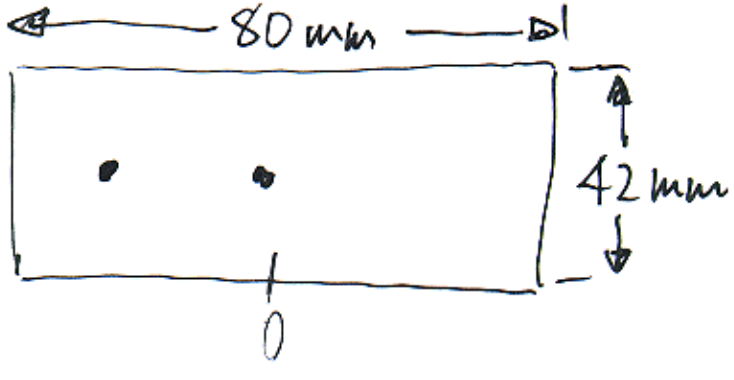
Variable with V_{RF}

VUV Electron Beam Stored in α-Buckets
(SLK & JBM, 3/18/99)



1.5 – 2 m

$$\Delta X = \eta_x \cdot \frac{\Delta E}{E} \quad , \quad \Delta y = \eta_y \frac{\Delta E}{E}$$



For $\frac{\Delta E}{E} = 1\%$, $\Delta X \simeq 2$ cm.