

ISM EHF Workshop

Lece 9-14/9/89

Bunch Rotation

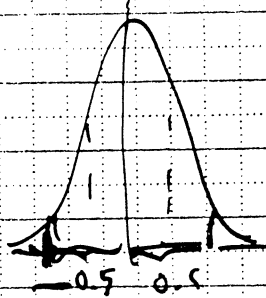
by

M. Cowie

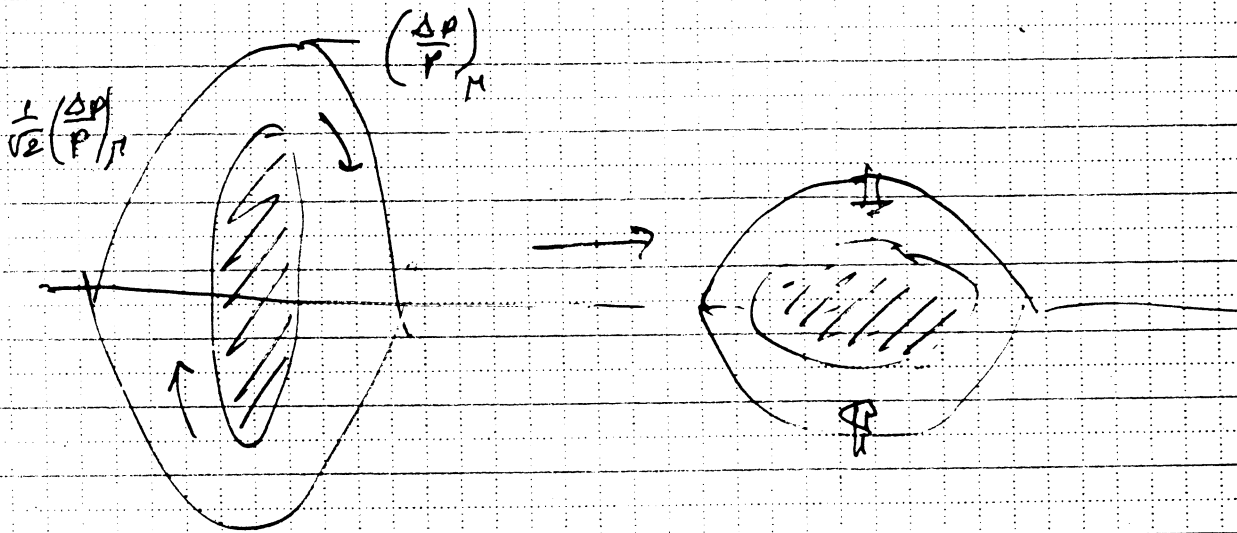
J. Griffin

$$\frac{6.68 \times 10^6}{11} = 6.07 \times 10^5 \text{ fragments p.p}$$

with $\frac{\Delta p}{p} = \pm 0.5\%$



have their momentum spread reduced by bunch rotation



$$\frac{\Delta p}{p} = \frac{1}{\sqrt{2}} \left(\frac{\Delta p}{p} \right)_M = \frac{1}{\sqrt{2}} \sqrt{\frac{2}{\pi h \eta \beta^2 \gamma} \frac{V_{RF}}{V_0}}$$

$$V_{RF} = \pi h \eta \beta^2 \gamma \left(\frac{\Delta p}{p} \right)^2 V_0 \approx 1.8 \text{ MV}$$

$$V_0 = \frac{A}{2} V_{amu} \approx 1.86 \text{ GV} \quad (A=100, Z=50, V_{amu} = 932 \text{ MV})$$

$$h = 45$$

$$\beta = 0.869$$

$$\gamma = 2.020$$

$$\beta^2 \gamma = 1.5$$

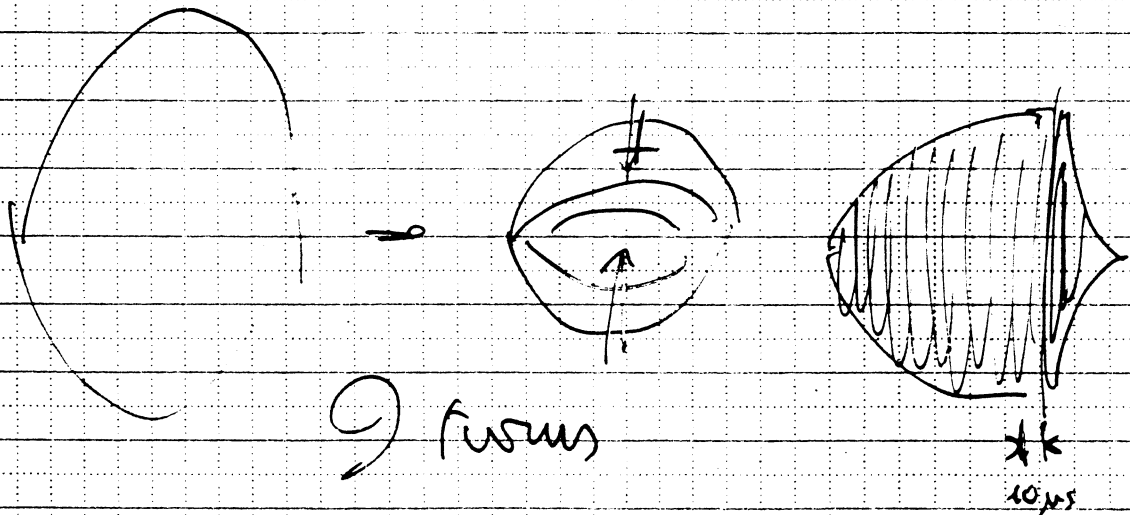
$$\gamma_{cr} = 3.95$$

$$\eta = \frac{1}{\gamma^2} - \frac{1}{\gamma_{cr}^2} = 0.181$$

$$N_{\text{revolution}} = \frac{0.25 \tau_s}{\tau_{\text{rev}}} \approx \frac{1}{4} \sqrt{\frac{2\pi \beta^2 \gamma V_0}{h \eta V_{RF}}} \approx 9 \text{ turns} \quad (10 \mu\text{s})$$

$$\tau_{\text{rev}} = \frac{C}{\beta c} = 1.02 \mu\text{s} \quad (f_{\text{rev}} = 0.98 \text{ MHz})$$

$$C = \frac{800 \text{ m}}{3} = 266.67 \text{ m}$$



Power Problems Arise

$$P = \frac{V^2}{2R_{\text{shunt}}} \approx 203 \text{ kW}$$

$$\frac{R_{\text{shunt}}}{Q} = 200 \Omega \quad \rightarrow \quad R_{\text{shunt}} \approx 2 \times 10^6 \Omega$$
$$Q = 10^4$$

$$V = 0.9 \text{ MV} \quad (2 \text{ cavities})$$

$$\langle W \rangle = \frac{Q P}{\omega_{\text{RF}}} = \frac{Q P}{2\pi h \text{ freq}} \approx 7.3 \text{ Joules}$$

$$P_{\text{inst}} = \frac{\langle W \rangle}{\tau_{\text{rev}}} \approx 7 \text{ MW}$$

Curves (?):

$$V \propto \eta$$

$$I \propto \eta^2$$

$$\left(N_{\text{turn}} \propto \frac{L}{\sqrt{\eta}} \right)$$

Why don't reduce η by
e.g. a factor of 10 via
pulsed quadrupoles?

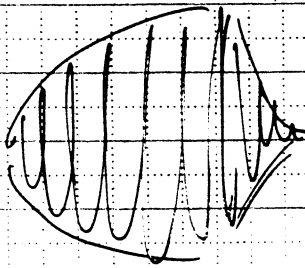
$$\gamma_{\text{tr}} = 3.95 \rightarrow \gamma_{\text{tr}} = 2.1$$

$$\left(N_{\text{turns}} \rightarrow \sqrt{\eta} N_{\text{turn}} \approx 3 N_{\text{turn}} \approx 30 \text{ turns} \right)$$

30 μs /

Or

Make use of the damping part
of the RF-voltage



But STRANGE bunch
distortions can occur

Computer analysis is required