

Energy Compensation at BC1

ISG8 at SLAC

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Bunch Compress in BC1 (90 degrees Rotation)

$$\begin{aligned} \Delta z_f = & \left(1 - \frac{kR_{56}VC}{E-VS} \right) \Delta z_i \\ & - \frac{k^2 R_{56} \{ V(1+2C^2) - ES \}}{2(E-VS)^2} \Delta z_i^2 \\ & + \frac{k^3 R_{56} VC(E + 8VS)}{6(E-VS)^2} \Delta z_i^3 + o(\Delta z_i^4) \end{aligned}$$

**1st and 2nd terms are cancelled
by adjusting the voltage and phase of cavities.**

For JLC design 5mm to 450 μ m

Vc = 148.2 MV

ϕ = 12.6 deg.

(L-band Structure)

Beam Loading Compensation in BC1

Same Energy Gain in Cavity V_0

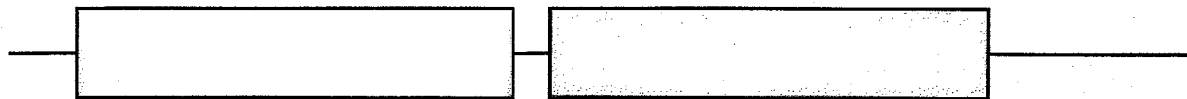
- Longitudinal position shift is generated.

Requirement

Same Derivative in Cavity dV/dt

- Bunch length at the exit of BC1 is shifted.

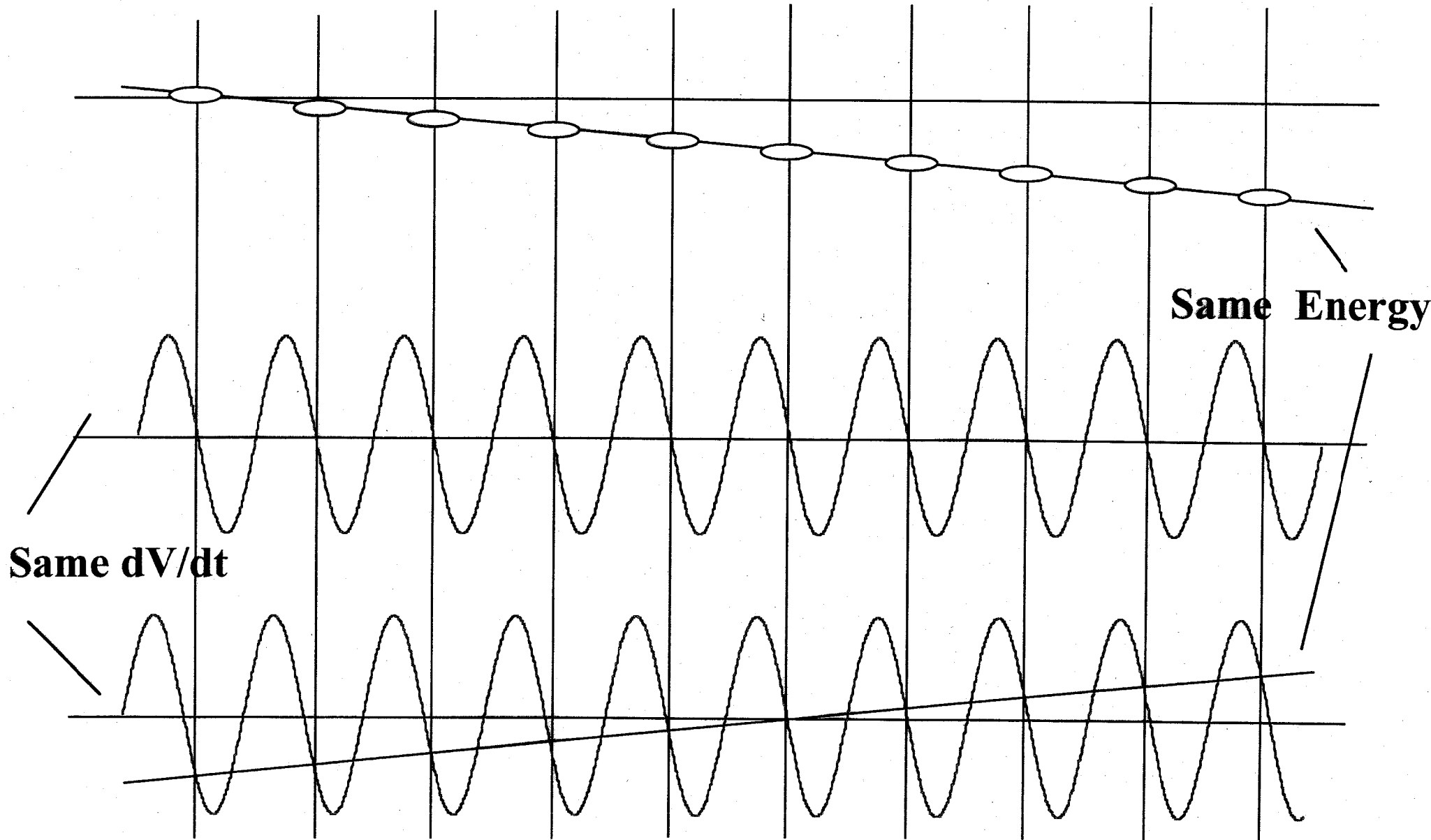
Method --- Frequency Modulation



Frequency : f Frequency : $f - \Delta f$

Beam loading for several beam current was compensated by changing the balance of rf voltage for cavities.

Schematic Figure of Beam Loading Compensation



L-band

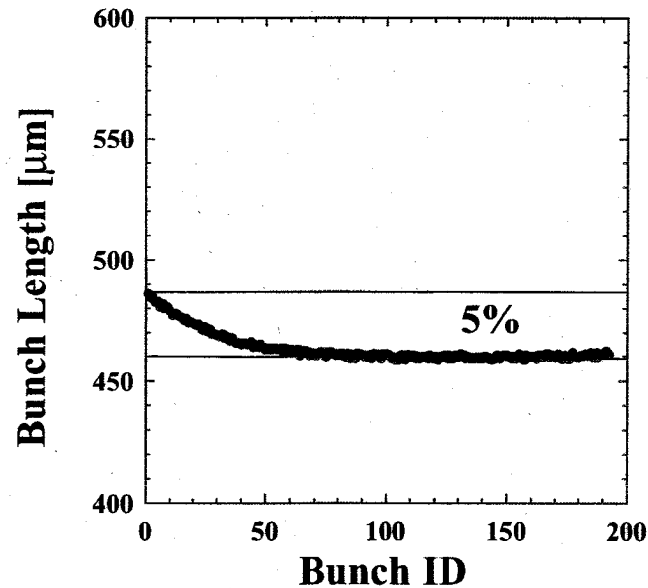
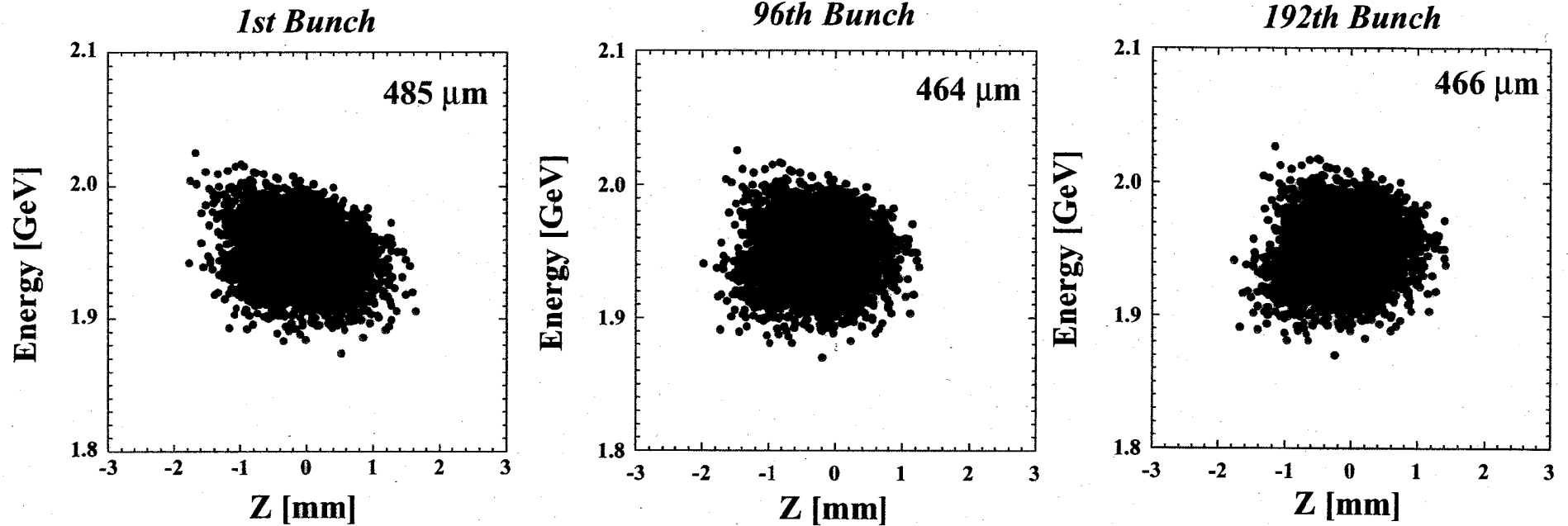
accelerating gradient 12.3 MV/m

4 3m long structures

} 2 : nominal 1.428 GHz

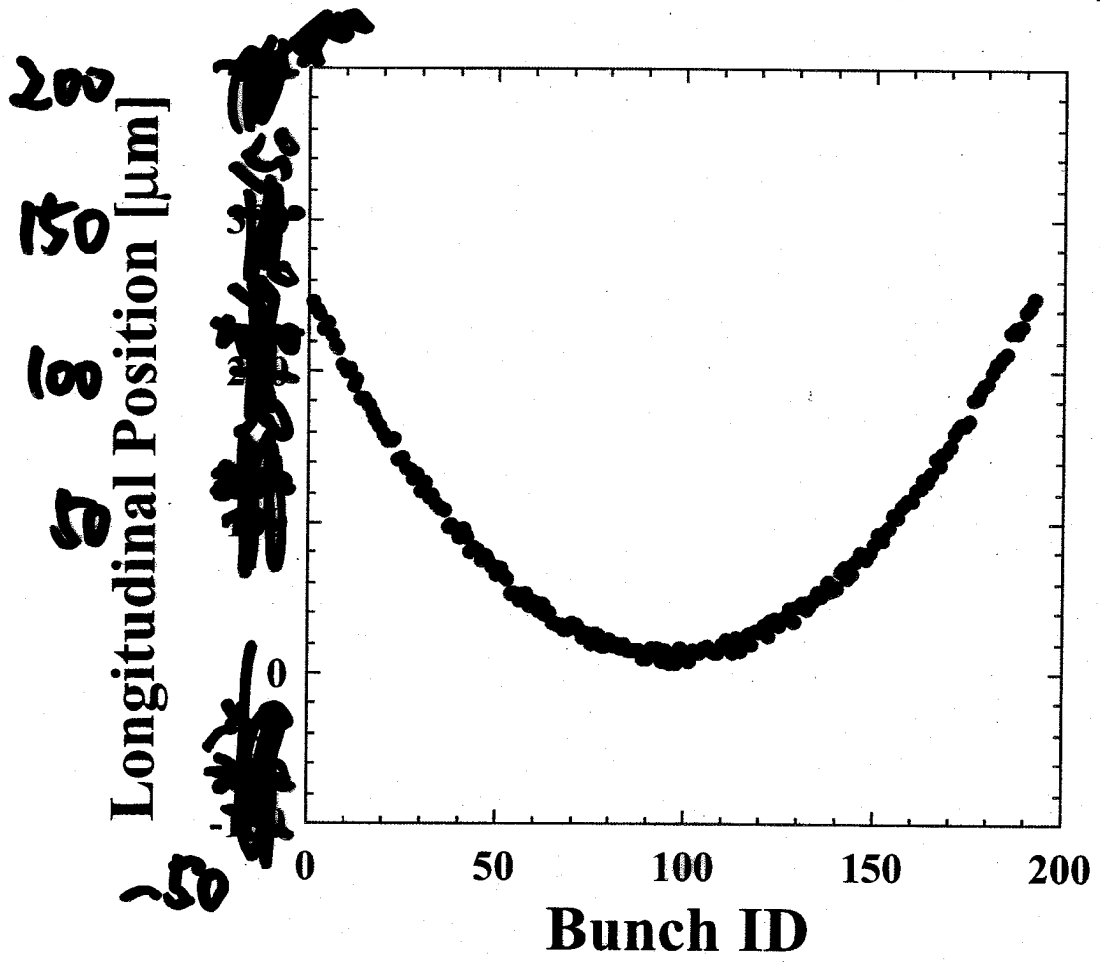
} 2 ; $-\Delta f$ ($\Delta f \approx 0.5$ MHz)

2) Effect on Bunch Length for Phase Shift by Energy Compensation



**Bunch lengths are different
by 5% for all bunches.**

3) Effect on Longitudinal Position Shift for Energy Uniformity by Energy Compensation



Longitudinal Position Difference is almost $\sigma/1.5$

→ 1% of energy difference at I.P..
0.5