Bunch Merging with Wiggler

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J. C. Gallardo, R. Fernow, R.B. Palmer

gallardo@bnl.gov
Outline

- Bunch Merging Beamline
- Initial Beam
- Wiggler
- Results
Buncher Merging Beamline

BEAM LINE OF BUNCH MERGER

- Initial drift
- High Frequency rf (201.25, 402.5, 603.75, 804 MHz)
- Low Frequency rf (5,10,15, 20 MHz)
- Linear wiggler
- Bucket formation (201.25 MHz)

There is an overall solenoidal field B = 1 T, except on the wiggler.

Schematics of the beamline.
Initial longitudinal phase space, showing 21 bunches (LEFT); weight distribution (RIGHT). $\epsilon_T = 1.45 \text{ mm}$, $\epsilon_L = 1.6 \text{ mm}$ (all bunches 330.8 mm); $<p_z> = 0.2 \text{ GeV/c}$.
Long phase space at entrance of wiggler

Notice that the lower energy particles are ahead in the bunch train;

\[ L_{\text{train}} \approx 30 \text{ m}. \]
Planar Wiggler

- $B_0 = 0.775 \ T$, $\lambda_s = 2 \ m$ and $k_y = 2.75$

- $B_x(s) \approx -B_0 k_x^2 x y \cos (k_s s + \phi_0)$
- $B_y(s) \approx B_0 \cos (k_s s + \phi_0)$
- $B_s(s) \approx -B_0 k_s y \sin (k_s s + \phi_0)$ with $k_x^2 = k_s^2 - k_y^2$

- Wiggler parameter
  \[ K_\mu = \frac{qB_0}{m_\mu c k_s} \approx 93.44 B_0 [T] \lambda_W [m] \times \frac{m_e}{m_\mu} = 0.452 B_0 [T] \lambda_W [m] \]

- Back of the envelope calculation
  \[ < \beta_s > \approx 1 - \frac{1 + K_\mu^2/2}{2\gamma^2} \]

- Momentum compaction factor $\alpha_c = \frac{\Delta L}{L\delta} \approx (\gamma^2 - 1) \frac{(1 + K_\mu^2/2)}{\gamma^4}$

- Distance for the tail of the train to catch up with the front
  \[ s = L_{\text{train}} \frac{m_\mu^2}{p \Delta p} \frac{\gamma^3}{(1 + K_\mu^2/2)} \approx 163 \ m \]
Results

Long phase space at the end of the wiggler (LEFT); at the end of the bucket formation section (RIGHT).

Decay $\approx 25\%$  $\epsilon_T \approx 2.3$ $mm$  $\epsilon_L \approx 87$ $mm$  Efficiency$\approx 52\%$.

MUCH MORE WORK IS NEEDED