Bunch Merging with Wiggler

Friday Phone Meeting
1 June, 2007

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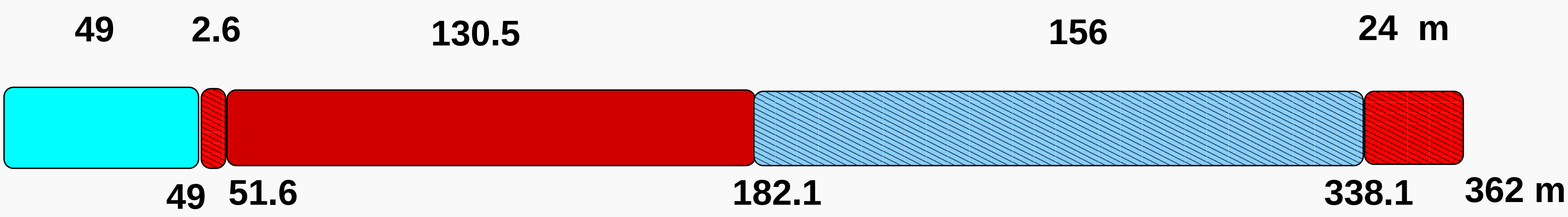
Outline

- Bunch Merging Beamline
- Initial Beam
- Wiggler
- Results

Buncher Merging Beamline

BEAM LINE OF BUNCH MERGER

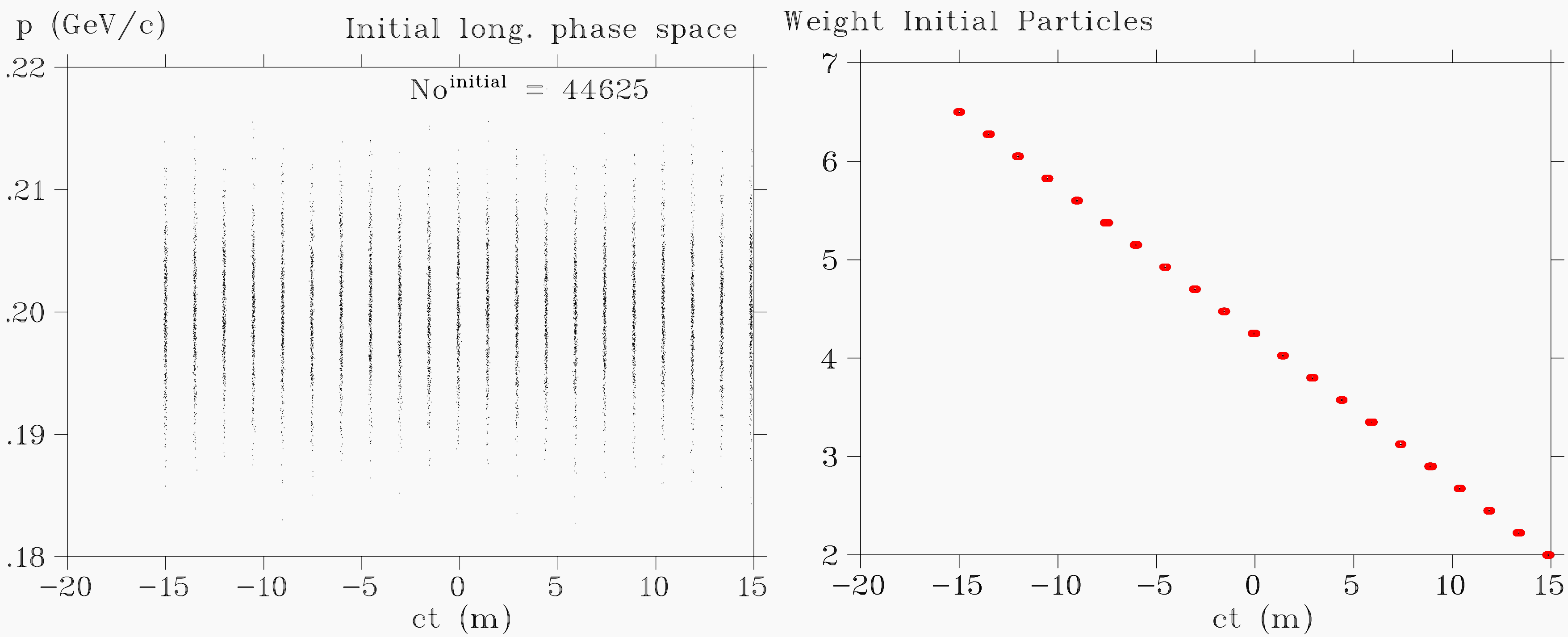


- Initial drift
- High Frequency rf (201.25, 402.5, 603.75, 804 MHz)
- Low Frequency rf (5,10,15, 20 MHz)
- Linear wiggler
- Bucket formation (201.25 MHz)

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

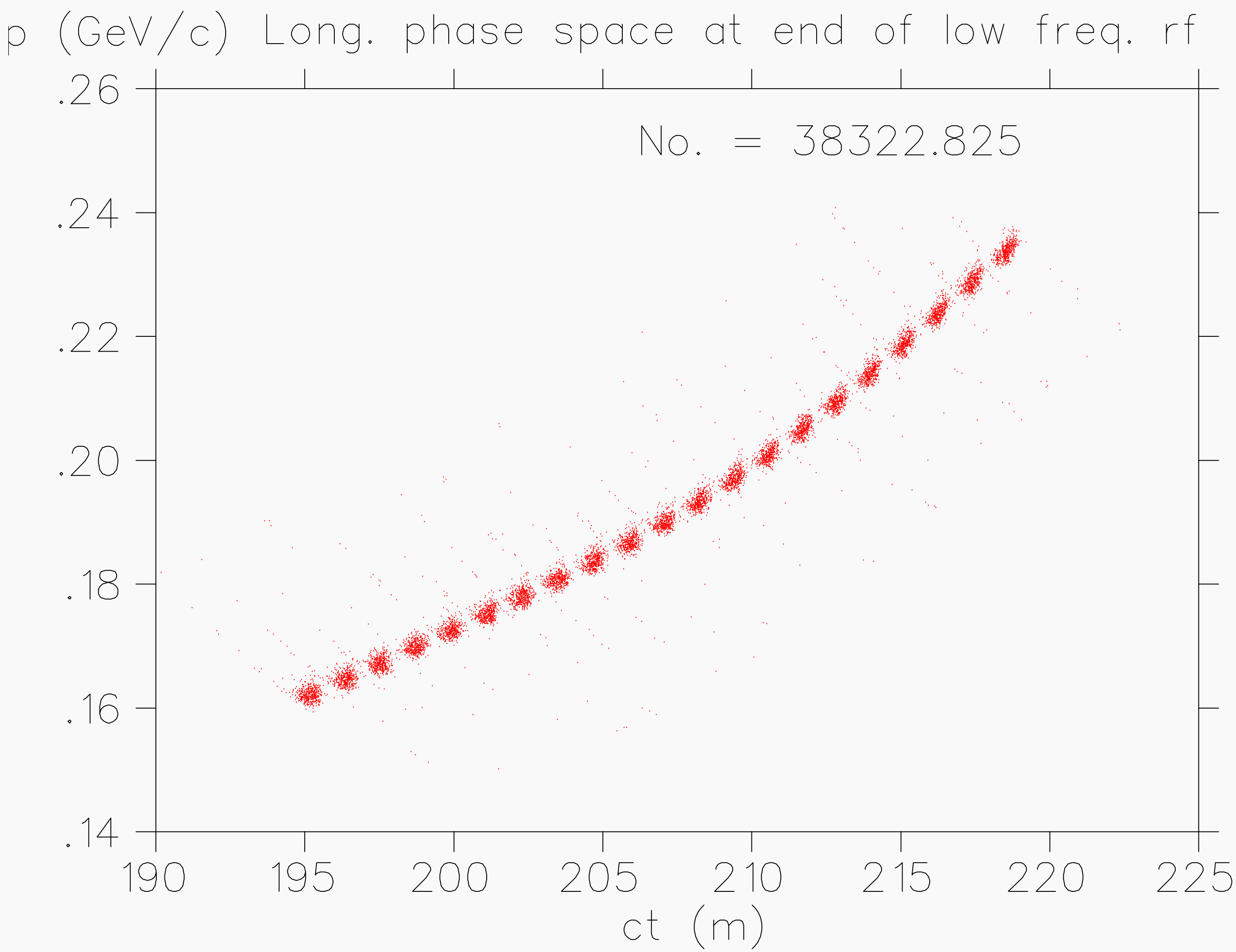
Schematics of the beamline.

Initial Beam



Initial longitudinal phase space, showing 21 bunches(LEFT); weight distribution (RIGHT). $\epsilon_T = 1.45\ mm$, $\epsilon_L = 1.6\ mm$ (all bunches 330.8 mm); $< p_z >= 0.2\ GeV/c$.

Long phase space at entrance of wiggler



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

$$L_{train} \approx 30\ m.$$

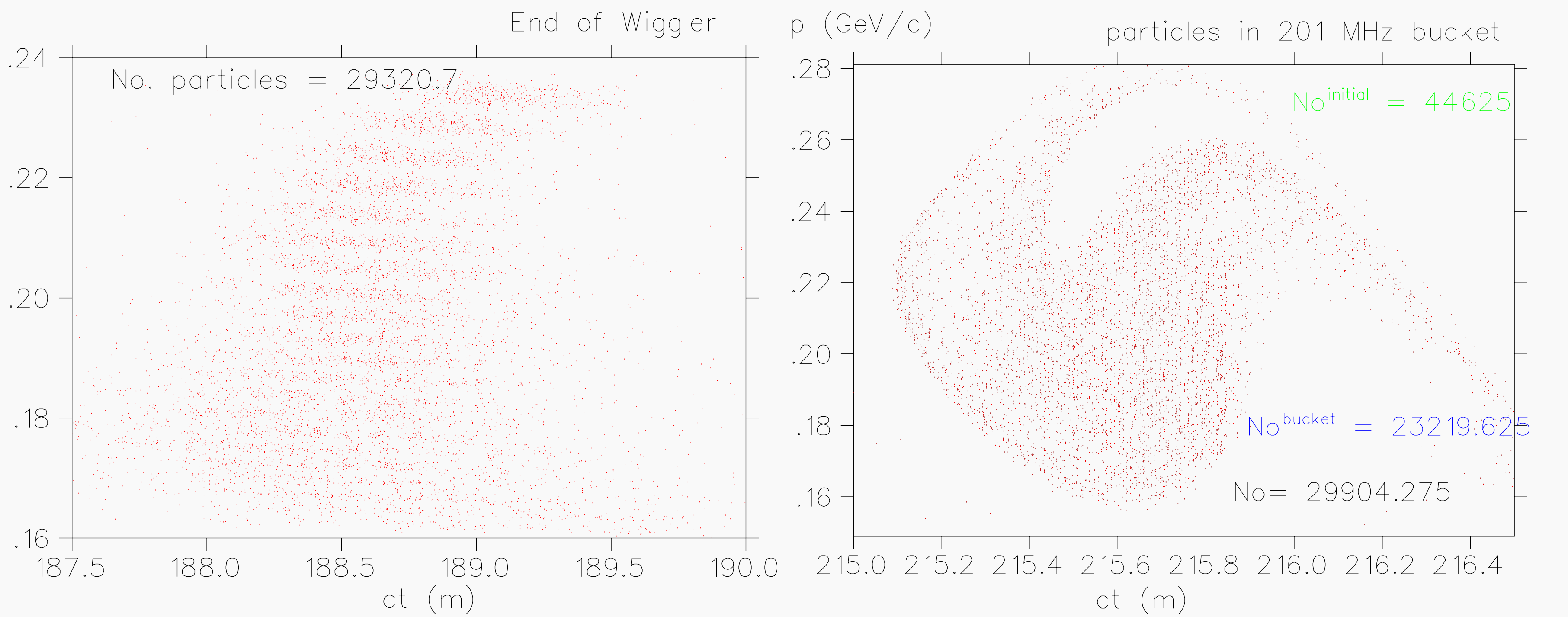
Planar Wiggler

- $B_0 = 0.775\,T, \quad \lambda_s = 2\,m$ and $\quad k_y = 2.75$
- ▷ $B_x(s) \approx -B_0 k_x^2 xy \cos(k_s s + \phi_0)$
  ▷ $B_y(s) \approx B_0 \cos(k_s s + \phi_0)$
  ▷ $B_s(s) \approx -B_0 k_s y \sin(k_s s + \phi_0)$ 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*

  $$s = L_{train}\frac{m_\mu^2}{p\Delta p}\frac{\gamma^3}{(1+K_\mu^2/2)} \approx 163\,m$$

Results



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

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

MUCH MORE WORK IS NEEDED