Beam Spectrum Measurements
and remarks on bunch lengths

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Thanks to D. Valuch, T. Bohl, U. Wehrle

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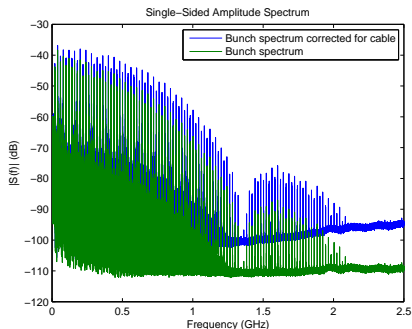# Beam Spectrum Measurements

Motivation:

- Get a better idea about the bunch distribution
- Provide potentially useful information on the MKI and beam screen heating issues
- Setup a measurement for bunch distribution studies during the ramp to increase our understanding of the longitudinal blowup.

Measurement:

- There are two longitudinal wideband pickups per beam. They are used for the BQM, mountain range, beam phase loop. One of them was used for this measurement.
- An effort has been made to correct for the dispersion due to the $\sim$380 m cable to the surface, which dominates the signal distortion on this chain.
- Measurement during fill 2009, 11 hours into physics. 1380 bunches, 1.5e14p. Bunch lengths: B1 1.33 ns, B2 1.32 ns.
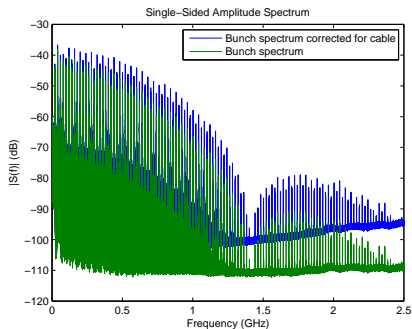
Frequency Domain Measurements

- As expected, the bunch spectrum is not gaussian.

- Significant power around 1.6 GHz. 35 dB below the 400 MHz component (factor of 3000 in power).

- Does the side lobe overlap a kicker resonance?

- The IF BW for this measurement is 20 kHz, which results in averaging over fraction of a turn.

- The effect of the filling pattern is obvious: 20 MHz lines from 50 ns spacing.

Single-Sided Amplitude Spectrum

- Higher frequencies for B2 -> bigger tails for B1

- Can this explain the B1 losses at collision?

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Single−Sided Amplitude Spectrum

Legend:
- Bunch spectrum corrected for cable
- Bunch spectrum

Axis: |S(f)| (dB) vs Frequency (GHz)

- Higher frequencies for B2 -> bigger tails for B1

- Can this explain the B1 losses at collision?

Time Domain Reconstruction

- The time domain signal can be reconstructed using an inverse fourier transform.

- The phase dispersion due to the cable corrugation becomes significant in this case. We are working on improving the post-processing correction.

- Next step: make a series of measurements during the ramp (blowup).
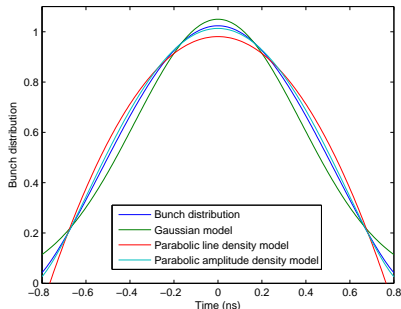
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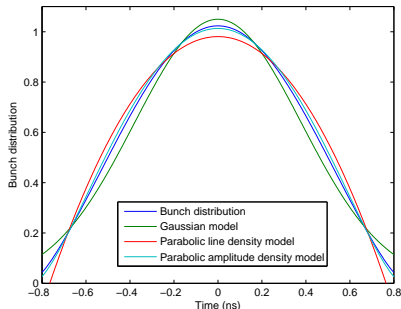
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Bunch Length Remarks

- The bunch length difference between the two beams is (usually) well within the spread of bunch lengths along the ring.

- Hard to conclude that there is a correlation with the beam lifetime.

- It might be useful to check the relationship between individual bunch losses and bunch lengths. We welcome OP help.

Bunch lengths Fill 2009