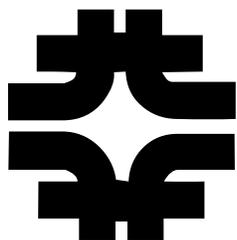


On Longitudinal Emittance dilution, July 9th Study, Revisited



Paul Lebrun

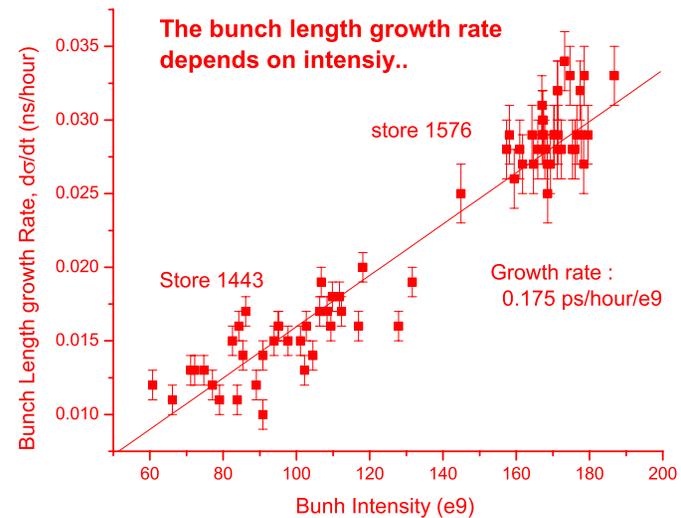
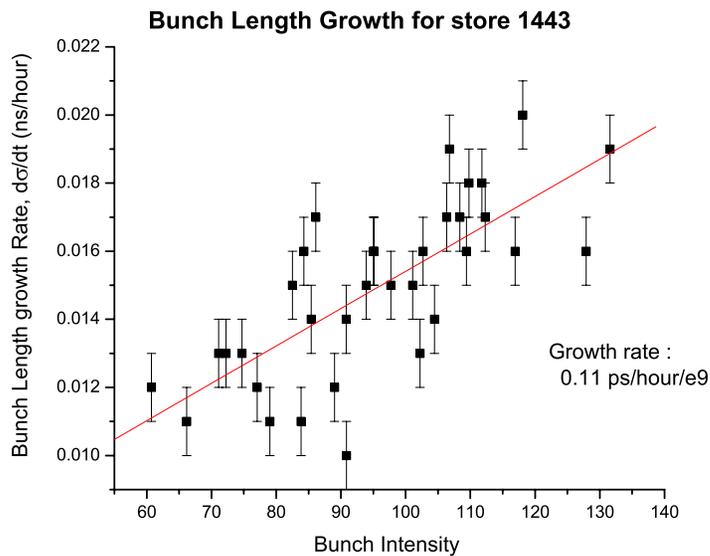
Fermilab

Aug 3 2002

Does the bunch length growth rate depends on Intensity ?

- Conflicting statements :
 - Special studies with proton only answered “no” (V. S., Slava,..)
 - systematic analysis of HEP data answered “yes” (P.L.)
- Resolution:
 - Talking Different quantity (ds/dt or $1/s * ds/dt$)
 - Given the wide fluctuation in these quantity, no real difference between the study on July 9 and what happens during HEP
 - Ds/dt was not constant.

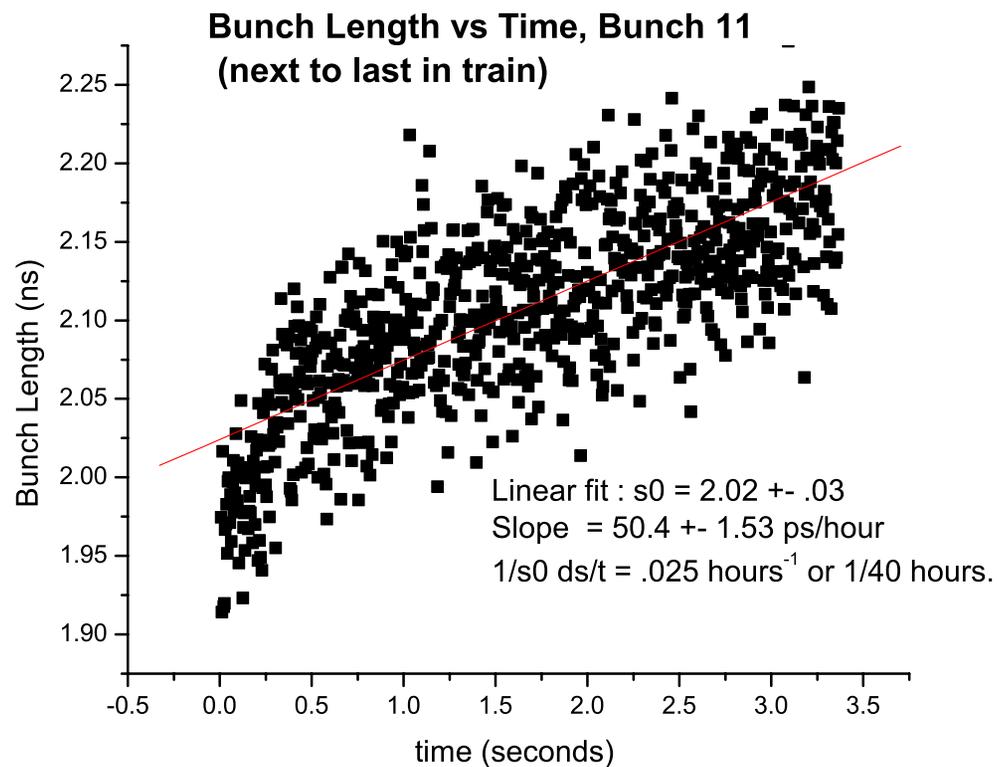
$d \sigma_s/dt$ during HEP



The slope seems to vary a bit on a store basis.

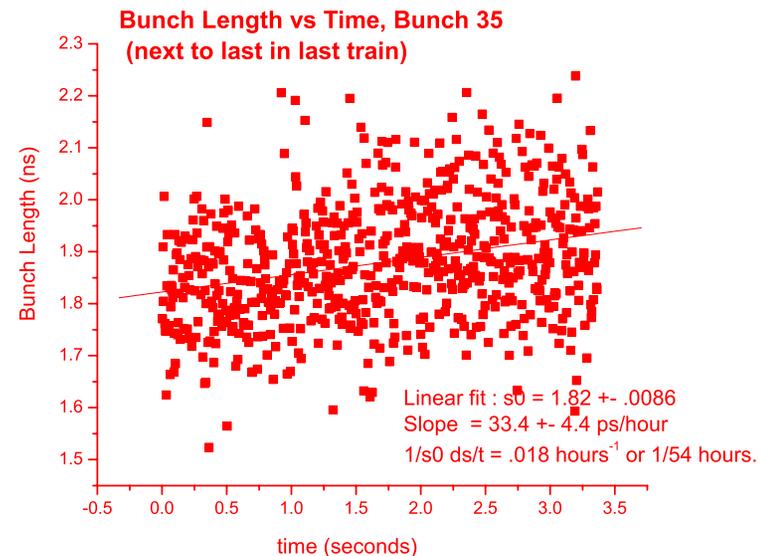
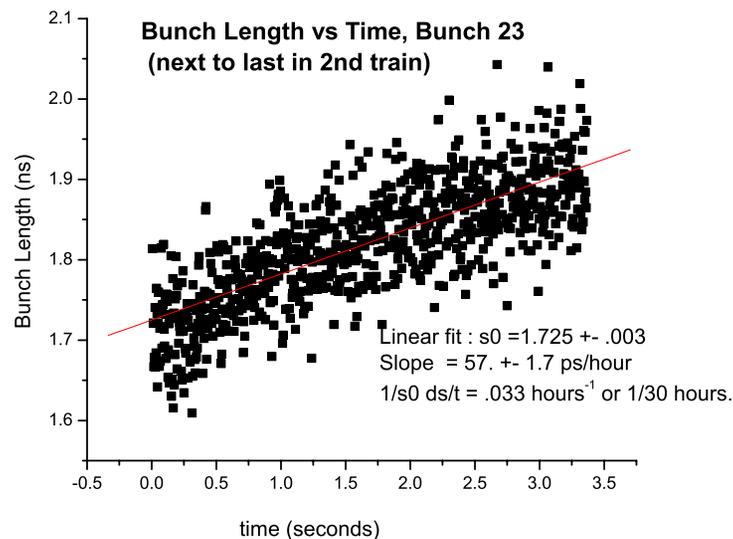
Indeed, store to store (unexplained!!!) variation of $d \sigma_s/dt$ Masks the other possible correlations..

$d\sigma_s/dt$ July 9 Proton Only Study (V.S., Slava)



Intensity:
175. e9
After ramp

$d\sigma_s/dt$, July 9th, bunches 23 and 35

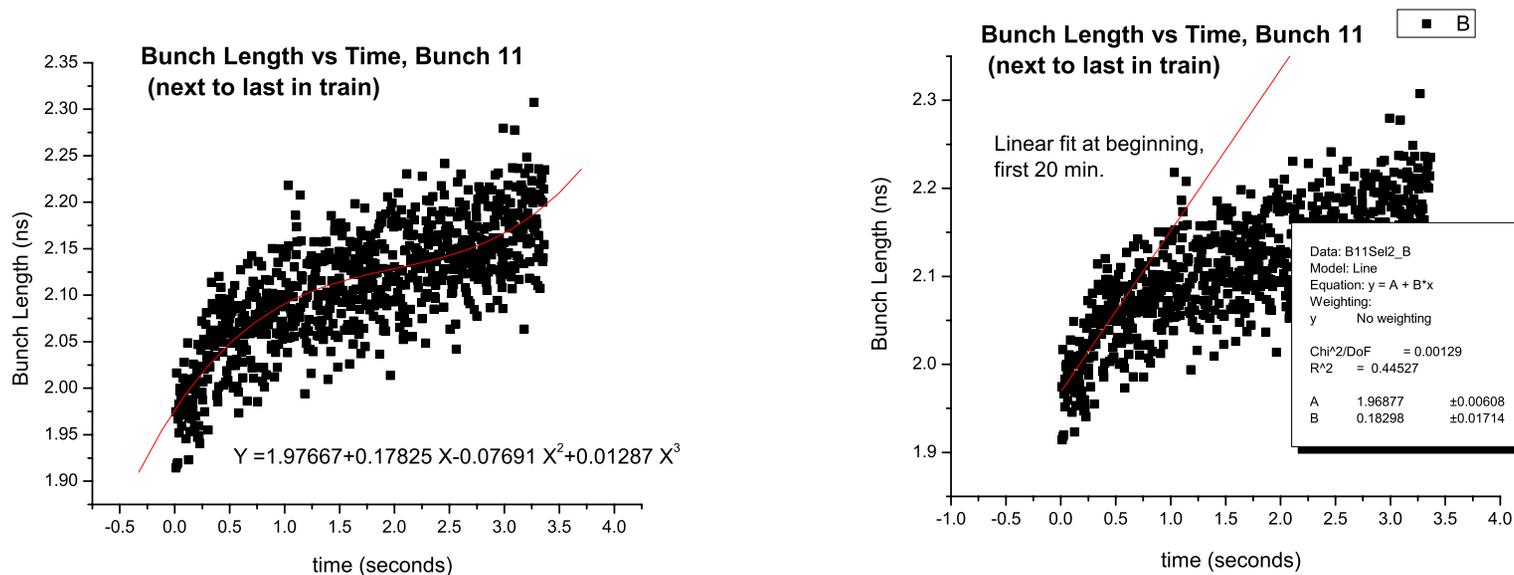


Intensity: 123 e9

Intensity: 56 e9

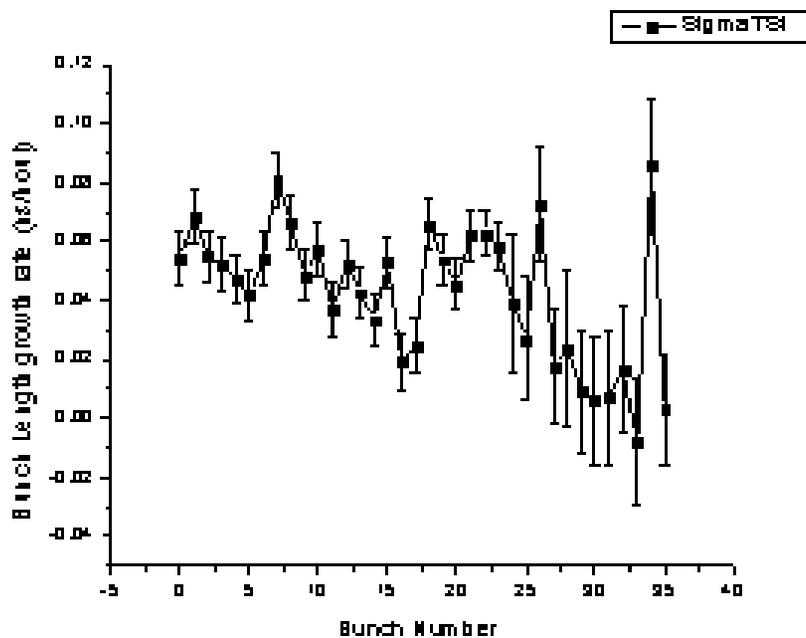
The fitted slope (using Origin linear regression tool) return
Significantly different answers.

Bunch 11 : at early time vs late time



The bunch length growth rate ds/dt was 3 times bigger during the First 20 min... (50 ps/hour vs 183 ps/hour)

All bunches, low rate data (from data lazy data loggers)



SBD data rate acquisition:

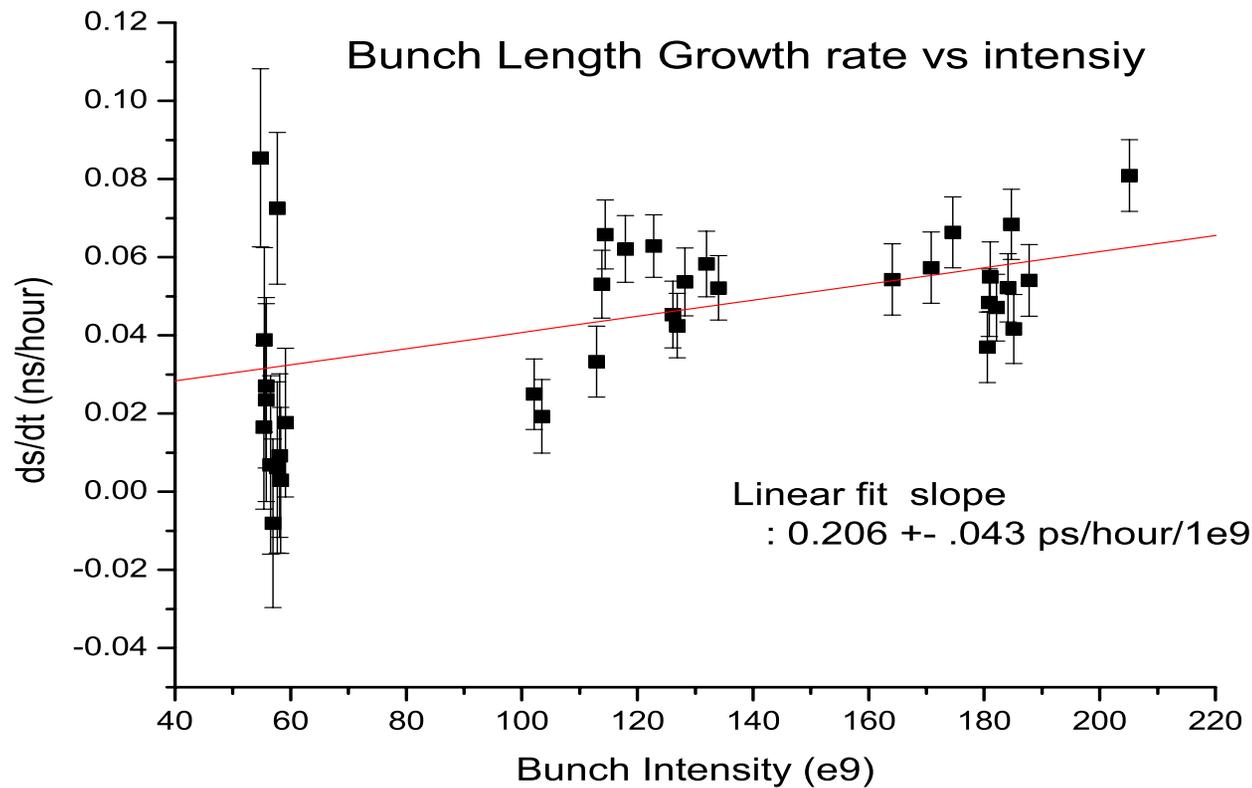
One measurement

every 10 min, -> low accuracy.

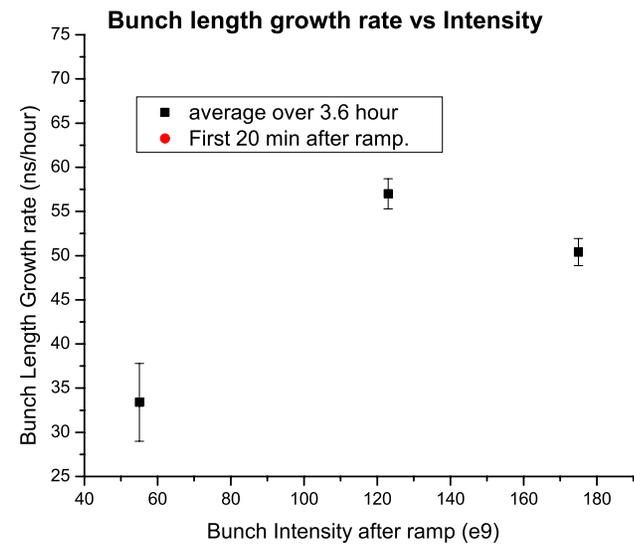
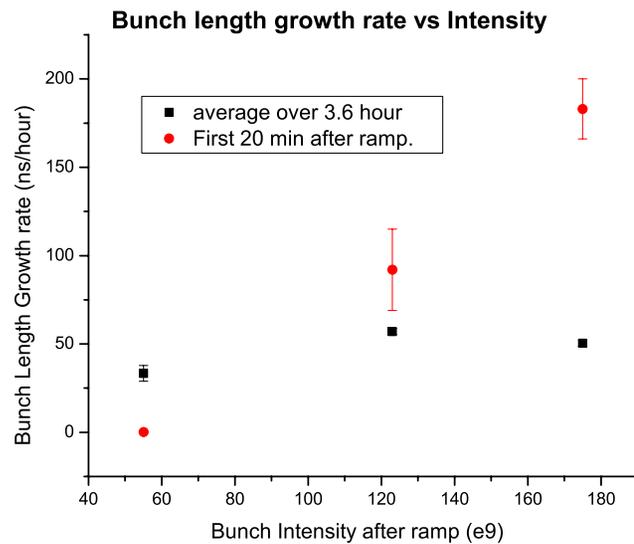
Low intensity bunches ($\sim 60 \text{ e9}$)

Are for the last train.

All bunches, low rate data.. Vs Intensity

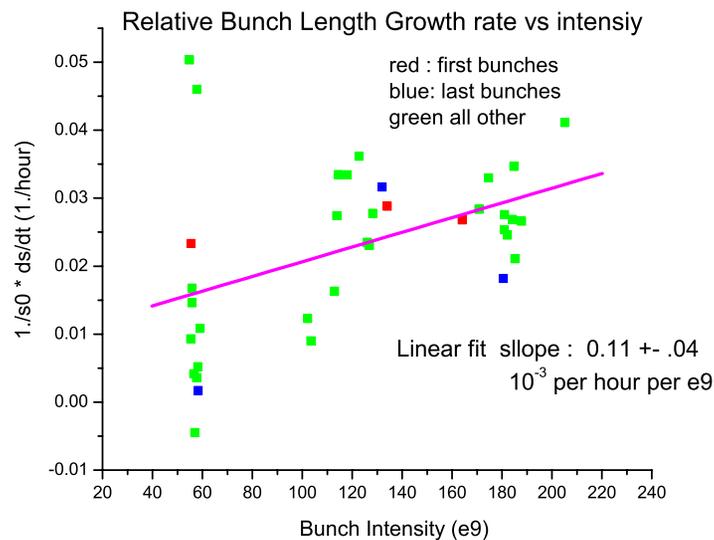


ds/dt on intensity, accurate data, only 3 bunches



At earlier time, more pronounced effect..

1.0/s * ds/dt on intensity..



From accurate data,
Average over all times,
For only 3 bunches
At 55 e9 → 0.0185 / hour
123 e9 -> 0.033 /hour
175 e9 -> 0.025/hour
First 20 min.
At 55 e9 ~ 0.0 / hour
123 e9 -> 0.053 /hour
175 e9 -> 0.091/hour

1/s ds/dt less sensitive to intensity than ds/dt

At earlier time, there seems to a more pronounced effect.

Conclusion

- The discrepancy study vs HEP was in great part simply due to a confusion on variables: relative growth rate or absolute growth rate. Since the bunch length depends on intensity (low intensity \rightarrow low emittance), so ds/dt and $1/s$ do not have the same dependency on intensity.
- No significant disagreement between HEP data and July 9th study.
- There is more: On July 9th, the growth rate changed after \sim 20 min at 980 GeV.
- This analysis could be a lot more accurate if the 1Hz data would have been saved!.