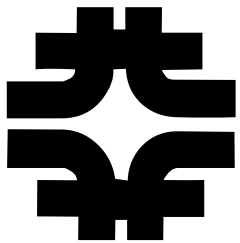
On Pbar Lifetimes at 150 Gev In the Tevatron, II



Paul Lebrun

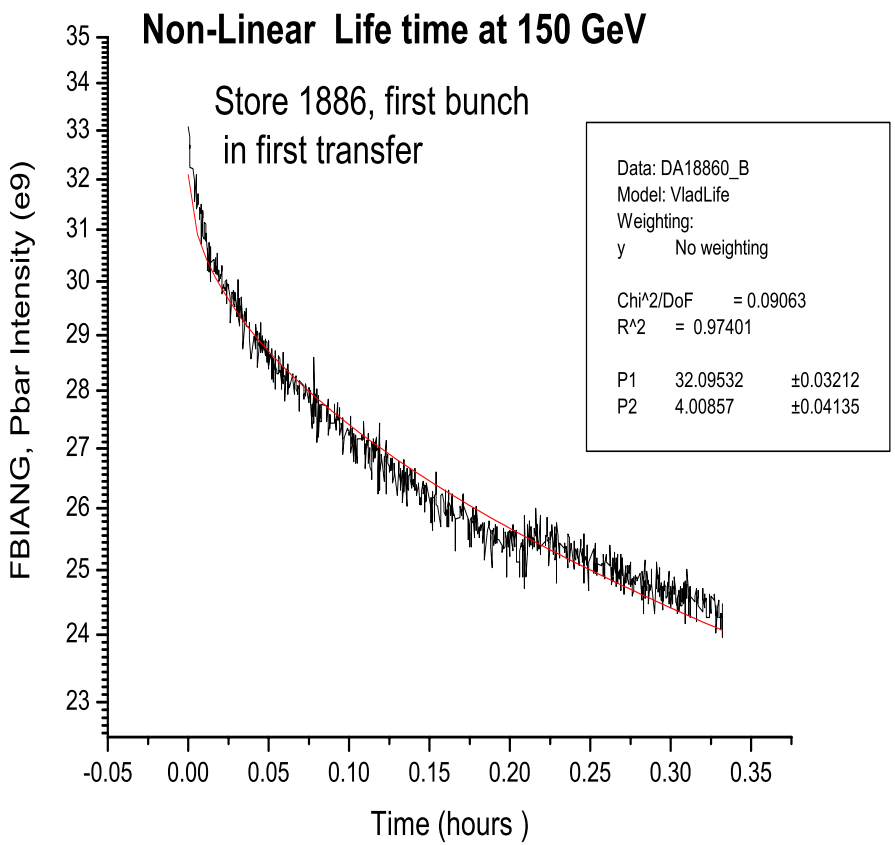
Fermilab

October 21 2002

Suggested by Vladimir Shiltsev:

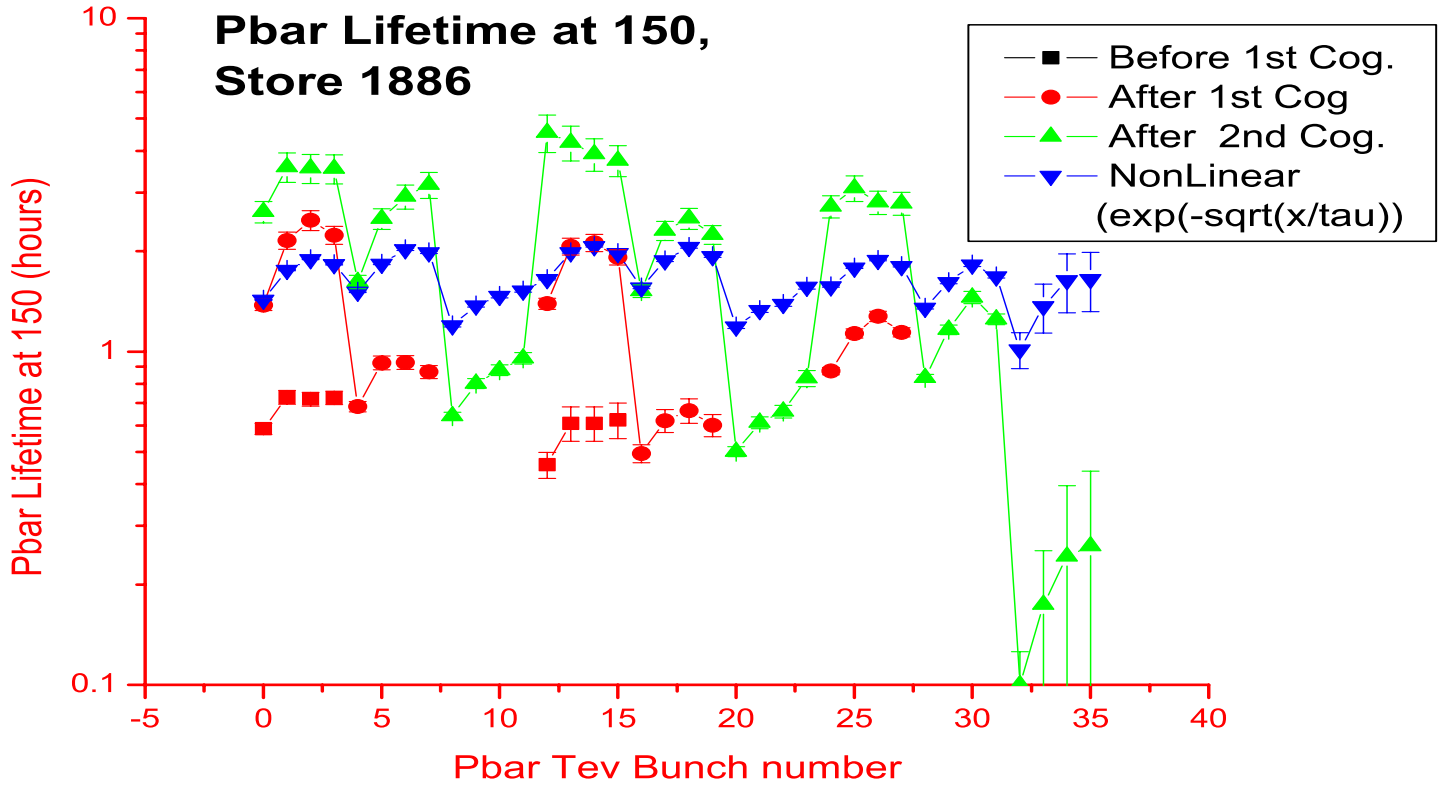
- Since the pbar lifetime at 150 decreases as a function of time (as the bunch are "shaved" by the proton current), try $I = I \exp(-\sqrt{t/\tau})$ instead of a simple exponential
- Does this non-linear lifetime correlates better with longitudinal or transverse emittance?

Non-linear lifetime, $I \sim e^{-\mathrm{sqrt}(t/\tau)}$

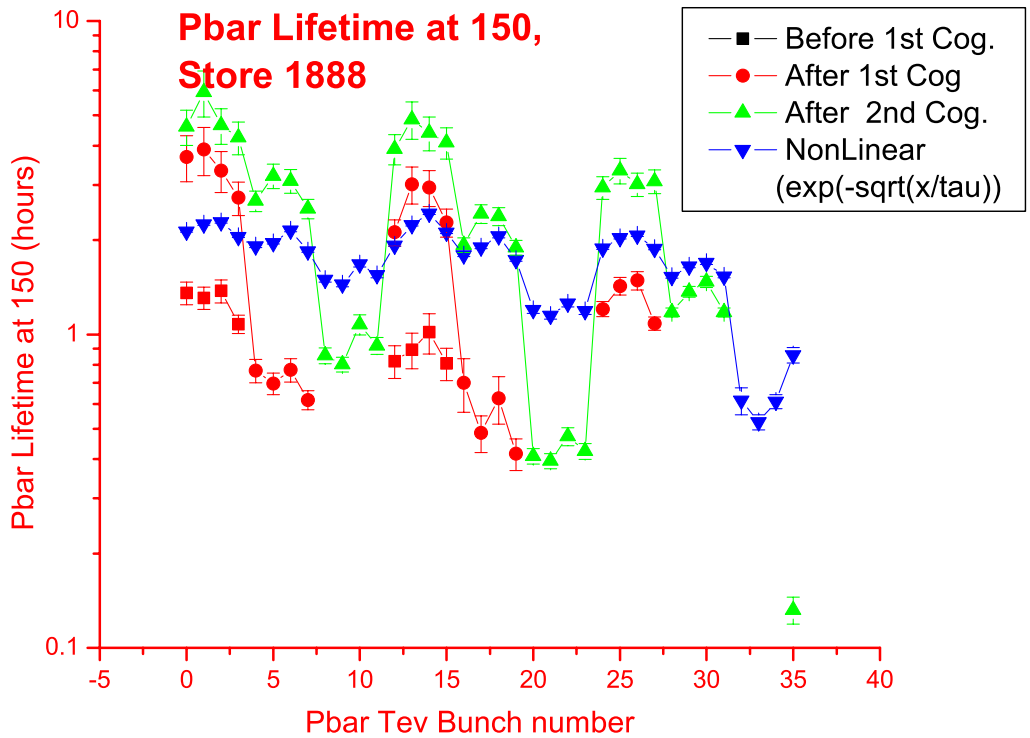


- Note the logarithm scale. Despite the non-linearity, such fits are surprisingly good. This bunch/store is not exceptional.
- Yet, the physics justification for such a formulas eludes me..
- One instrumentation caveat: we are still sensitive to the jump in FBI calibration at cogging time (around 21 min. after beginning of injection).

This Non-Linear lifetime is an average of "early" and "late" lifetime:

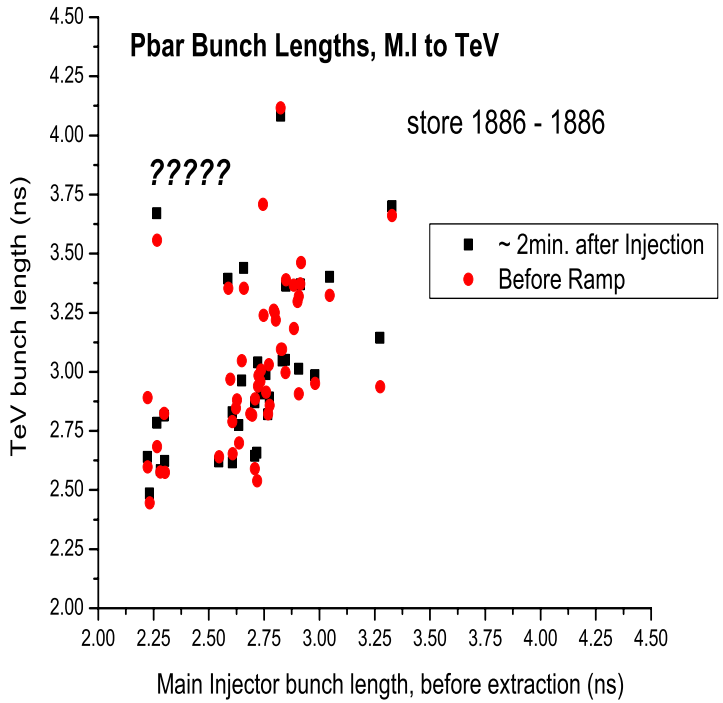


An other store..



Store 1888 was low Luminosity, low pbar Intensity, due to MI BLT tuning problem. Presumably, the emittance was larger. Yet, the lifetime is good..

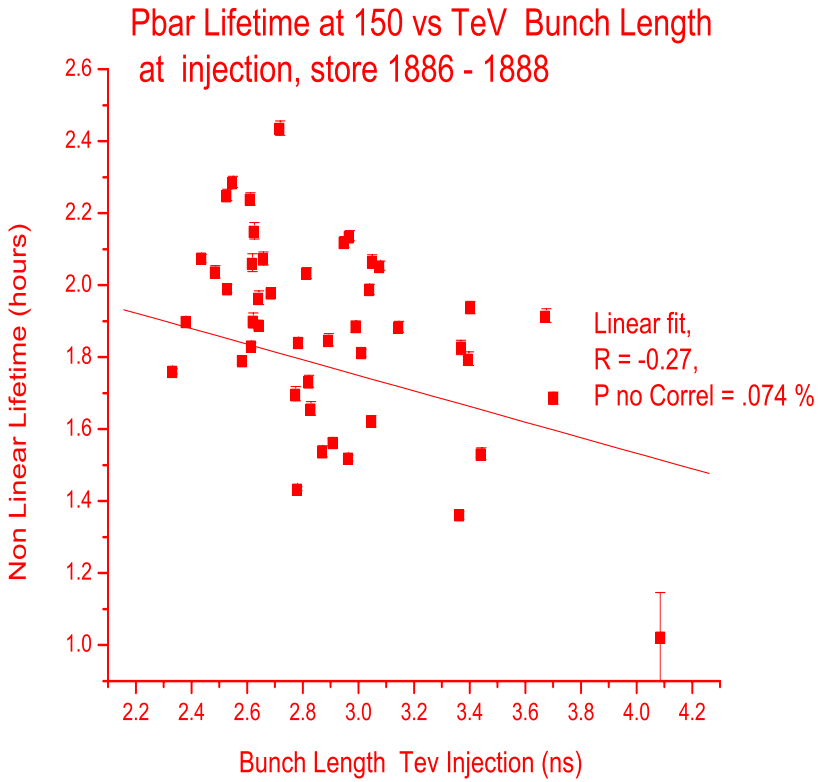
Longitudinal Emittance measurements: Comparison of MI and TeV bunch lengths..



We have no SBD data immediately (~ seconds) after injection, only after ~ 2min. (SDA DAE limitations)

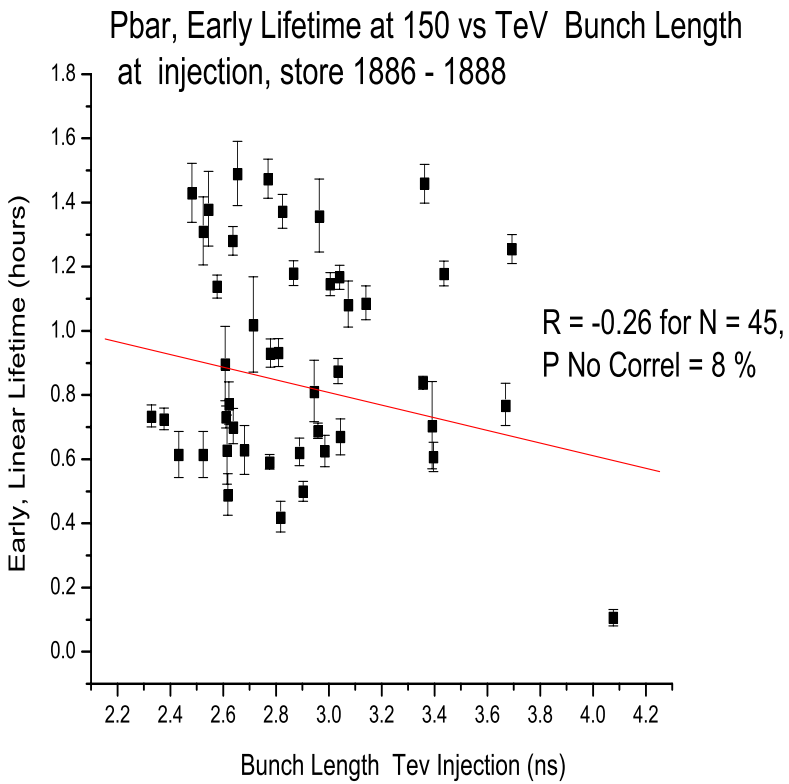
There is a lot of scatter! An error of ~ 10 to 15 % on each measurement is probably realistic. (unfortunately).

Non-Linear Lifetime vs bunch length in TeV



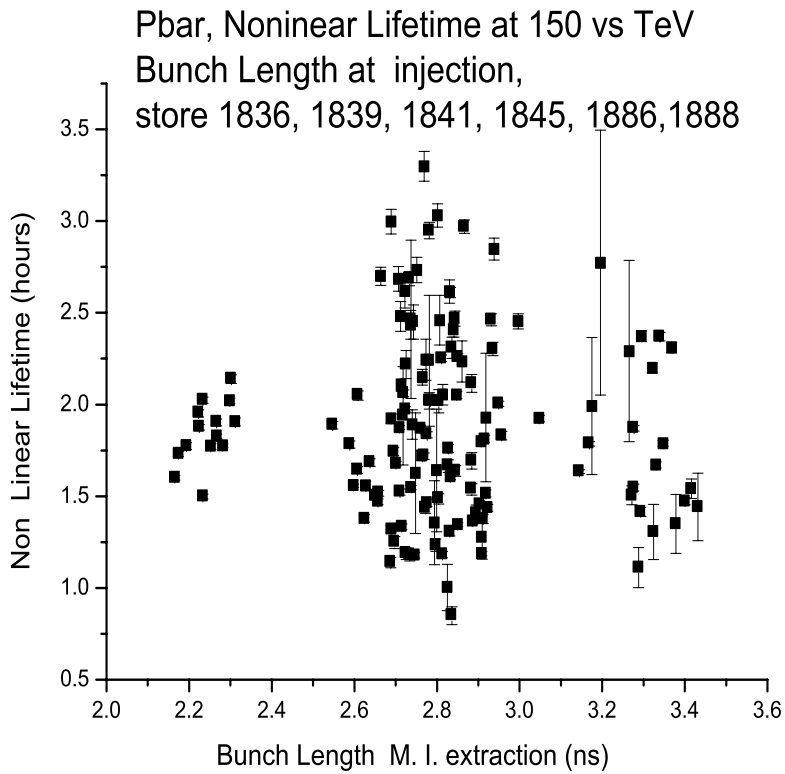
The TeV bunch lengths are measured a few min. after injection. Some shaving already took place..
On two recent stores, the correlation is barely a 2 sigma effect.

Early, Linear Lifetime vs bunch length in TeV



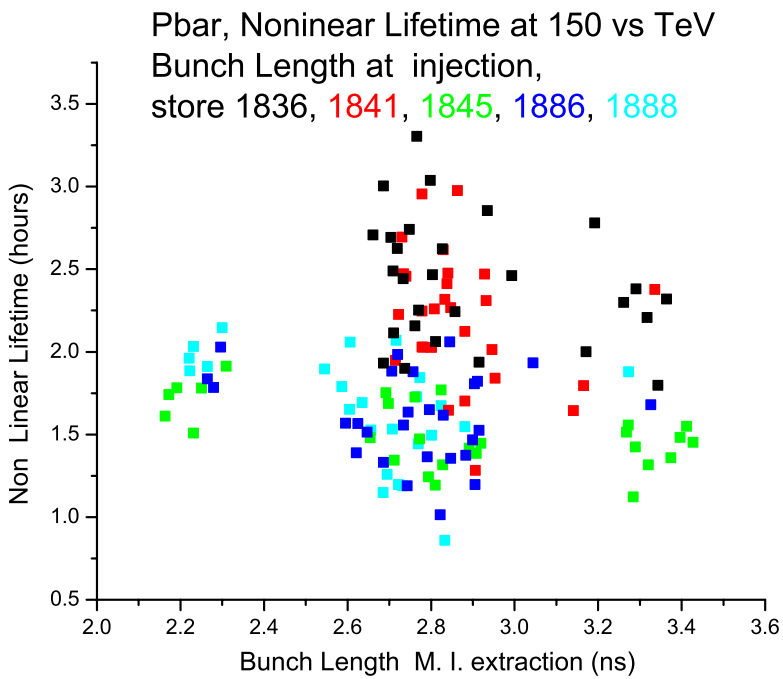
The same scattering of the data appears in the "early" (~ 5 to 10 min.), linear fits. (before the first cogging).
The correlation factor is about the same.
More data is required..

Non- Linear Lifetime vs bunch length in MI



The SBD Pbar data has only been made available recently, older store, meanwhile, older data (via archived D44 data) has been re-analysed using the non-linear lifetime.
The correlation between bunch length in M.I. and this lifetime is rather weak!

Non- Linear Lifetime vs bunch length in MI, II



Can we combine different stores?

No distinctive pattern..

Note also the "bunching" of the M.I. Bunch lengths around 2.25, 2.8 and 3.3 ns .. Why?

Things to do…

1. Correlation between transverse emittance at injection (in TeV) and lifetime. We need first to "stabilize" ("jumping" up and down of the emittance, measurement after measurement..) and re-calibrate the FWs before one can use the data, unfortunately.
2. Understand why the non-linear model works.
3. Fix the SDA DAE bug on the SBD pbar data.
4. Study the SBD data (pbar bunch length) vs time at injection (The SBD data comes every few seconds..)
5. Correlate the lifetime with injection errors (e.g. with BLT data), which presumably slightly modify the average transverse position of the bunch.