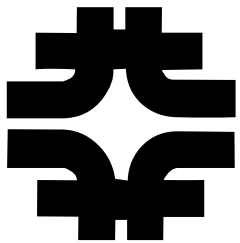
On Failed Attempts to Quantify Beam-Beam Effect with Lifetime measurements.



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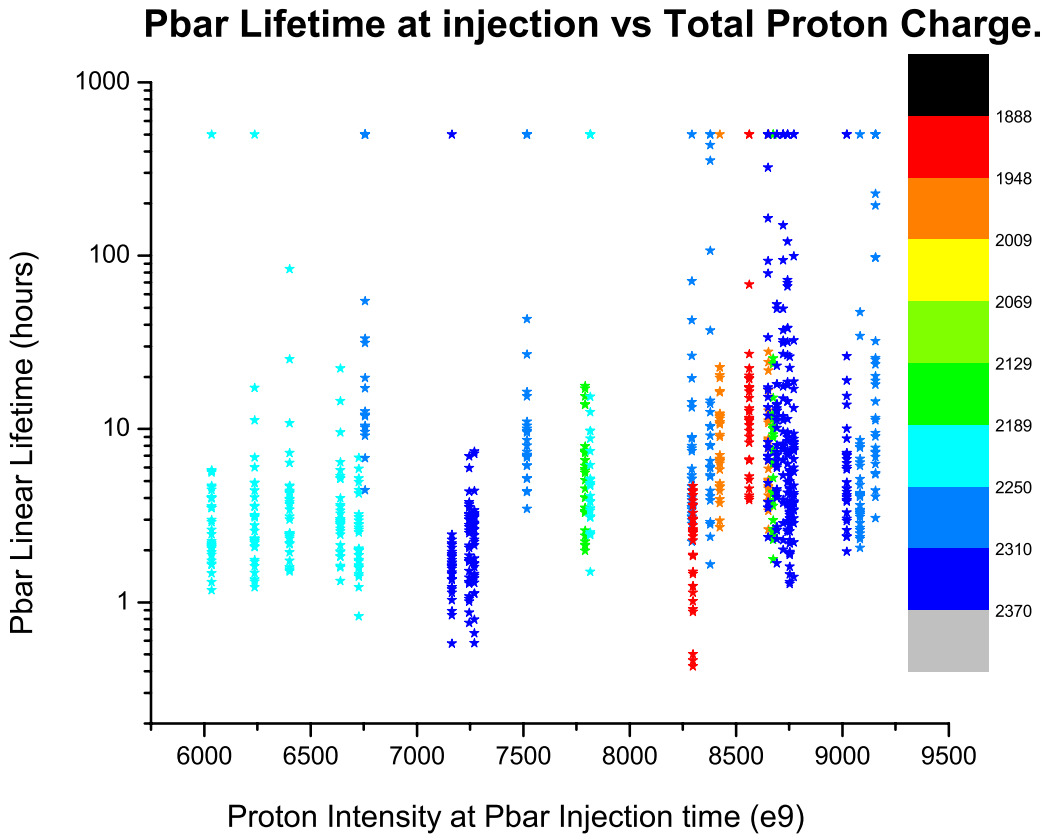
April 2 2003

Goal & Scope: Establish Beam-Beam via efficiency and lifetime

- Suggested by Tanaji Sen, March 27 2003
  - Plot lifetimes at 150 and 980, versus the total charge intensity in the other beam.
  - Same for Ramp and Squeeze efficiency
  - See list of instruction.
- Scope: Since we see no dependency what so-ever, this study has been cut short..
  - Must look at the dynamic apertures, which are very sensitive to orbits!

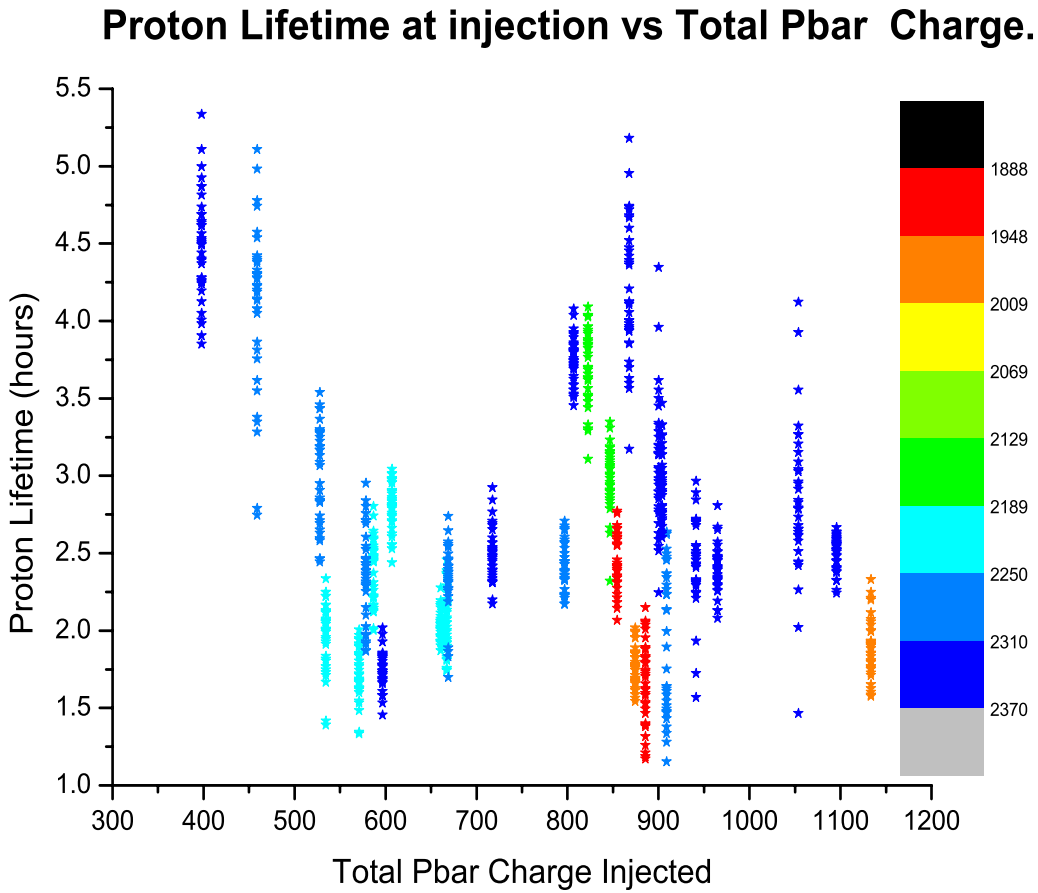
At 150 GeV, Pbar Lifetime vs Proton Intensity



In all of these plots, one symbol corresponds to one bunch. The color is coded to the store number.
For some bunch, lifetime is consistent with being infinite! (graph saturate at 5000 hours)

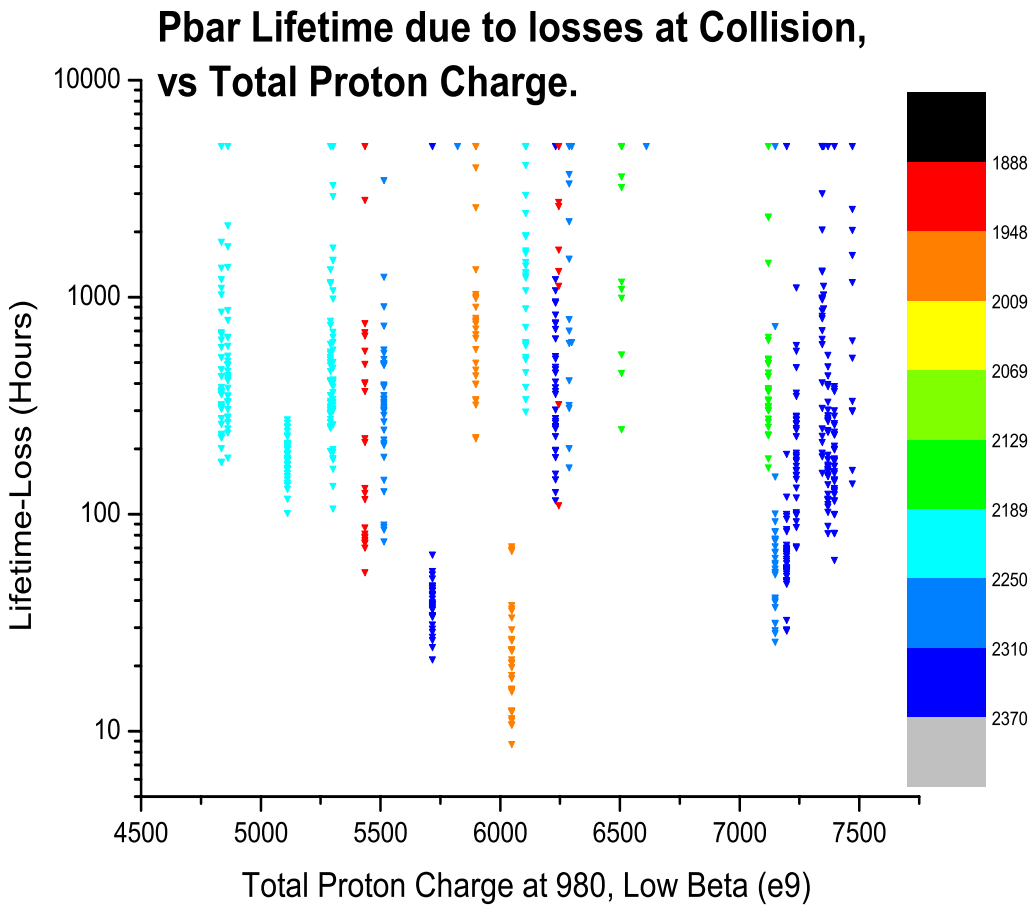
There might be a trend to longer lifetime at higher proton intensity, which is purely accidental, as running with higher proton coincides with a reduced transverse impedance and/or increased physical aperture, and/or better magnet alignment.

At 150 GeV, Proton Lifetime vs Pbar Intensity



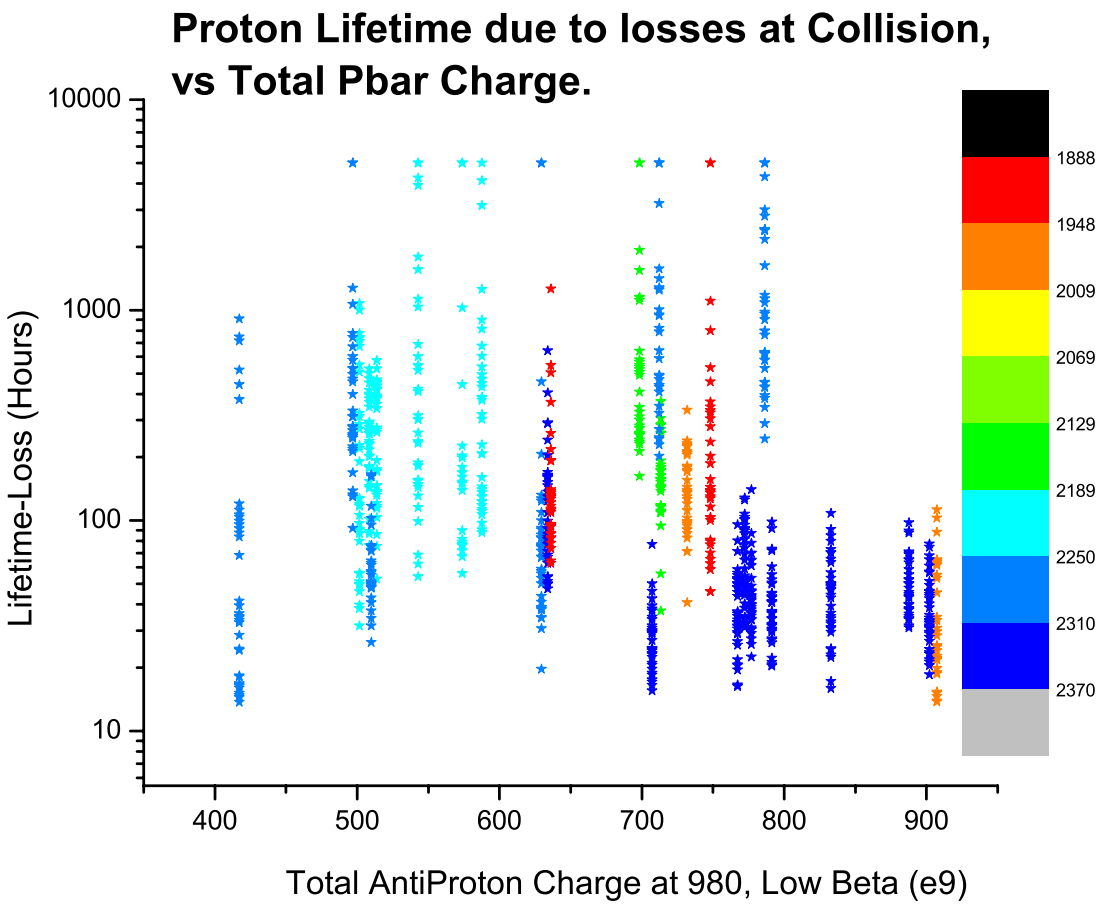
Again here, no obvious trend. The proton lifetime is typically shorter than the pbar one, due to the larger emittances (transverse and/or longitudinal). The fluctuation in the data is still large, as well as pronounced store to store fluctuation.

At 980 GeV, during HEP, Pbar Lifetime vs Proton Intensity



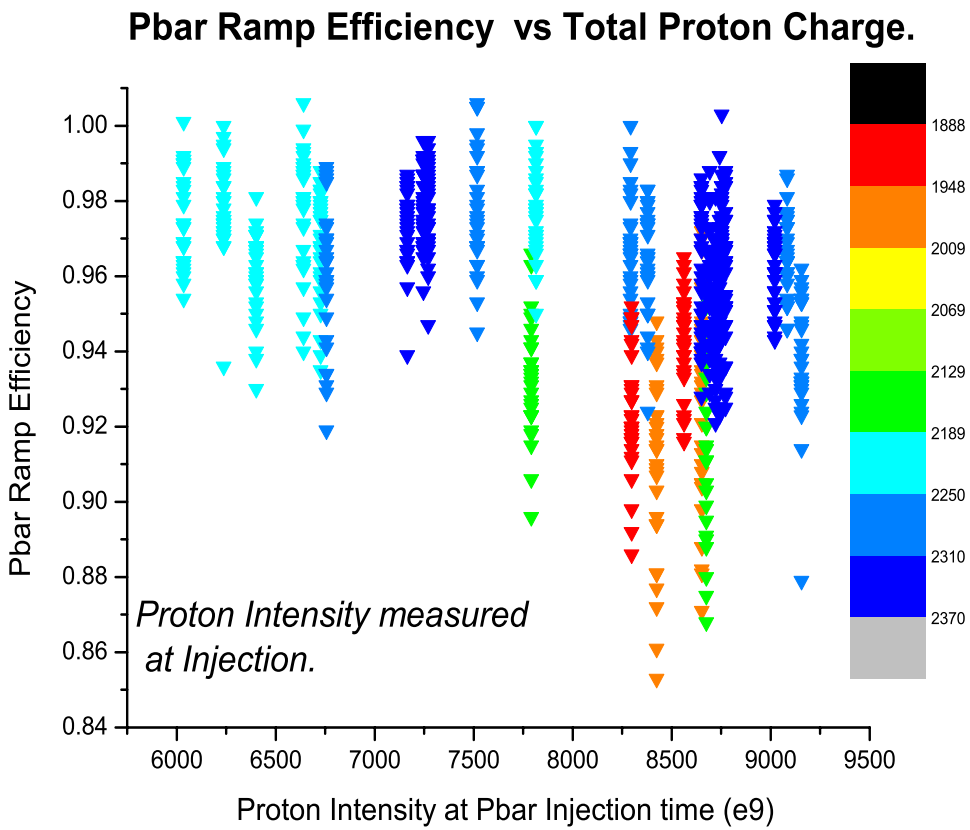
These are the lifetime due to losses. The contribution due to pbar "burning" at the I.P at CDF and D0 have been subtracted. Since the bunch-by bunch Luminosity vs time from D0 were not available in SDA, we assume that the collision rate for a given pbar at D0 is the same as the one at CDF. For about 1/3 of the data, this loss is negative, due to measurement error. These infinite lifetime are arbitrarily set to 5000 hours.

At 980 GeV, during HEP, Proton Lifetime vs AntiProton Intensity



As anticipated, large fluctuations and no obvious trend. We are running with more losses, as we keep more beam at 150 and through the acceleration.

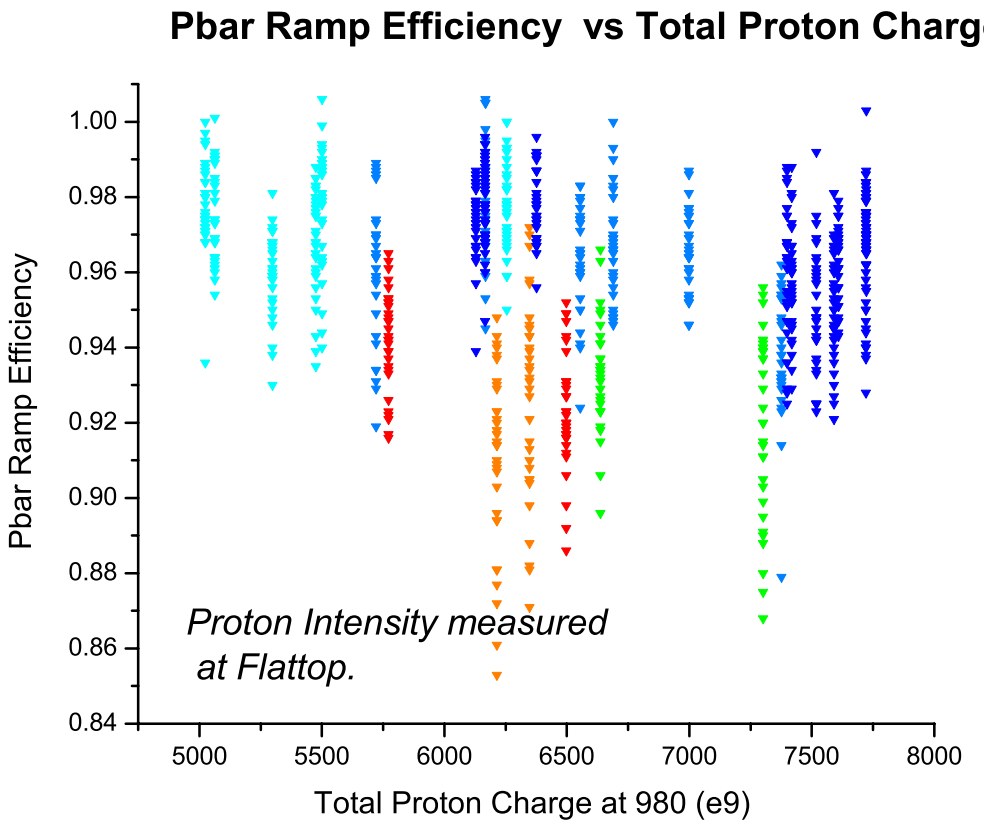
Pbar Ramp Efficiency vs Total Proton Charge.



Again, No obvious trend!.

The proton intensity is measured at 150 GeV, at injection.

Pbar Ramp Efficiency vs Total Proton Charge.

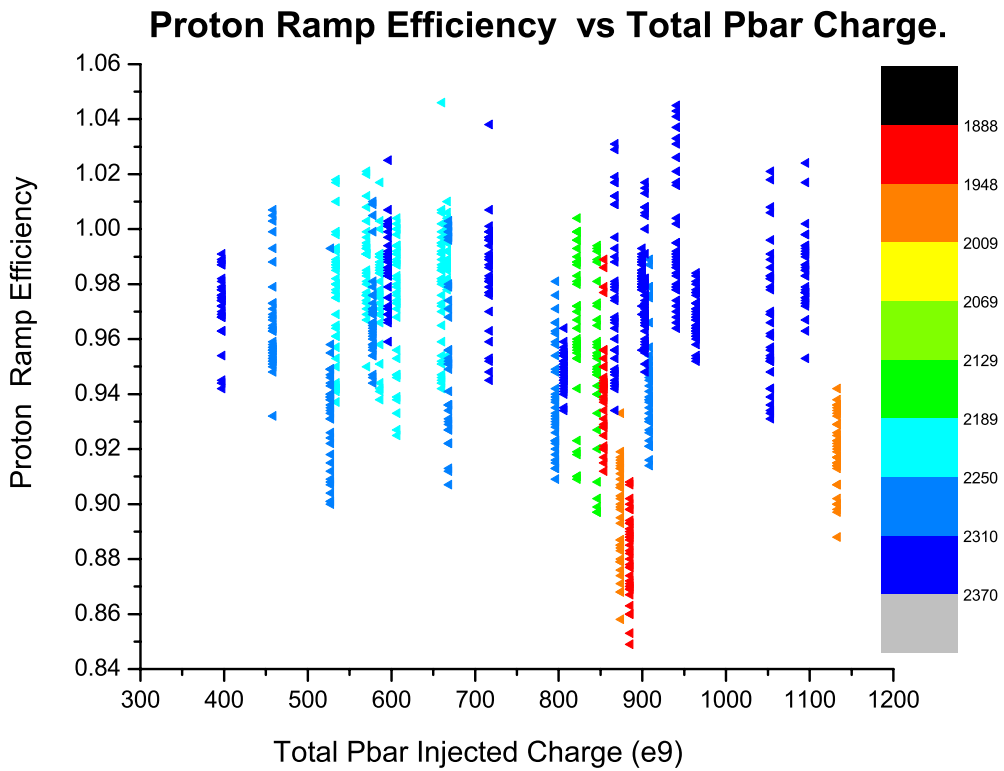


To avoid possible confusion, the proton intensity is now measured at 980 GeV, at Flattop.

Again, no "really" significant trend.

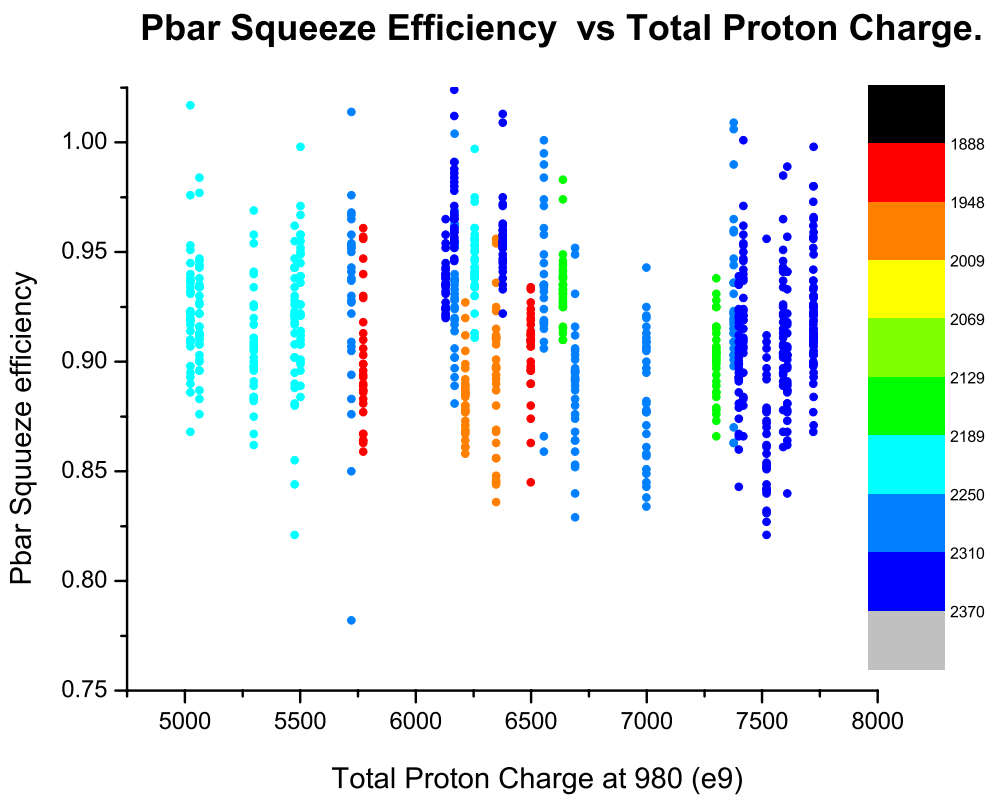
A fit gives a slope with expected sign, about -0.1% per e12 protons, which, from an operational perspective, is negligible.

Proton Ramp Efficiency vs Total Pbar Charge.



For sake of completeness..

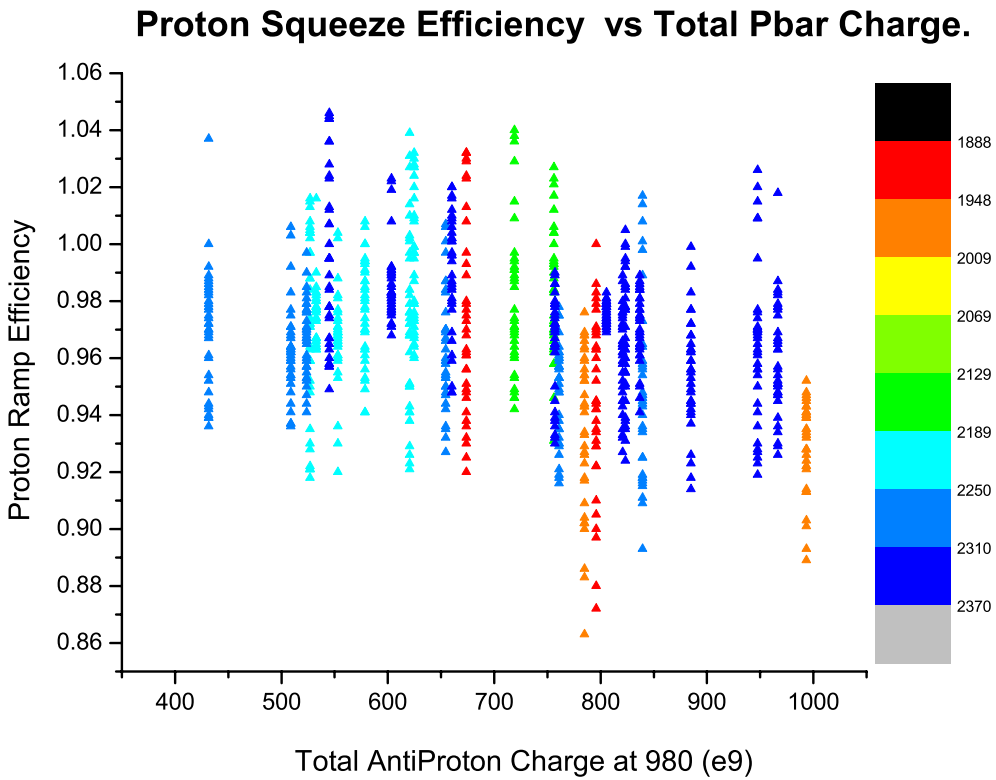
Pbar Squeeze Efficiency vs Total Proton Charge.



The slope is -0.6% per 1 e12, which is still too small to notice….

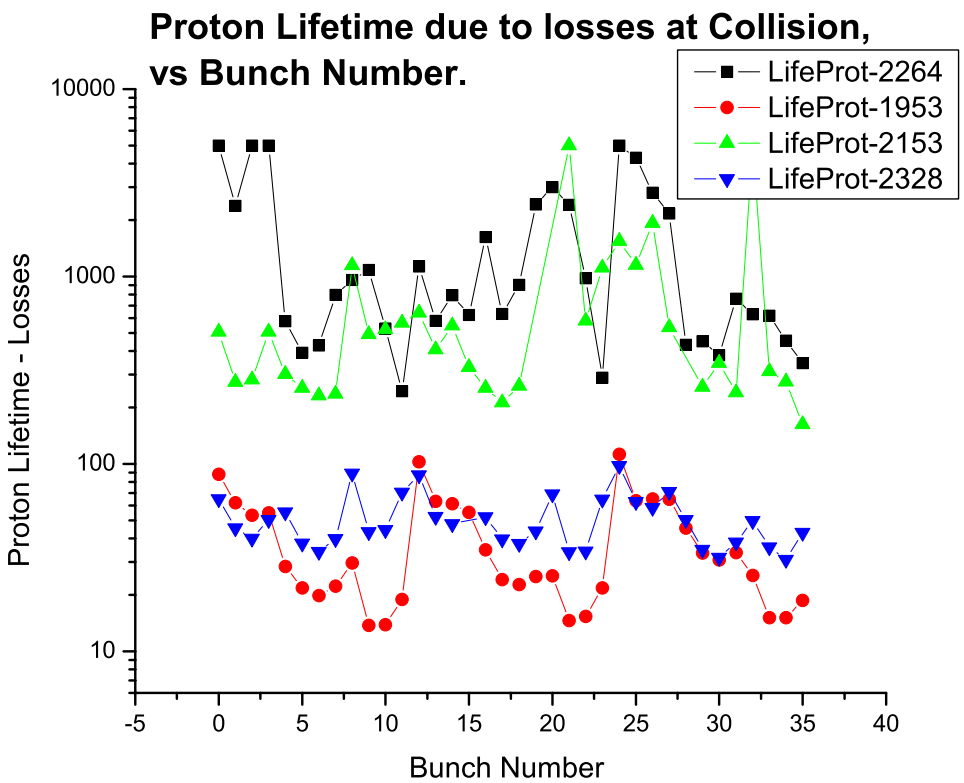
We are still missing the Dominant cause of fluctuations..

Proton Squeeze Efficiency vs Total AntiProton Charge.



The fitted slope is -5% per 1 e12, which is 10 times bigger than for the pbar, which , in the context of beam-beam, makes no sense!

More Studies could be conducted..



The proton losses at 980 can be severe and now start affecting the Luminosity lifetime advserly.

Note that for the old store 1953, something reminiscent to beam loading problem start to appear. However, this effect is less pronounced for recent store 2328.

Tentative Conclusions

Using this crude lifetime technique, we have no quantitative, reliable evidence for adverse beam-beam effects.

We are missing the root cause of large lifetime fluctuations, both bunch to bunch within one store, and store to store.

We have shown in a previous document (#508) that there seems to be an indication of a bunch number dependency of the pbar lifetime at 150, presumably correlated to emittance variations at the source. A correlation of the M.I. Emittances and Pbar life time at 150 is pending..

The store to store variation is presumably attributed to overall TeV running condition, such as orbits, tunes, chromaticities. We should include the orbits data (BPM) into SDA to establish such possible trends.