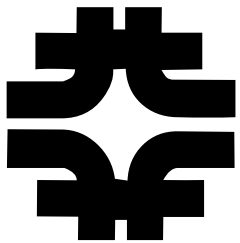
On Luminosity vs Number of Injected Protons; Simple Phenomenological observation of beam-beam effects



Paul Lebrun Fermilab

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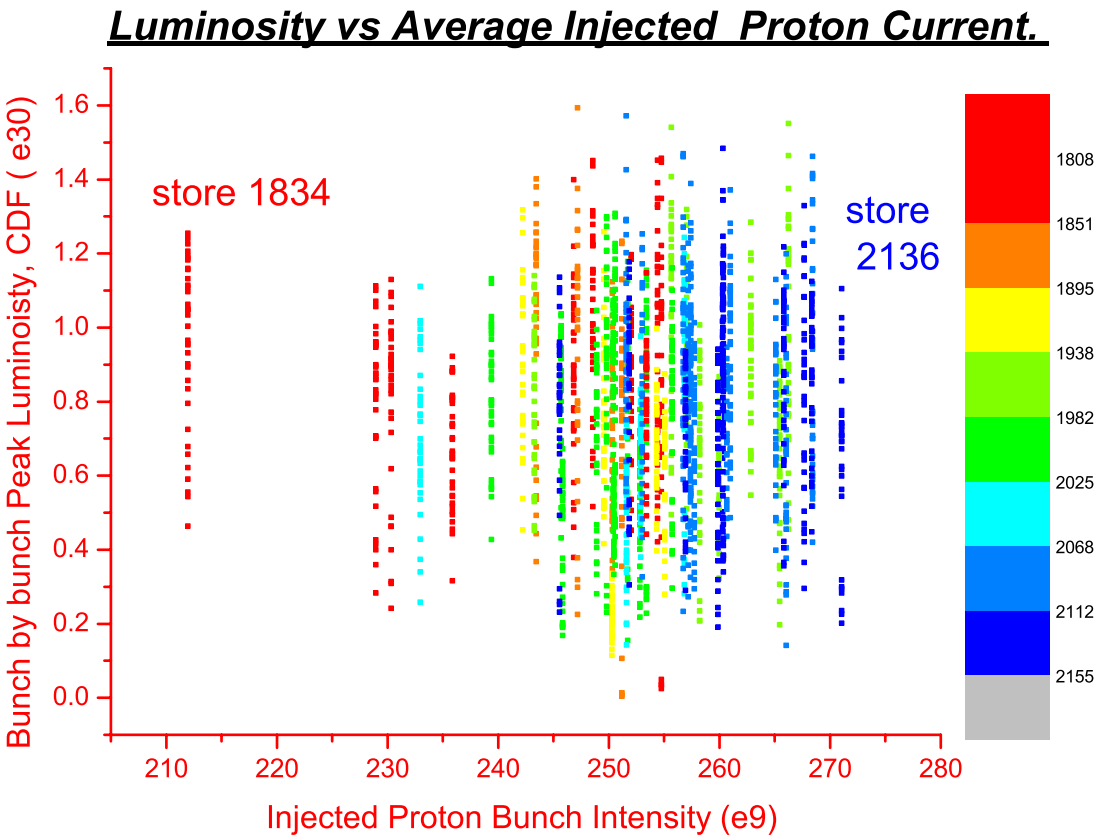
Optimum Injected Proton Intensity ?



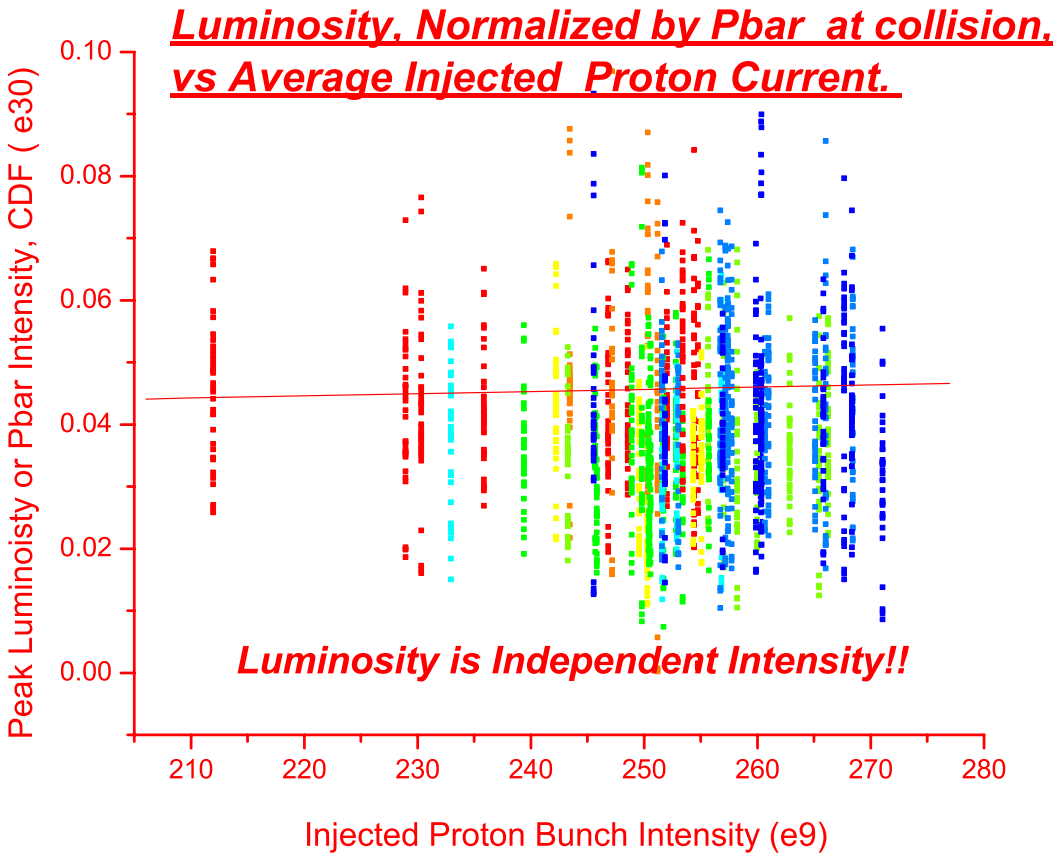
One would naively expect to see a linear correlation between the number of proton per bunch, injected into the Tevatron, and the corresponding bunch Luminosity.

This is not the case. It is not due to measurement errors.

Mostly, we loose the excess proton at 150, are during acceleration.

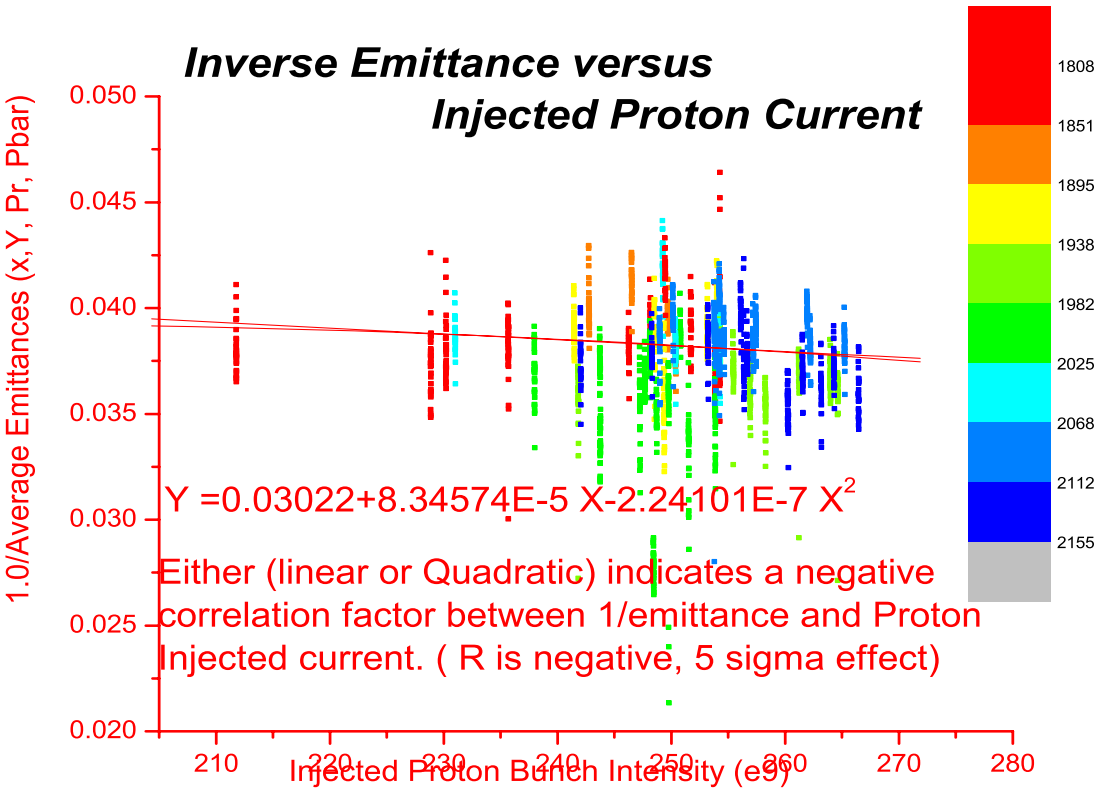
But there is more..

Optimum Injected Proton Intensity, II ?



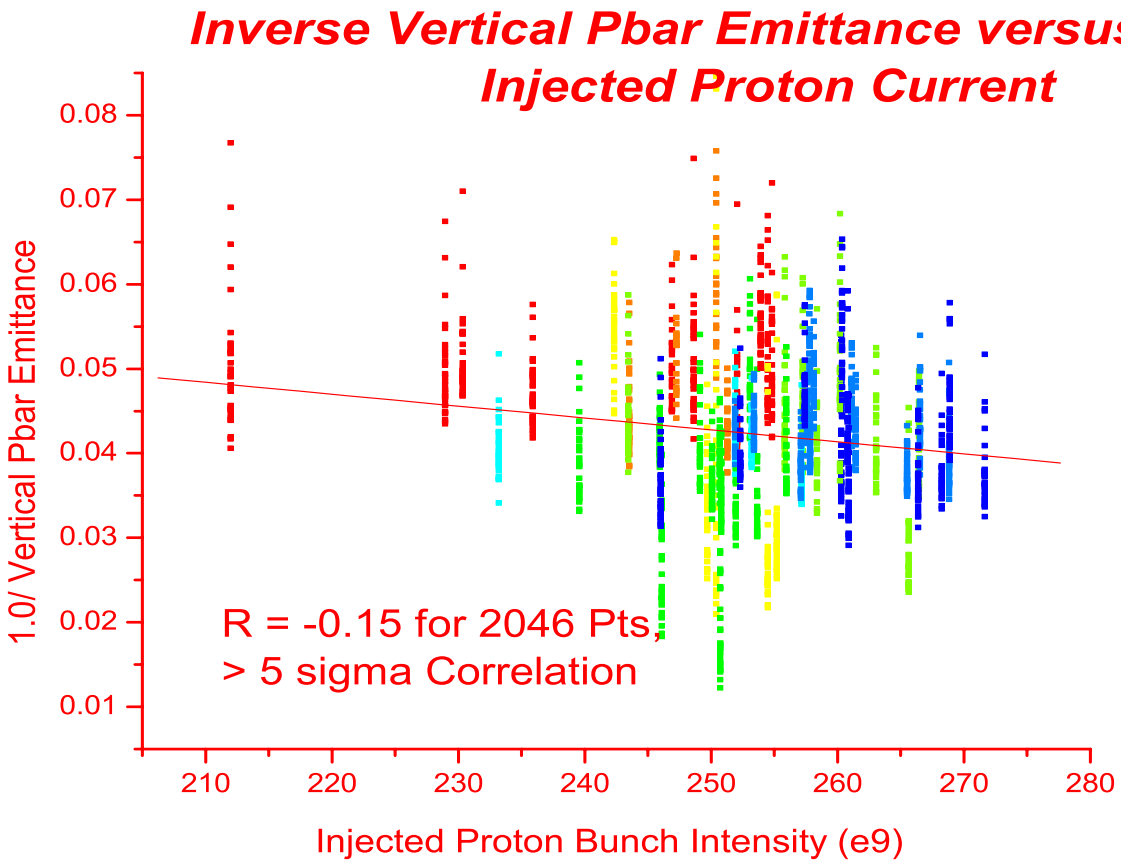
- Large fluctuation in the bunch by bunch luminosity occurs due to fluctuation in emittance and Pbar yield. Mostly due to pbar bunch intensity.
- The relative rms of the luminosity divide by the number of Pbar at collision is indeed smaller than the luminosity itself.
- However, the positive linear correlation between injected protons and the luminosity does not show up. Note the most intense store 2136 gave us less luminosity per pbar than store 1834

Where Are We loosing ?



- Mostly, by simply scraping away the excess proton at large emittances.
- And, by increasing the transverse emittances, in both planes..
- Here we simply compute the inverse of the average X &Y, Proton and Pbar emittances, at Collisions, vs Injected Proton Intensity.
- The correlation factor is negative and statistically significant.

Also, In Pbar Emittances!



- O.K., we blew the protons..
- We also affect the Pbar emittances!.
- The best measurement of the Pbar emittance is in the vertical plane.
- The inverse of the vertical pbar emittance at collision is anti-correlated with the injected proton current.
- *This can only be explained by beam-beam effect.*