Update on Tune Shifts at Injection

Electron Cloud Meeting

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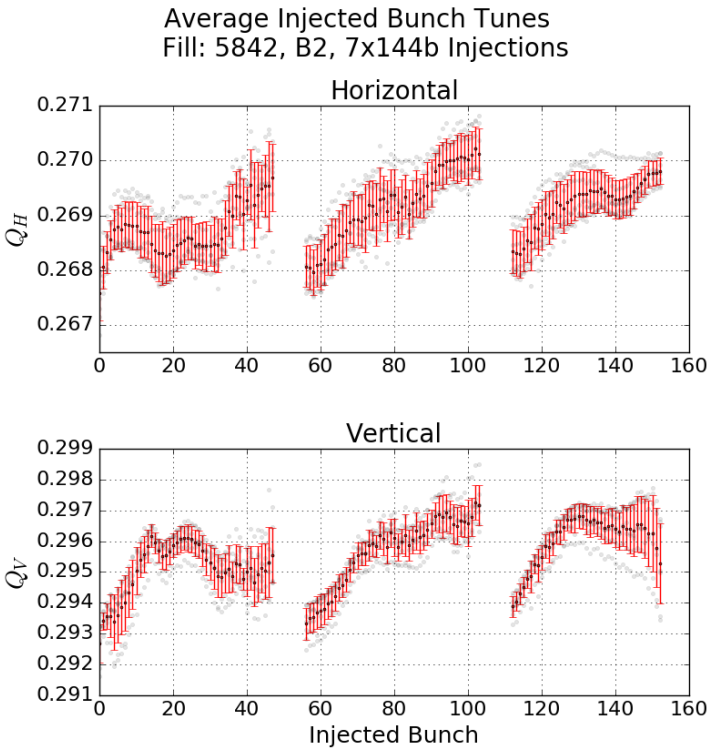
Introduction

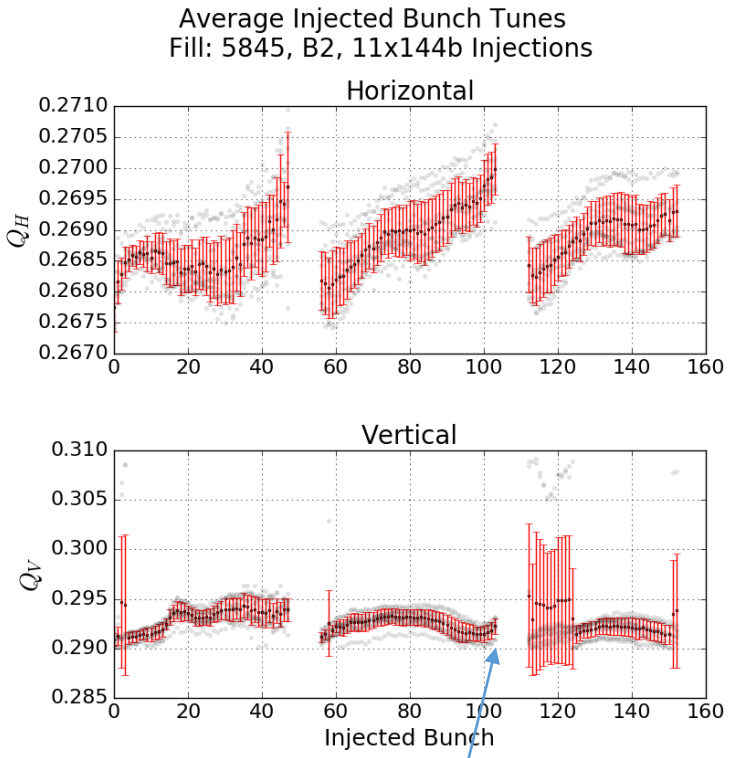
- Can we obtain the tune shift along the batch from the injection oscillations to get a measure of local electron density?
- **Challenging** due to ~50-60 turns worth of usable data. Combination of **strong ADT** and **high chromaticity** means it is not possible to obtain more usable turns.

- Have been **saving all injection oscillations** (bunch-by-bunch turn-by-turn) since mid-2016 (with small gaps when script fails).
- If we make the assumption that **the gap between SPS trains in the LHC is enough to reset the local electron cloud**, (seen in synchronous phase shift) then life becomes easier.
- Can make a fill overview plot for each plane, whereby the tunes are averaged over all the injections for each bunch slot.
- Some good data acquired for injections during the scrubbing. Can also shown some from just before TS1 in 2017.

- Note: This is not a complete study, and what is being shown is the result of **cherry picking** the data that looks how it should. Work is still underway to provide adequate filtering of the data to consider, and then a complete statistical analysis can be performed. More later.

An example





Adjacent fills show different tune shifts (here in vertical)

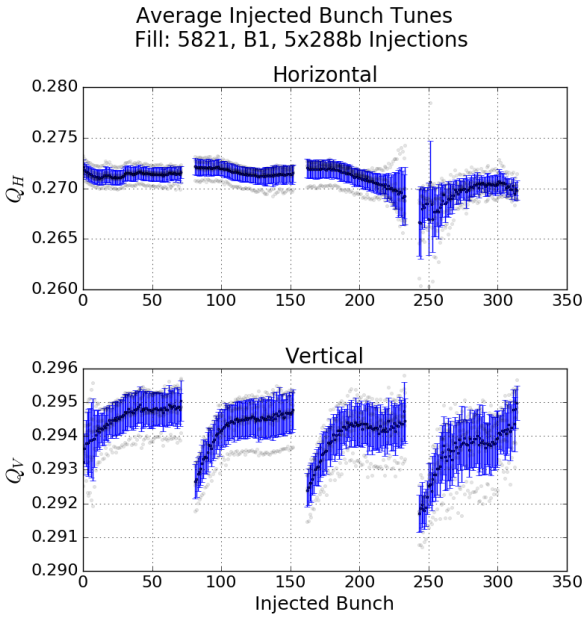
Small std deviation from 11 injections, can not be neglected

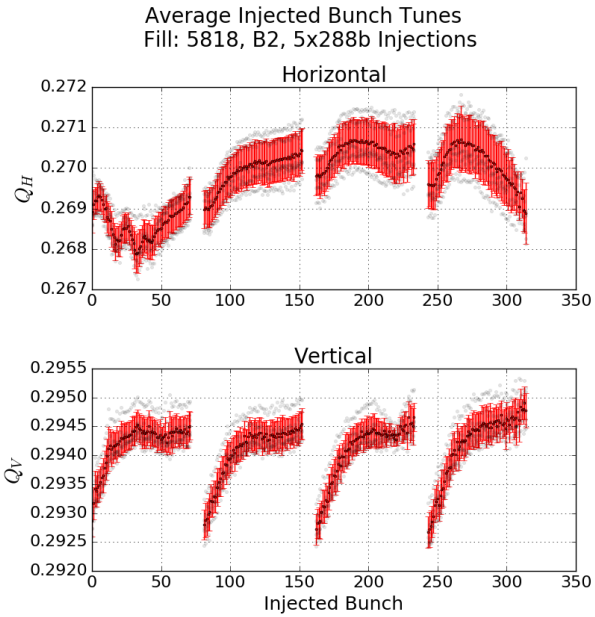
2017 – Scrubbing

- Fills occurred at the end of the scrubbing run in 2017 (around 12/06/17).
- For these fills with 288b injections, for shifts over 72b

ΔB1H ~ 0
ΔB1V~2e-3

ΔB2H ~ ?
ΔB2V ~ 1.5e-3



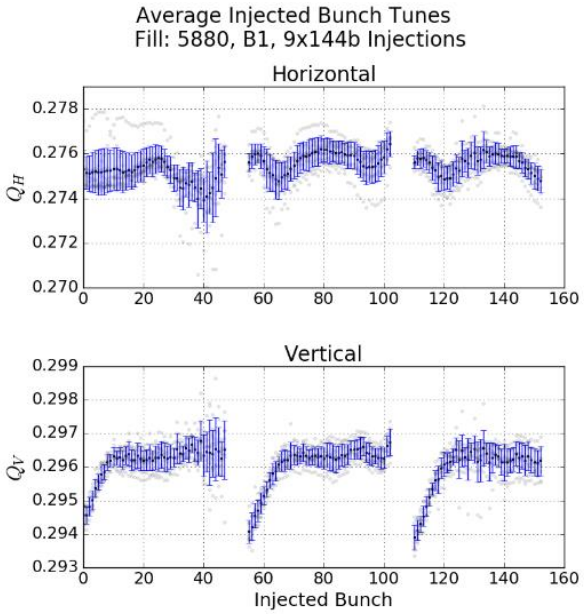


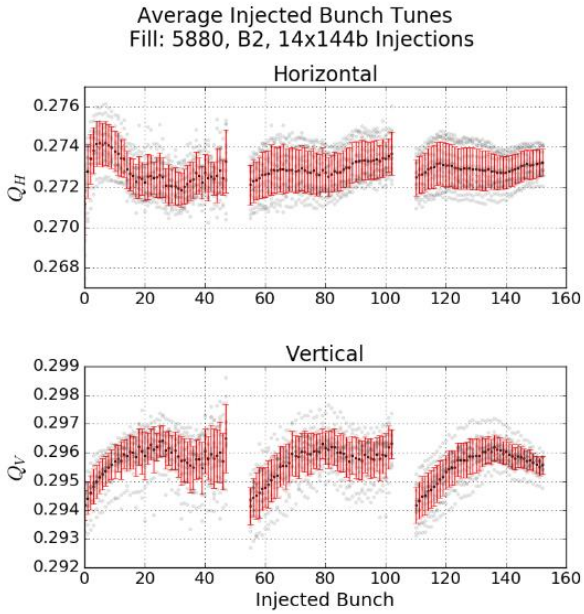
2017 – Before TS1

- Fill 5871, 28/06/17
- For these fills with 144b injections (from 3 BCMS batches), for shifts across 48b

ΔB1H ~ ? ΔB2H ~ 0

ΔB1V~2.5e-3 ΔB2V ~ 2e-3





Thoughts & Next Steps

- Data shown here is **horrendously cherry picked**, clearly a more scientific and statistical approach is needed.

- Define a **rigid set of criteria for data quality** and stick to it.
  - Minimum of 5 injections
  - Set a threshold on the spread of standard deviations for the first and last bunches.
  - If it does not pass this test, do not include it.

- My feeling from looking at individual plots, is that probably the full dataset of all injections in all fills will be reduced to about 10 meaningful points.

- Also working on a way of accounting for the Laslett shift. Currently done automatically in steps of 2e-4 once the accumulated trim from Laslett shift exceeds this value.
- Could possibly **remove the automatic trim and apply one that is more adiabatic** and based on past measurements.