Measurements of the second order chromaticity with the new SPS octupole scheme

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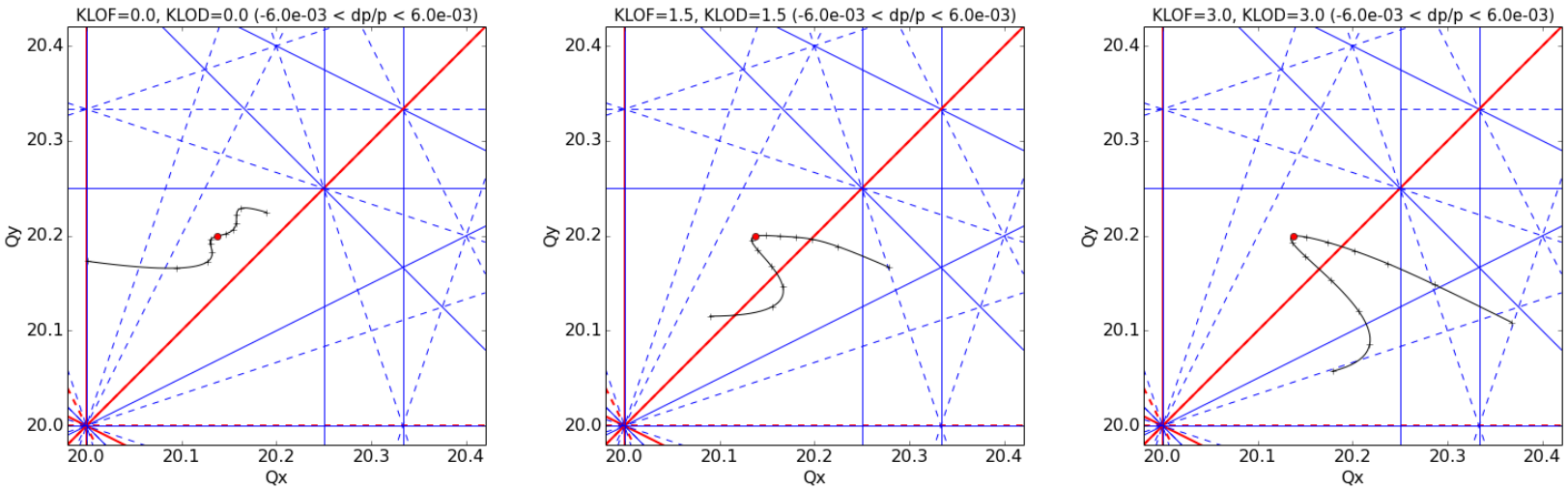
4x48 bunches (LIU intensity) exhibit **single bunch instabilities**...

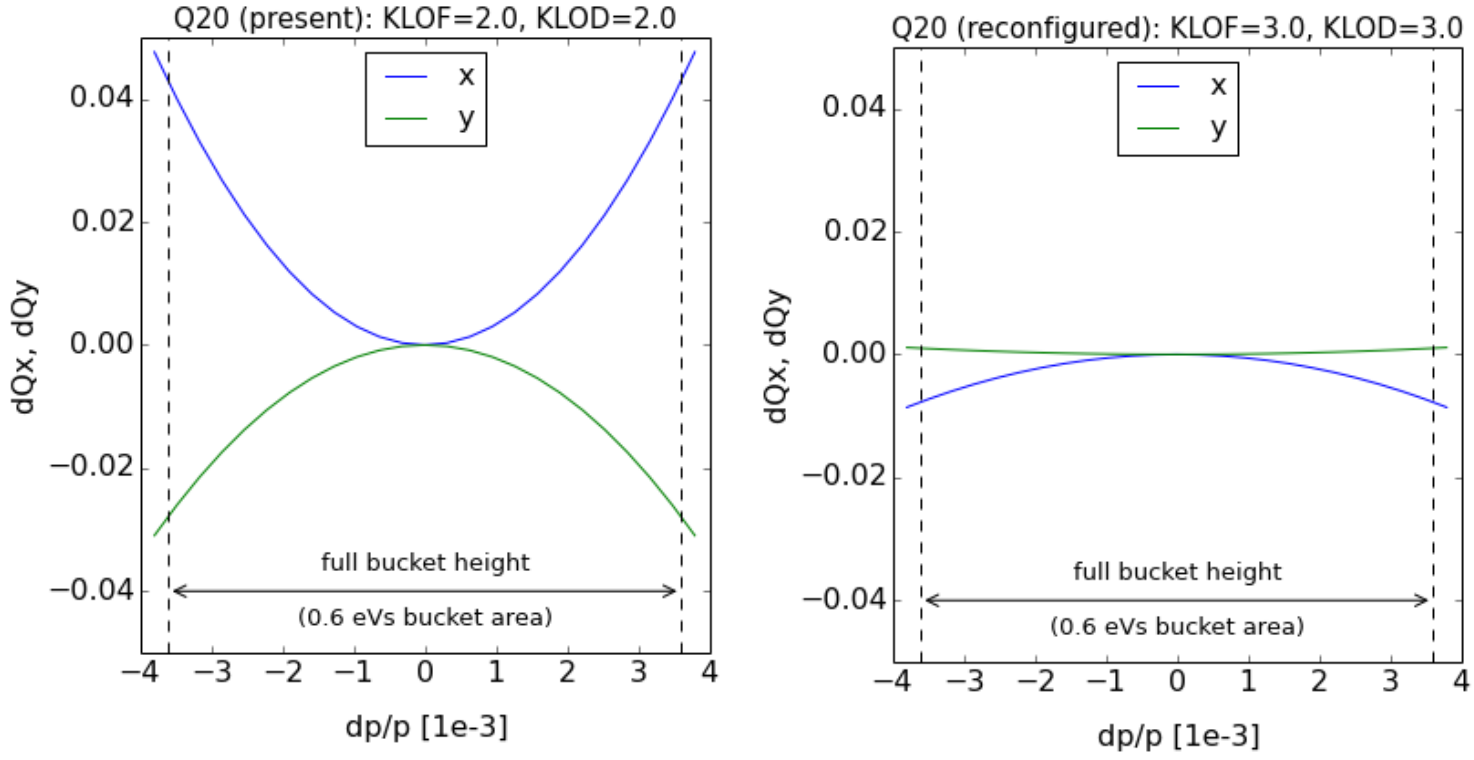
- Single bunch instabilities can be cured with chromaticity
  $\rightarrow$ **Large chromaticity** results in **non-coherent losses**
- **Octupoles** mostly **suppress these instabilities**
  $\rightarrow$ **non-coherent losses** similar as with high chromaticity
- Non-coherent **losses** most likely due to **2nd order chromaticity** induced by large dispersion in Q20:



Tune spread from octupoles can be an efficient way of suppressing instabilities if 2nd order chromaticity is avoided

During September technical stop **octupoles** configuration has been **modified.**

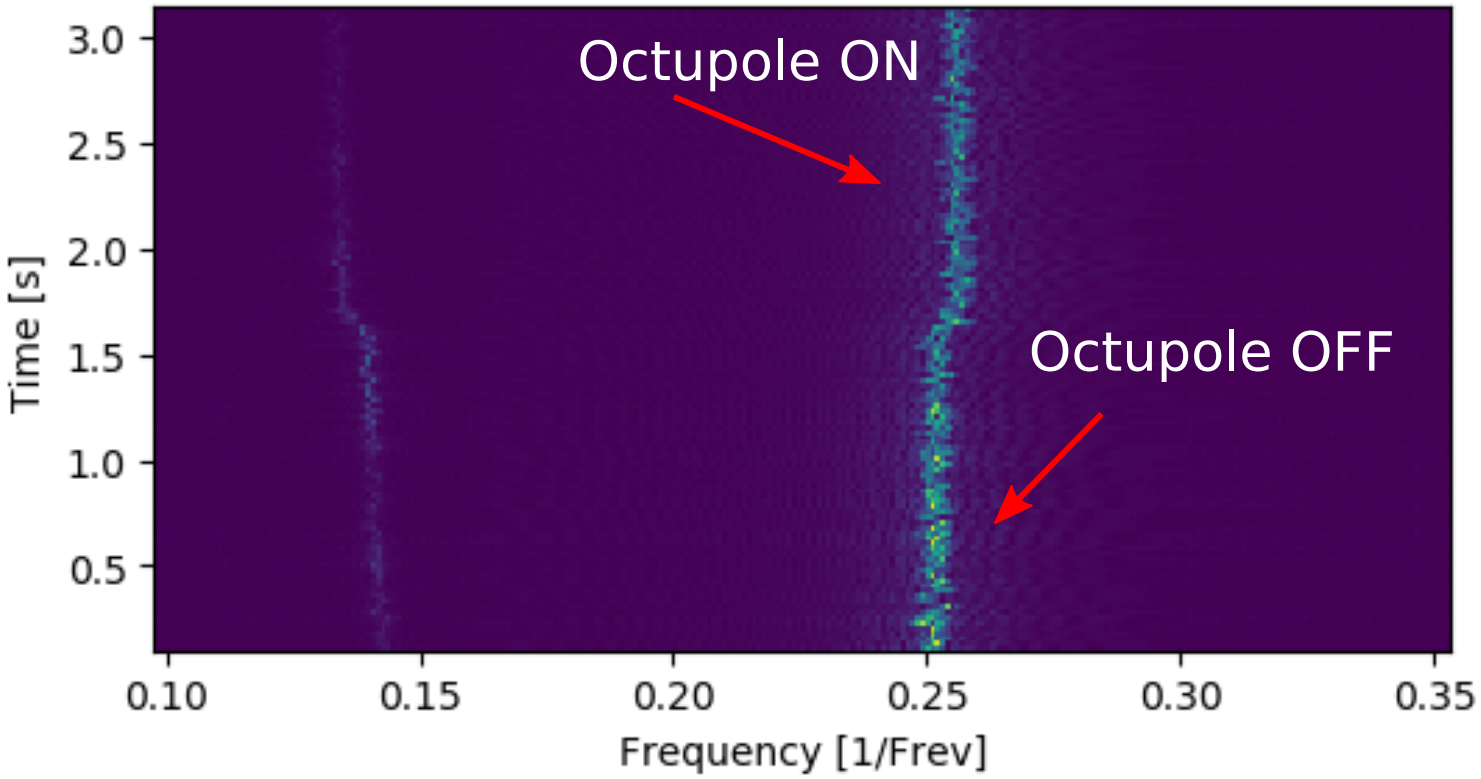
- The new configuration exhibits **lower second order chromaticity.**
- **Non-linear chromaticity** has been measured before and after the reconfiguration to **proof** the new configuration.



Particular care was taken to carry out chromaticity measurements

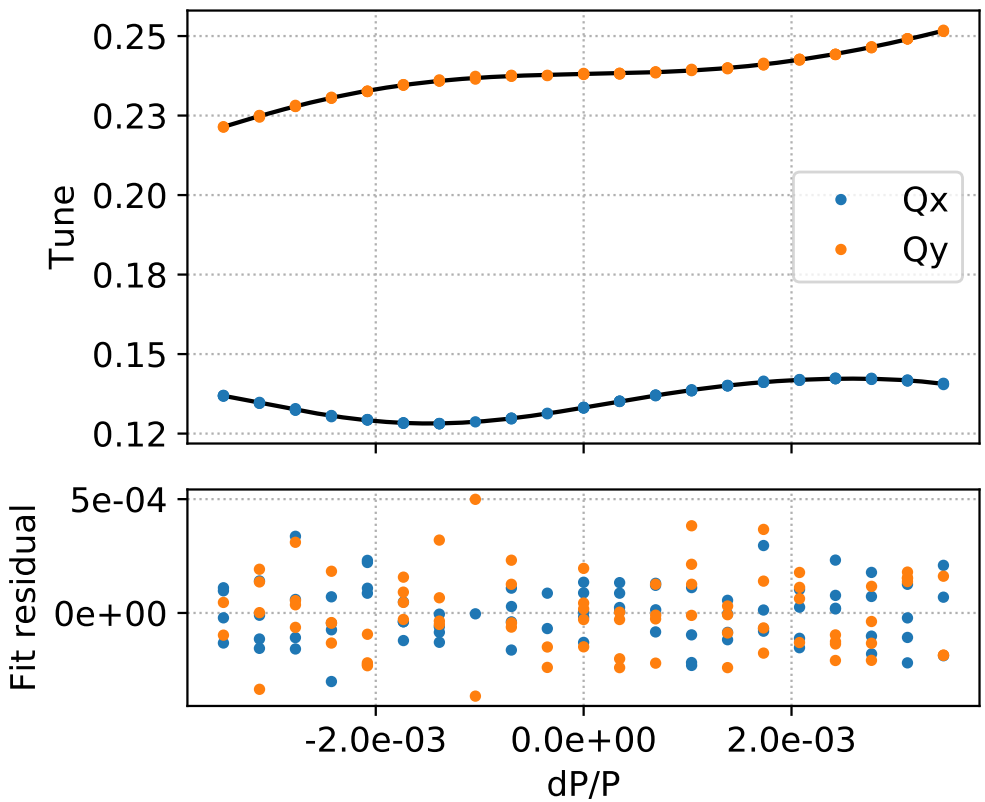
Chromaticity measurements

- The energy is kept constant during the cycle:
  one cycle $\rightarrow$ one point in the chromaticity scan
- Octupoles are on for half of the cycle
- Tune is measured with BBQ
- Energy is derived from RF frequency



Special low intensity beam provides improved stability

- A 50ns long single bunch is prepared in the PS and recaptured in the SPS in several buckets. (PS bunch rotation is switched off.)
- The stability margin is such that is possible to operate the SPS with slightly negative chromaticity (without feedback)



Horizontal (QPH: +0.65)
Q[0] : 1.3e-01 +/- 0.0 %
Q[1] : 5.5e+00 +/- 1.0 %
Q[2] : 9.7e+02 +/- 6.5 %
Q[3] : -4.2e+06 +/- 4.2 %
Q[4] : 6.2e+08 +/- 25.9 %
Q[5] : 4.0e+12 +/- 14.2 %
Q[6] : -1.6e+15 +/- 16.5 %
Q[7] : -4.0e+18 +/- 28.1 %

Vertical (QPV: -0.30)
Q[0] : 2.4e-01 +/- 0.0 %
Q[1] : 6.5e-01 +/- 10.6 %
Q[2] : -9.5e+01 +/- 90.2 %
Q[3] : 2.7e+06 +/- 8.7 %
Q[4] : -2.6e+08 +/- 87.3 %
Q[5] : -1.7e+12 +/- 45.2 %
Q[6] : 2.6e+14 +/- 147.8 %
Q[7] : 1.1e+18 +/- 146.7 %

SPS *gold-settings* for wide chromaticity scan

- Extra long single bunch (recaptured in several buckets)
- Low total intensity ($\sim 10^{10}$p)
- Chromaticity as low as possible (even negative)
- Low RF voltage ($\sim$0.5MV)

The wide dynamic range of the BBQ allows to measure tunes with very low intensity, where **most of the diagnostic is blind.** Once switched to long bunches BPMs are not usable anymore.

Measurements and Simulations