Beam-beam + impedance MD

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More detailed presentation can be found at:

http://emetral.web.cern.ch/emetral/ICEsection/2012/2012-10-03/SB_Coherent.pdf

Motivations

- Instabilities regularly observed during end-of-squeeze, adjust, collapse of the separation bumps and stable beams

- Until now different filling schemes, chromaticity, octupoles and damper gain settings were used to mitigate these effects

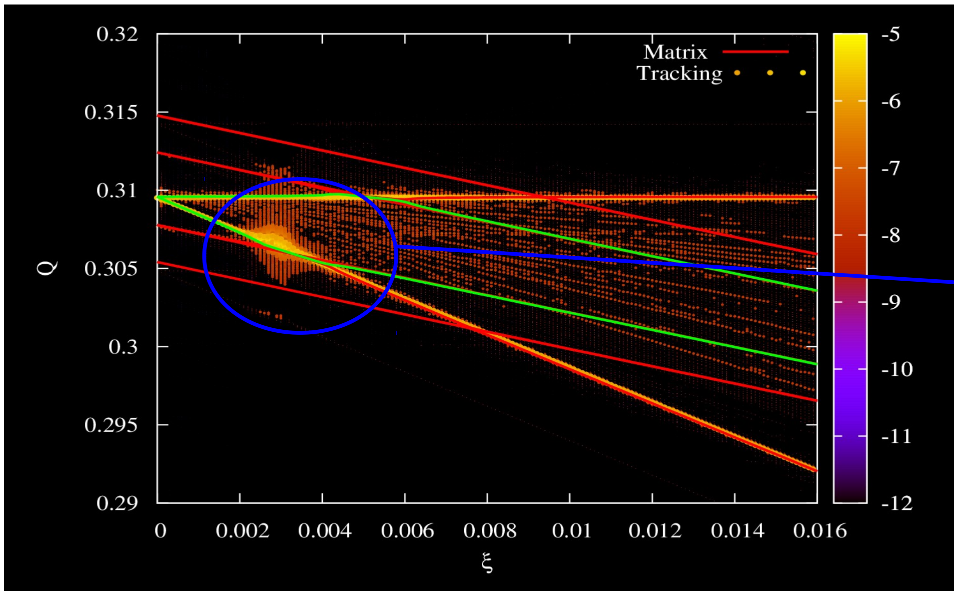
- During all these beam processes beam-beam effects have a significant impact on coherent and incoherent beam dynamics either through head-on or long-range interactions:

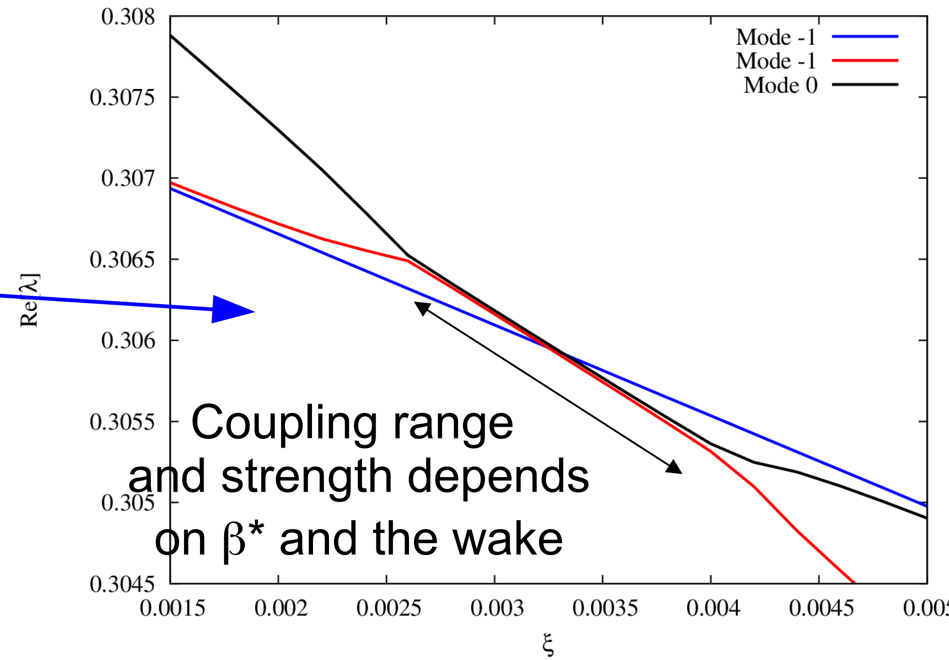
  → Can beam-beam interactions affect beam stability?

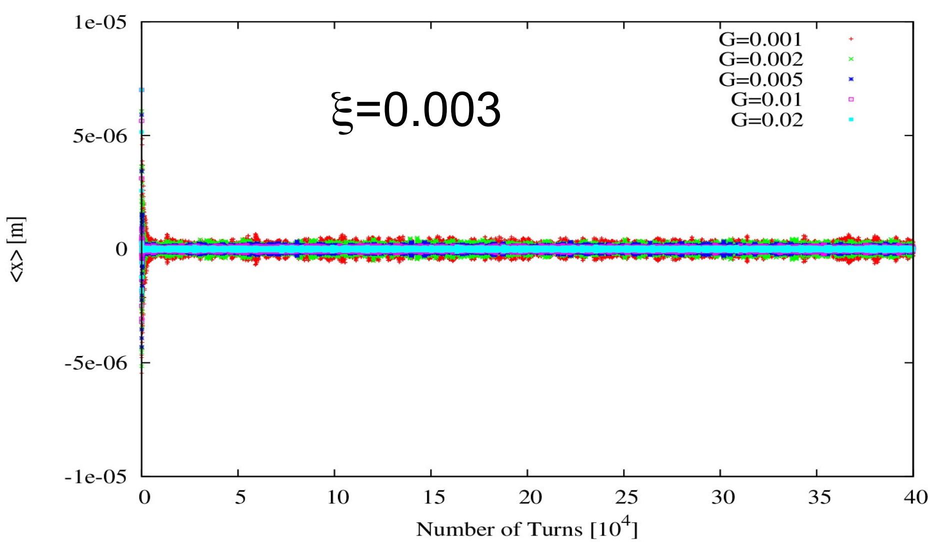
  → Could they explain some of the observations made in 2012?

  → How do they interplay with other key parameters such as octupoles, chromaticity and damper gain?

Head-on + impedance







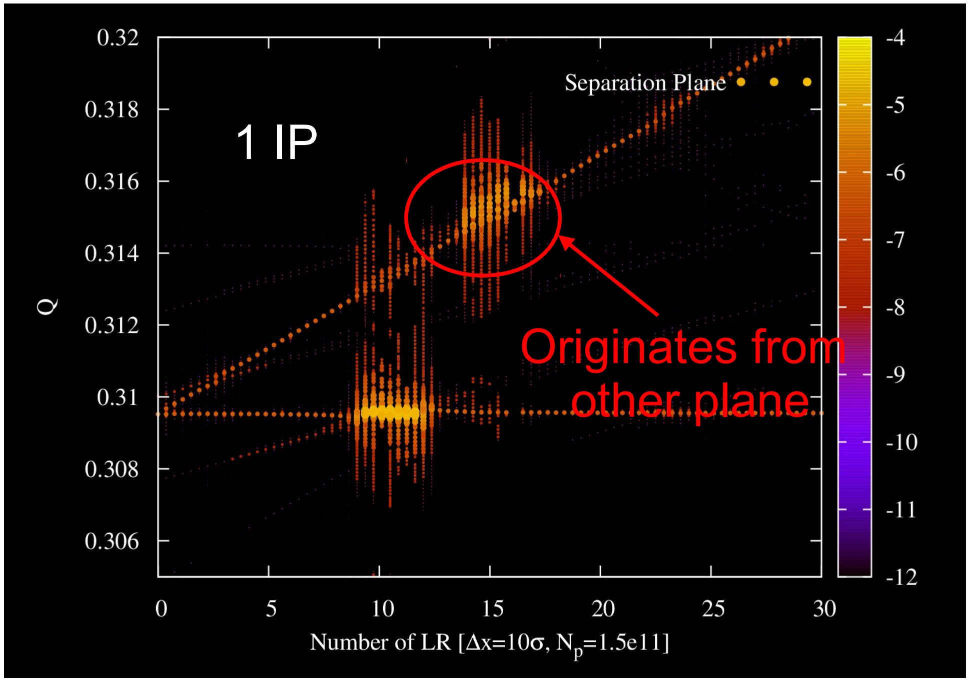
→ Scan HO tune shift at constant wake

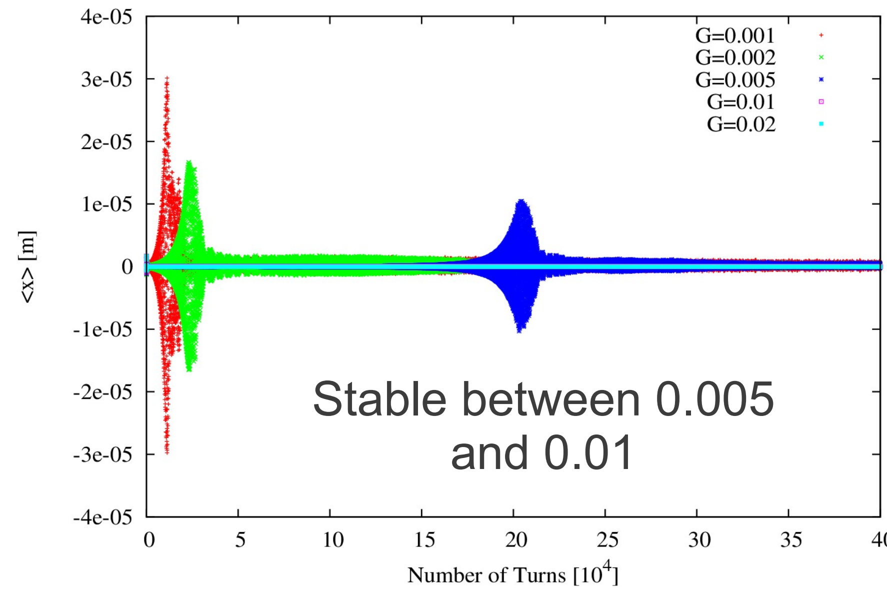
→ Strong instability observed when π-mode couples with mode -1

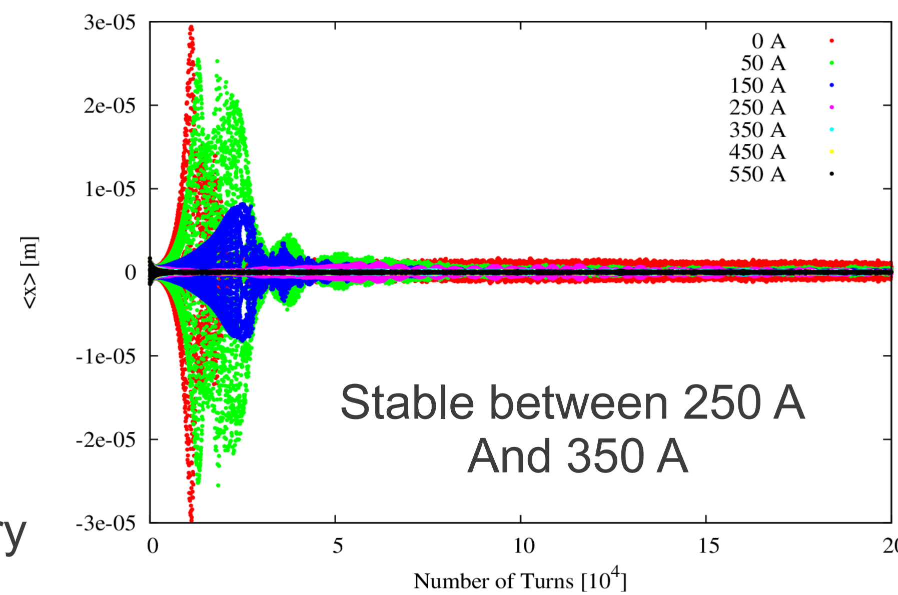
→ Instability appears to be cured by the damper in the case of HO interaction

→ Octupoles have no impact in this case

Long-range + impedance







→ Same phenomena observed for LR

→ Damper much less efficient against LR instabilities – driven by tails particles

→ Octupoles have a stabilizing effect providing sufficiently high current

→ Done for 1x nominal impedance – preliminary data indicate that this could be underestimated

Experiment Proposal

- Simulations done for simplified cases: it is important to understand how these processes impact machine performances under realistic condition.

  → **HO instabilities:** scan head-on tune shift – beam conditions compatible with noise studies request see talk by X. Buffat and T. Pieloni: could combine the two

  - Few bunches (single bunch impedance no LR) with different intensities (disentangle reduction of tune spread with coherent effects) – 1.0e11 to 2.0e11 small emittances
  - Scan separation at different IPs (effect of β^*) for different damper and chromaticity settings

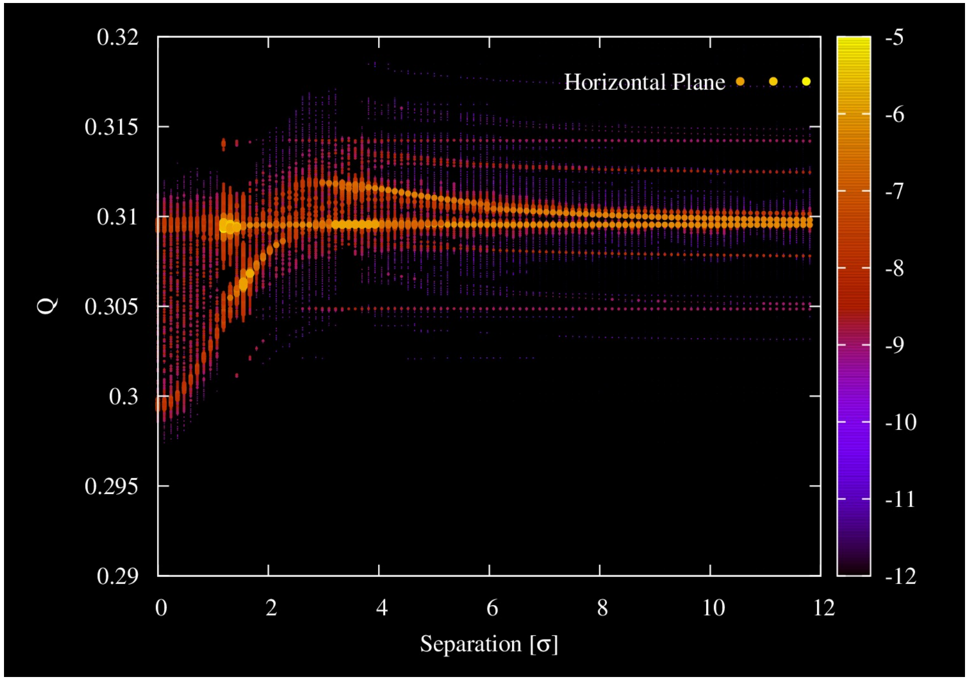
  → **LR instabilities:** scan long-range tune shift at the end of the squeeze

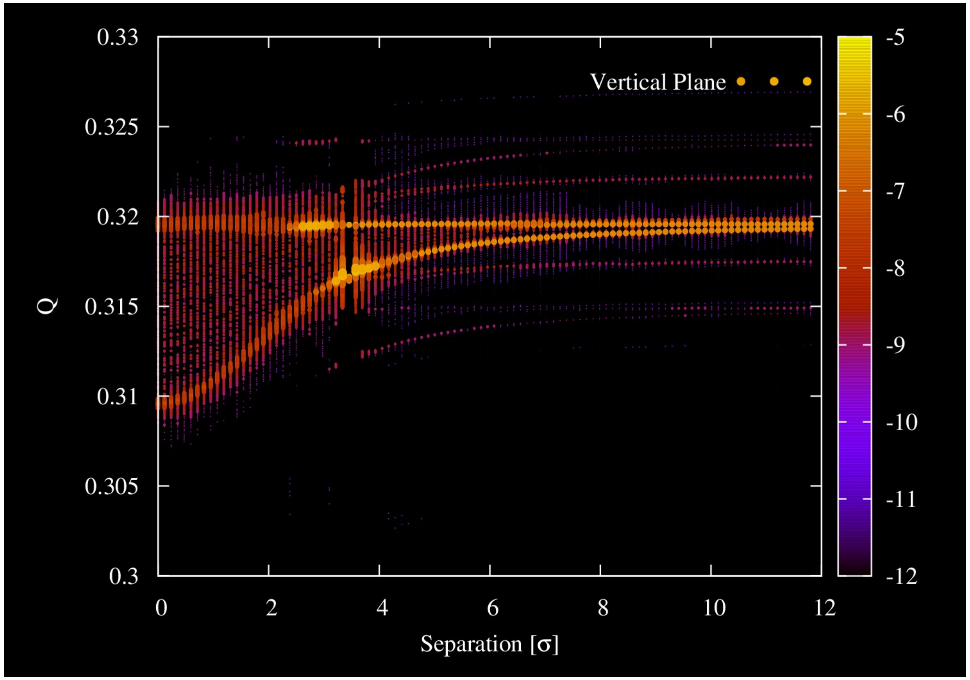
  - Simplest seem to scan number of long-range interactions with longitudinal displacement – two configurations: 1b against 36b and 36b against 36b colliding in IP8
  - Other possibility is crossing angle scan → machine protection? DA issues?
  - Impact of octupoles, damper gain and chromaticity

- Results could help understand some of the observations made in 2012 and provide key information for LHC operation after LS1

SPARES

Separated Beams





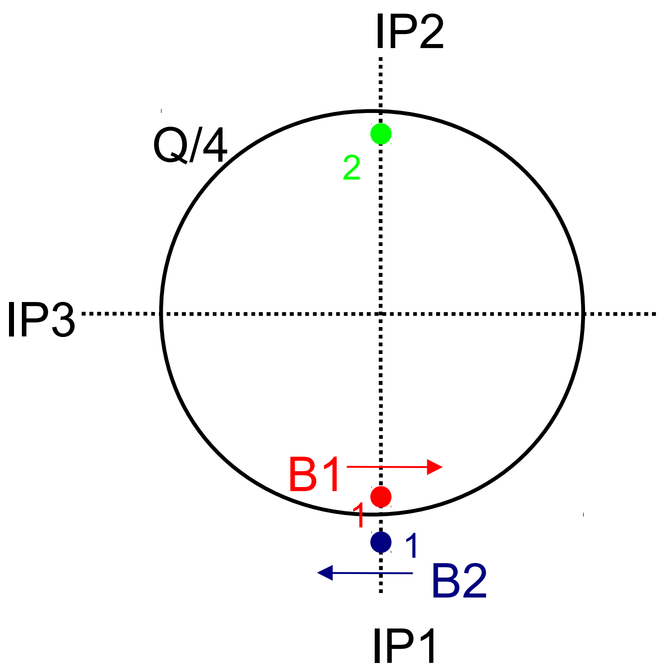
→ Single head-on interaction – apply separation in the horizontal plane

→ Same behavior is observed when the π or σ modes cross the +/-1 modes

→ To be noted that now the instability appears in different places depending on the plane

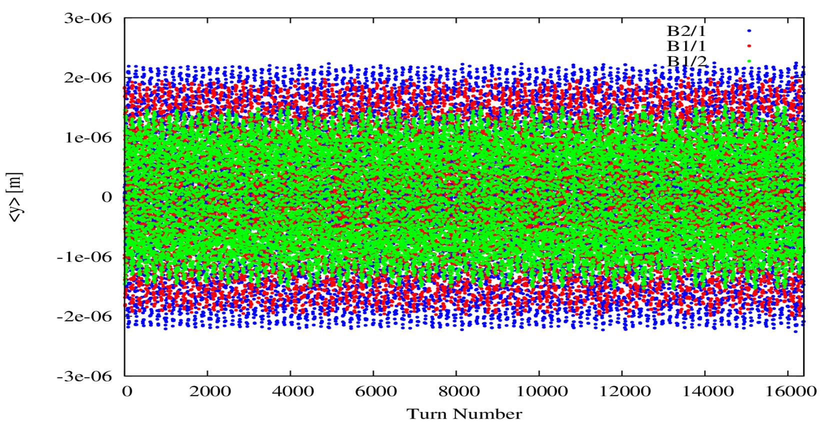
→ In between purely HO or LR but provides excellent knob to scan BB tune shift

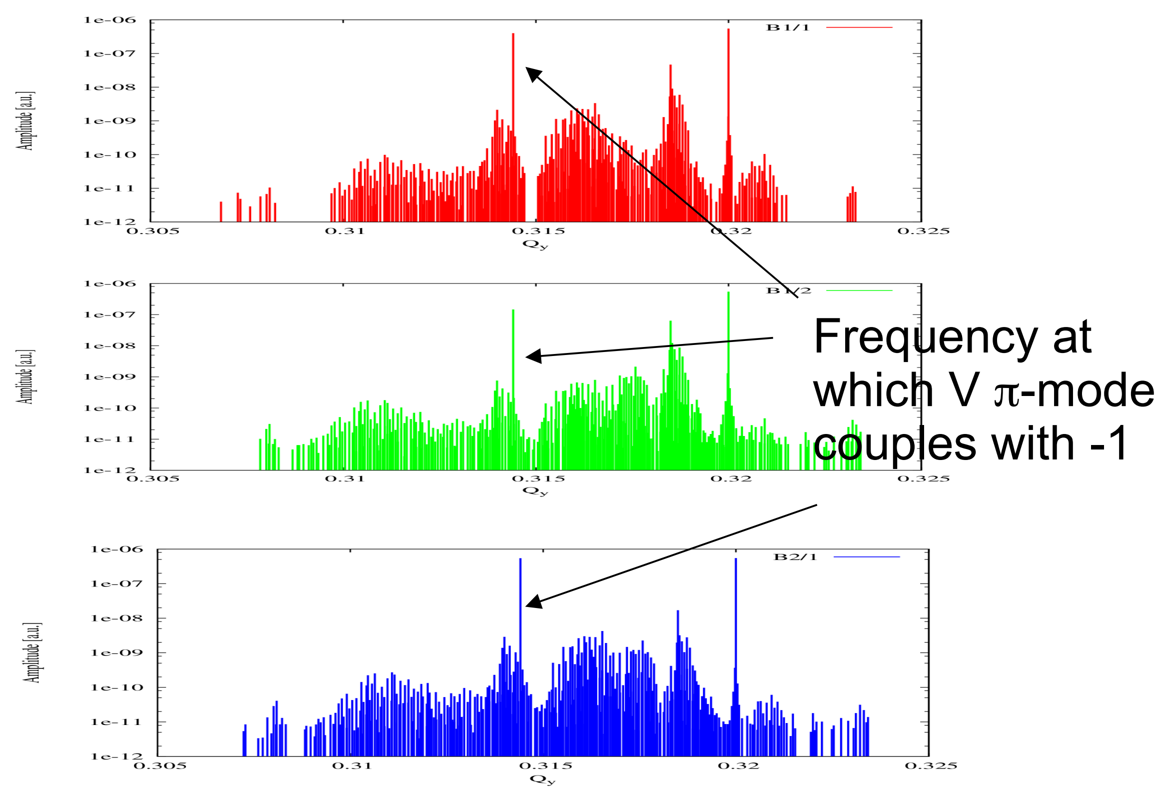
More Complex Collision Pattern



At all IPs equivalent of 7 LR with 10σ separation in H plane

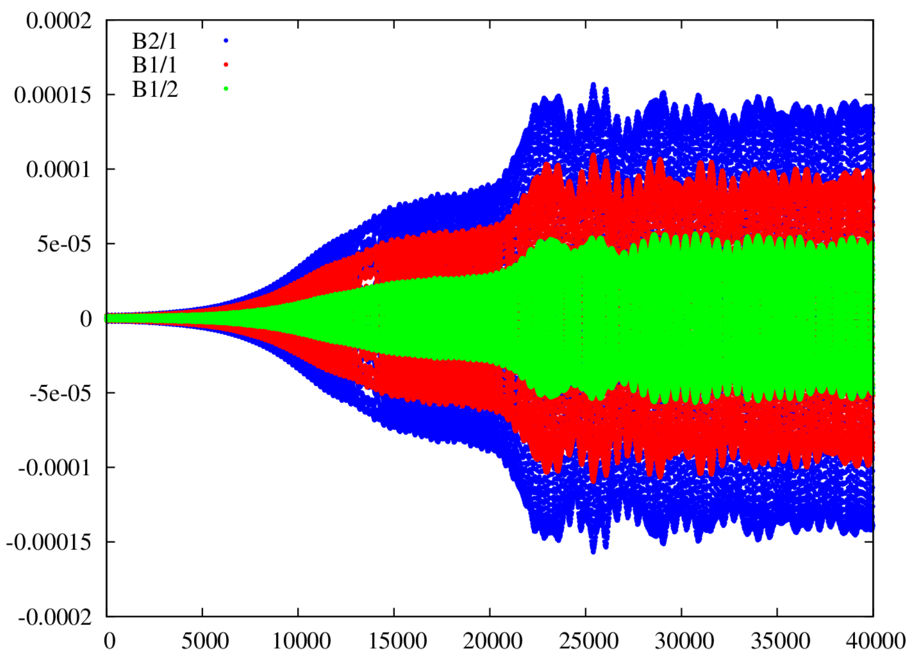
	IP1	IP2	IP3	N_{LR} tot.
B1/1	1	1	0	14
B1/2	0	0	1	7
B1/1	1	1	1	21

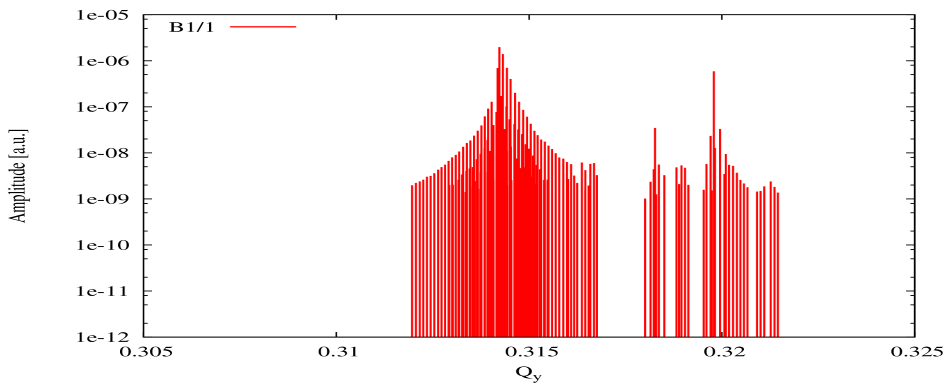


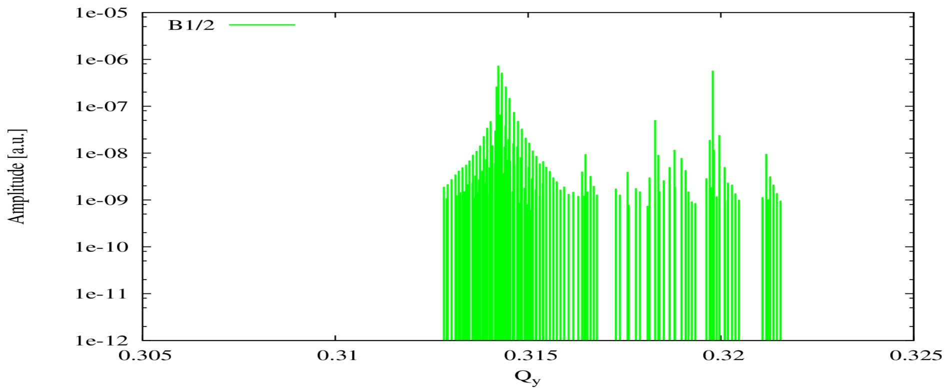


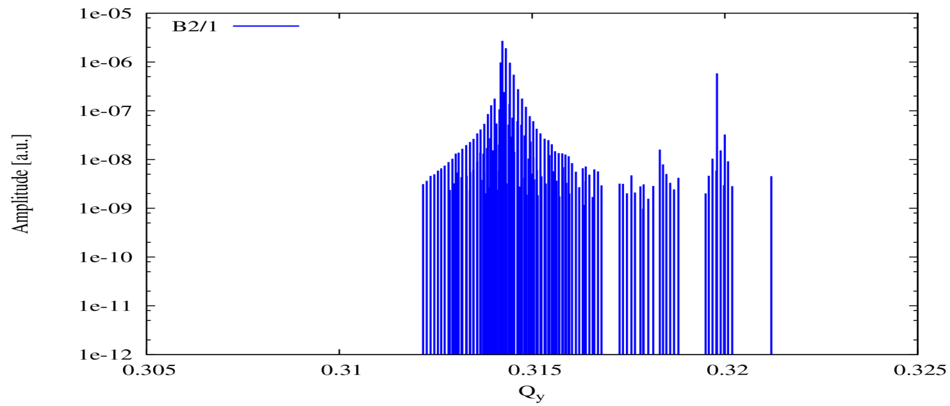
→ BB only all bunches stable

Including Impedance









→ Same frequency driving all the bunches unstable

→ Amplitude is different for all bunches but oscillation pattern and rise-times (0.3s) are the same

→ This was only observed for LR – in the case of HO both beams rise with same speed and amplitude