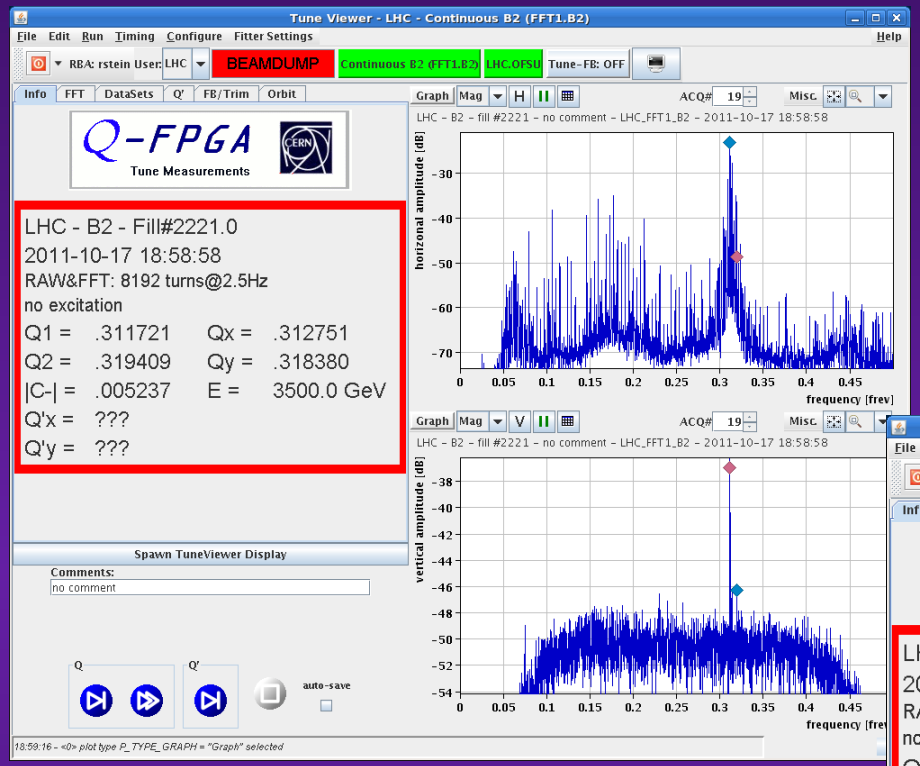
LHC BEAM INSTABILITY OBSERVATION ON 17/10/11 AND POSSIBLE INTERPRETATION

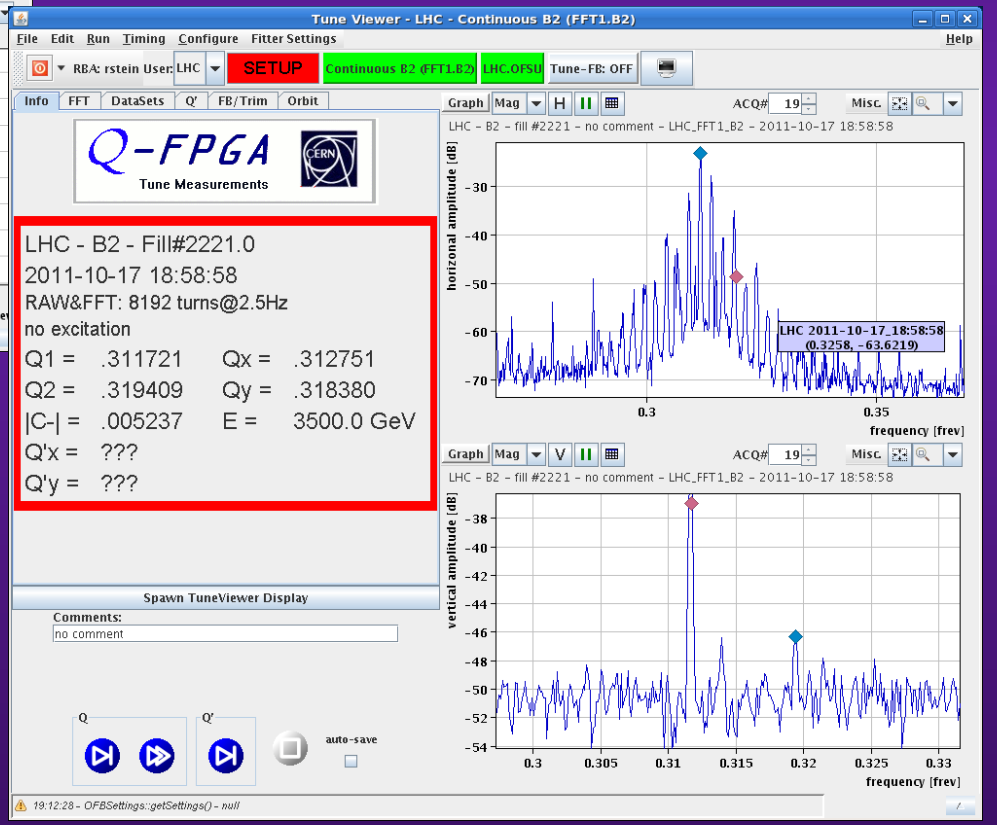
Elias Métral

- **Observations => “Christmas tree” at the end of the squeeze with ~ 1.45E11 p/b**
- **Predictions from our model**
- **Conclusion and recommendation**

OBSERVATIONS (1/6)

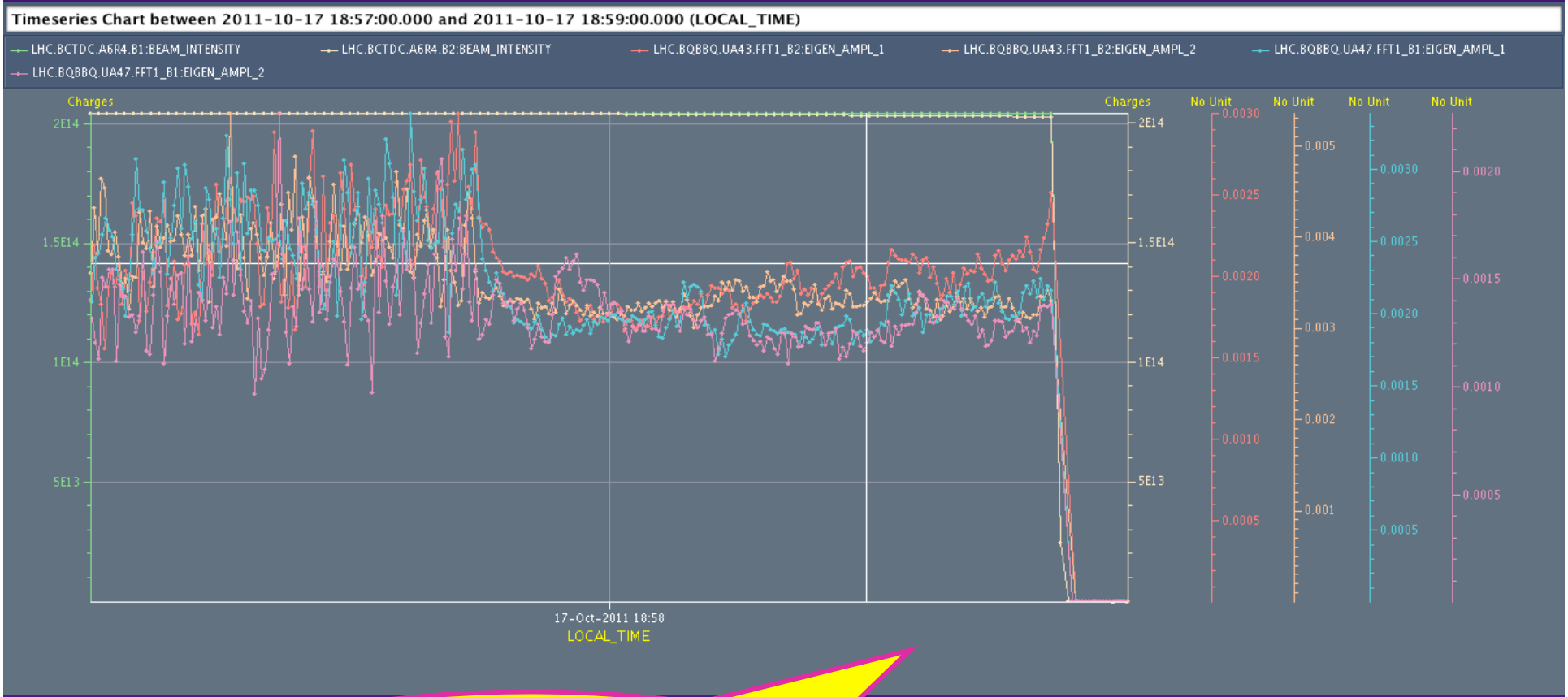


From LHC 08:30 meeting on TU 18/10/11



"Christmas tree" observed on MO 17/10/11 at 18:58:58

OBSERVATIONS (2/6)

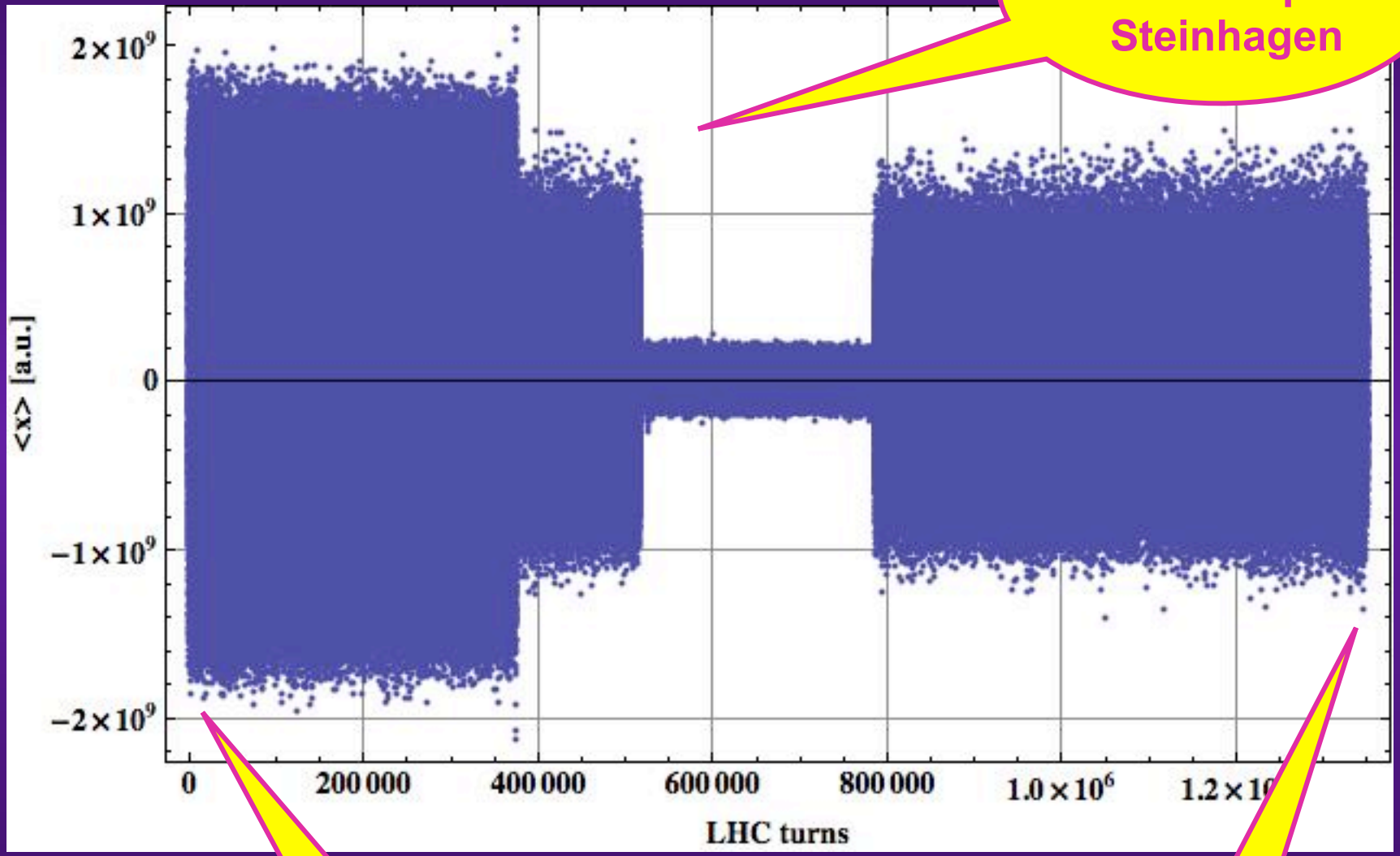


Signals not relevant anymore according to Ralph Steinhagen, as they do not reveal the max. anymore (18/10/11)

OBSERVATIONS (3/6)

B2H

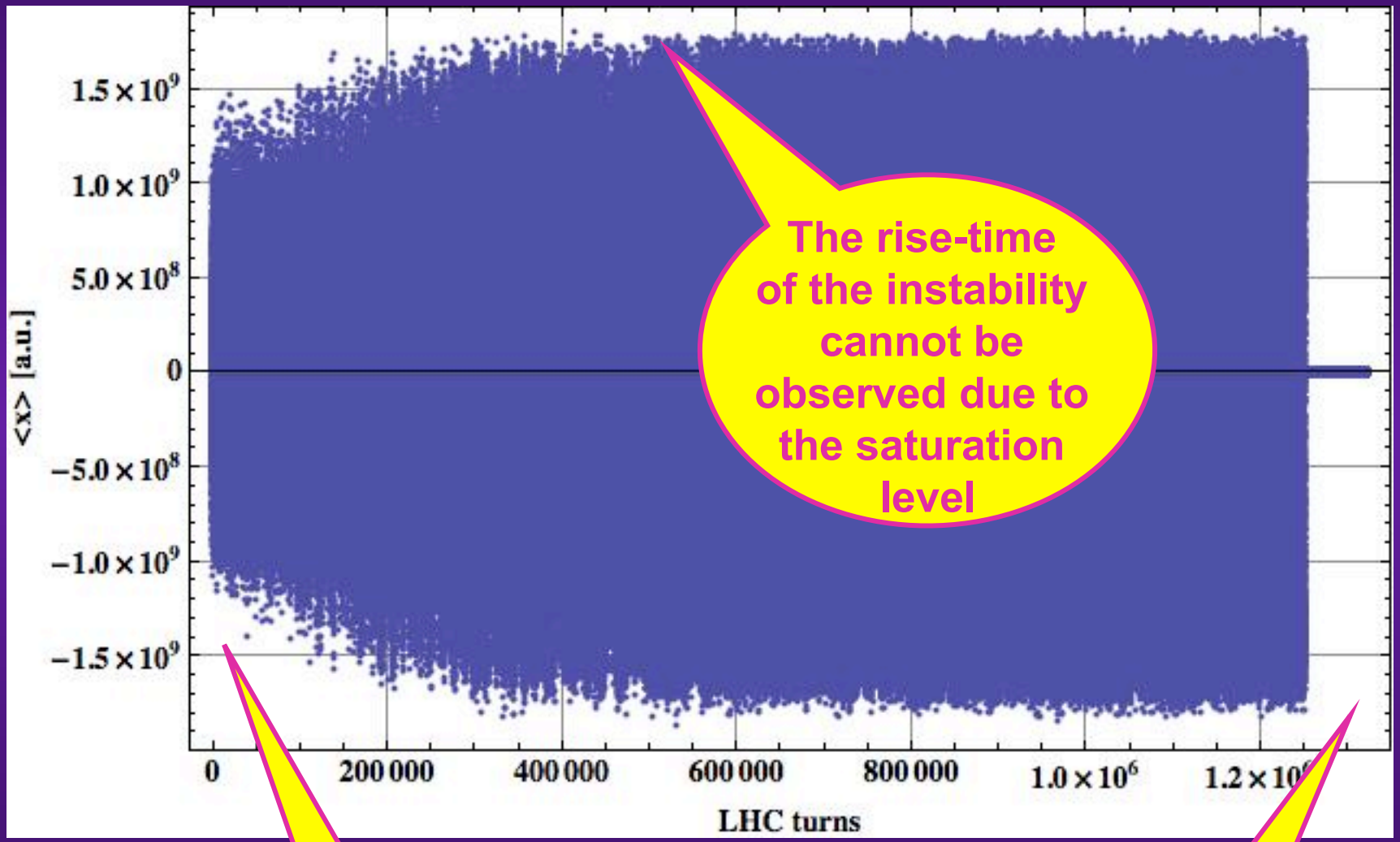
Changes of gain from Ralph Steinhagen



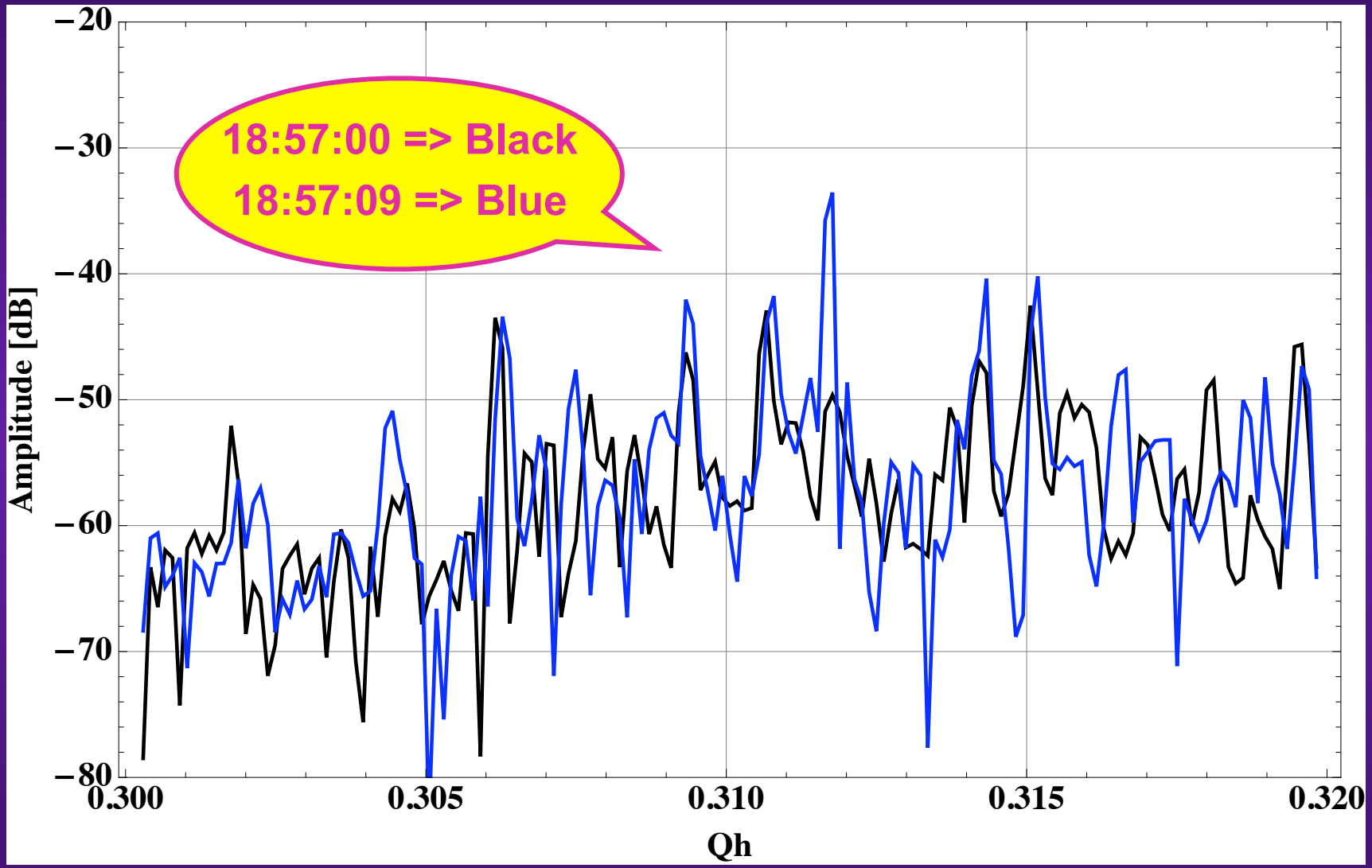
18:55:00

18:57:00

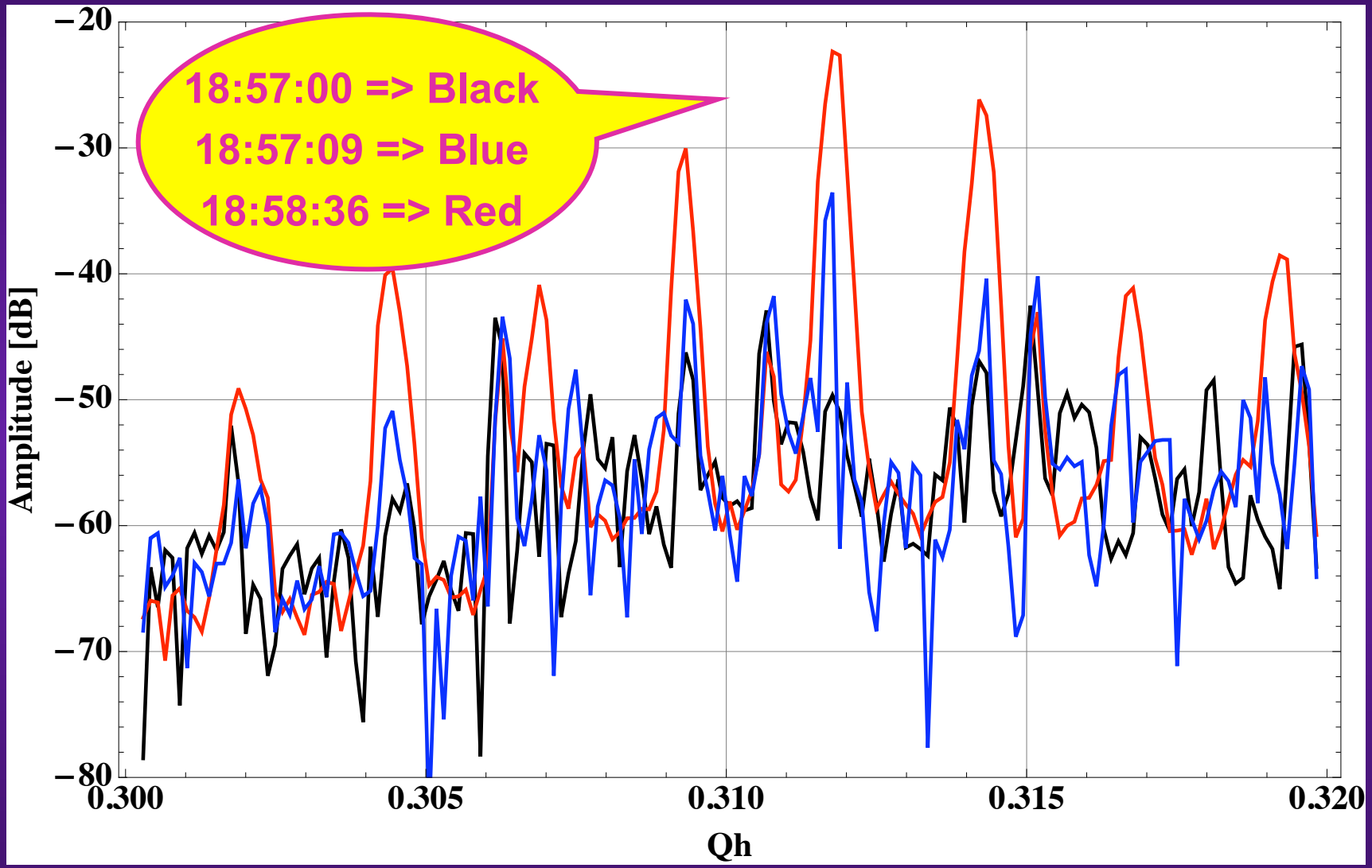
OBSERVATIONS (4/6)



OBSERVATIONS (5/6)

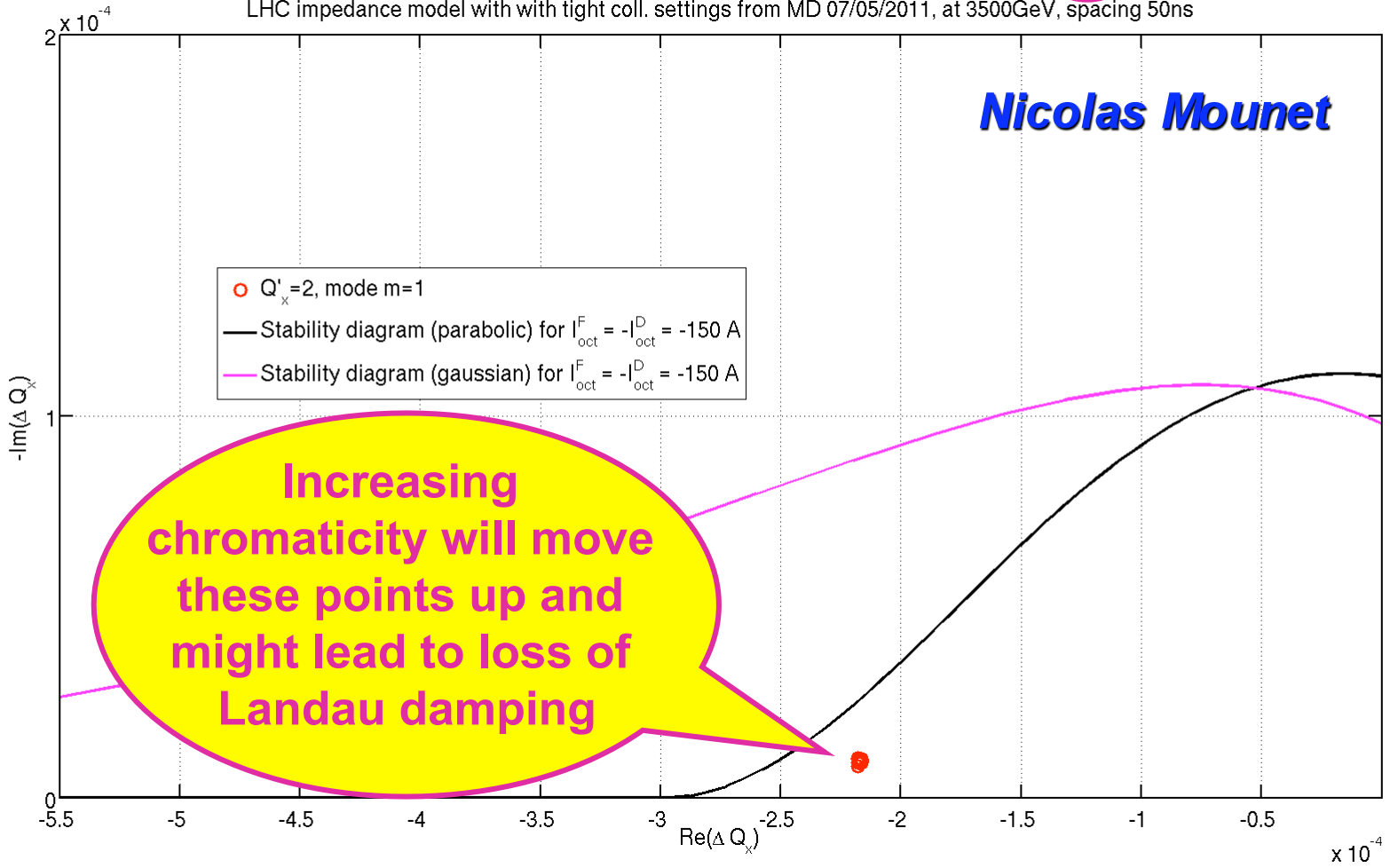


OBSERVATIONS (6/6)



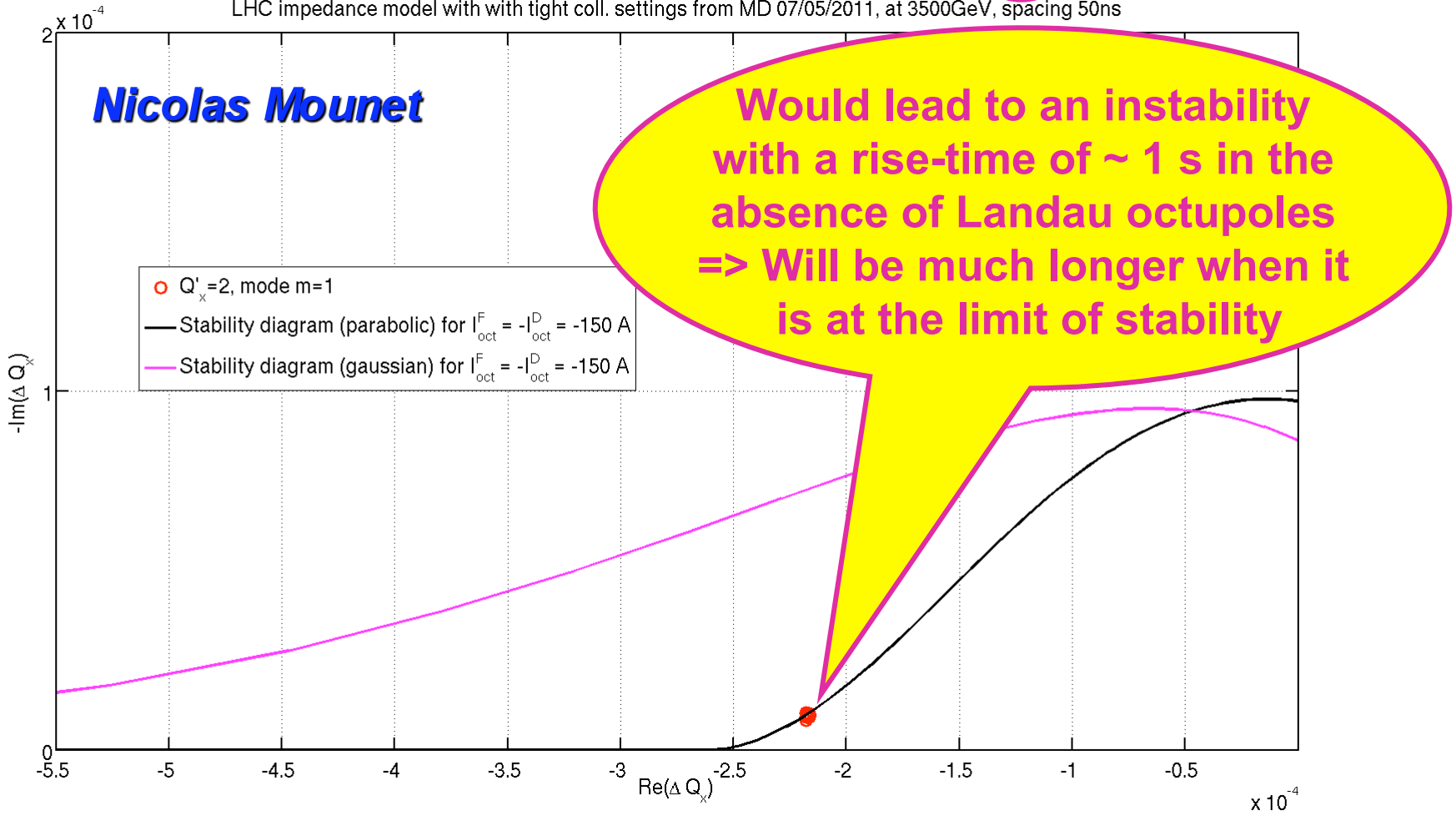
PREDICTIONS FROM OUR MODEL (1/2)

Sacherer horizontal tune shifts for unstable coupled-bunch modes, with stab. diagram (parabolic distribution) at ε_x=2.5, Nb part.=1.45 10^{11}, σ_z (rms)=9cm,
LHC impedance model with with tight coll. settings from MD 07/05/2011, at 3500GeV, spacing 50ns



PREDICTIONS FROM OUR MODEL (2/2)

Sacherer horizontal tune shifts for unstable coupled-bunch modes, with stab. diagram (parabolic distribution) at ε_x=2.2, Nb part.=1.45 10^{11}, σ_z (rms)=9cm,
LHC impedance model with with tight coll. settings from MD 07/05/2011, at 3500GeV, spacing 50ns



Would lead to an instability with a rise-time of ~ 1 s in the absence of Landau octupoles => Will be much longer when it is at the limit of stability

CONCLUSION AND RECOMMENDATION

- As already mentioned for the instability observed at the end of the squeeze when the beta* = 1 m was first tried (see https://lhc-beam-operation-committee.web.cern.ch/lhc-beam-operation-committee/minutes/Meeting17-30_08_2011/RecentObservationsOfLHCBeamInstabilities.pdf), the observed instability "could be" TCBI of mode |m| = 1 (would also explain the Chrismas tree as observed with SBI |m| = 1 and the very slow rise-time)
- In the previous case the settings of the collimators were tighter, but the intensity lower, and it seemed that the BBLR played also a role at that time (but this mechanism mush have been also present, maybe with transverse distribution modified by BBLR as already discussed)
- Recommendation: Increase a little bit the octupole strength, to go from a current of - 150 A to - 200 A or - 250 A to have some margin. Furthermore, we should also always try to reduce the chromaticity as much as possible