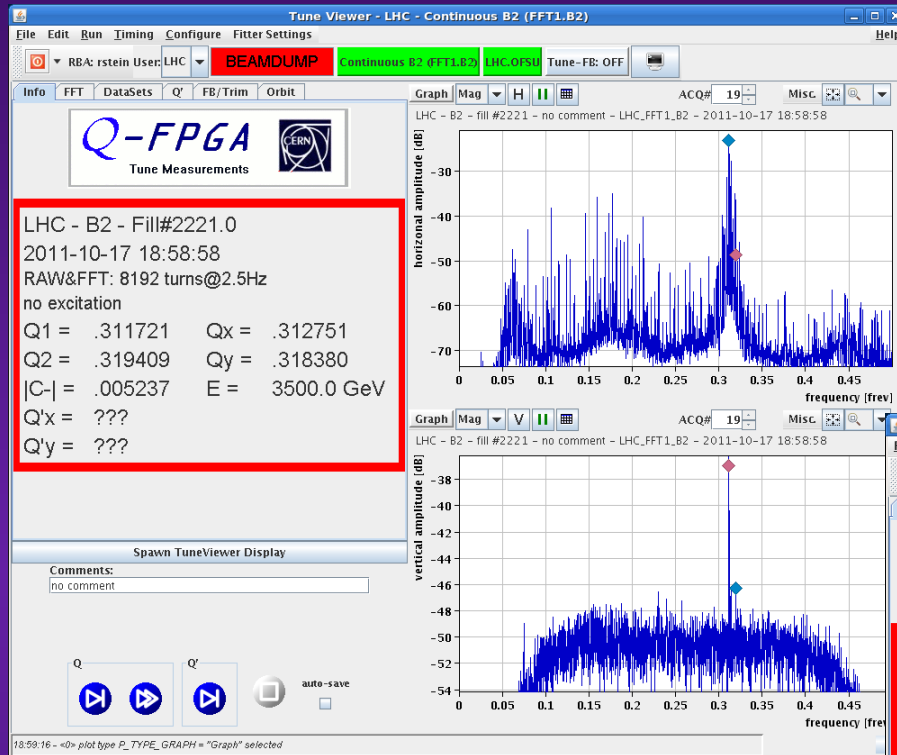


# LHC BEAM INSTABILITY OBSERVATION ON 17/10/11 AND POSSIBLE INTERPRETATION

Elias Métral

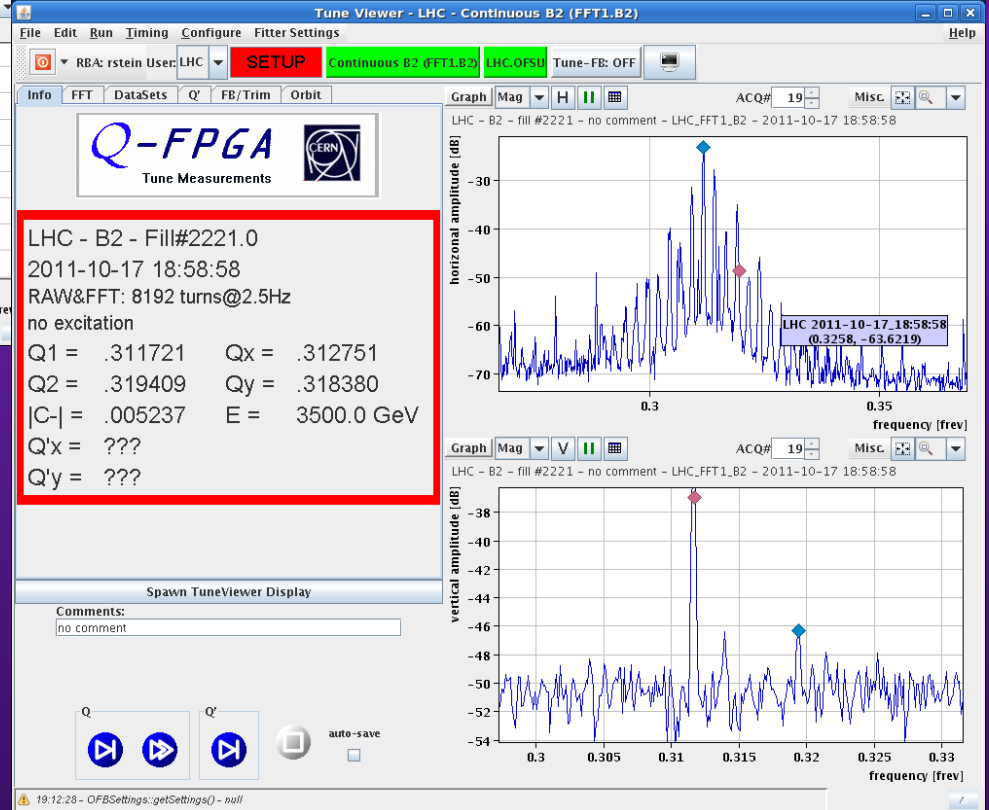
- ◆ Observations => “Christmas tree” at the end of the squeeze with  $\sim 1.45E11$  p/b
- ◆ Predictions from our model
- ◆ Conclusion and recommendation

# OBSERVATIONS (1/6)



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

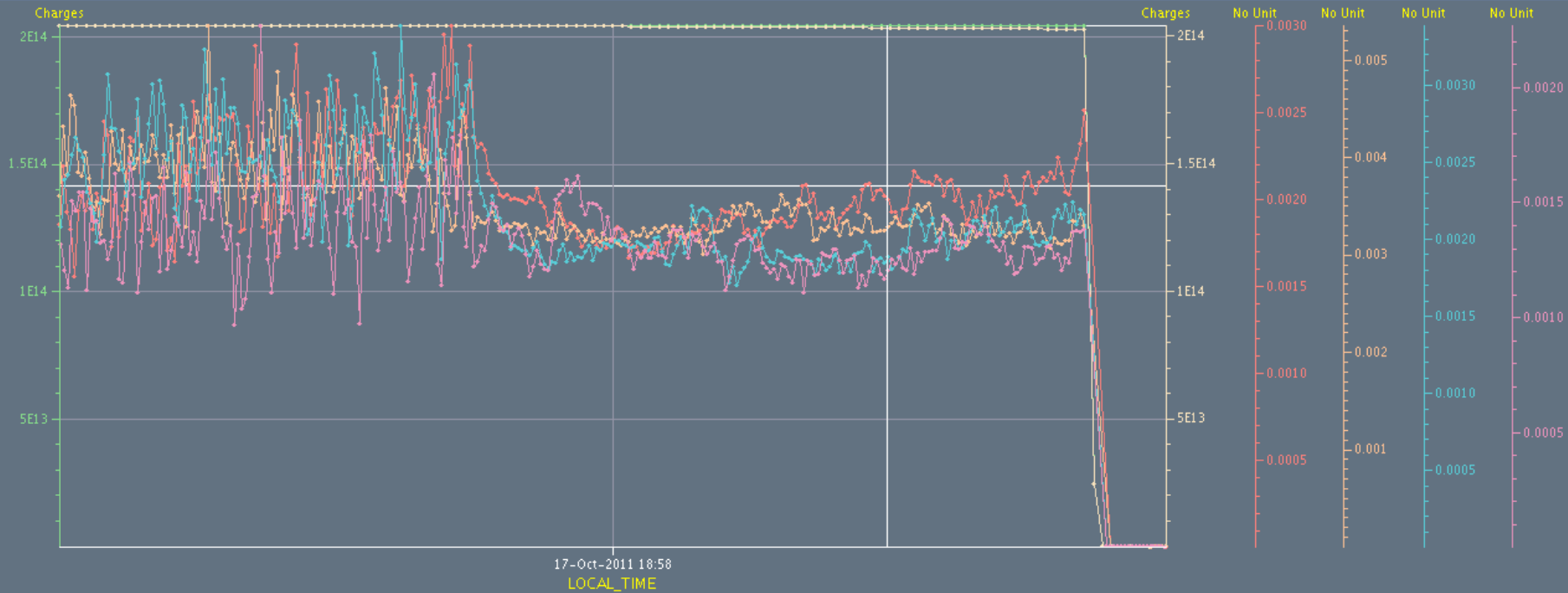
“Christmas tree” observed on MO 17/10/11 at 18:58:58



# OBSERVATIONS (2/6)

Timeseries Chart between 2011-10-17 18:57:00.000 and 2011-10-17 18:59:00.000 (LOCAL\_TIME)

LHC.BCTDC.A6R4.B1:BEAM\_INTENSITY    LHC.BCTDC.A6R4.B2:BEAM\_INTENSITY    LHC.BQBBQ.UA43.FFT1\_B2:EIGEN\_AMPL\_1    LHC.BQBBQ.UA43.FFT1\_B2:EIGEN\_AMPL\_2    LHC.BQBBQ.UA47.FFT1\_B1:EIGEN\_AMPL\_1  
LHC.BQBBQ.UA47.FFT1\_B1:EIGEN\_AMPL\_2

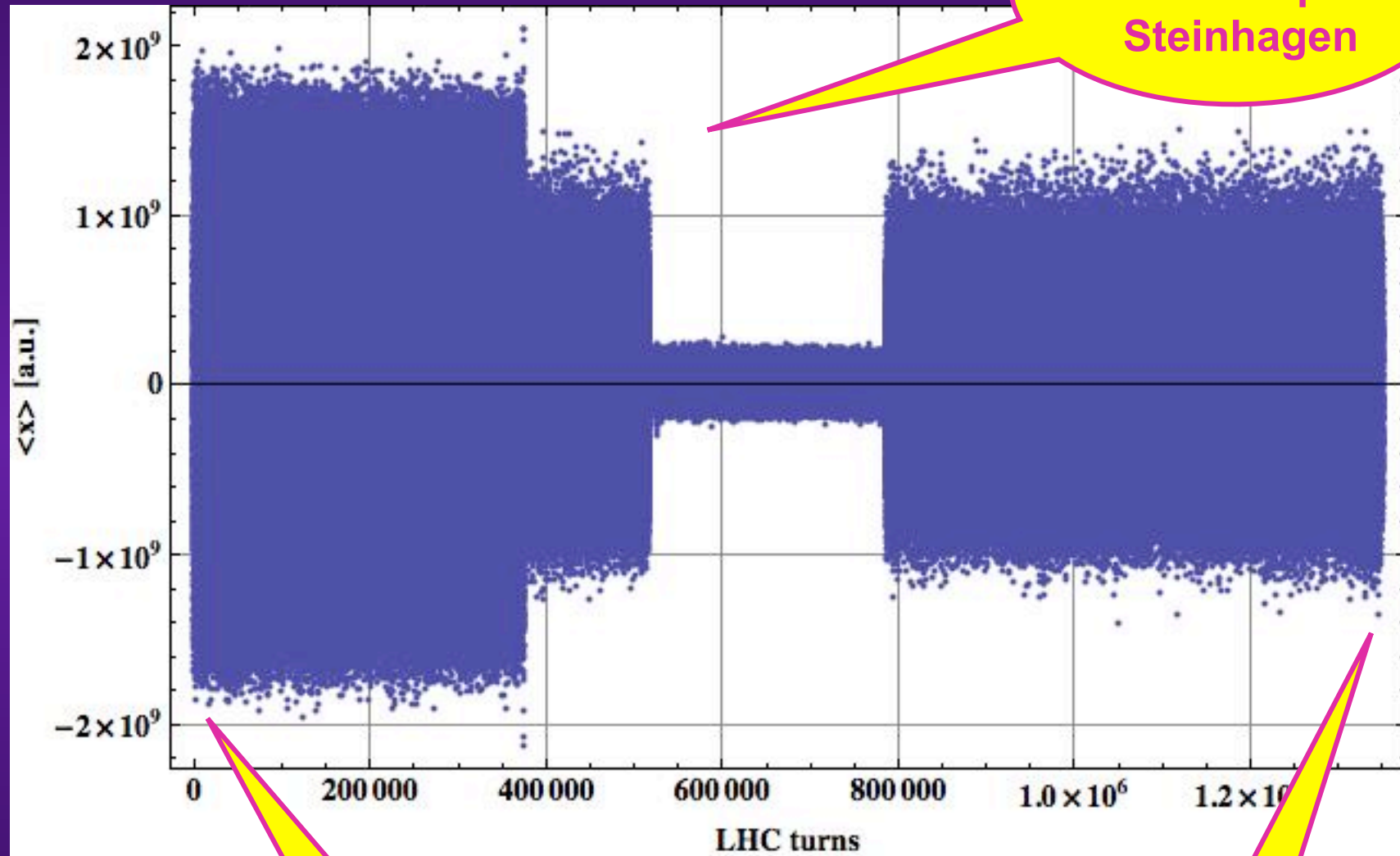


**Signals not relevant anymore  
according to Ralph Steinhagen,  
as they do not reveal the max.  
anymore (18/10/11)**

B2H

# OBSERVATIONS (3/6)

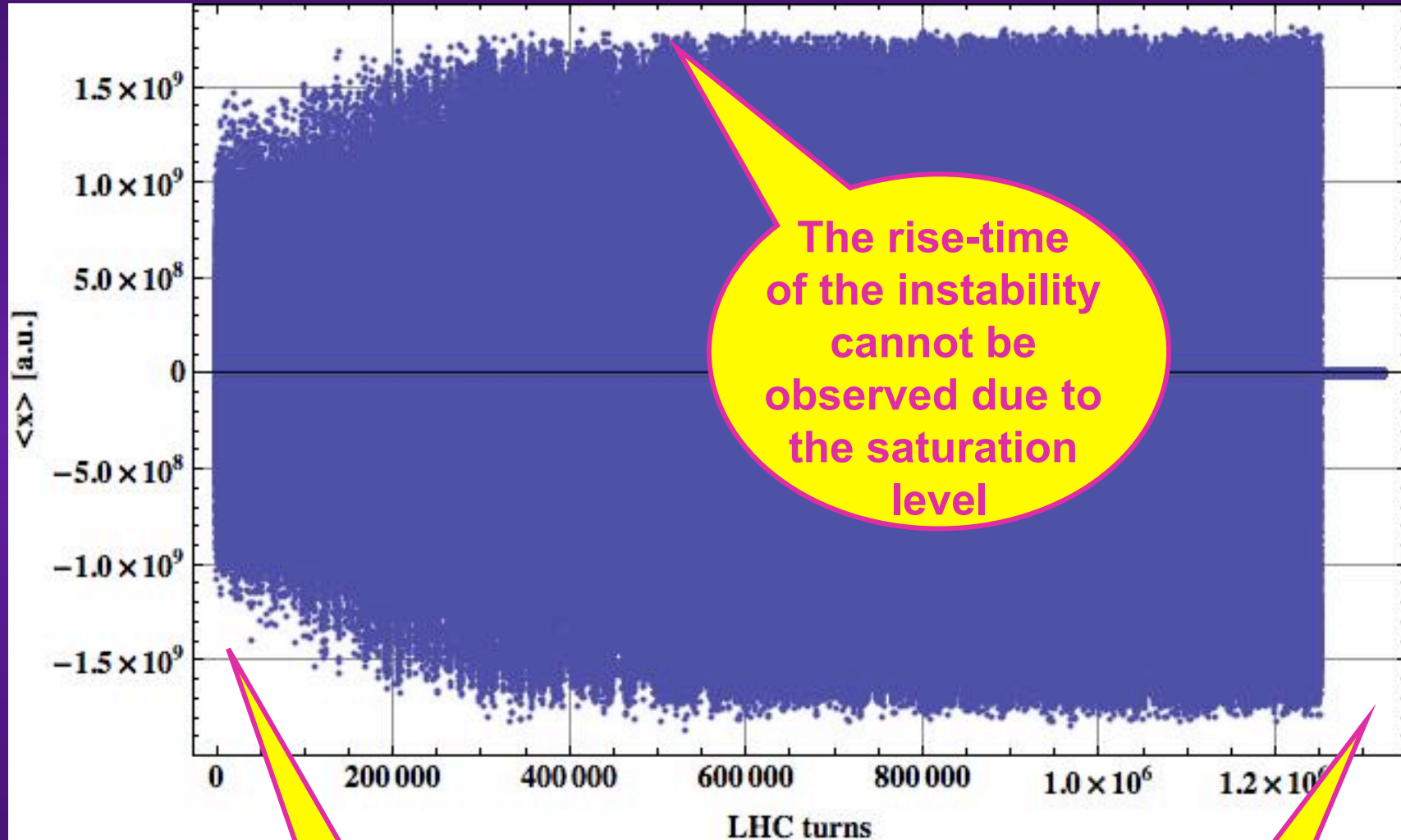
Changes of gain from Ralph Steinhagen



18:55:00

18:57:00

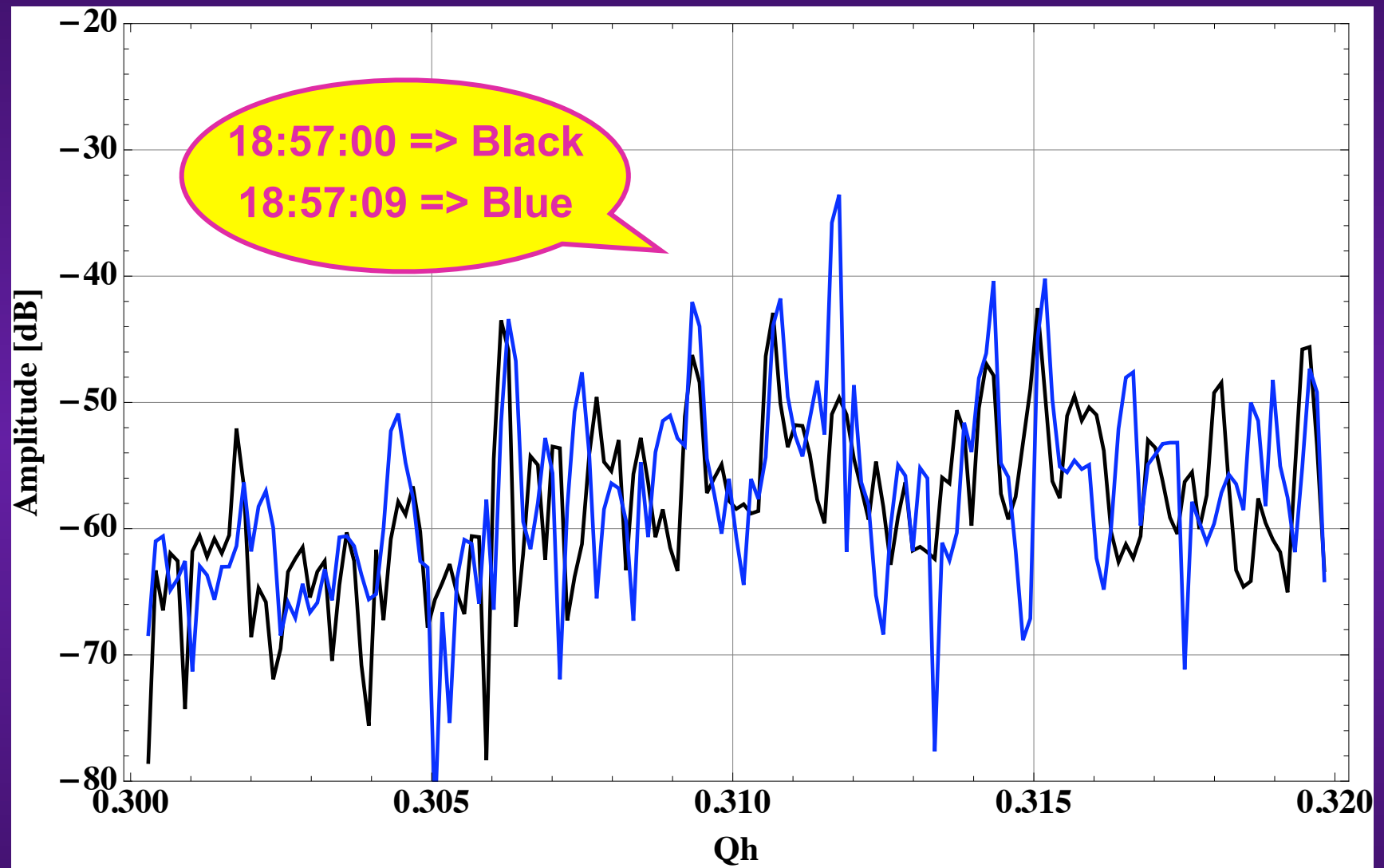
# OBSERVATIONS (4/6)



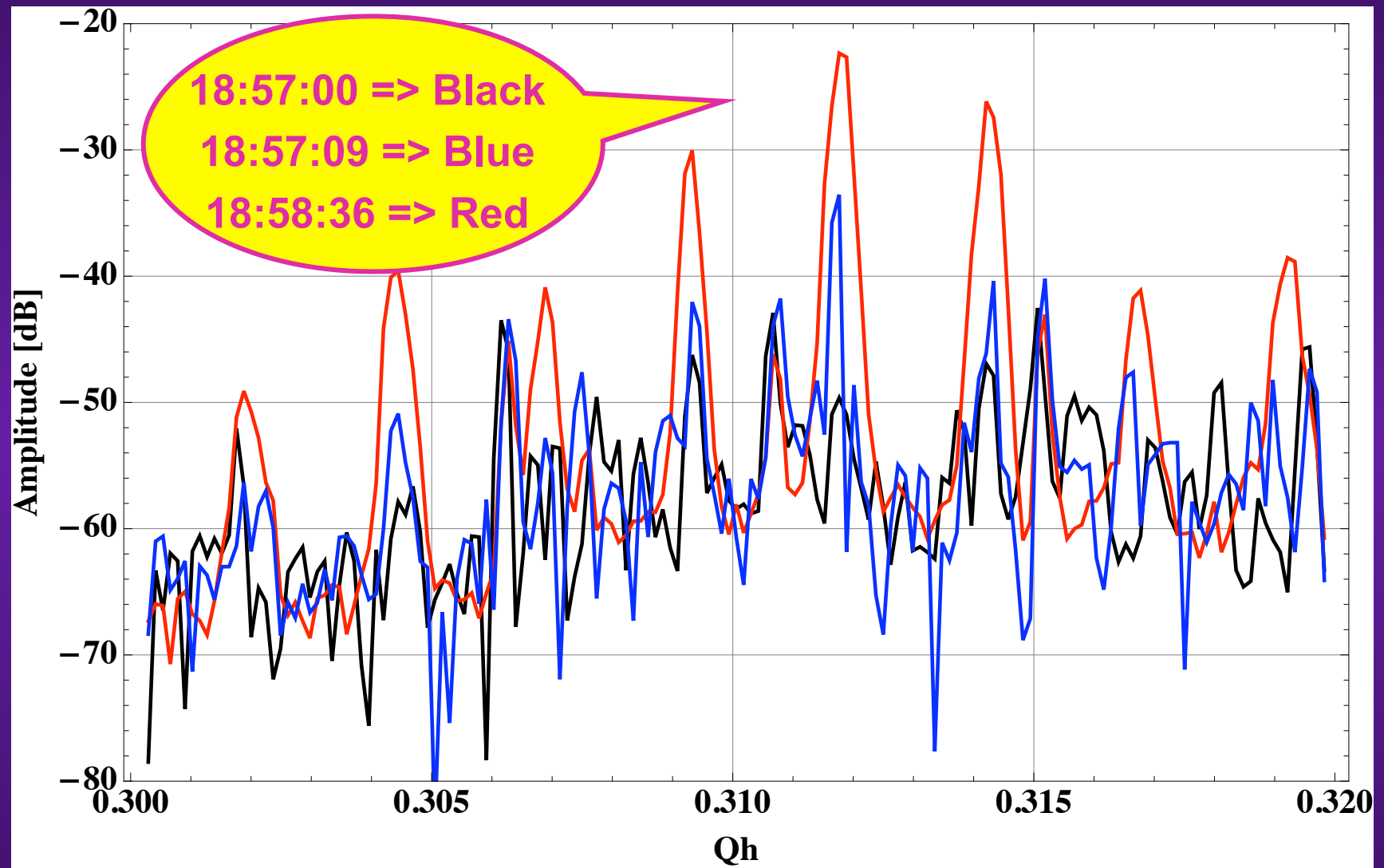
18:57:00

18:59:00

# OBSERVATIONS (5/6)



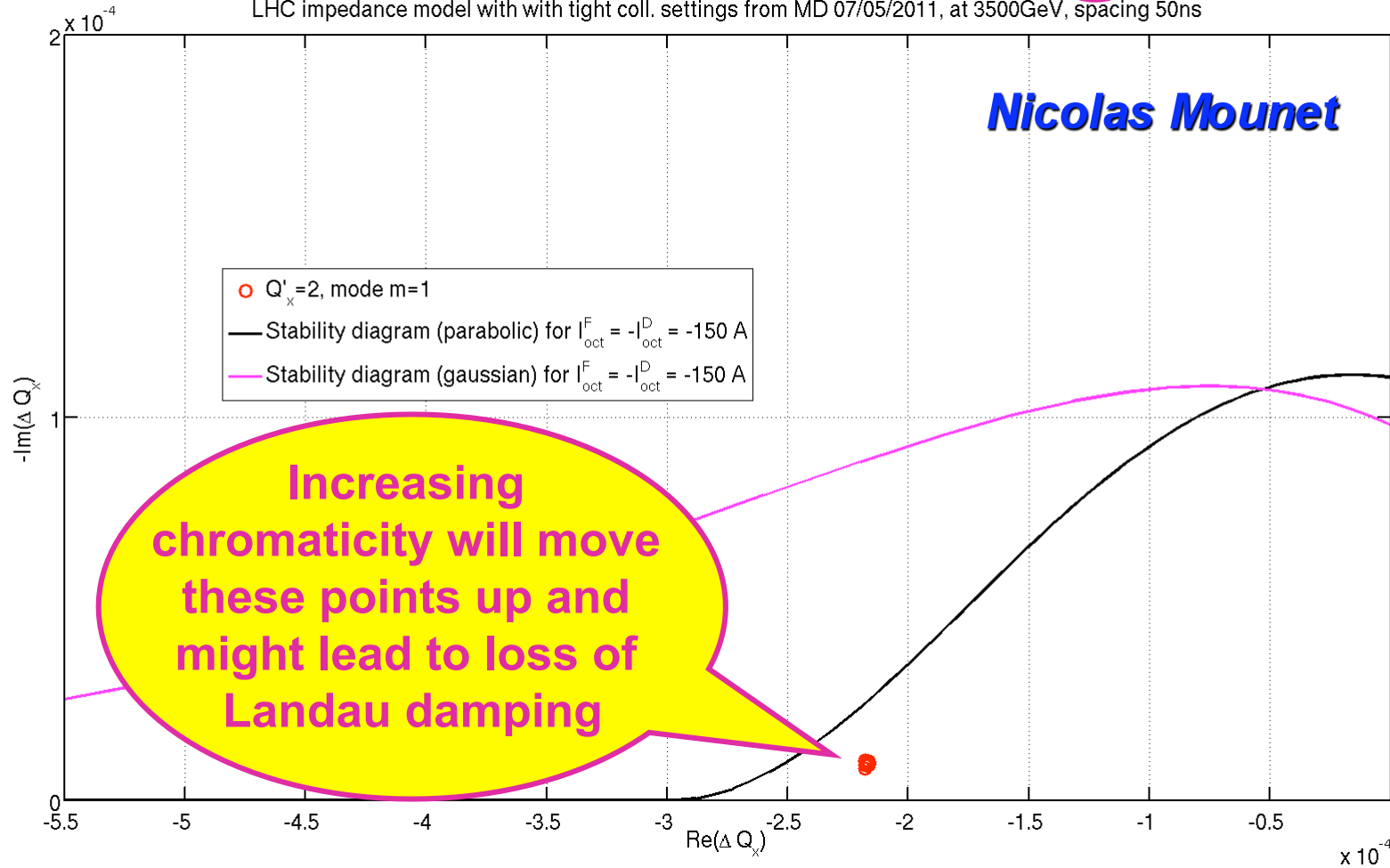
# OBSERVATIONS (6/6)



# PREDICTIONS FROM OUR MODEL (1/2)

Sacherer horizontal tune shifts for unstable coupled-bunch modes, with stab. diagram (parabolic distribution) at  $\epsilon_x = 2.5$ , Nb part. =  $1.45 \cdot 10^{11}$ ,  $\sigma_z$  (rms) = 9cm,

LHC impedance model with with tight coll. settings from MD 07/05/2011, at 3500GeV, spacing 50ns

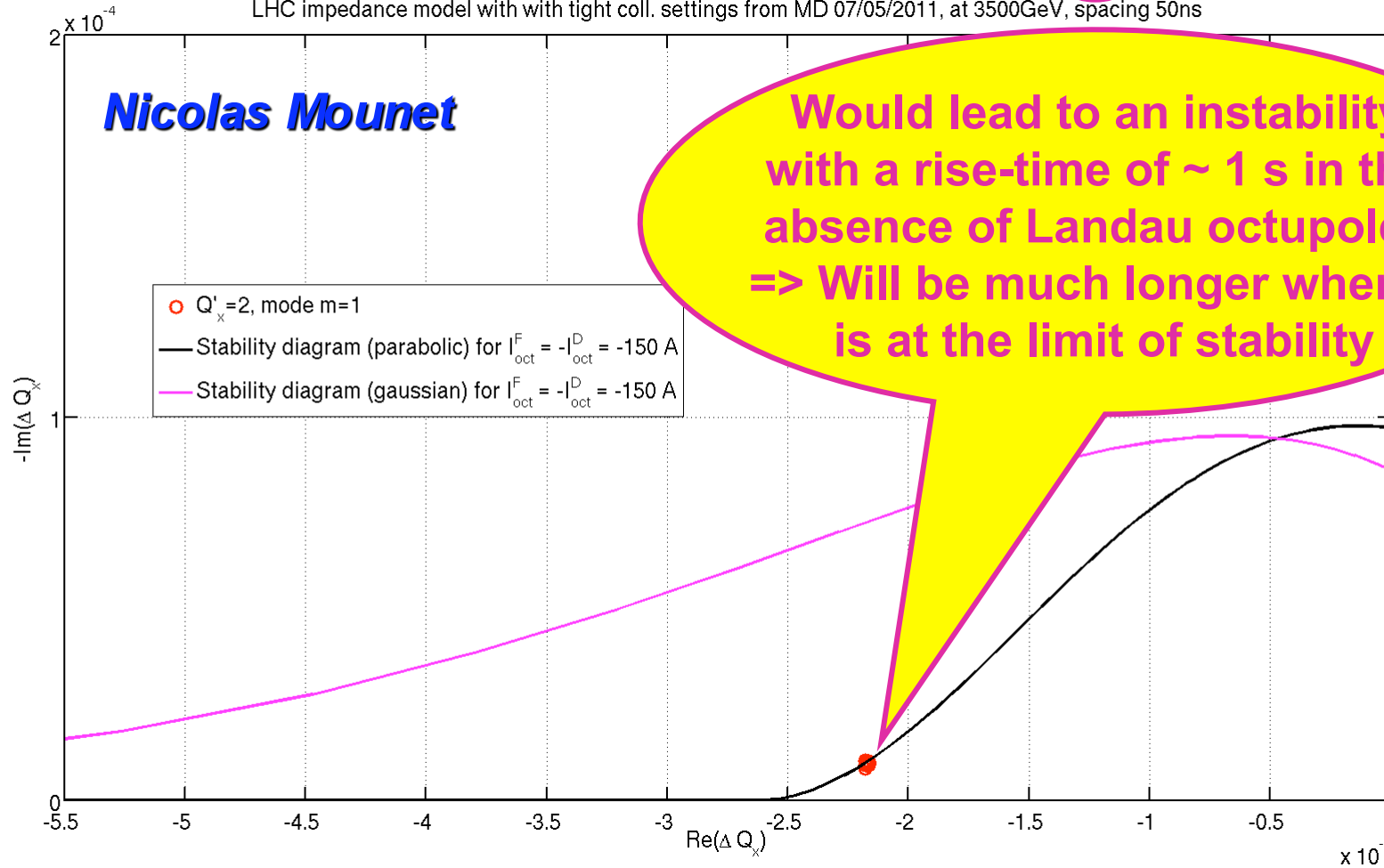




# PREDICTIONS FROM OUR MODEL (2/2)

Sacherer horizontal tune shifts for unstable coupled-bunch modes, with stab. diagram (parabolic distribution) at  $\epsilon_x = 2.2$ , Nb part. =  $1.45 \cdot 10^{11}$ ,  $\sigma_z$  (rms) = 9cm,

LHC impedance model with with tight coll. settings from MD 07/05/2011, at 3500GeV, spacing 50ns



## 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](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 Christmas 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 must 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