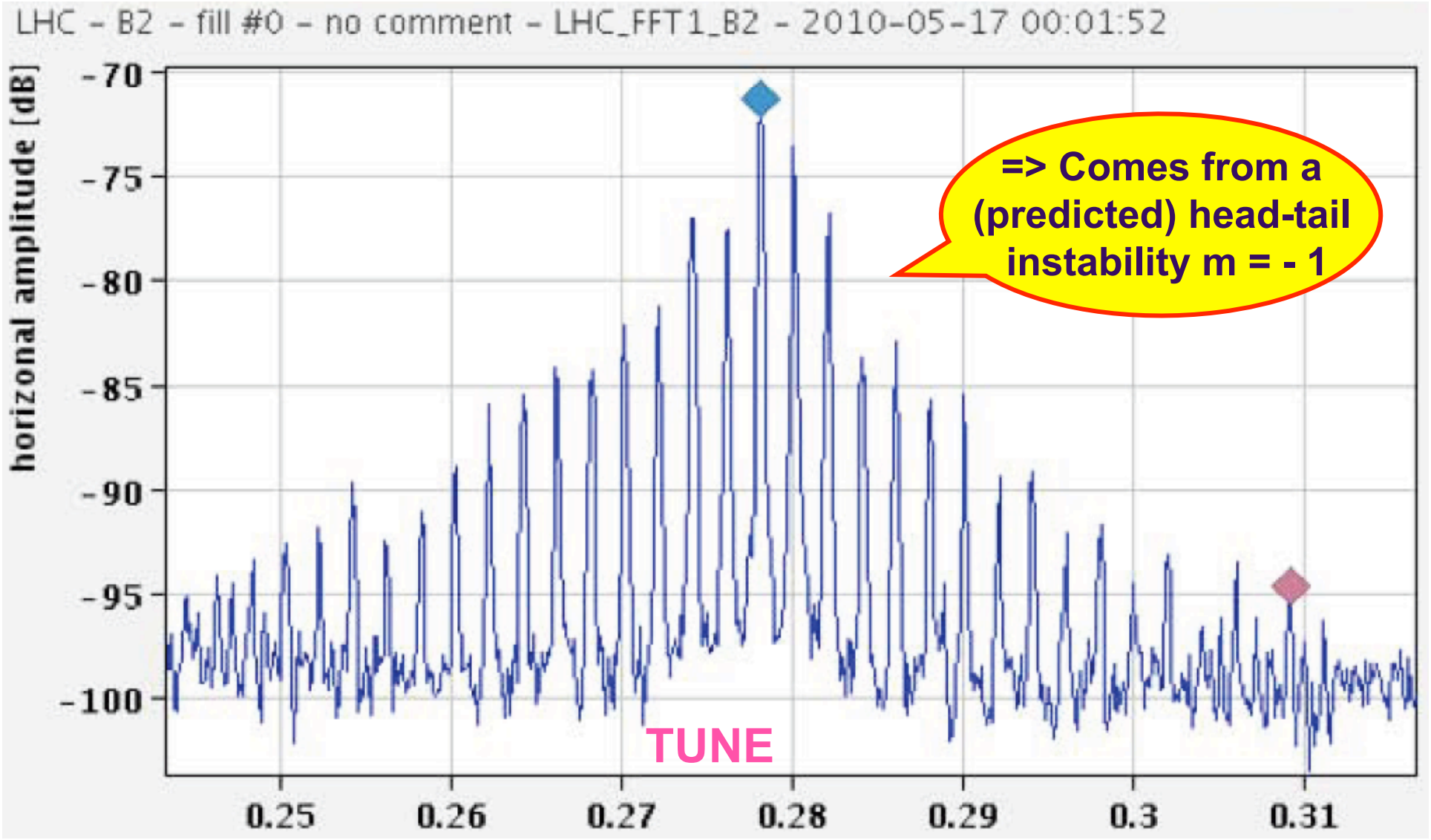
HORIZONTAL SINGLE-BUNCH INSTABILITY IN LHC

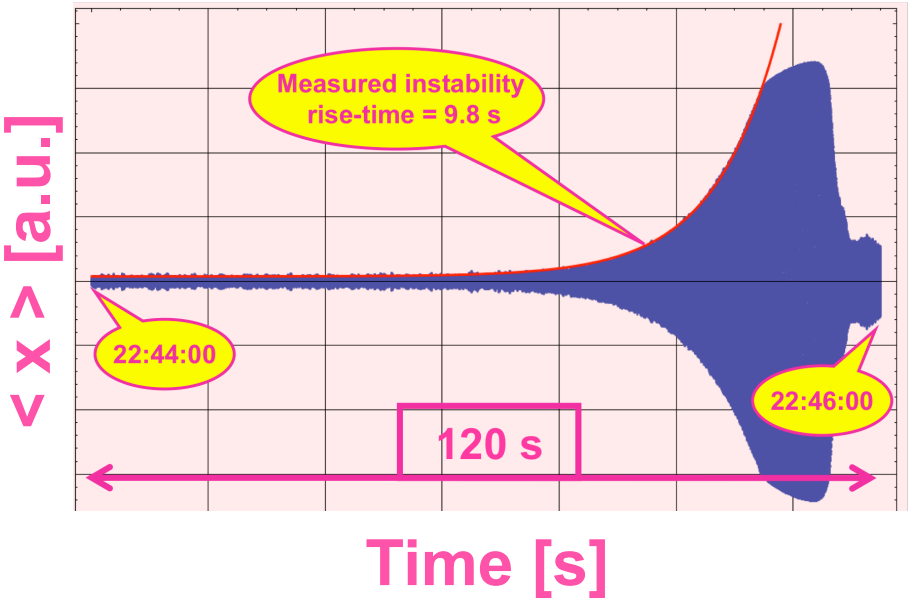
"CHRISTMAS TREE" MEASURED ON 17/05/2010



HORIZONTAL SINGLE-BUNCH INSTABILITY IN LHC

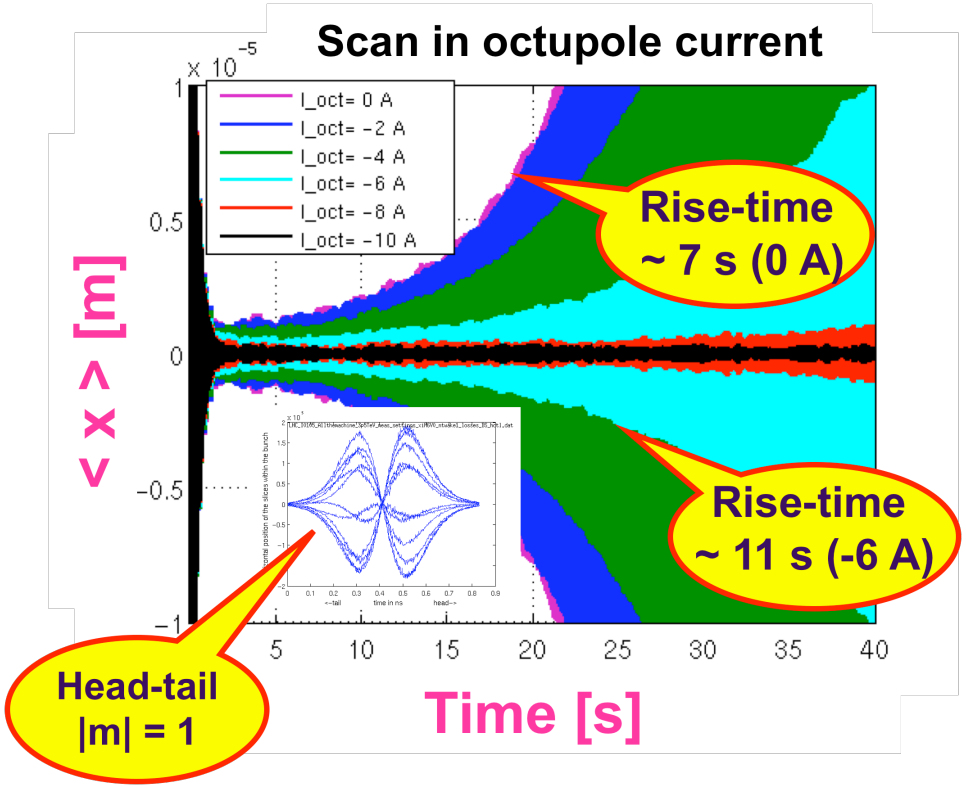
MEASUREMENTS

(17/05/2010 at 3.5 TeV/c)



- Unstable bunch for I_{oct} = - 10 A
  => Rise-time ~ 10 s
- Bunch was stable for I_{oct} = - 20 A
  => - 20 A < I_{oct} for stability < - 10 A

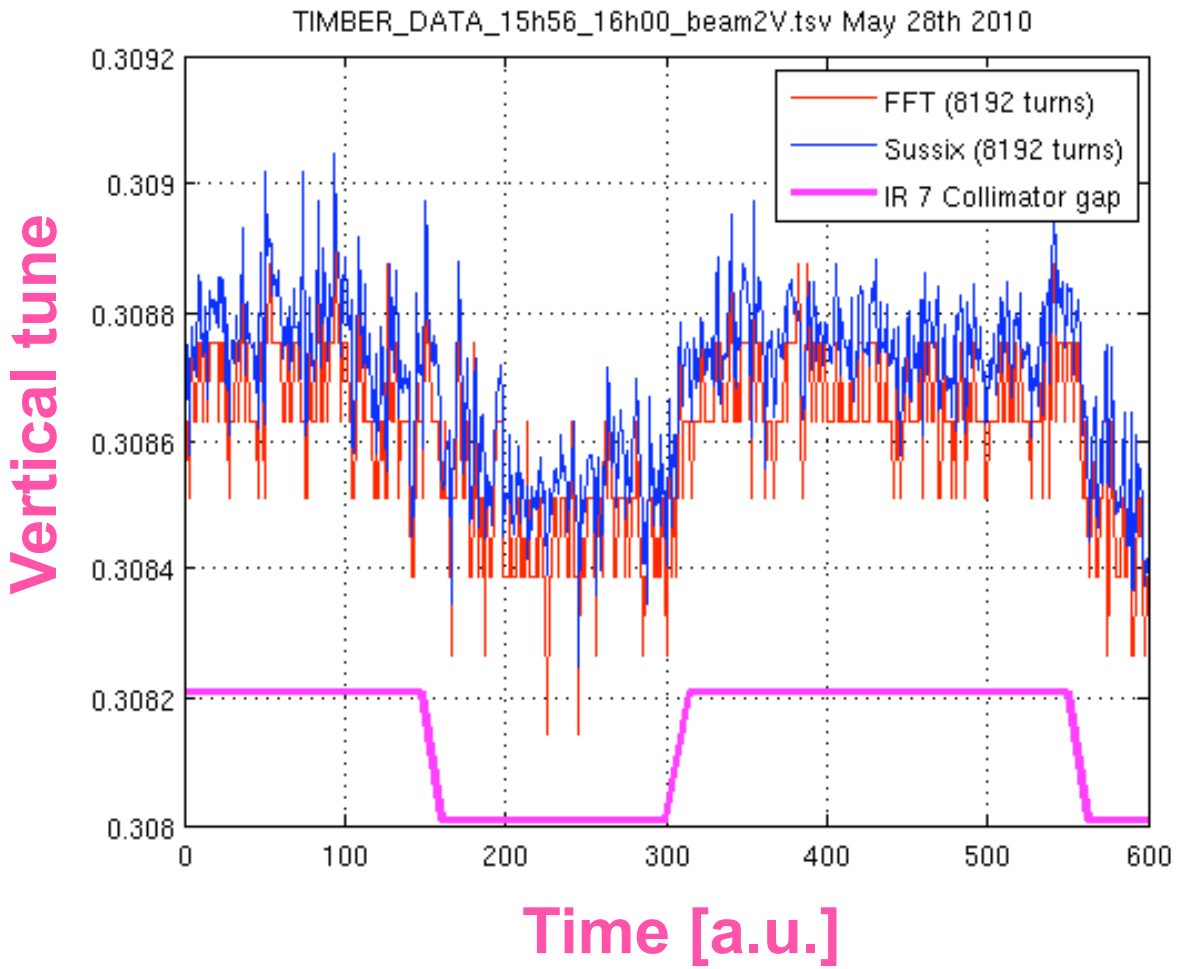
SIMULATIONS



- Unstable bunch for I_{oct} > - 10 A
  => Rise-time ~ 11 s for I_{oct} = - 6 A
- Stable bunch for I_{oct} ~ - 10 A

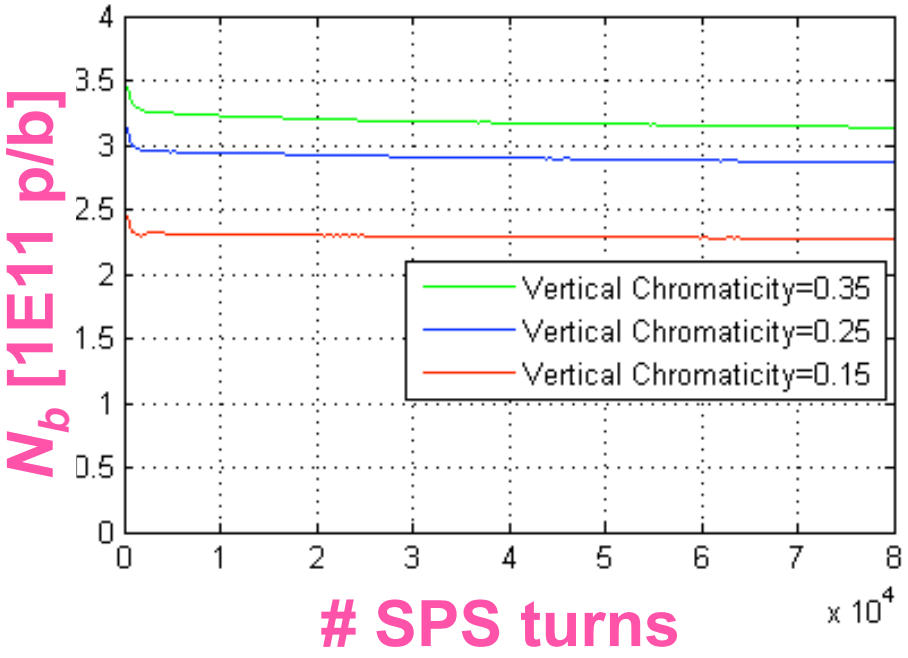
BEAM-BASED LHC IMPEDANCE MEASUREMENT

Moving IN and OUT all IR7 collimators at 450 GeV/c



- ΔQ_y (meas.) ~ - 2.4 10^{-4}
- ΔQ_y (impedance model) ~ - 2.0 10^{-4}

VERTICAL SINGLE-BUNCH INSTABILITY IN SPS

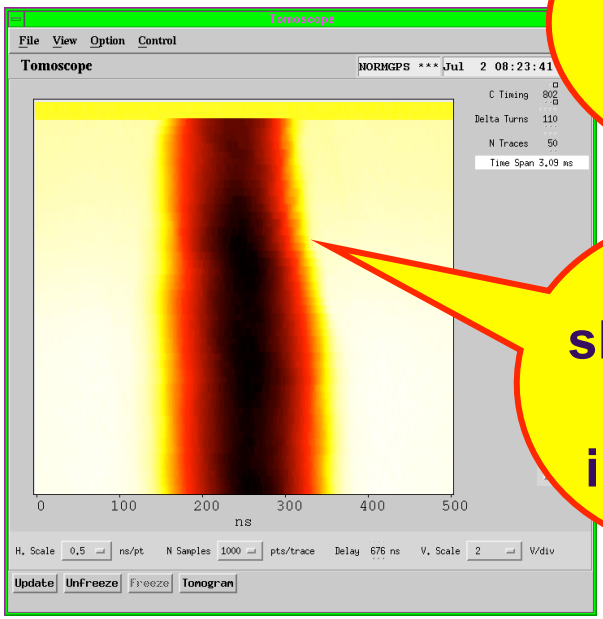


- **Fast vertical instability (TMCI) could be damped by increasing chromaticity (as predicted) => Up to ~ 3-3.5E11 p/b could be injected within 1 bunch (trans. emitt. still to be checked)**

- **1 bunch up to 2.3E11 p/b could be accelerated with small losses (3 to 6%) and acceptable norm. rms. trans. emitt. (< 3.5 microm)**

LOSSES IN PSB RING 4 BEFORE EXTRACTION

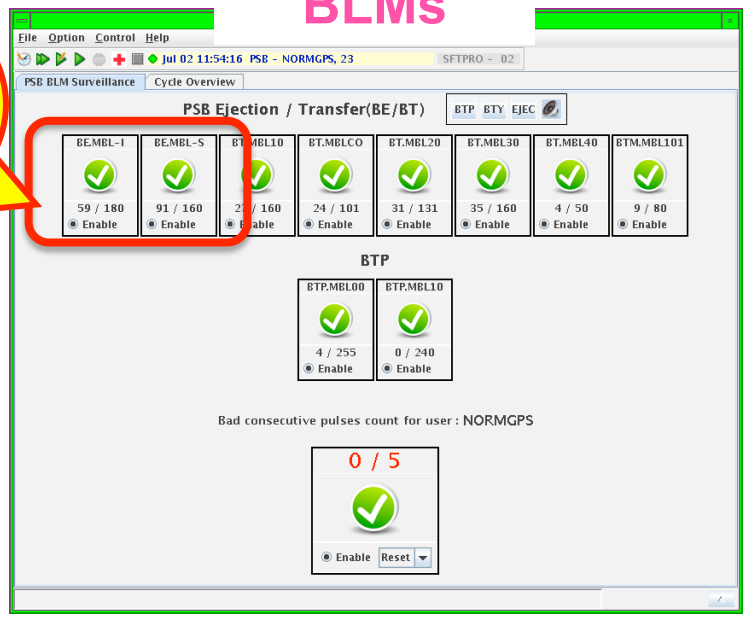
- Even with the feedback system ON, Ring 4 has been suffering for years from a transverse instability appearing right before (~ 2 ms) extraction for intensities > 800E10 p
- This instability would trigger the BLMs on the ejection line and stop the beam to ISOLDE
- Increasing linear coupling between the transverse planes completely suppressed the unstable motion and associated beam losses



1100E10 p accel. and extracted with low losses in the ejection line (with linear coupling)

Bunch shortening during instability

BLMs

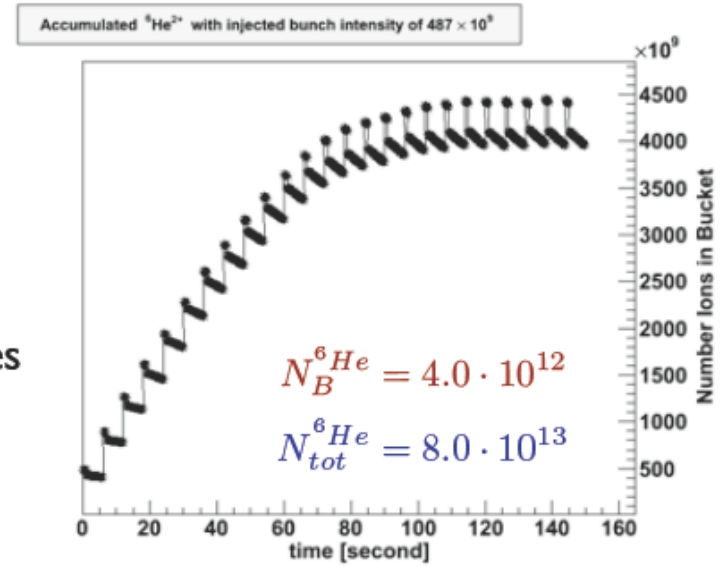


Decay Ring RF & Collective Effect Simulations

FOR BETA-BEAMS

- DR Injection
  (for ^{6}He & ^{18}Ne and ^{8}Li & ^{8}B):
  → Capture
  → Merging
  → Accumulation

- Simulations give bunch intensities at Saturation by including
  → Collimation
  → Radioactive Decay



- Bunch Intensity Limits in DR studied based on
  → Direct Space Charge
  → Transverse Resonance Impedance →

- The latter gives very challenging upper limits of the DR's Transversal Shunt Impedance