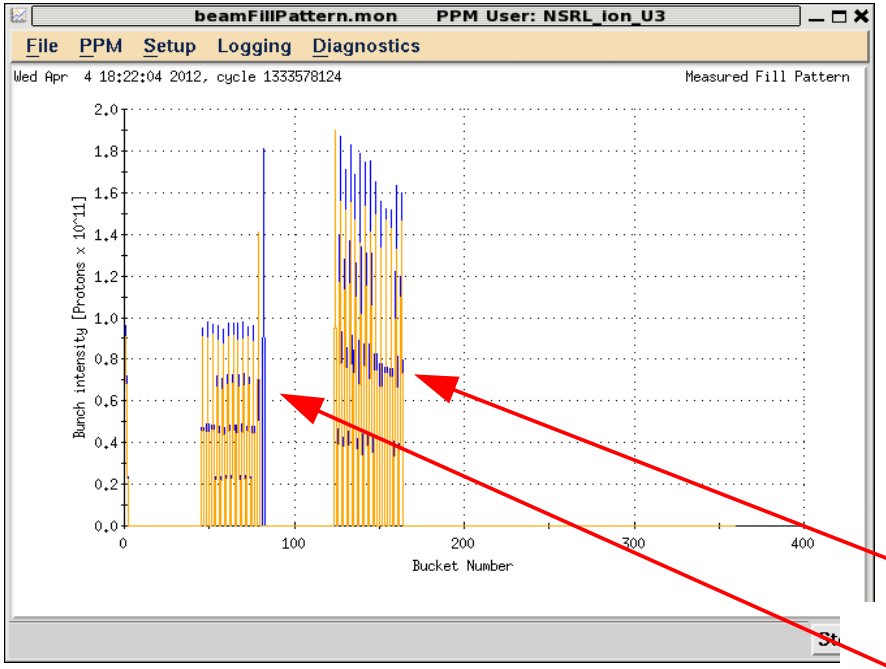
Beam-beam Studies

- Initial plan was to study the effect of white noise on emittance → had to changed due to the problems with the pC polarimeters:
  - Investigate the effect of coupling: tune scan
  - Excite the pi-mode with BBQ kicker
- Injected trains of bunches with different intensity to exercise for next week's experiment

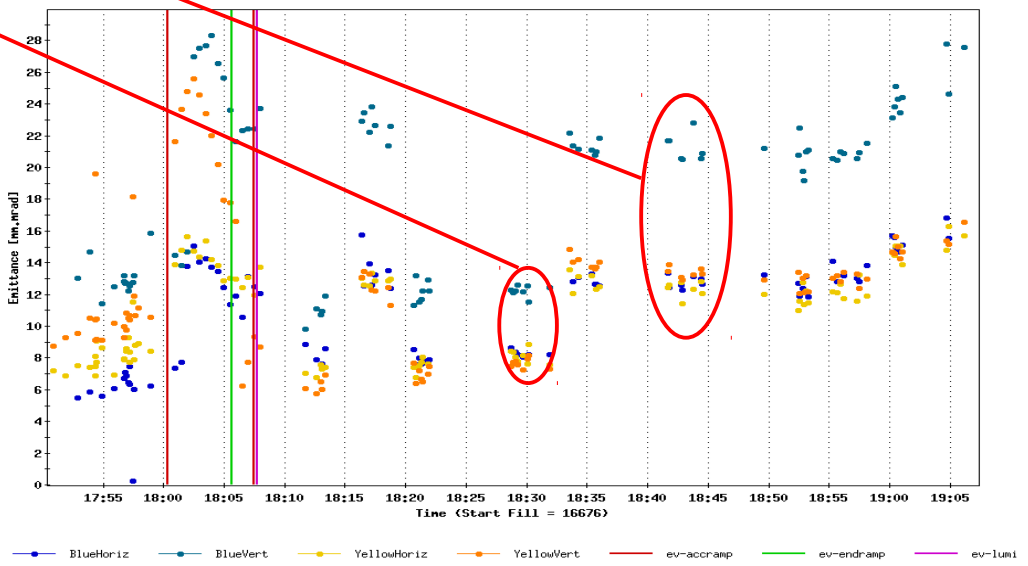
Fill Pattern



Two trains colliding in one IP with different bunch intensities – hope to get different beam-beam parameters

Had difficulties injecting the blue beams large mismatch in intensities for high intensity bunches

Added one non-colliding bunch as a probe

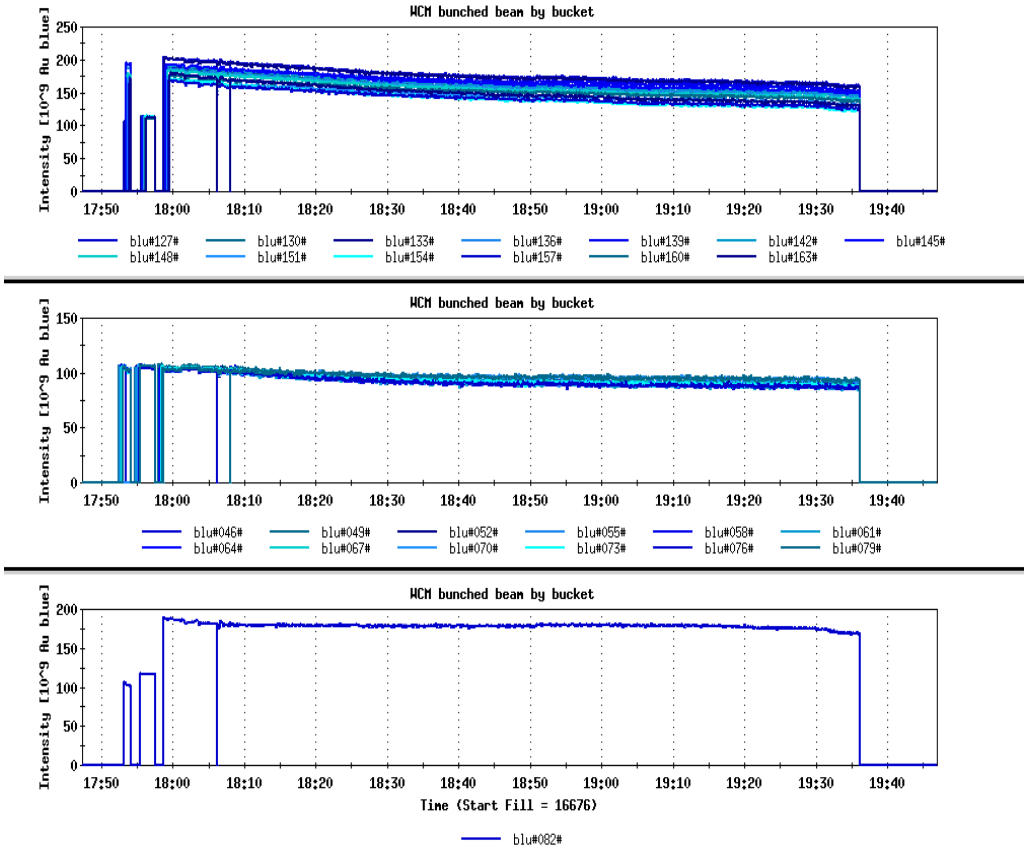


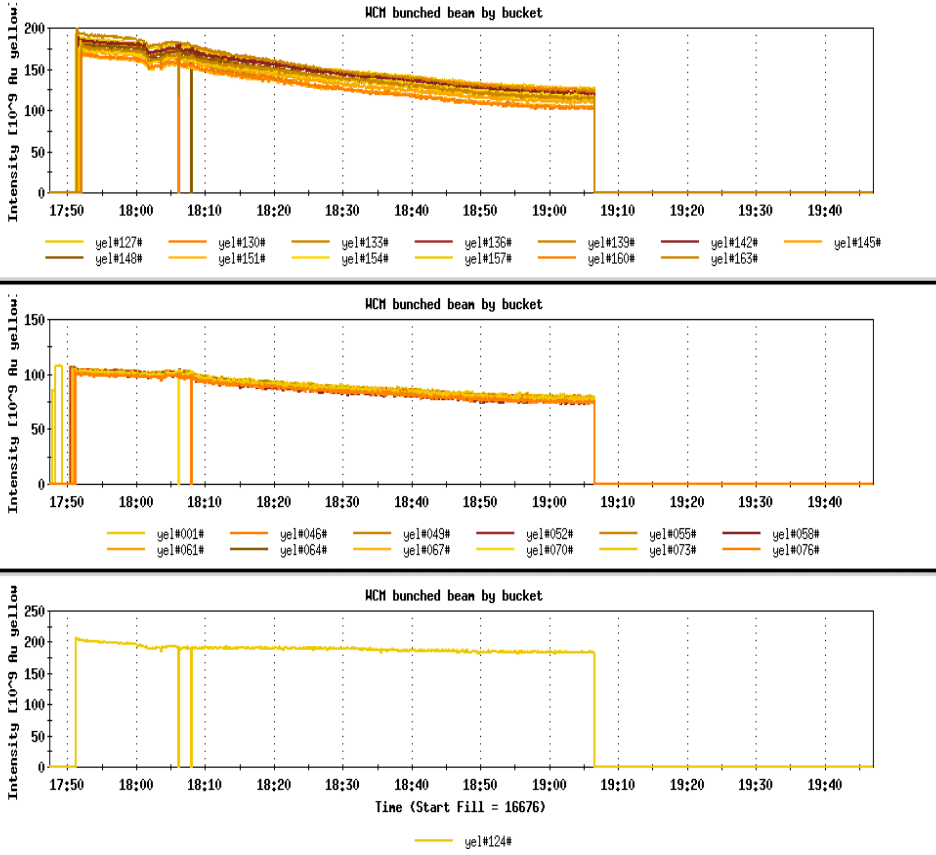
Emittance blown-up in the vertical plane - mismatch

Scales almost linearly with intensity → equivalent beam-beam parameters for both trains

Is there a way to conserve the emittance while increasing intensity?

Bunch intensity



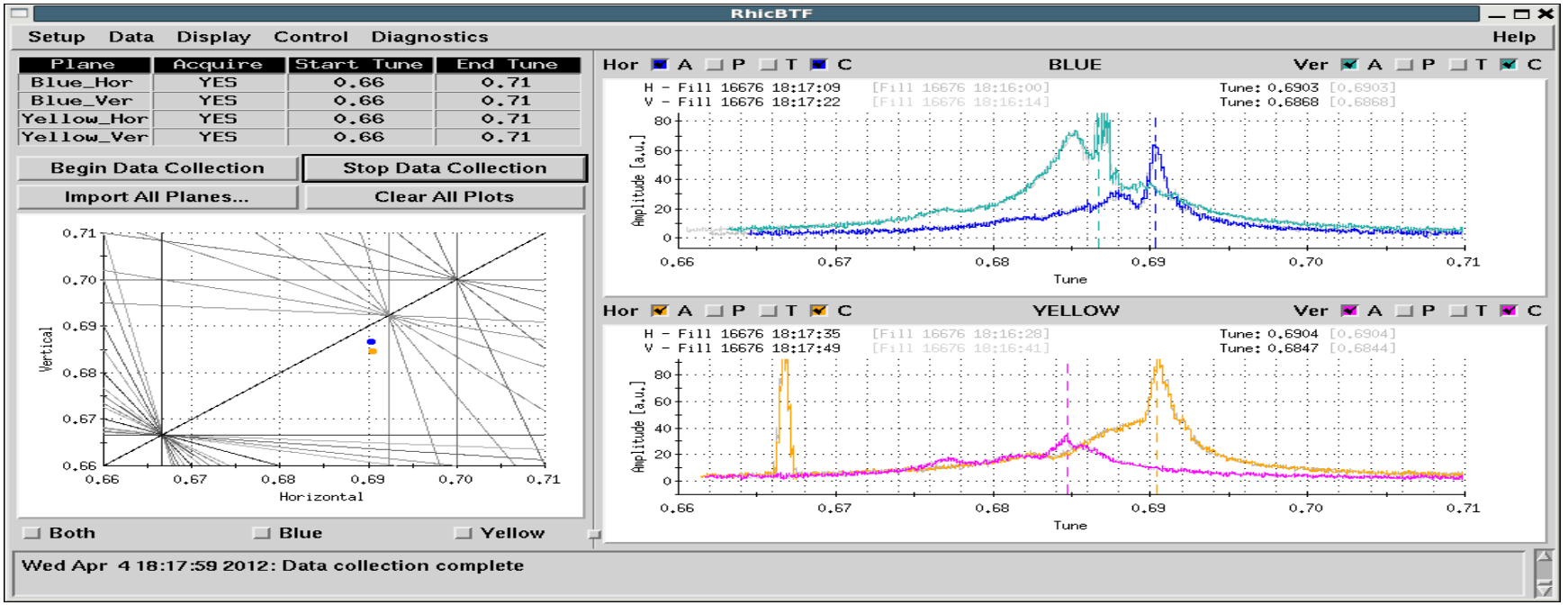


Non-colliding bunches have good lifetime

Low intensity bunches seem to lose more than high intensity bunches

They have similar beam-beam parameters → losses probably related to the stronger mismatch for high intensity bunches

Initial conditions



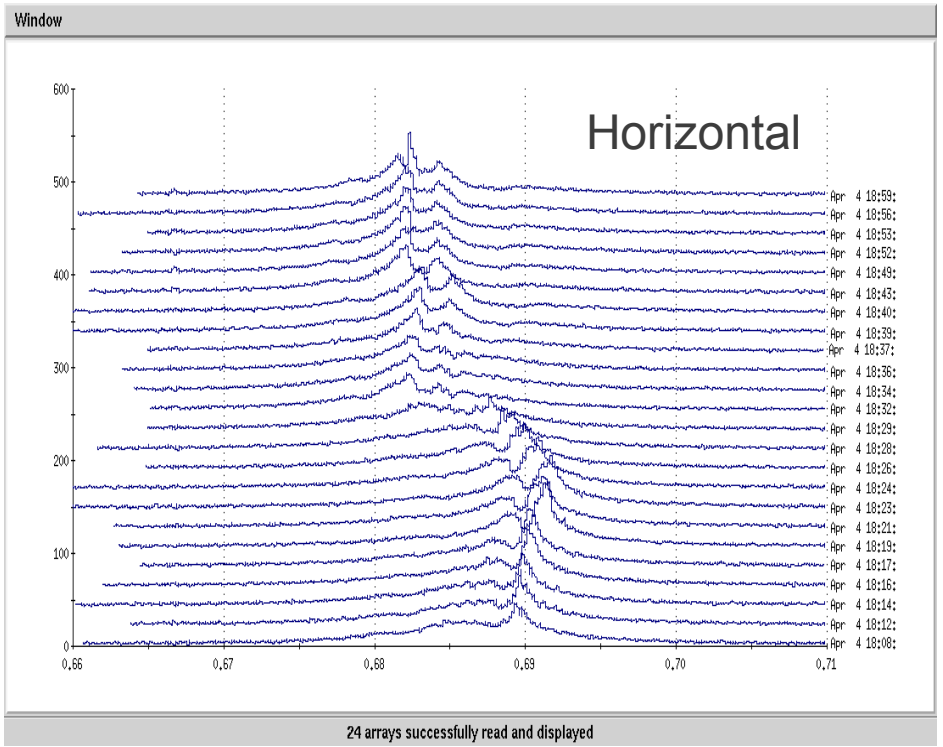
Weaker than usual pi-mode observed in the vertical plane → probably due to mismatch in intensity and emittance.

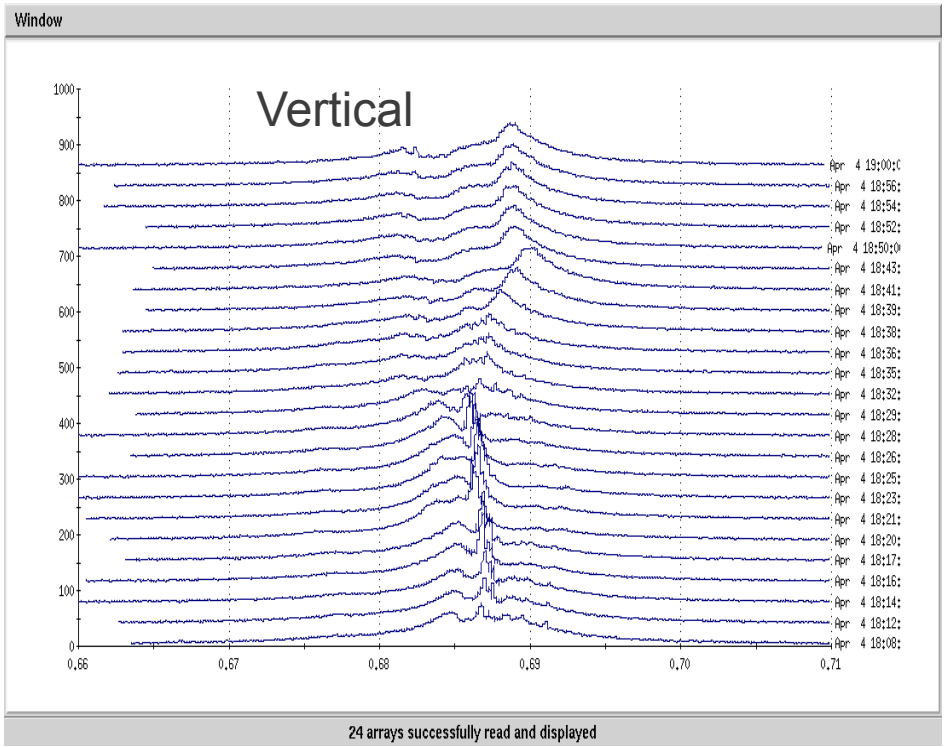
Beam-beam parameters at this point (using yellow beam parameters from IPM and WCM):

-low intensity: ~ 0.0092
-high intensity: ~ 0.009

→ Ended up very close due to emittances – low intensity higher!

Tune scan

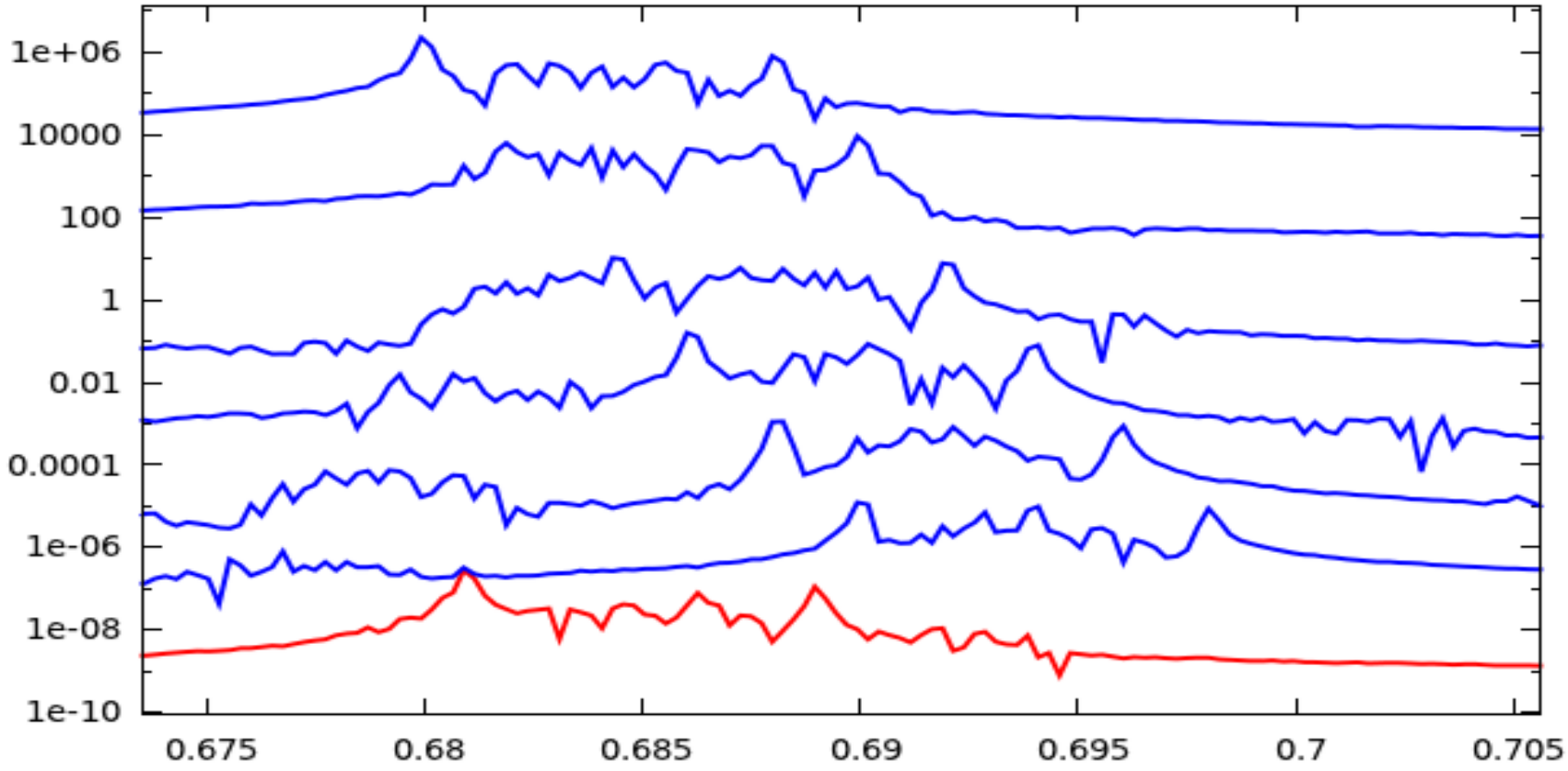




The goal was to cross the horizontal and vertical tunes and look at the effect of coupling on coherent modes

Even with only one IP colliding the tune range was smaller than expected
Started with high losses and blue/yellow mismatch: probably related

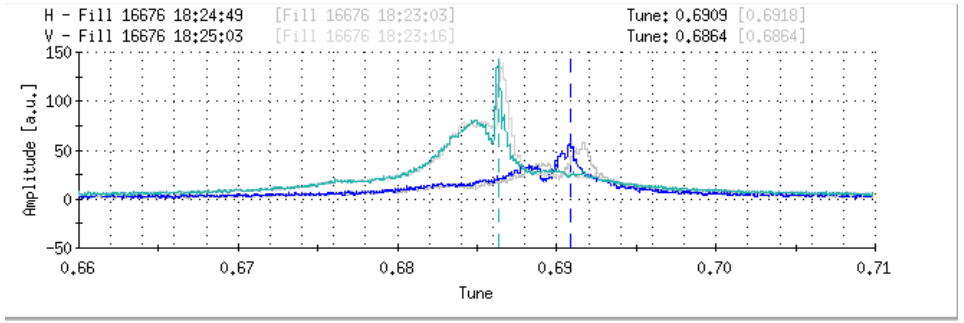
Simulations

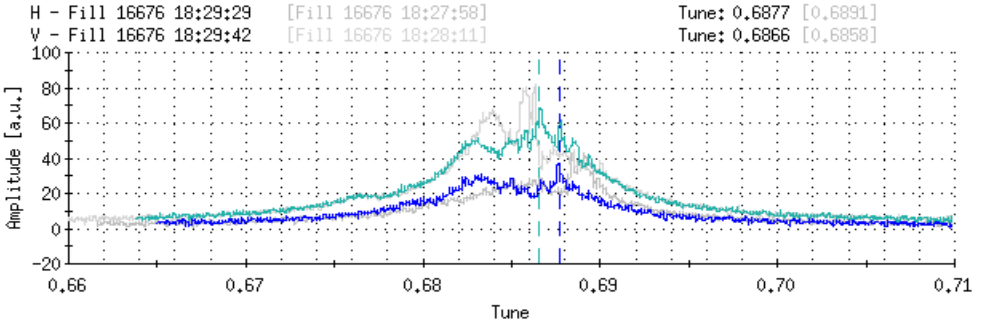


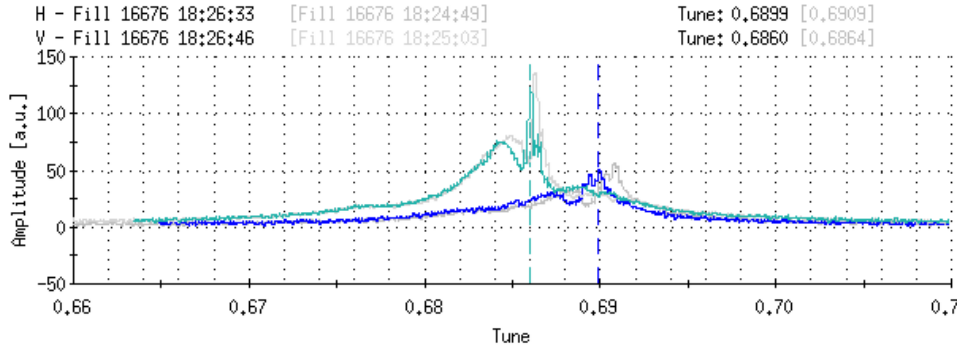
In red the horizontal spectrum, blue the vertical one – coupling strength = 0.001 m^{-1}

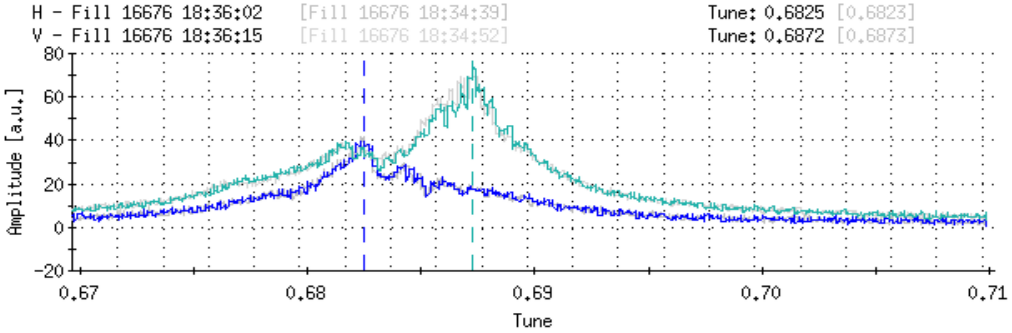
As the horizontal tune is swept across the vertical one the π-mode disappears and comes back once Qx<Qy

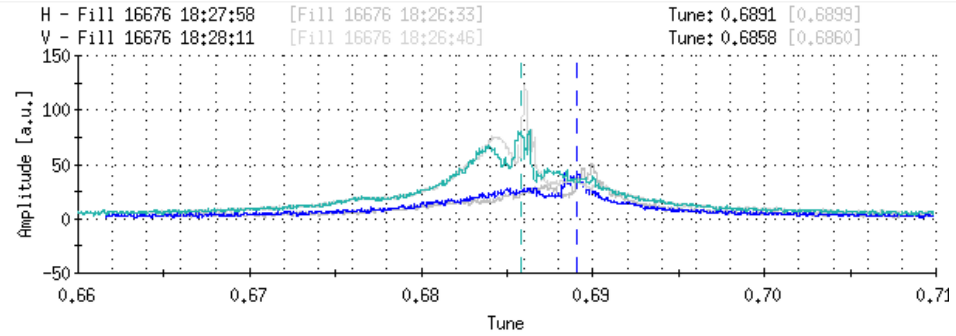
Experiment

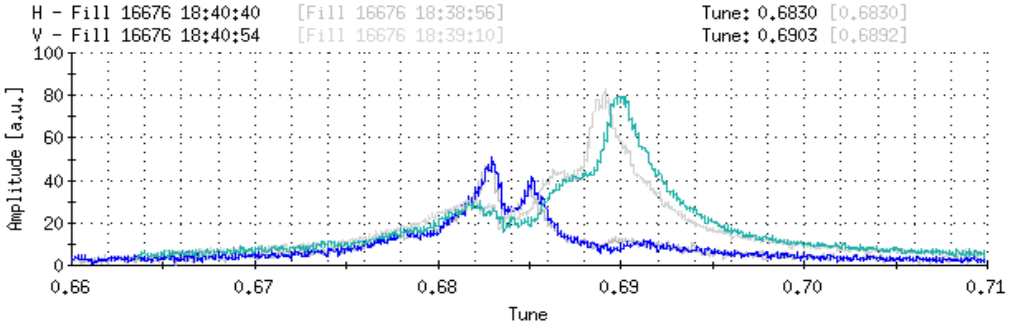






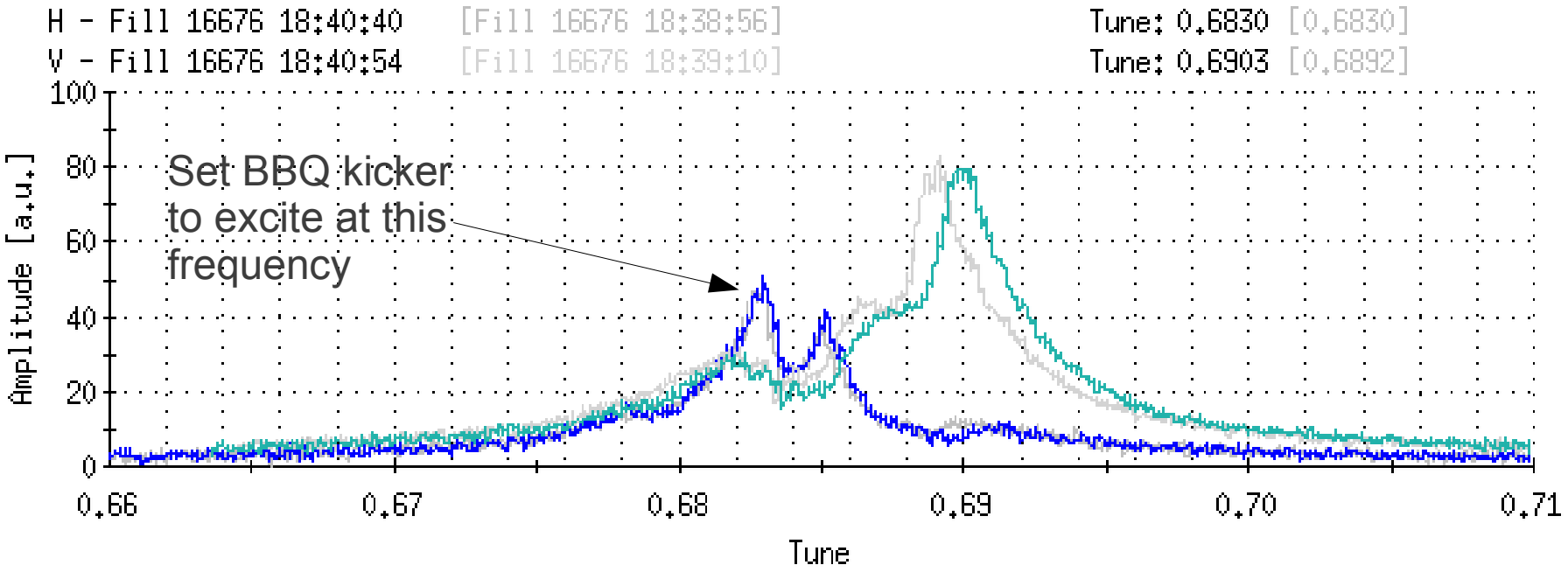






It appears that moving Qx through Qy provides landau damping when the modes overlap the tune spread of the other plane

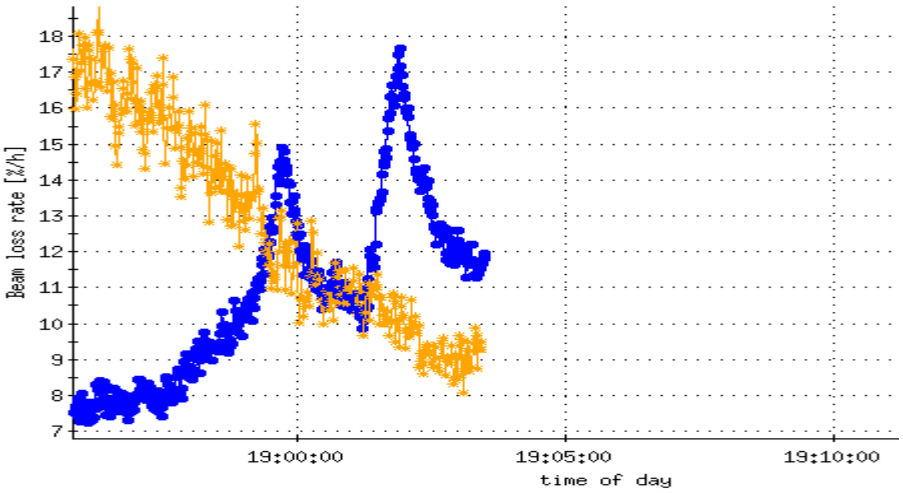
π-mode excitation



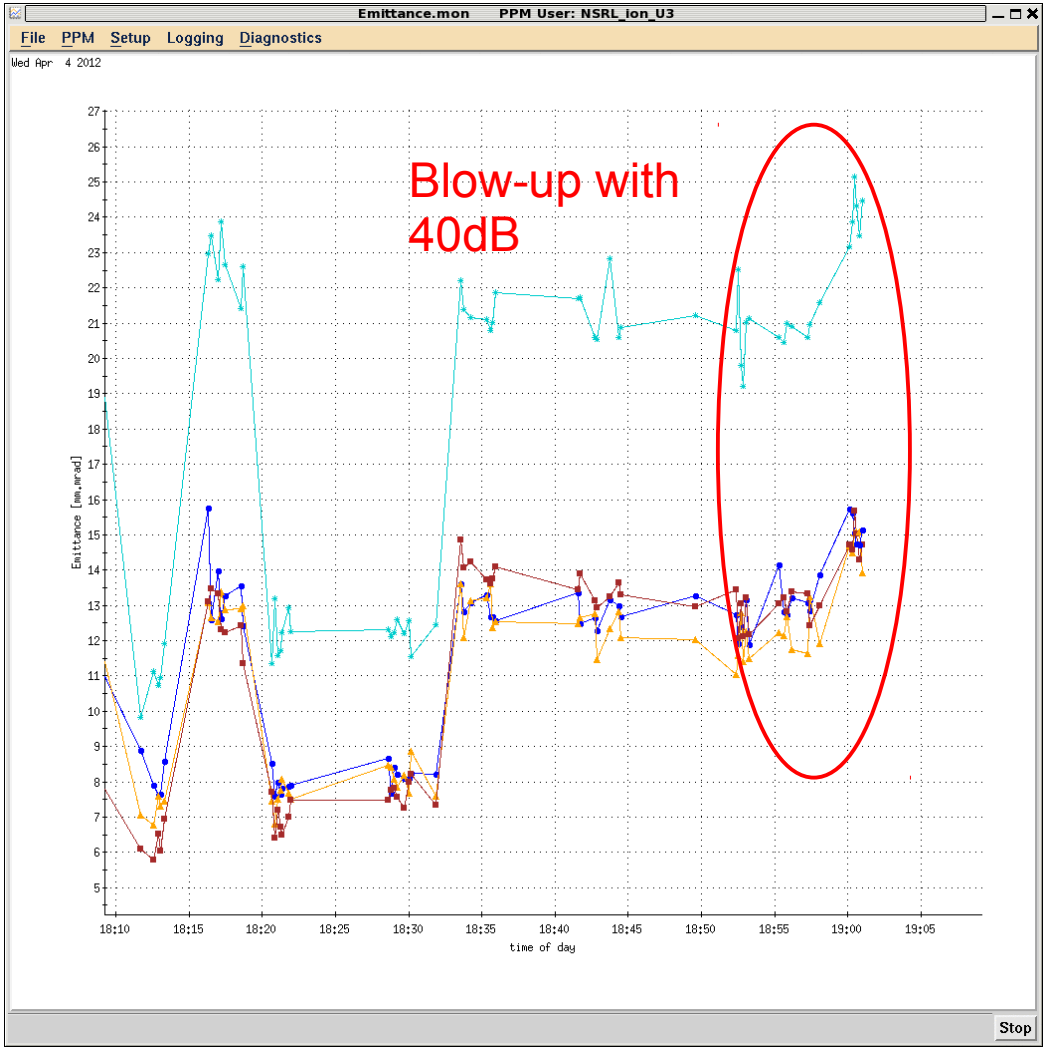
Had to set the kicker strength to about 35dB to see significant losses

Here kicker on and off at 40dB

Excited outside the spectrum (0.675) at 40 dB without increase in the loss rate



Emittances



Observed a clear emittance blow-up in both beams both planes for strong excitation – kicker gain at its maximum

Excited only one plane – coupling + BB
Transferred it to the other planes

No sign of coherent instability

We would need the kick amplitude for the analysis – not trivial

A white noise excitation can be calibrated by exciting non-colliding bunches
→ analytical model

The same kicker is used for both:
maybe we could try to cross calibrate the Sinusoidal excitation with the white noise