Tune Tracker Status

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24 Aug 2004

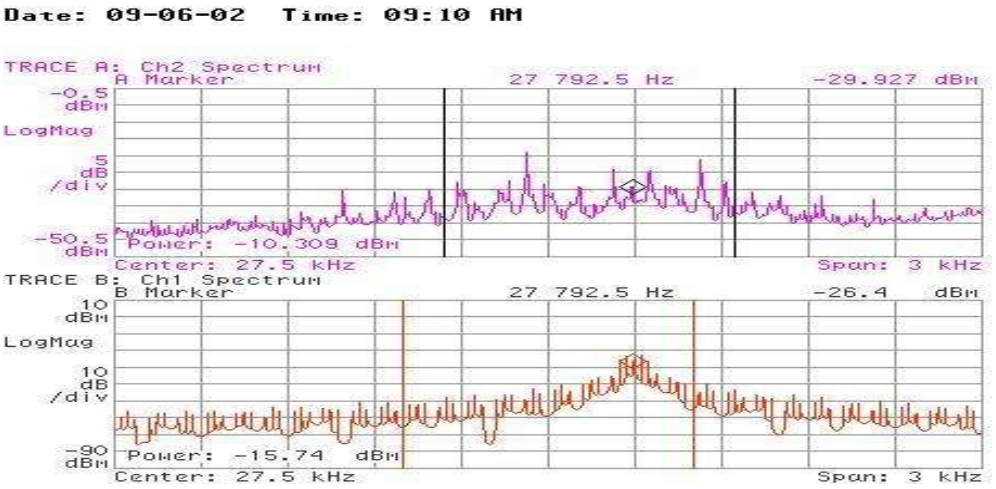
Current Status

- Tune tracker can track tunes up the ramp and through the squeeze.
  - Tested for uncolesced protons on central orbit.
  - Tested for 1 coalesced proton bunch on proton helix.
  - Successful for both continuous and pulsed excitation.
- No kicker feedback at this time.

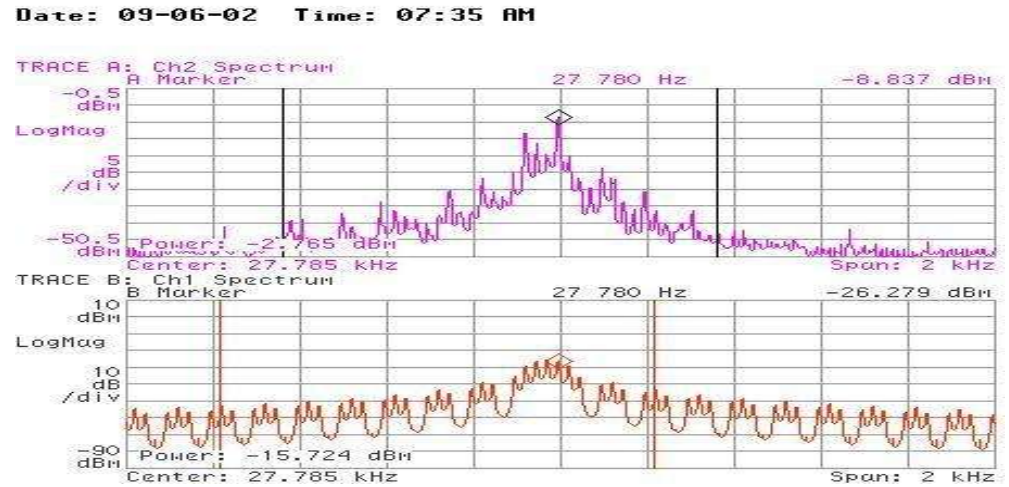
Coalesced Protons has a lot of coherent motion

- Coalesced protons must be kicked with MORE power than for uncoalesced protons because of large coherent motion.
  - For lock to succeed, must be 6dB above noise power.
  - 180 mW compared to 25 mW for uncoalesced
- In this talk, we will only talk about coalesced protons on the proton helix.

Spectra for different Excitations on Coalesced Protons on Helix

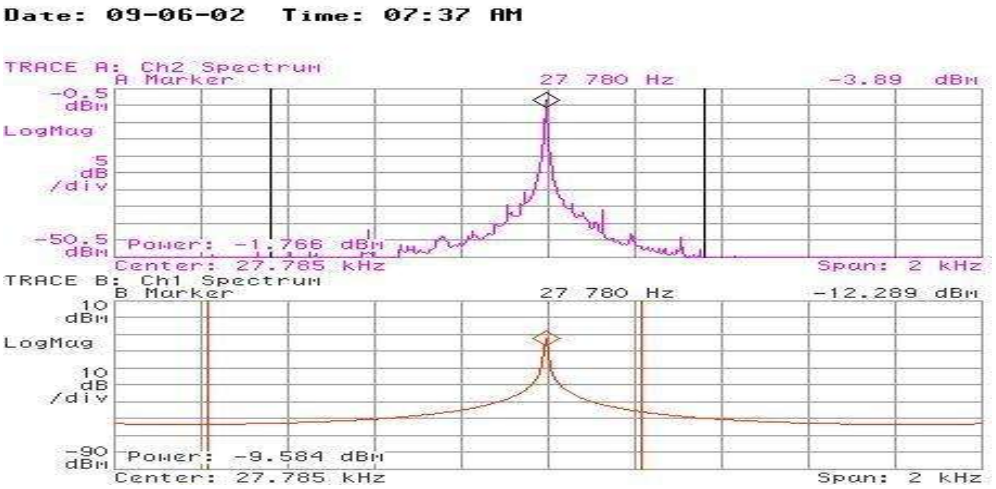


Spectrum with no excitation

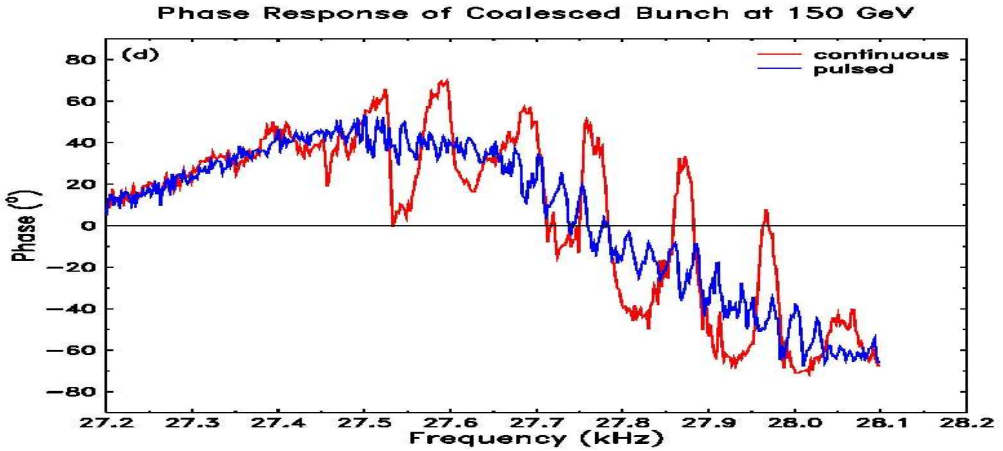


Spectrum with pulsed excitation (note horz scale change)

Spectra for different Excitations On Protons On Helix (Cont'd)

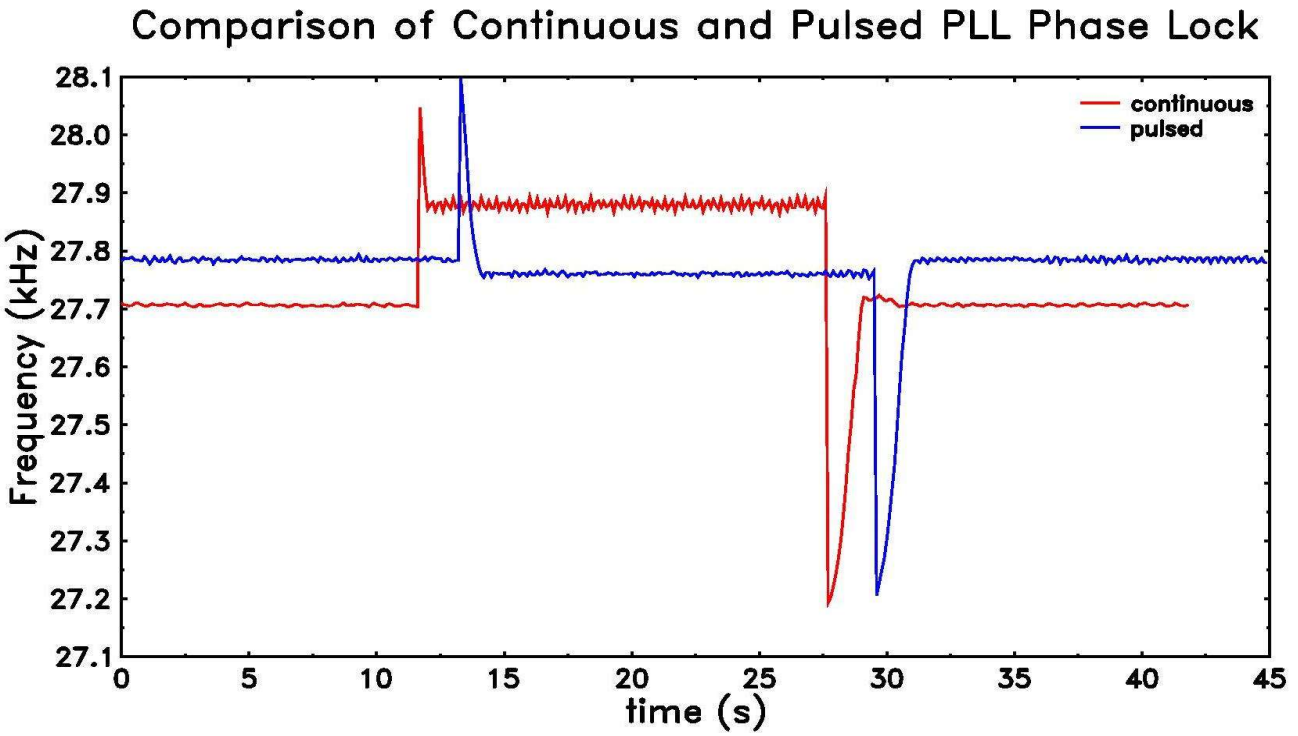


Spectrum with Continuous Excitation



Frequency Response

Jerking the Lock Frequency

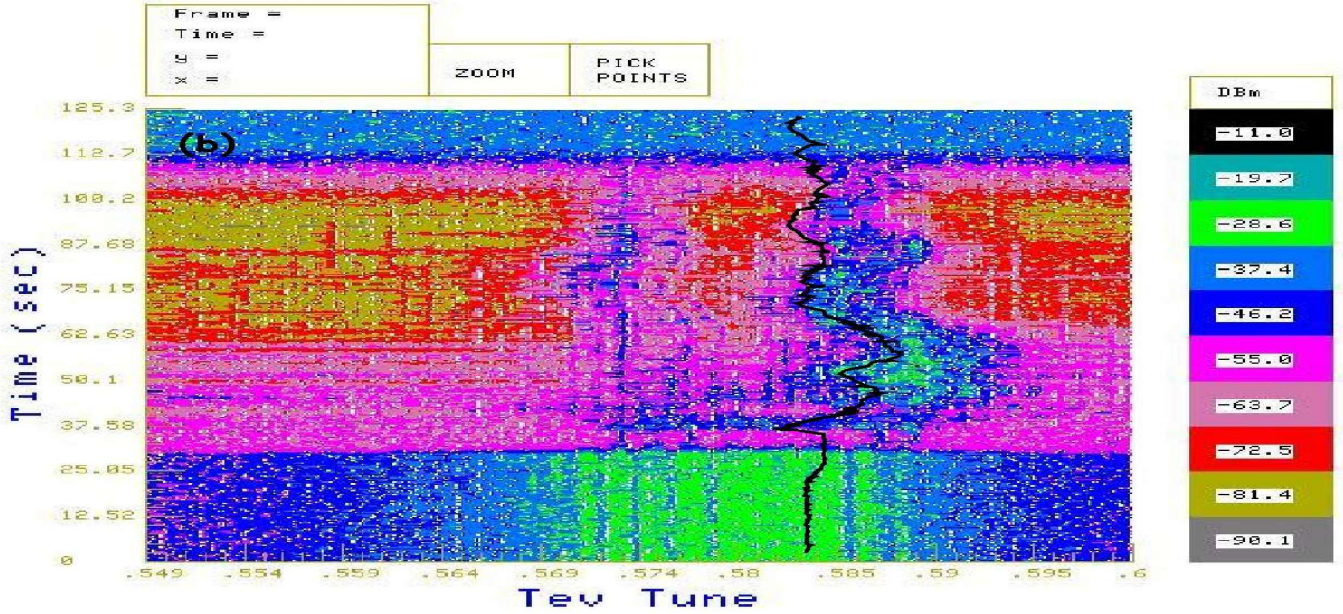


Continuous PLL locks to another synchrotron line, Pulsed PLL locks close to centre of betatron tune

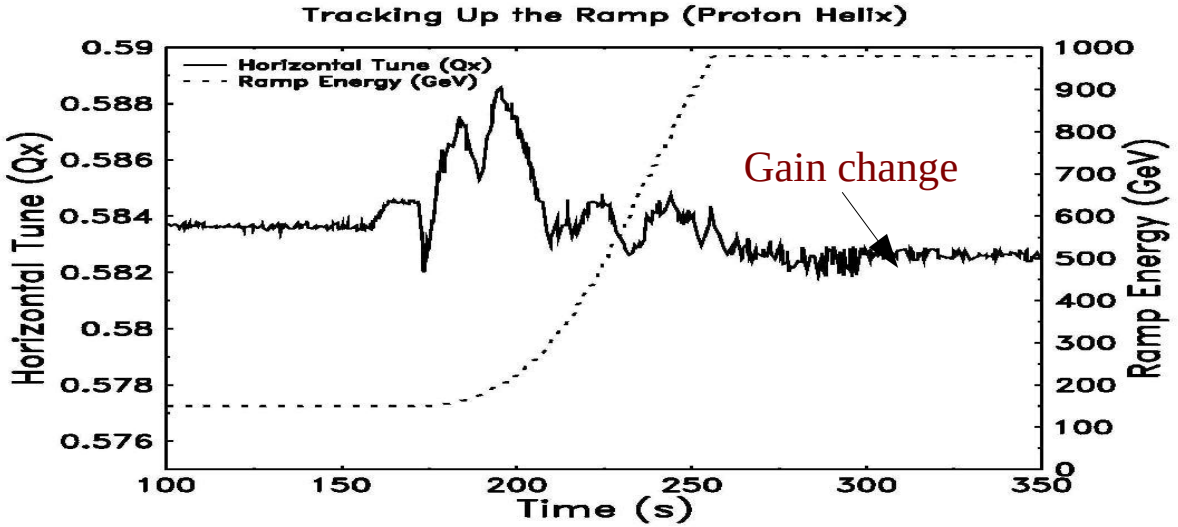
Why we compare Track to Store with NO track

- Because excitation is strong, if we just look at spectrum where we track with excitation, we can be misled by strong peak.
- So we will compare tracking on proton helix with one bunch and Schottky spectrum for HEP store (i.e. 36X36 bunches)

Tracking Up the Ramp with Coalesced Protons on Proton Helix with Continuous Excitation

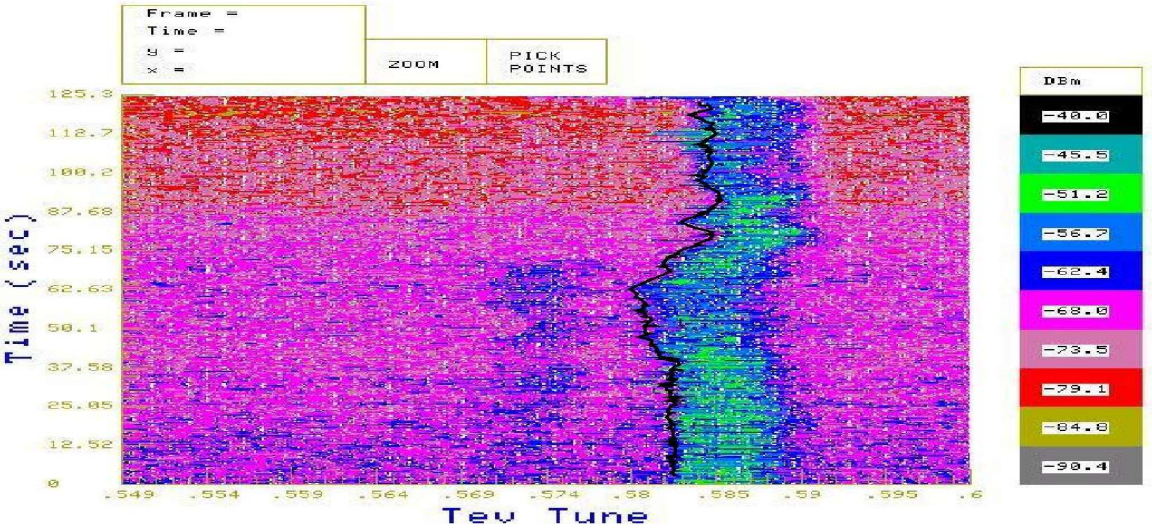


Comparing Track to Store 3699

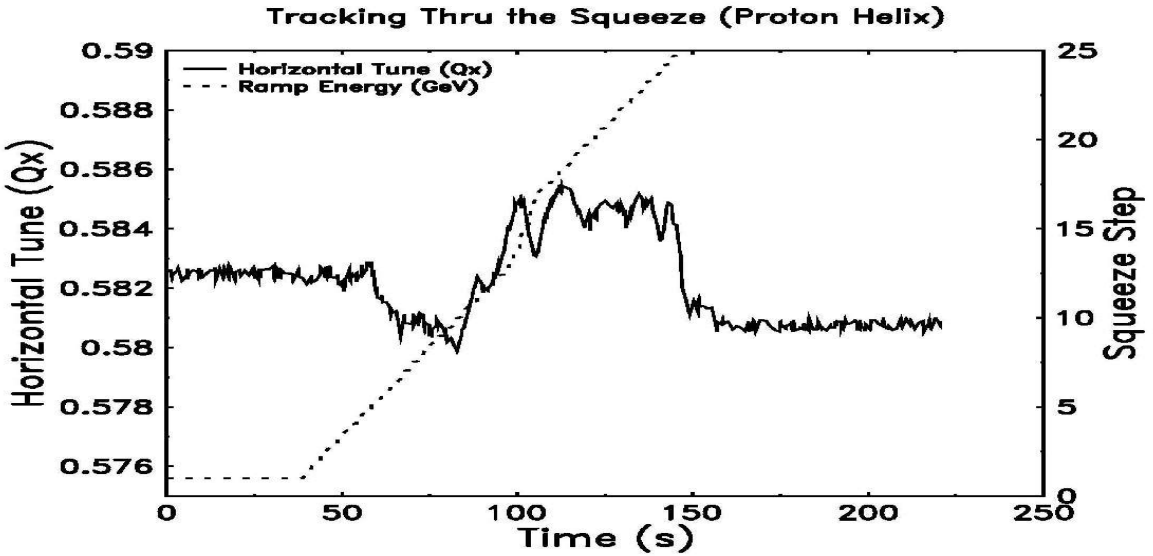


Gain Mult changed from 4 to 2

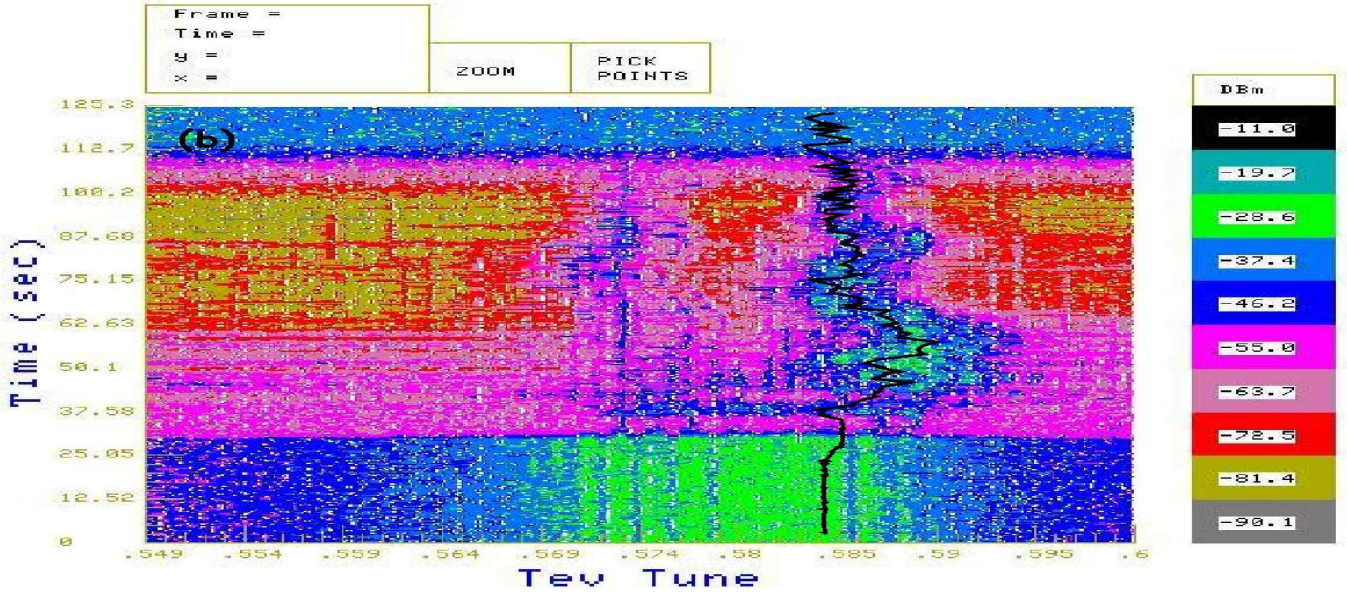
Tracking Through the Squeeze On Proton Helix with Continuous Excitation



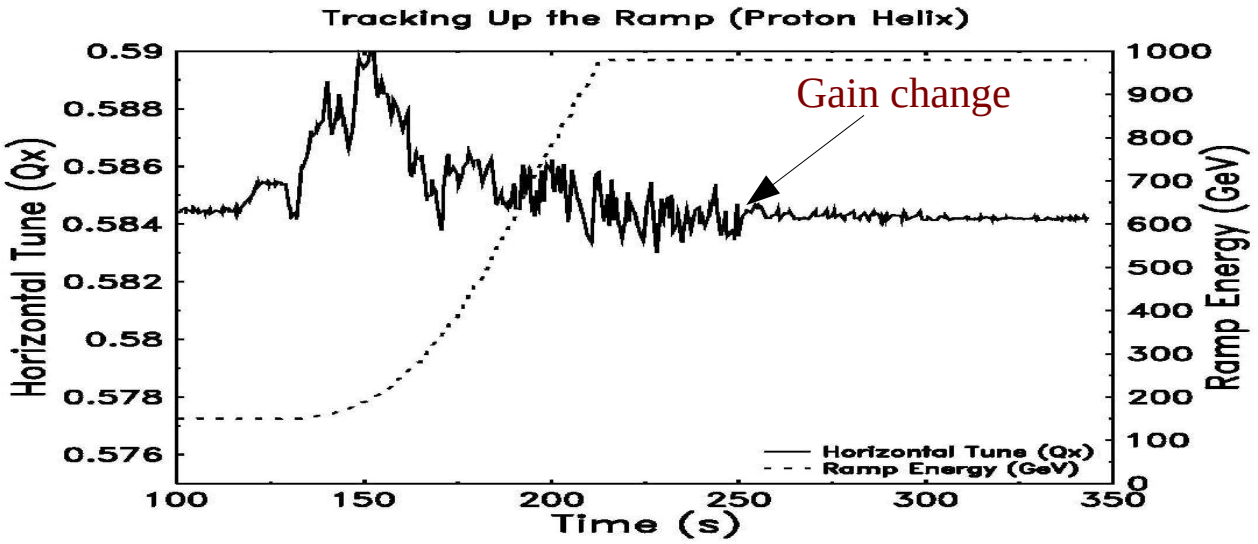
Comparing Track to Store 3699



Tracking Up the Ramp with Coalesced Protons on Proton Helix with Pulsed Excitation

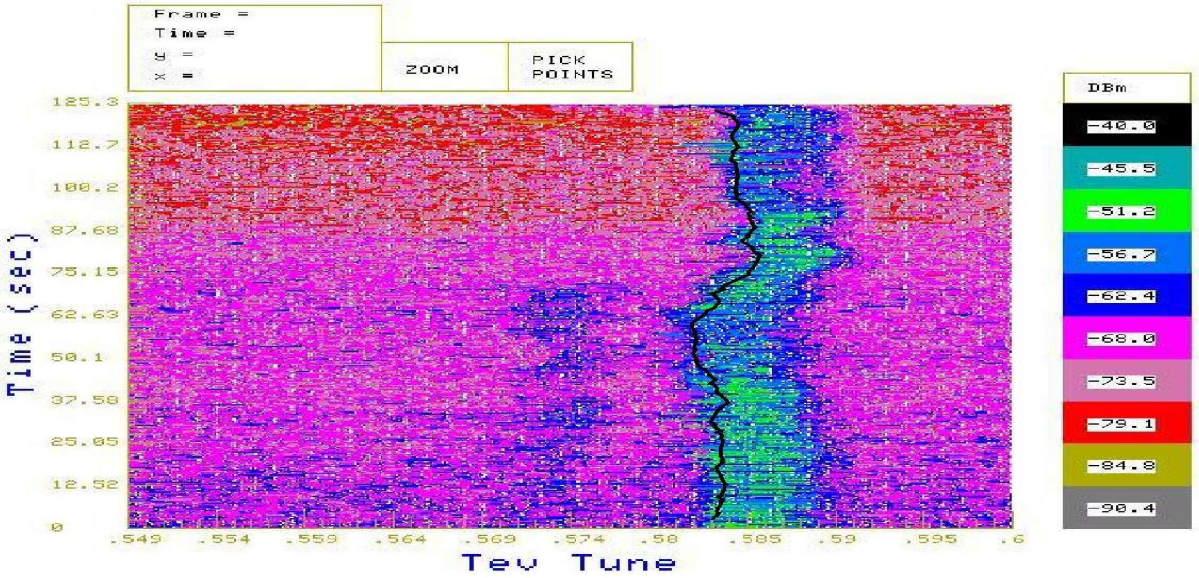


Comparing Track to Store 3699

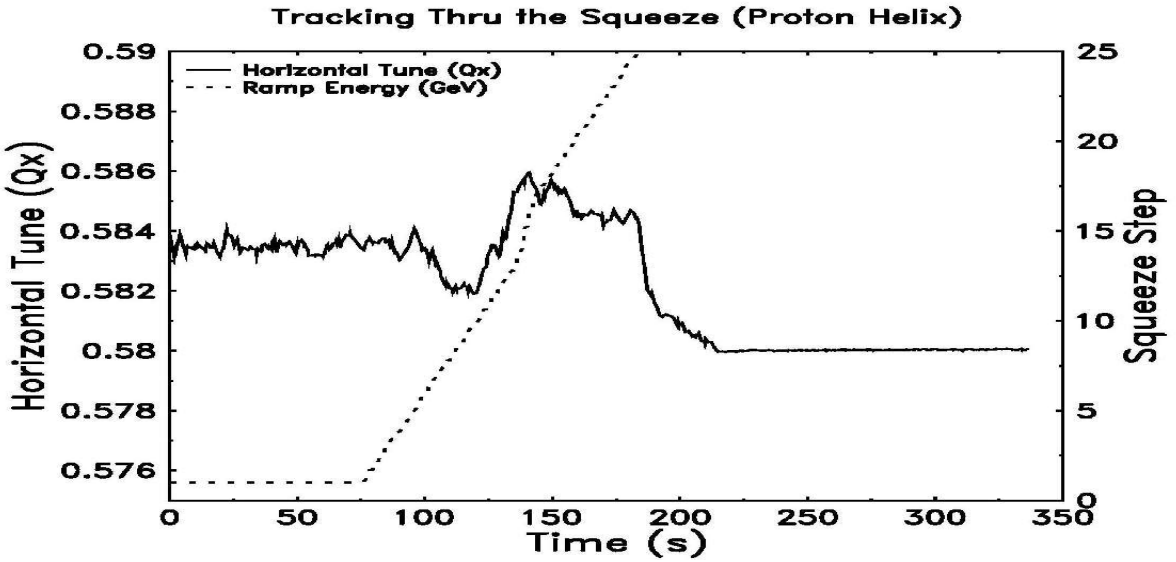


Gain Mult changed from 16 to 4

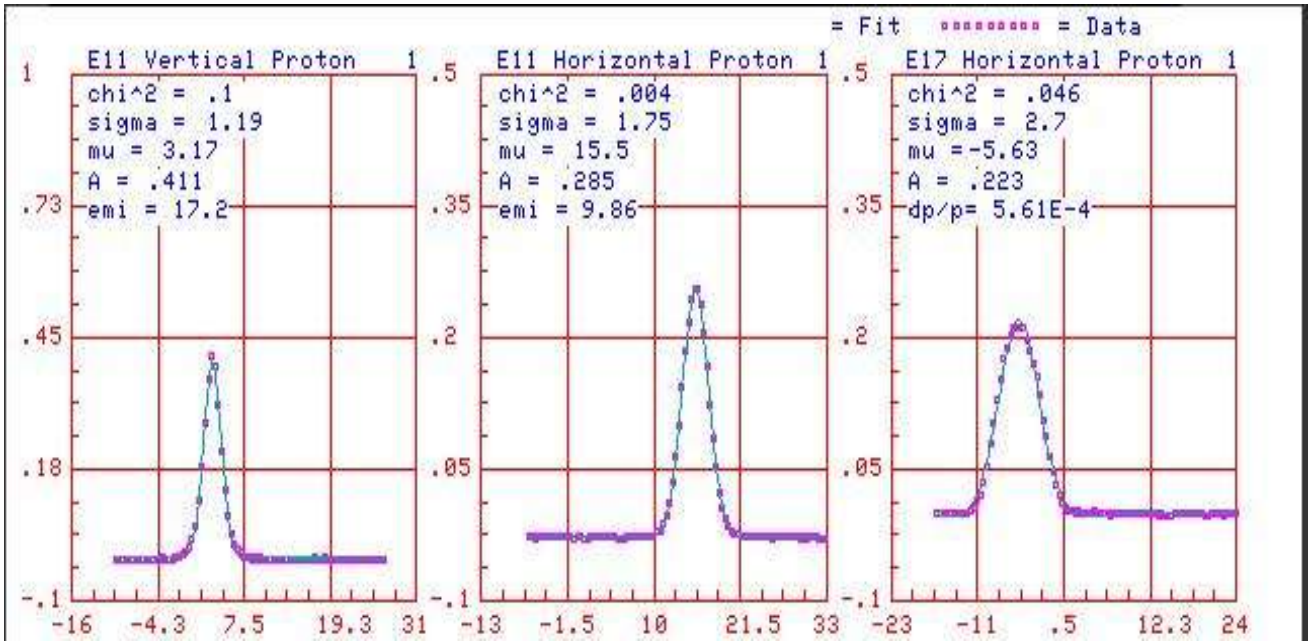
Tracking Through the Squeeze On Proton Helix with Pulsed Excitation



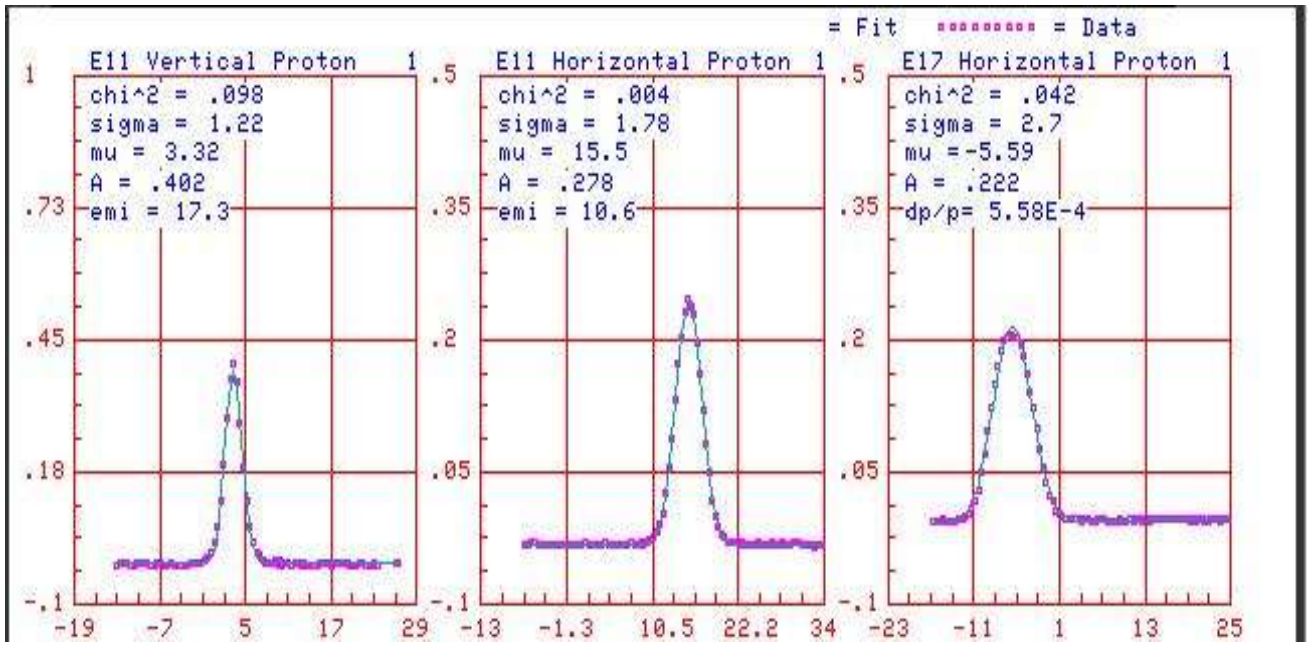
Comparing Track to Store 3699



Emittance before and after. Continuous excitation
Coalesced Protons on Proton Helix at 150GeV



Emittance at start



Horz emittance after 10 minutes of excitation. Note growth < Pi mm mrad. However, emittance did grow WITH no tickling from 8.1 to 9.86 which is > Pi after 10 minutes. So probably growth from excitation is small.

Some notes

- Continuous PLL is less noisy than Pulsed PLL.
- Continuous PLL will find an arbitrary synchrotron line to lock to.
  - There may be a phase change of 20 degrees from 150GeV to 980GeV which explains why pulsed PLL is locking to one side. (Needs to be reconfirmed).
  - Gain must be lowered as tracking goes up the ramp.

Things to be done during shutdown

- Complete kicker feedback unit.
- Add remote control for turning on/off kicker.
- Add control for changing gain/phase up the ramp and squeeze.
- Integrate tune tracker into control system. Add tune numbers to OAC.
- Fix more bugs ...

Conclusion

- Project from start to this time about 10 months.
  - Some mysteries, gain change and phase change up the ramp. Needs understanding.
  - Looks good so far.
- Start looking at chromaticity up the ramp. Probably use McGinnis method.