Tevatron Transverse Dampers

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Instabilities

- Why dampers?
  - ► Original sources of transverse head-tail instabilities:
    - – C0 and F0 lambertsons
    - – C0 lambertson removed.
    - – F0 lambertson metal liner to reduce impedance
  - ► Operate with low chromaticity
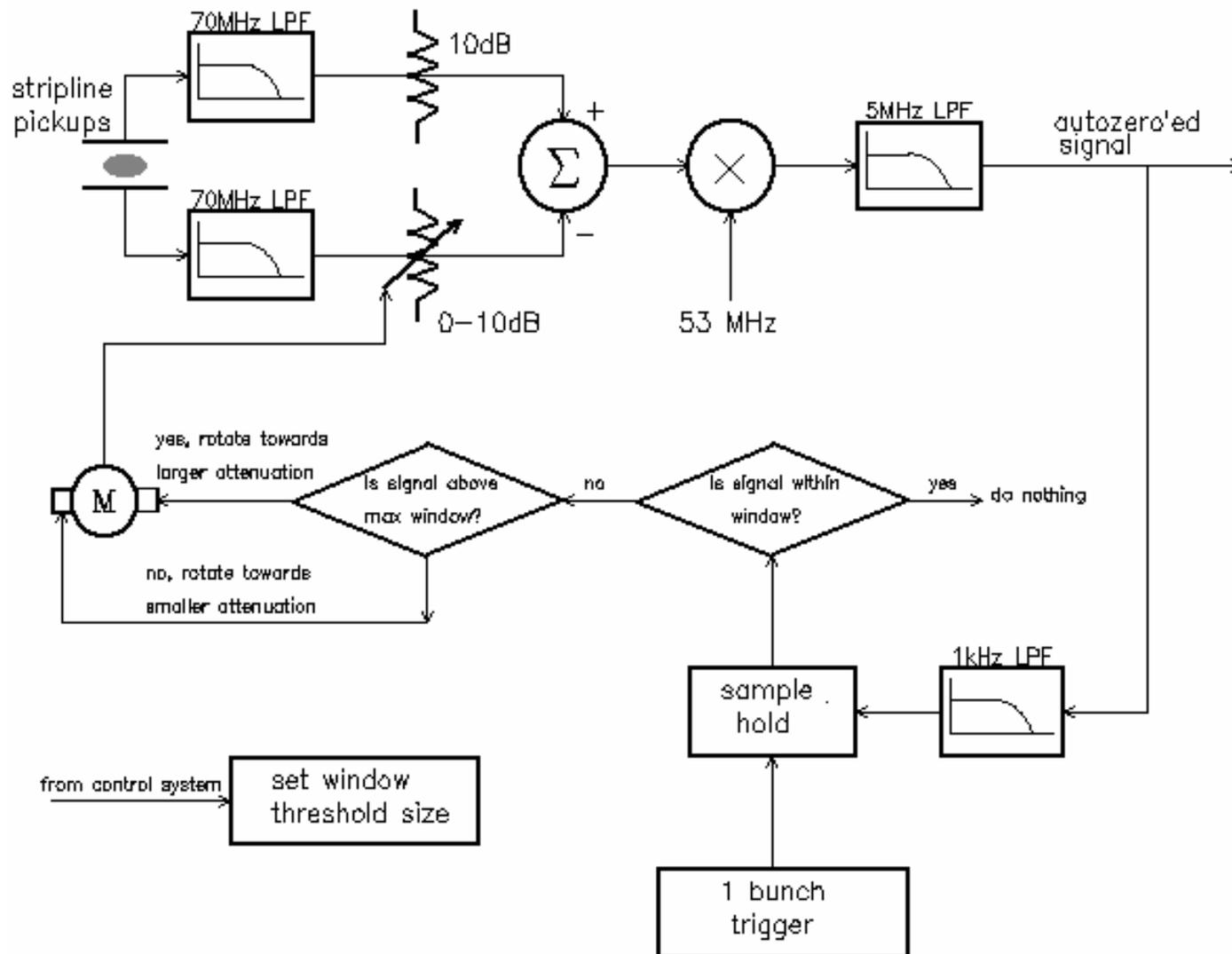   - – good lifetime
    - – but unstable

Goal of Transverse Dampers

- Enable running of Tevatron at low chromaticity between 2 to 4.
- Low chromaticity improves lifetime.
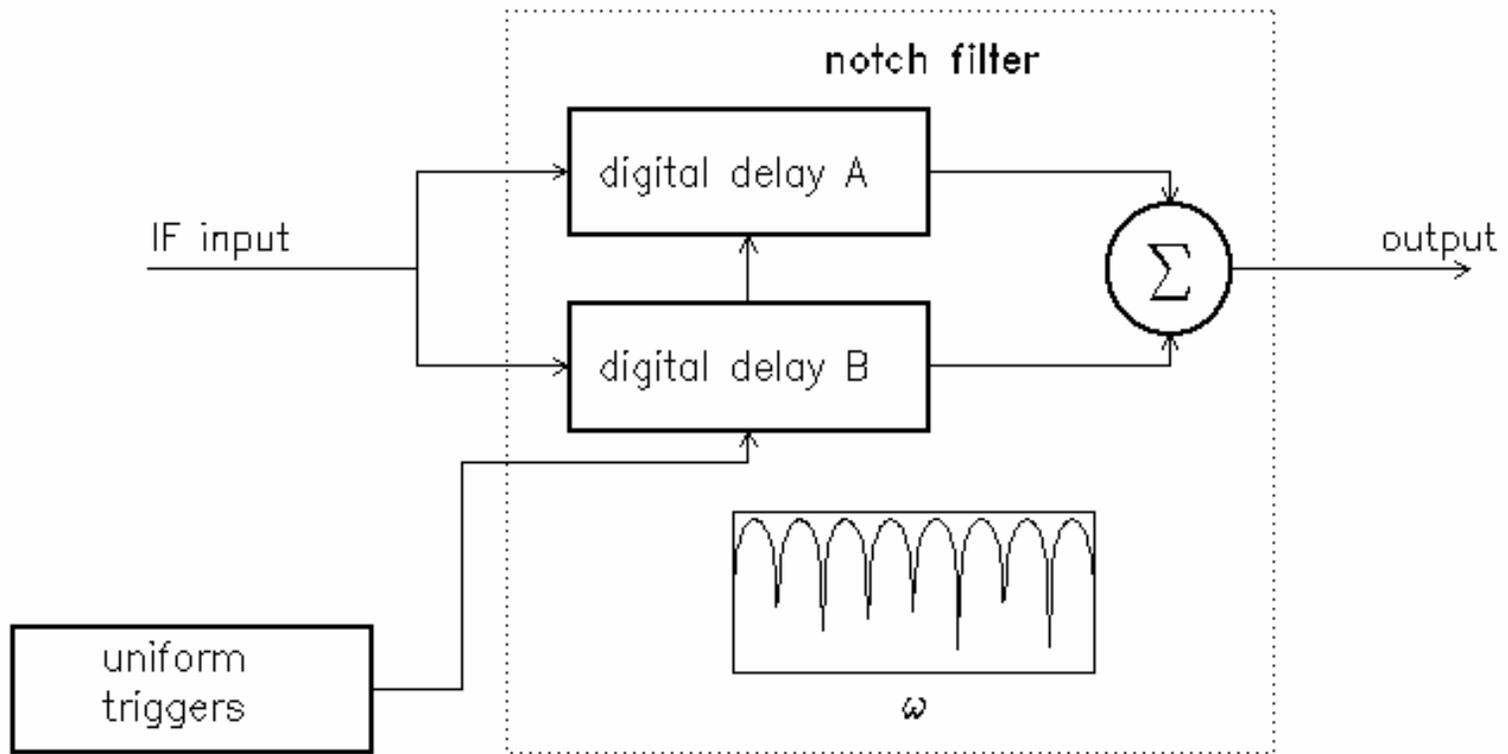- Landau damping is weaker, so beam is unstable.

Transverse Dampers
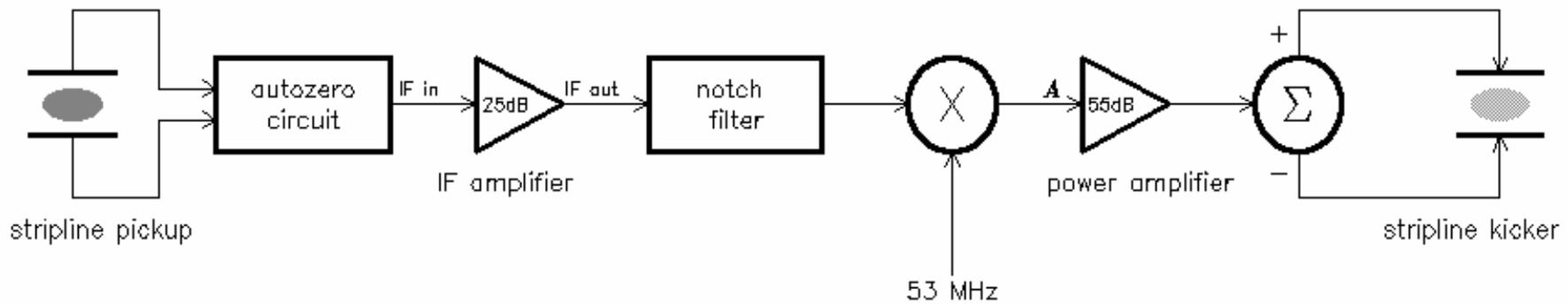
Autozero Circuit

Notch Filter

Demonstration of Effect of Notch Filter

Date: 09-21-00   Time: 06:18 AM

TRACE A: Ch2 Spectrum
A Marker   1 006 962.5 Hz   -120.17 dBm
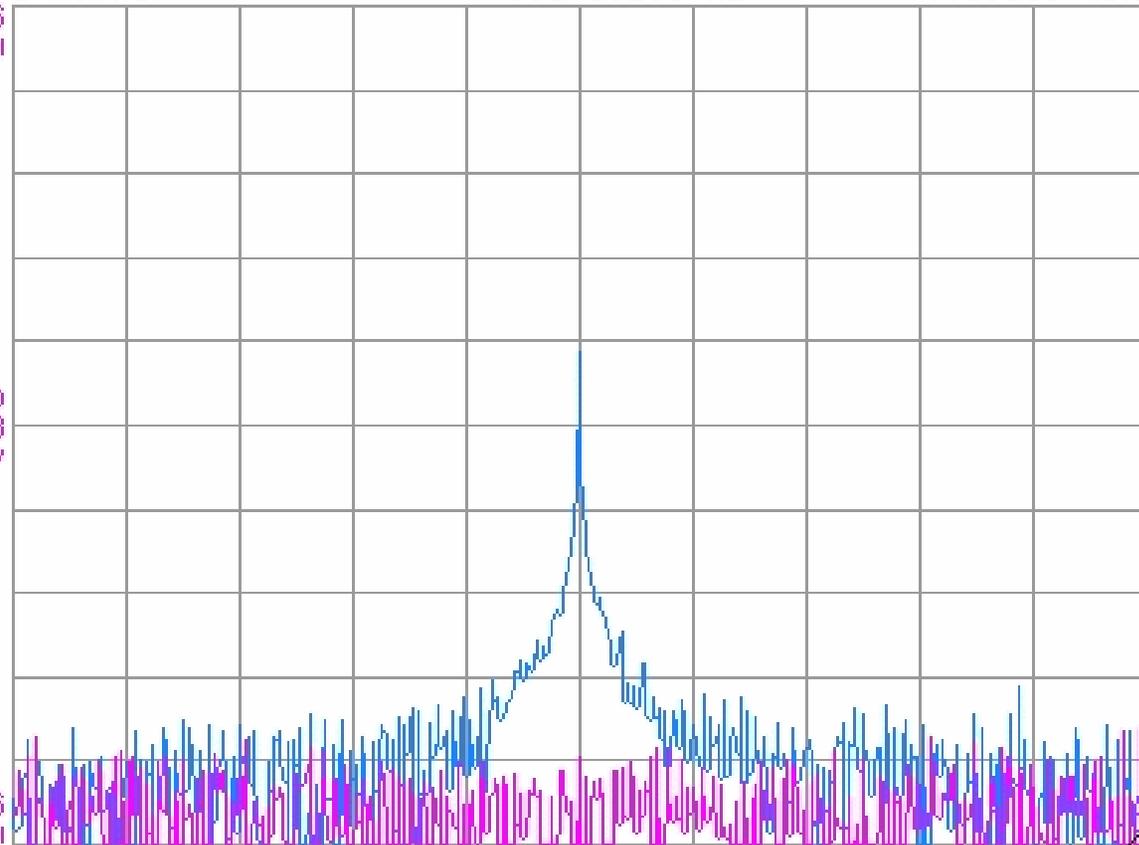C Marker   1 006 962.5 Hz   -113.368 dBm
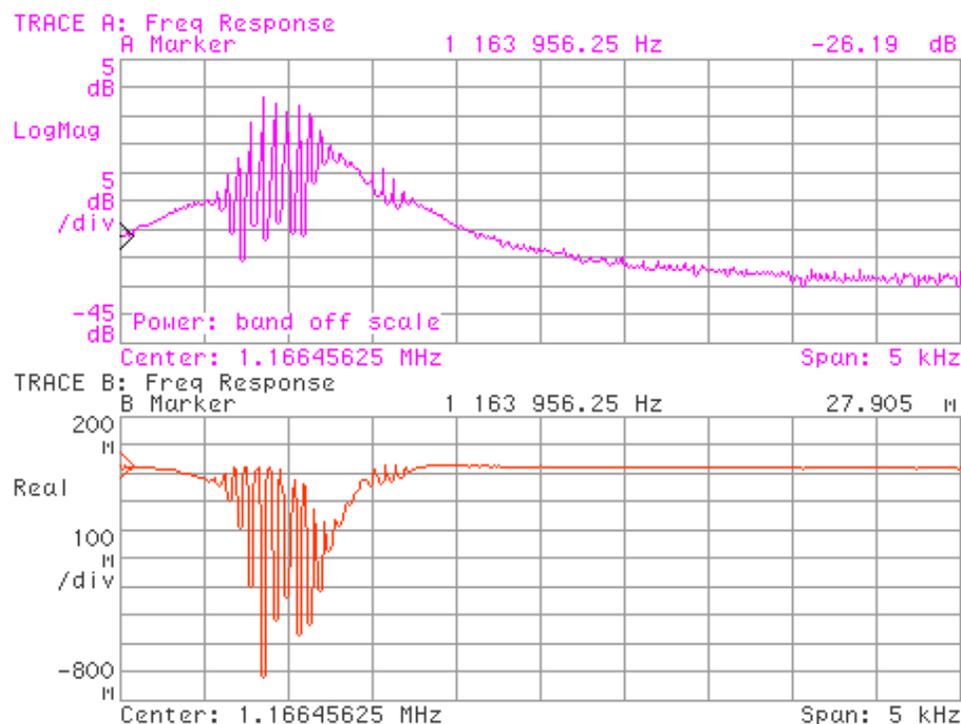
-16 dBm

LogMag

10 dB /div
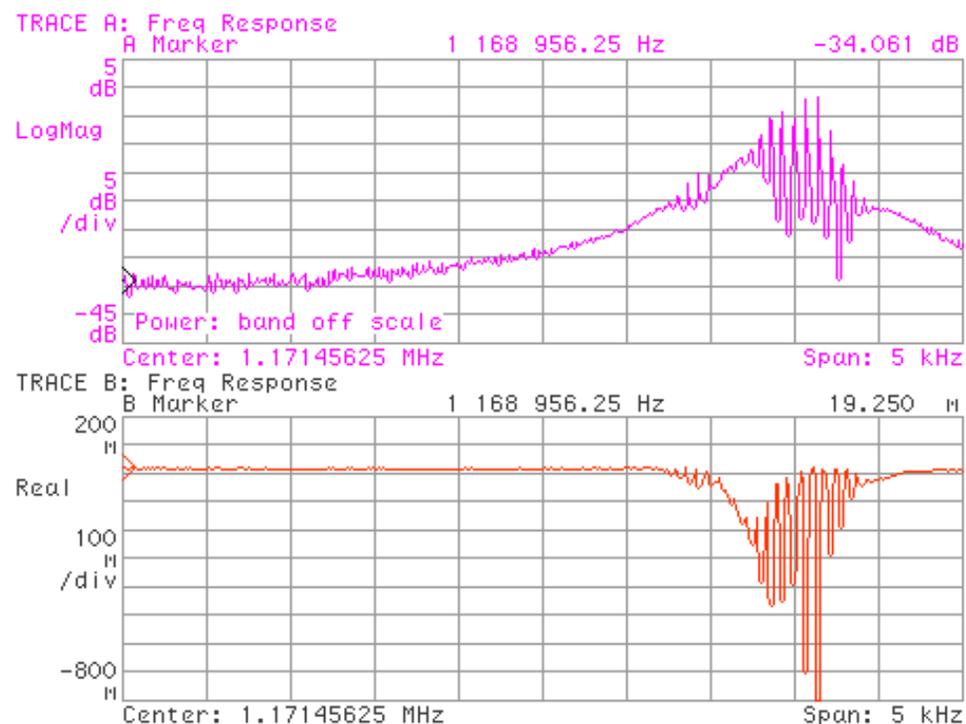
-116 dBm

Center: 1.0019625 MHz   Span: 10 kHz

Open Loop Response with delay and phase advance correct

Transverse Damping
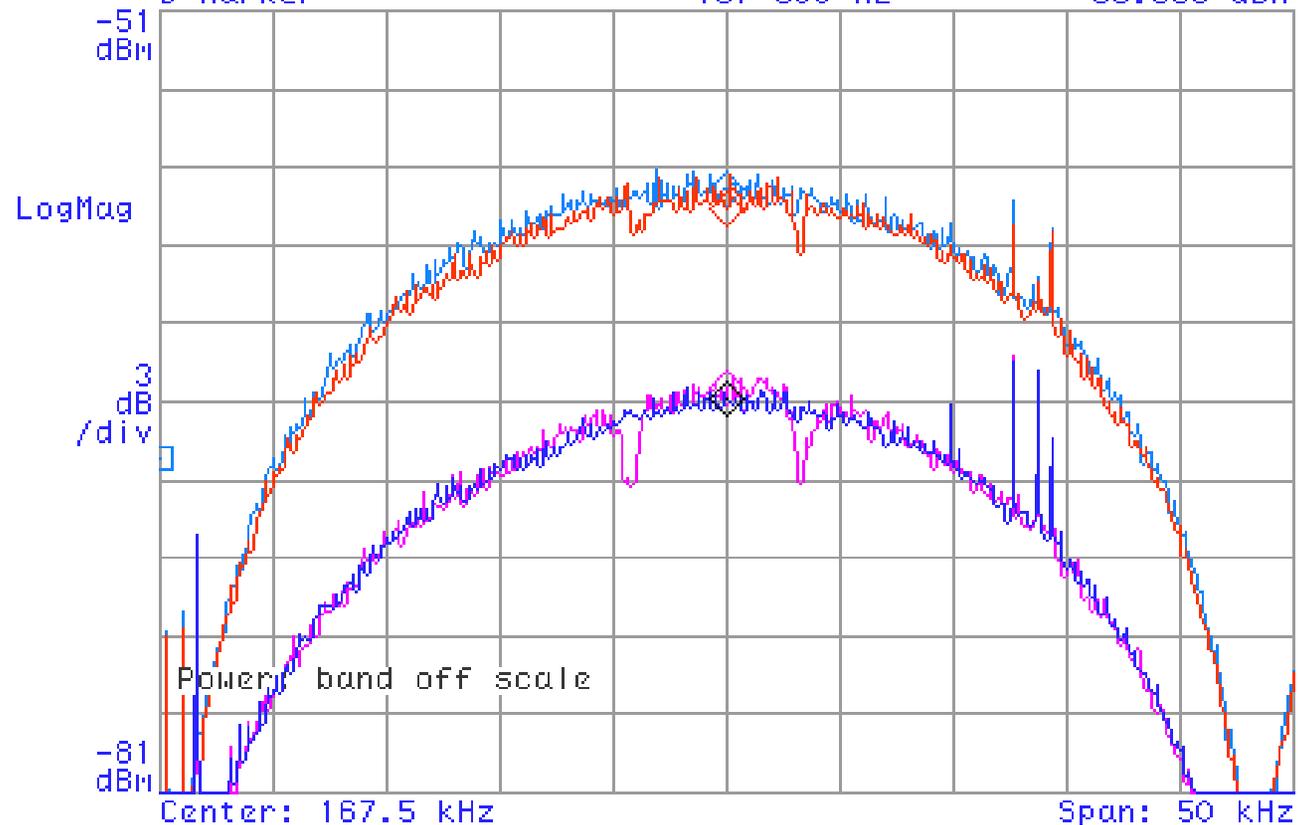
Improvements in Lifetime
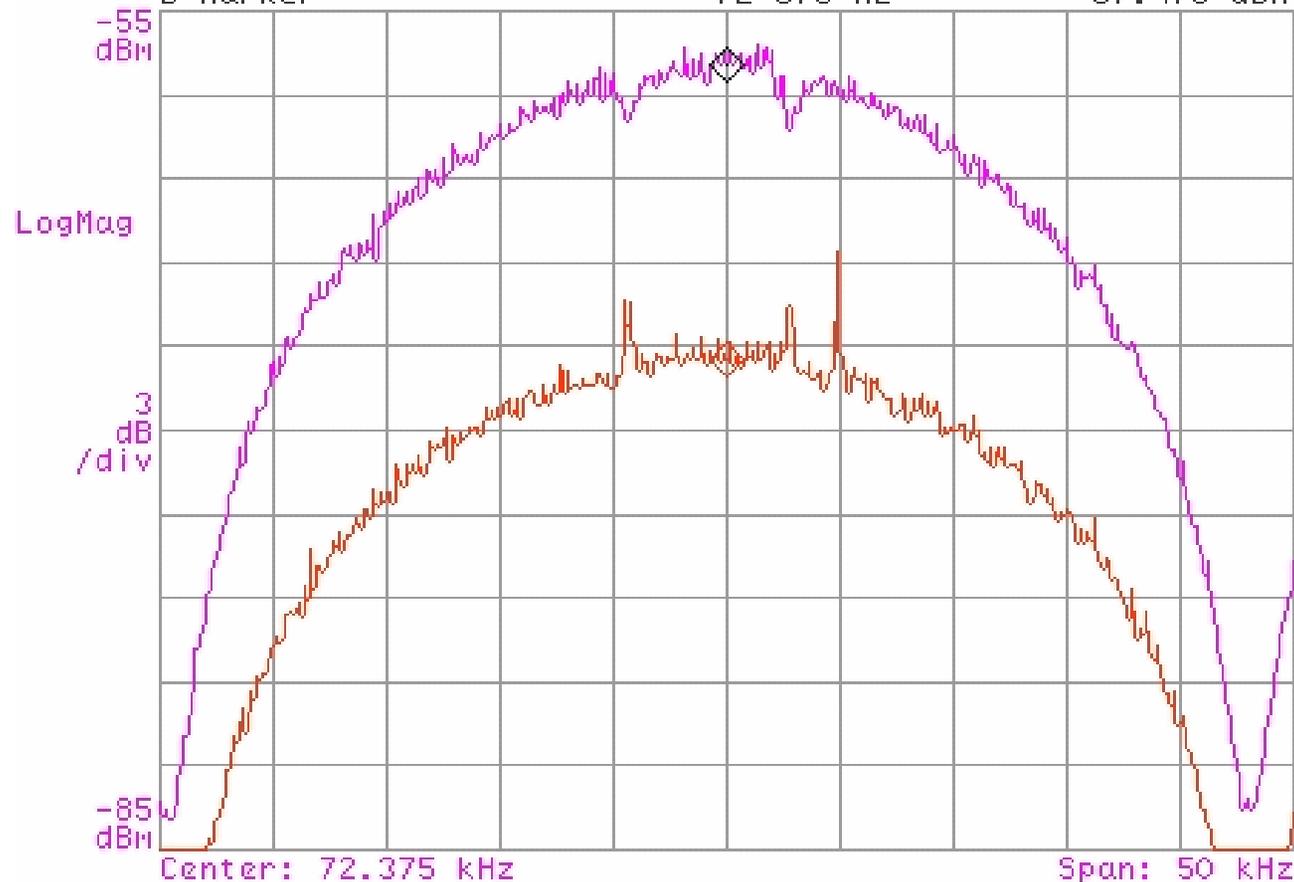
When dampers fail

Conclusion

- Transverse instability threshold for SINGLE bunch is improved after CO Lambertson removal, MULTIBUNCH after F0 Lambertson liner installed.

- Dampers:
  - ►Finicky - coupling is important.
  - ►When dampers are working, they work well.

- We are "on an edge of a knife. Stray but a little and it will fail to the ruin of all"