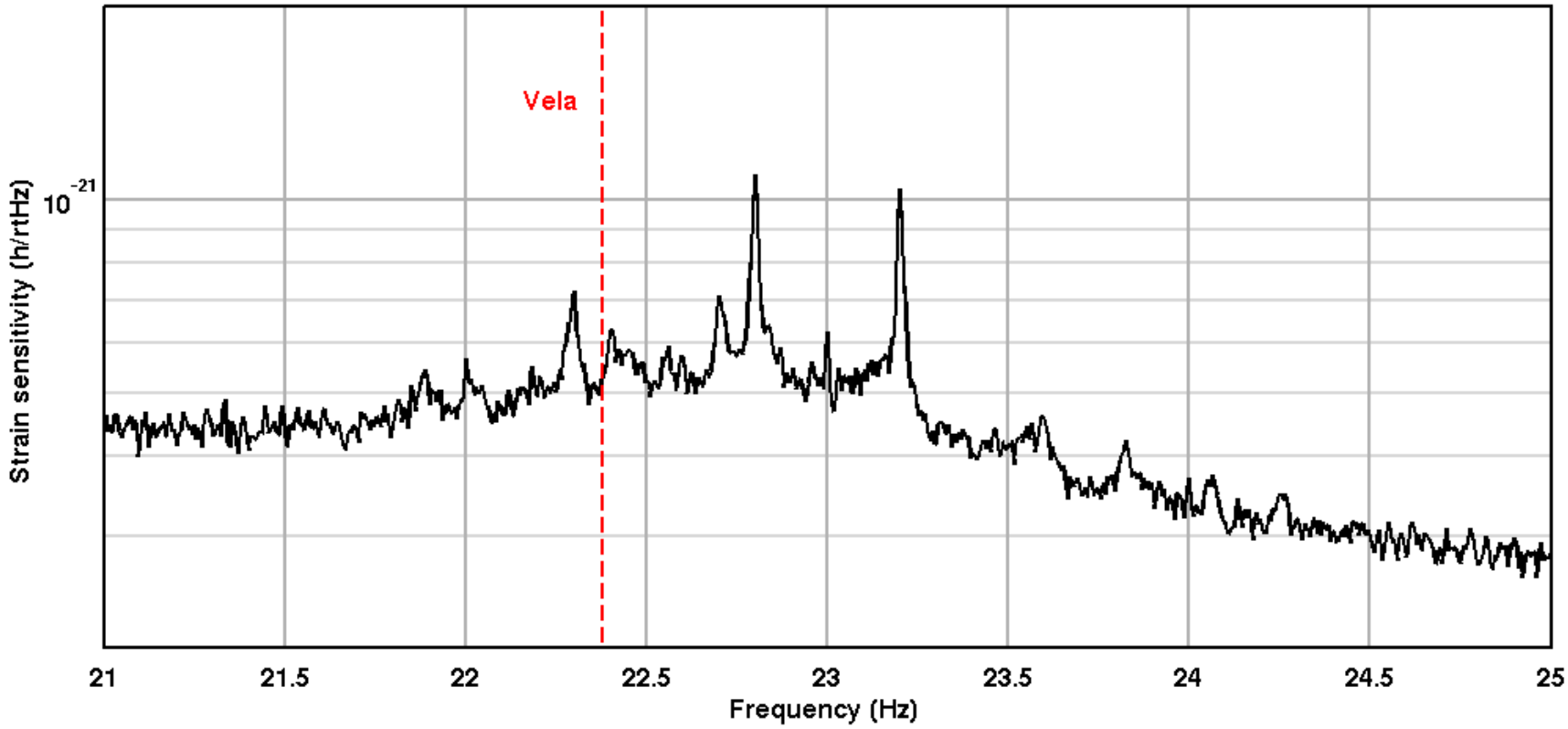
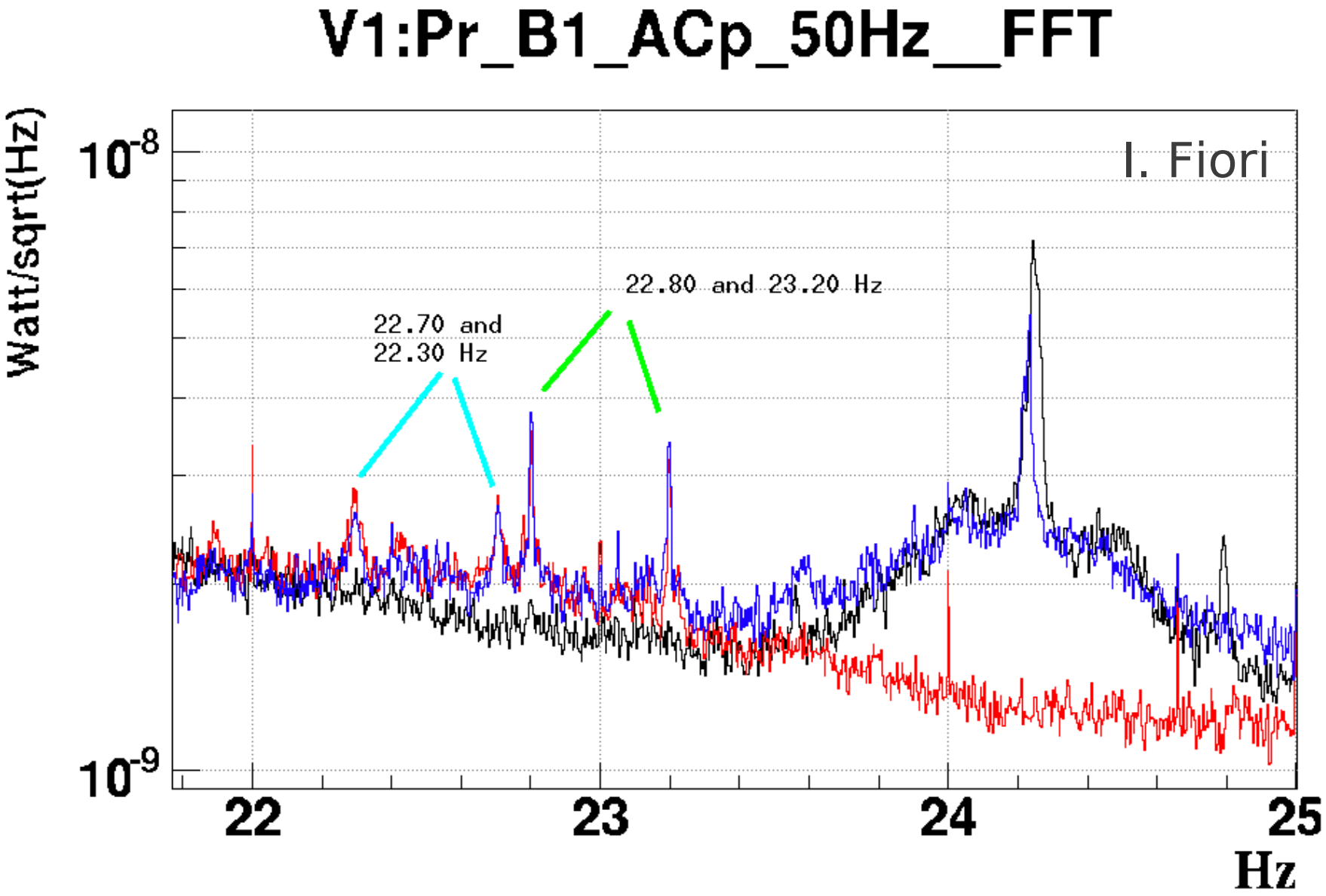
Up/down-conversion noise in the Vela region

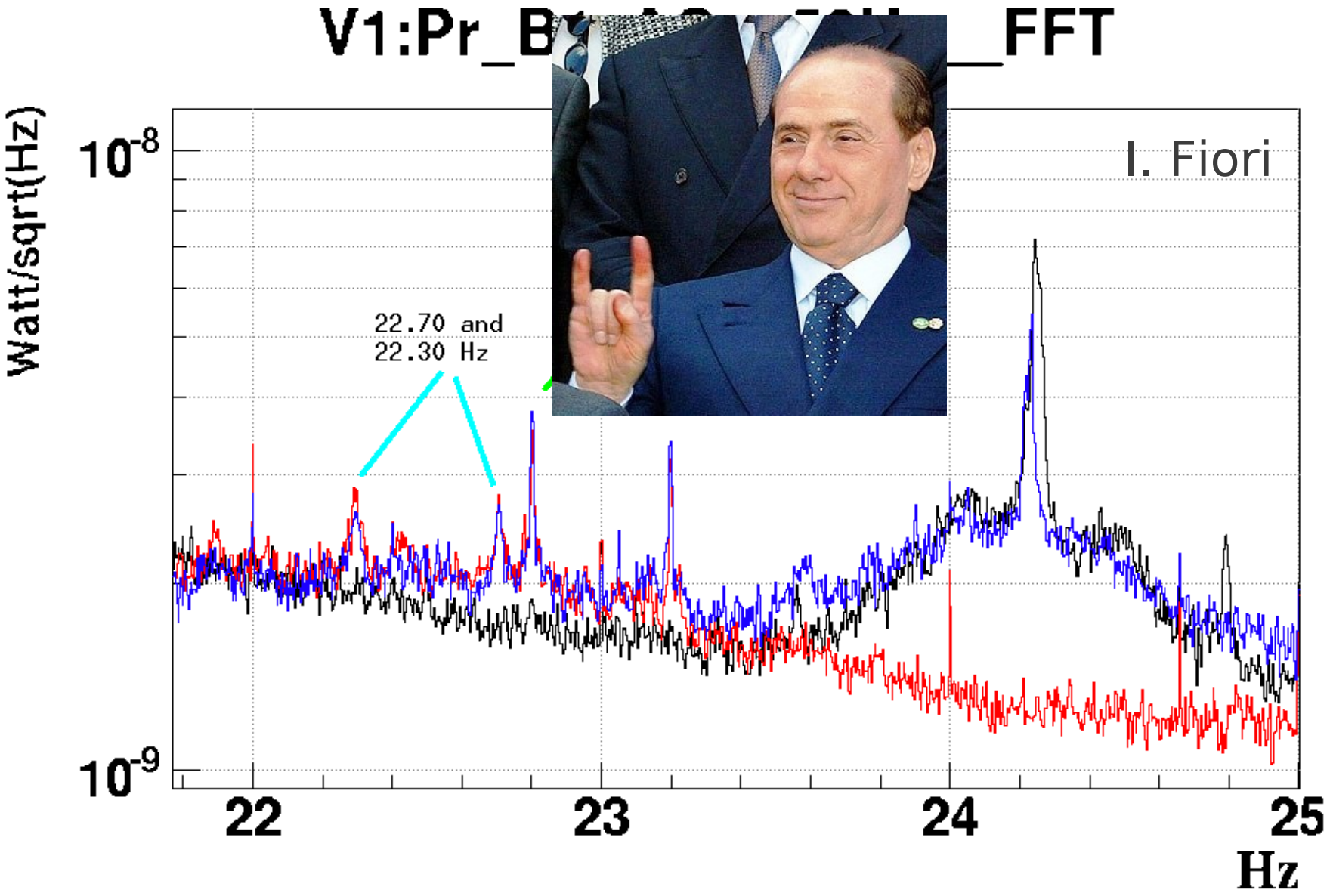


Bas Swinkels for the commissioning crew

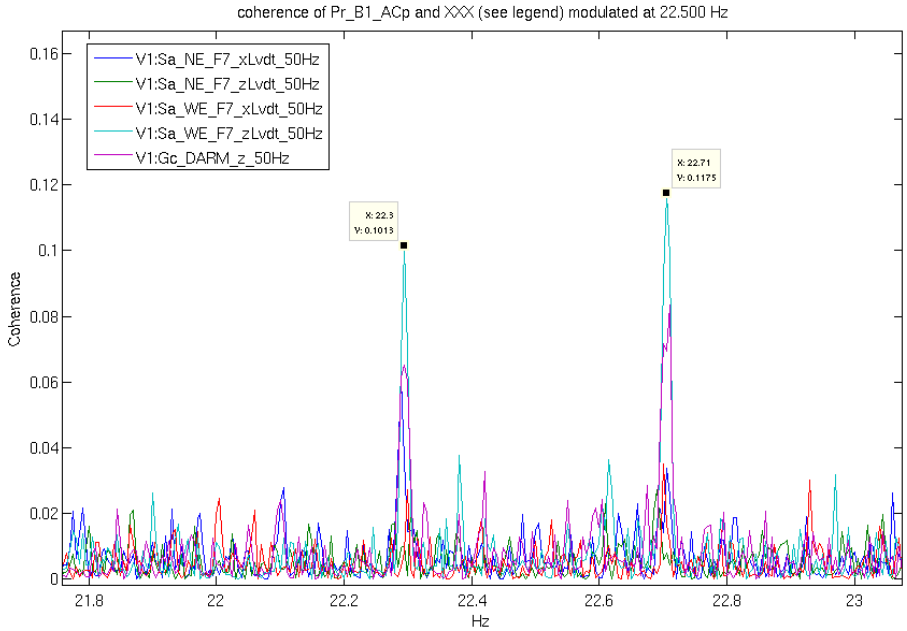
Horns around 22.5 and 23.0Hz

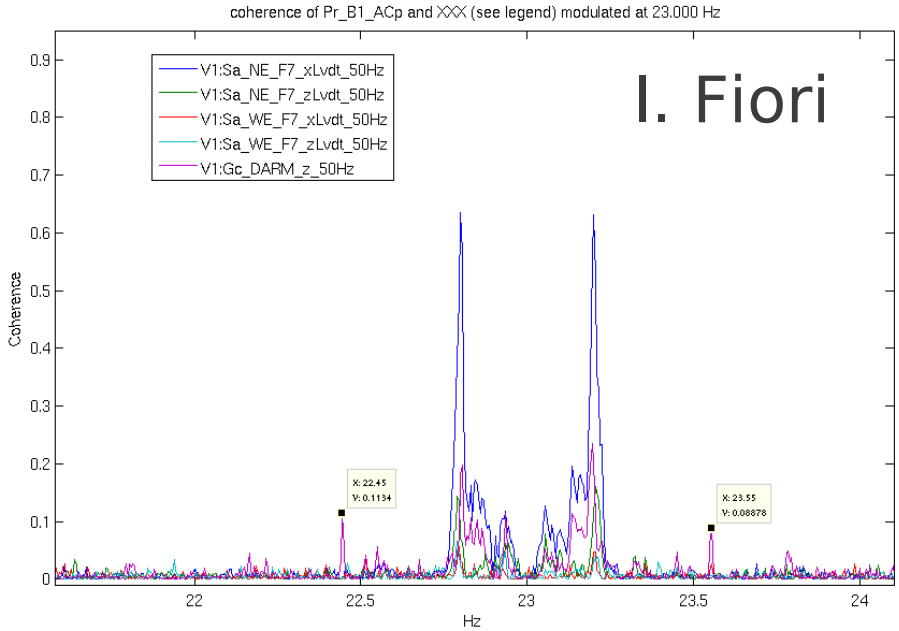


Horns around 22.5 and 23.0Hz



Up-conversion of LF noise



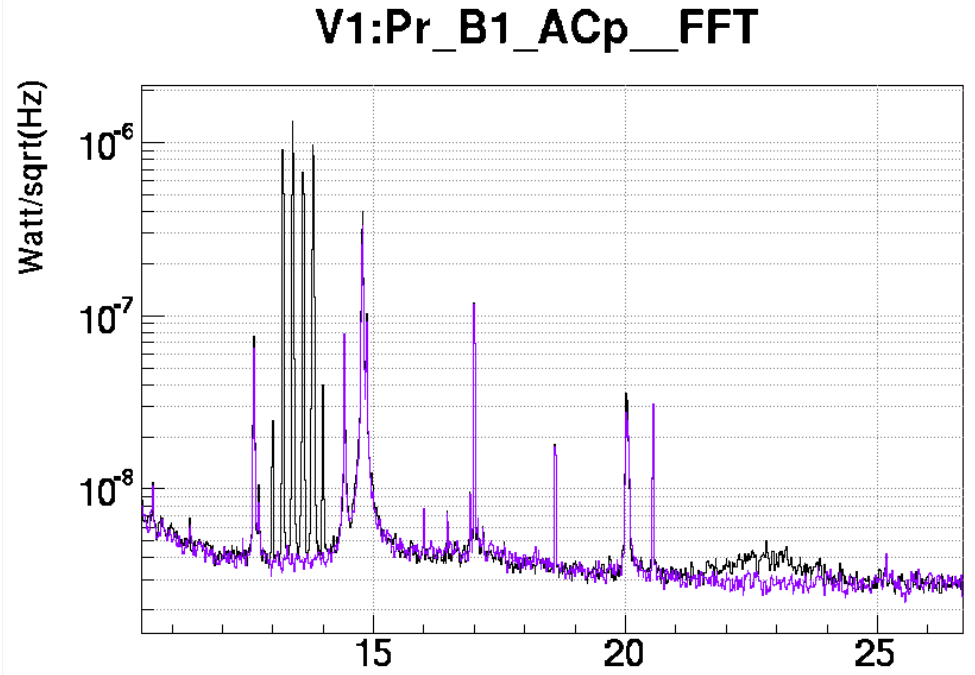


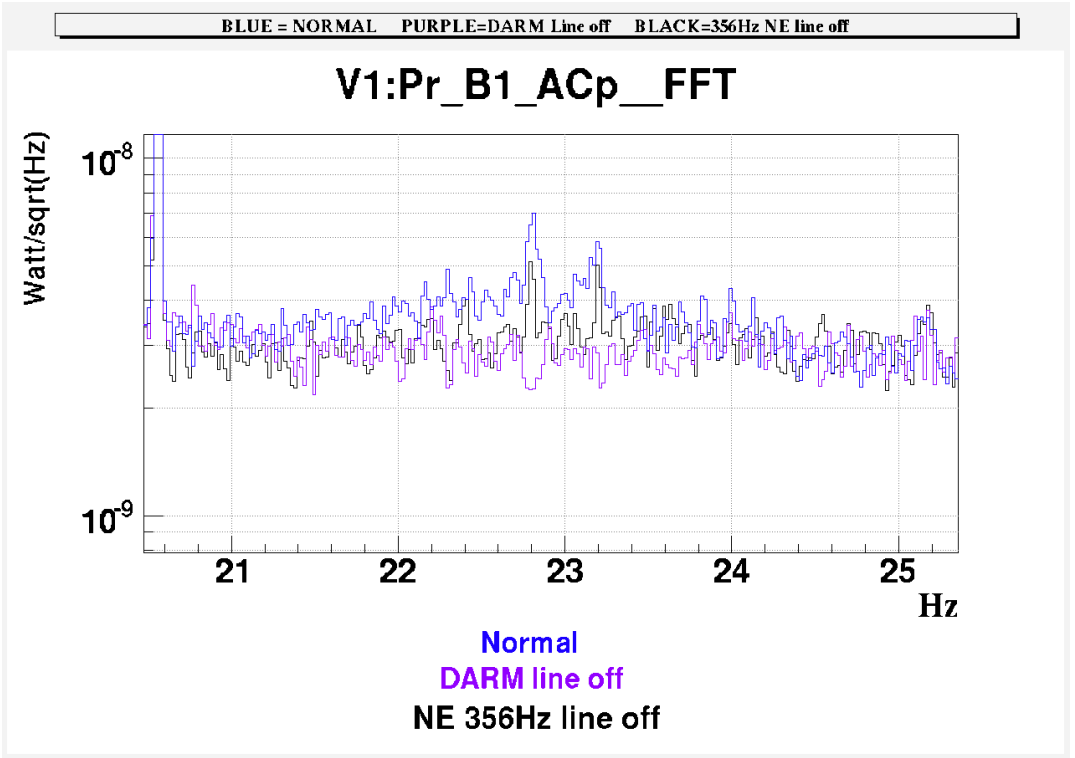
- Modulate LF suspension noise with pure sine
- Calculate coherence with dark-fringe
- Horns around 22.5 Hz: WE suspension
- Horns around 23.0 Hz: NE suspension

Sum/difference frequencies

```
21.4 Hz =  12.0 +   9.4 (Ca_BS_zMar + Sc_NE_tyPSDm)
21.5 Hz = 113.0 -  91.5 (Laser_freq – Ca_WE_zMirUD)
21.5 Hz = 379.0 - 357.5 (Gc_DARM – Ca_PR_zMir)
21.8 Hz =  12.0 +   9.8 (Ca_BS_zMar + Sc_WE_tyPSDm)
21.8 Hz =  13.0 +   8.8 (Ca_PR_zMir + Sc_NE_txPSDm)
22.0 Hz =  13.2 +   8.8 (Ca_WE_zMirUD + Sc_NE_txPSDm)
22.0 Hz = 113.0 -  91.0 (Laser_freq – Ca_NE_zMirUD)
22.0 Hz = 379.0 - 357.0 (Gc_DARM – Ca_BS_zMir)
22.1 Hz =  13.0 +   9.1 (Ca_PR_zMir + Sc_WE_txPSDm)
22.2 Hz =  13.4 +   8.8 (Ca_WE_zMar + Sc_NE_txPSDm)
22.3 Hz =  13.2 +   9.1 (Ca_WE_zMirUD + Sc_WE_txPSDm)
22.4 Hz =  13.0 +   9.4 (Ca_PR_zMir + Sc_NE_tyPSDm)
22.4 Hz =  13.6 +   8.8 (Ca_NE_zMar + Sc_NE_txPSDm)
22.5 Hz =  13.4 +   9.1 (Ca_WE_zMar + Sc_WE_txPSDm)
22.5 Hz = 379.0 - 356.5 (Gc_DARM – Ca_WE_zMirUD)          same actuator
22.6 Hz =  13.2 +   9.4 (Ca_WE_zMirUD + Sc_NE_tyPSDm)
22.6 Hz =  13.8 +   8.8 (Ca_NE_zMirUD + Sc_NE_txPSDm)
22.7 Hz =  13.6 +   9.1 (Ca_NE_zMar + Sc_WE_txPSDm)
22.8 Hz =  13.0 +   9.8 (Ca_PR_zMir + Sc_WE_tyPSDm)
22.8 Hz =  13.4 +   9.4 (Ca_WE_zMar + Sc_NE_tyPSDm)
22.8 Hz =  14.0 +   8.8 (Ca_BS_zMir + Sc_NE_txPSDm)
22.9 Hz =  13.8 +   9.1 (Ca_NE_zMirUD + Sc_WE_txPSDm)
23.0 Hz =  13.2 +   9.8 (Ca_WE_zMirUD + Sc_WE_tyPSDm)
23.0 Hz =  13.6 +   9.4 (Ca_NE_zMar + Sc_NE_tyPSDm)      same actuator
23.0 Hz = 379.0 - 356.0 (Gc_DARM – Ca_NE_zMirUD)          same actuator
23.1 Hz =  14.0 +   9.1 (Ca_BS_zMir + Sc_WE_txPSDm)
23.2 Hz =  13.4 +   9.8 (Ca_WE_zMar + Sc_WE_tyPSDm)      same actuator
23.2 Hz =  13.8 +   9.4 (Ca_NE_zMirUD + Sc_NE_tyPSDm)
23.4 Hz =  13.6 +   9.8 (Ca_NE_zMar + Sc_WE_tyPSDm)
23.4 Hz =  14.0 +   9.4 (Ca_BS_zMir + Sc_NE_tyPSDm)
```

Switch-off tests





- Bump disappears when switching off all calibration lines
- Switching off angular lines: no clear reduction
- Switching off DARM line: bump disappears partially

Concluding

- Annoying bump in Vela region (22.38 Hz)
- Horns at 0.2 Hz around 22.5 and 23.0 Hz
- Up-conversion of LF noise of NE/WE suspensions
- Non-linear process causes sum/diff frequencies
  - 13.x Hz calibration + 9.x Hz angular
  - **379.0 Hz DARM – 356.x Hz calibration**
- Possible causes of non-linear effect
  - **Actuators**: see e.g. VIR-NOT-LAP-1390-203, R. Flaminio, 2002
  - Detection: harmonics seen when 8Hz excited
  - ITF: scattered light, ...

To do

- Prevent dangerous combinations of lines
  - At least avoid dangerous pairs on the same actuator
  - 13.x Hz calibration lines might be moved to 15.x Hz
  - Move either 356.x Hz calibration or 379 Hz DARM-line
  - Reduce amplitudes if possible
- Understand source of non-linear effect

End