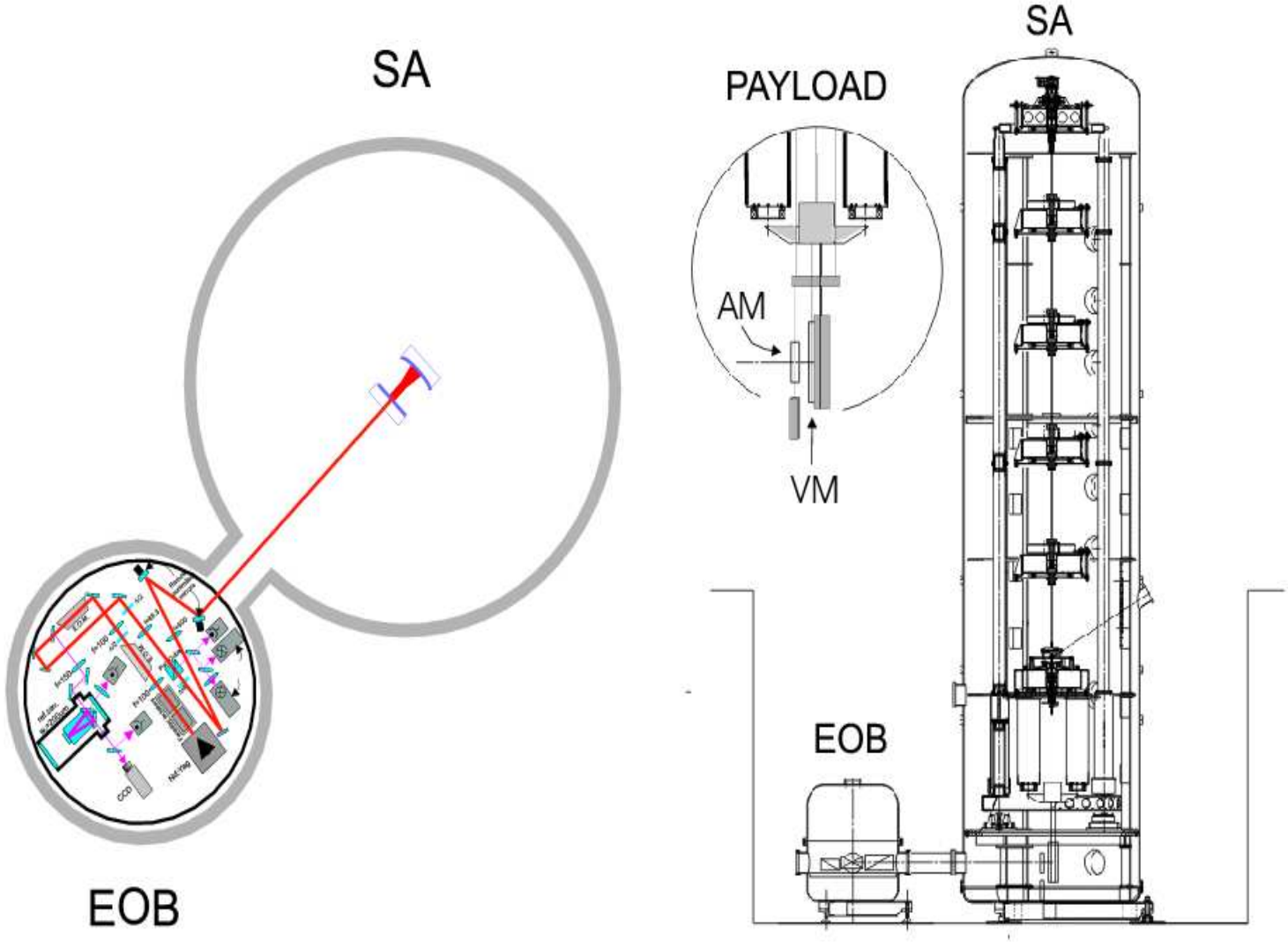
Low Frequency Facility

LFF is a Virgo INFN Commission II R&D experiment, to study, above and around 10 Hz, the noise of a 1cm Fabry

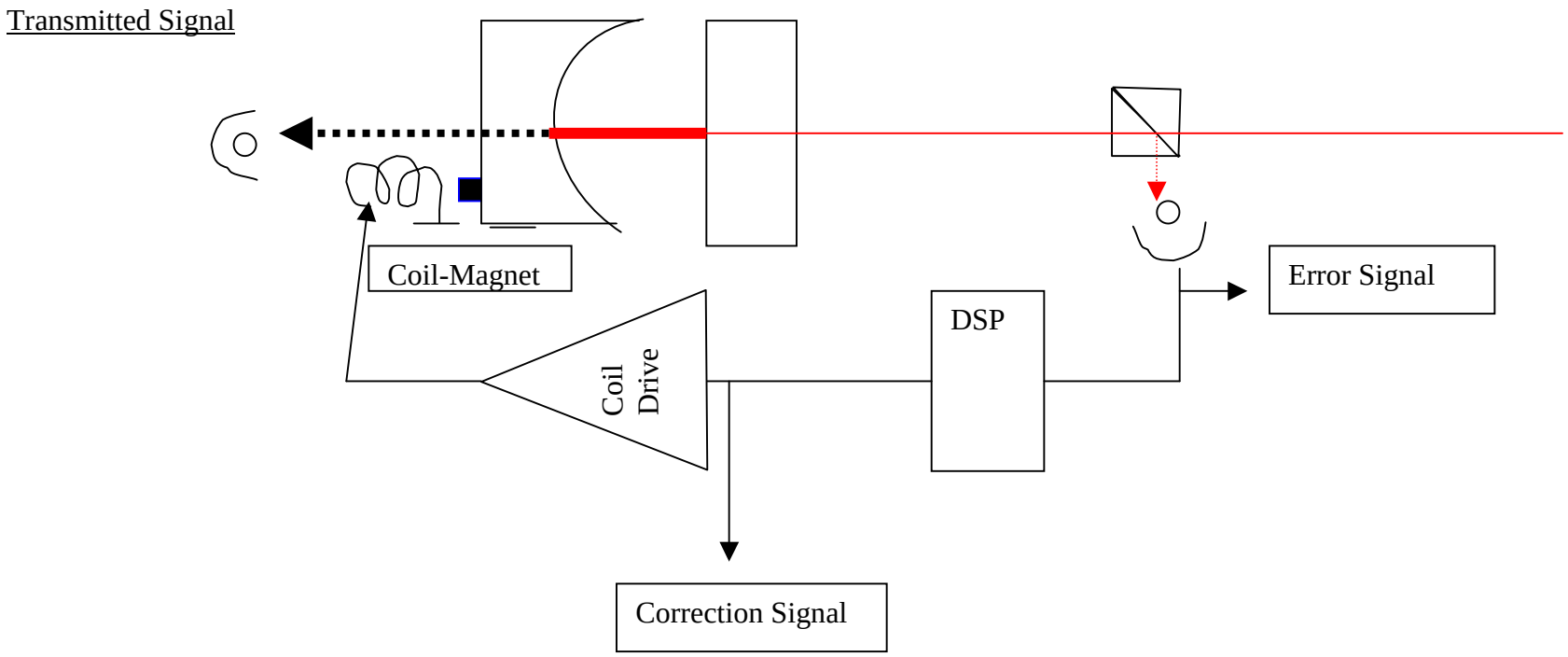
Perot cavity, suspended to a Virgo like suspension.

Firenze-Urbino, Napoli (Solimeno), Pisa and Roma1


SA
EOB
SA
PAYLOAD
AM
VM
EOB

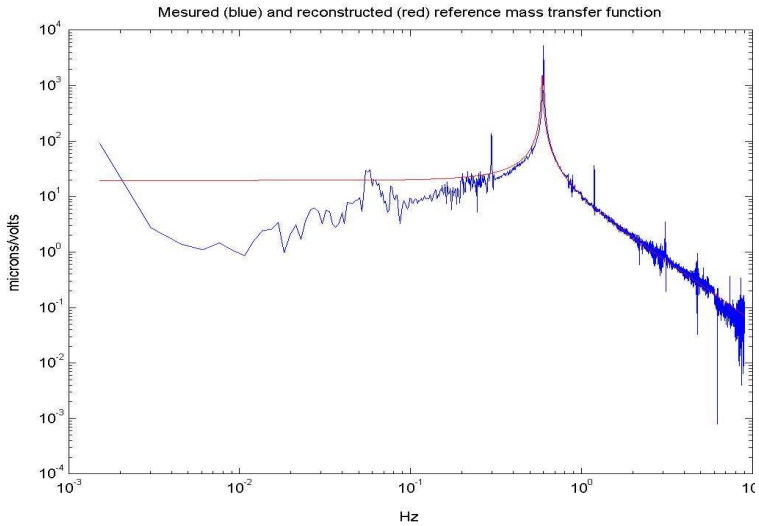
Feed-Backs

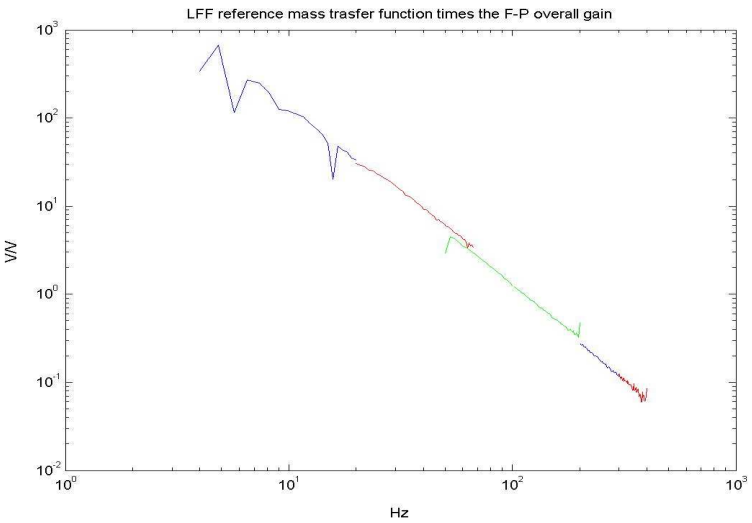
- Inertial Damping on
- Laser Frequency Stabilized
- Cavity longitudinally Locked using the Reference Mass
- Unity Gain Point around 100 Hz
- Feed Back stable for hours



3 acceleroteres measure seismic noise

Low Frequency Calibration

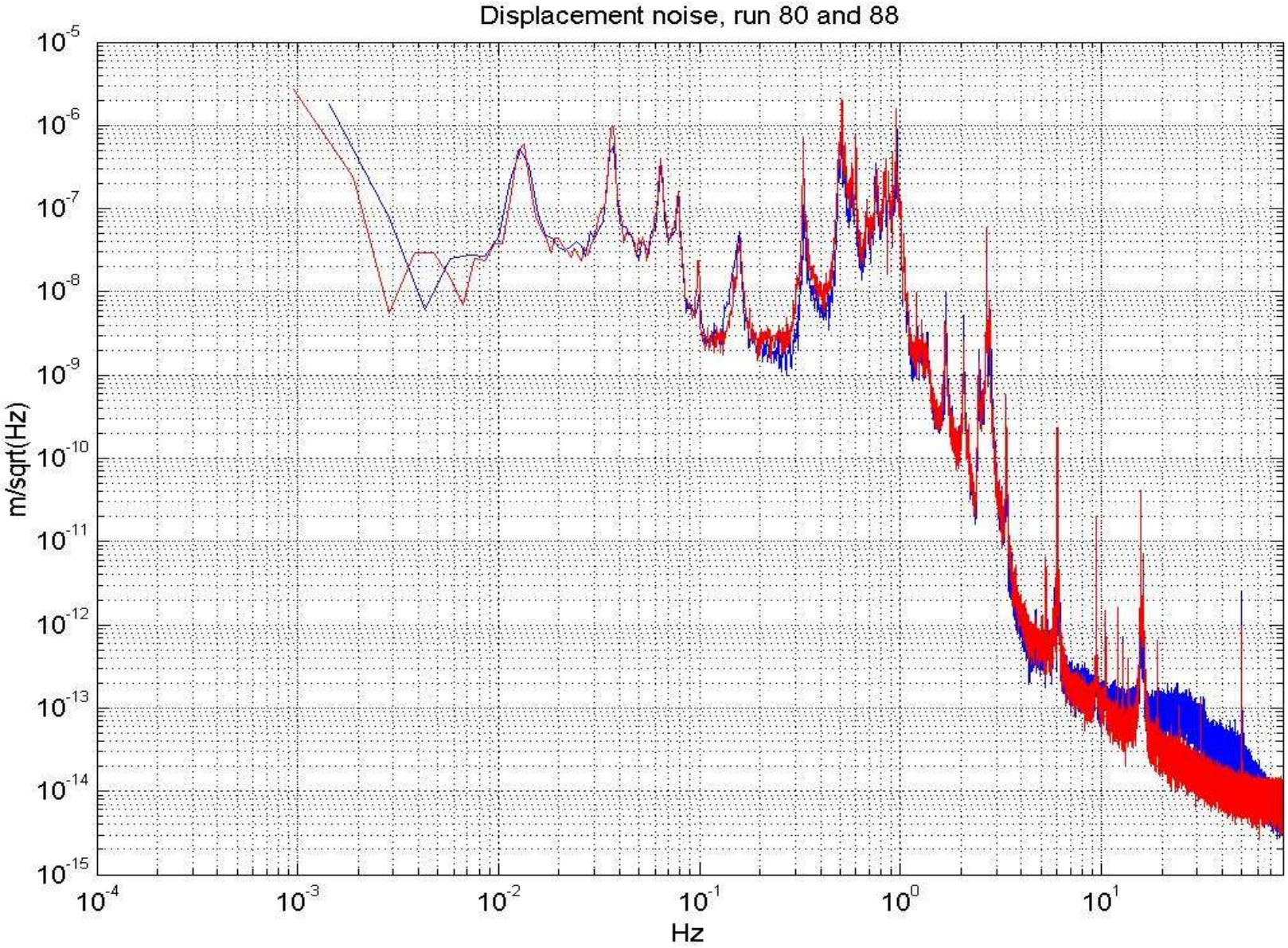


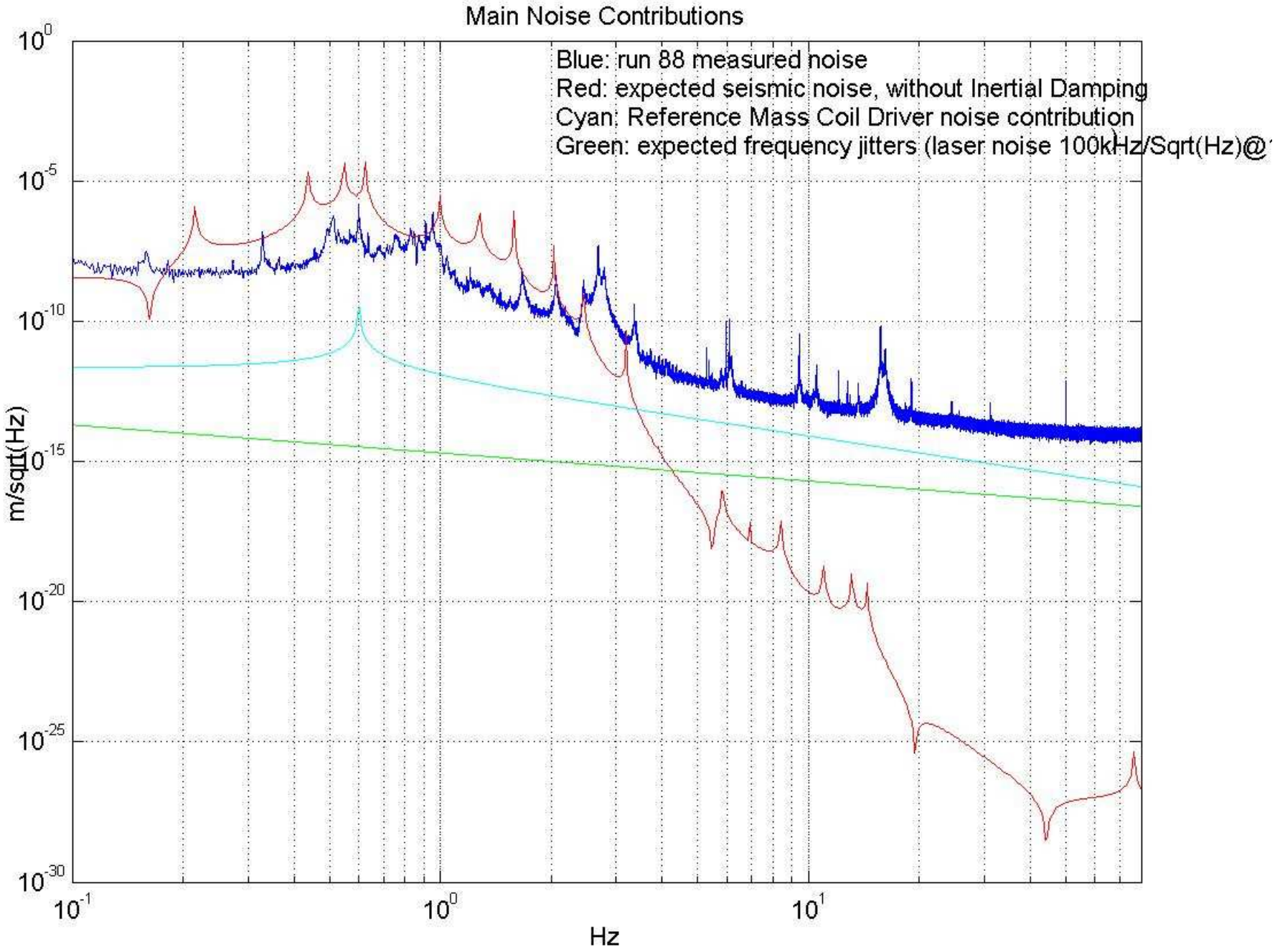


- Up to 9 Hz, Virgo Mirror transfer function measured using the array of LVDT
- From 5 to 400 Hz, the cavity mechanical transfer function has been directely measured (closed loop measurement).
- The cavity transfer function has been measured at very low frequency measuring the transmitted free spectral ranges (25, 30, 35 mHz, open loop)

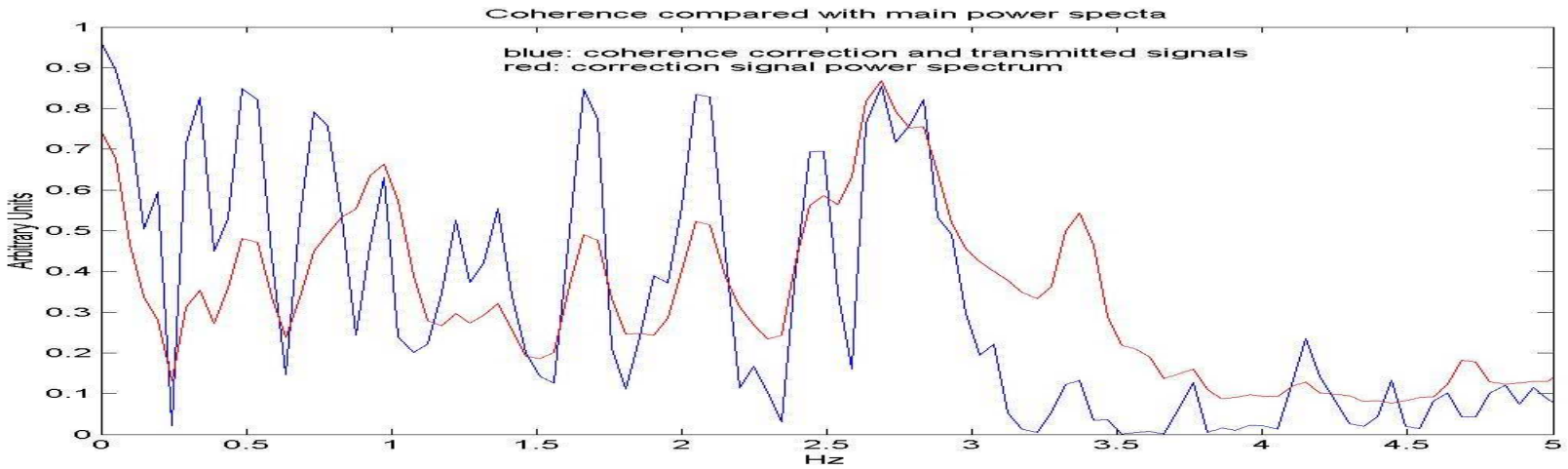
Cavity Transfer Function = Virgo Mirror Transfer Function

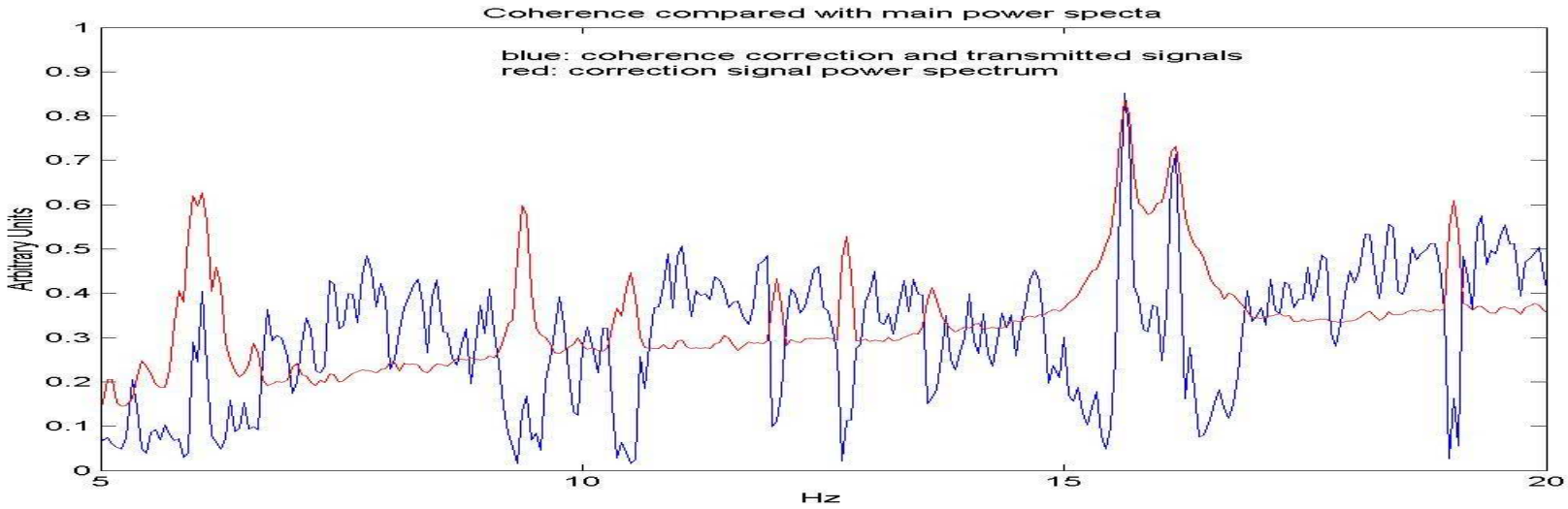
Low Frequency Displacement Noise



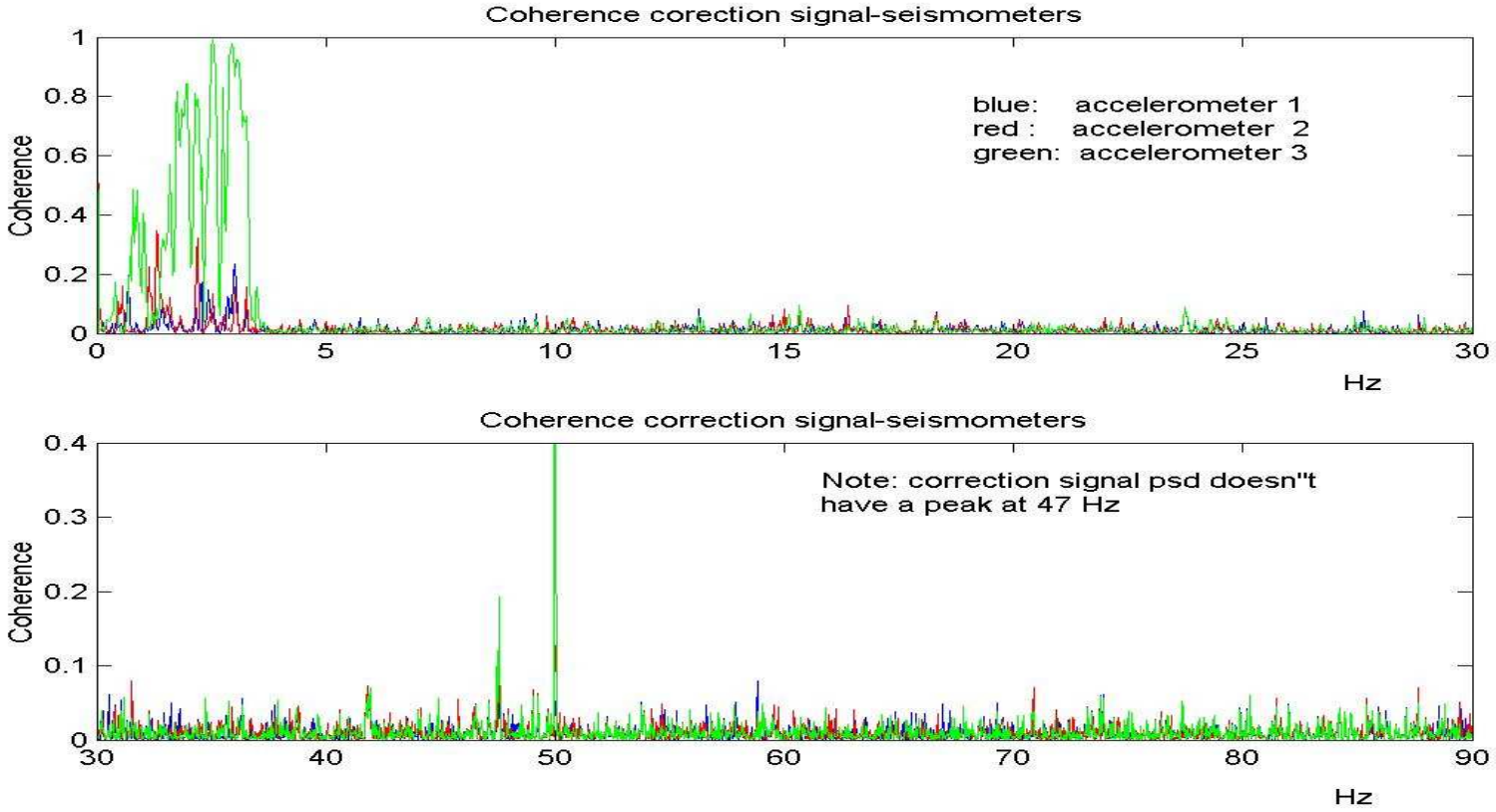

Main Noise Contributions
Blue: run 88 measured noise
Red: expected seismic noise, without Inertial Damping
Cyan: Reference Mass Coil Driver noise contribution
Green: expected frequency jitters (laser noise 100kHz/Sqrt(Hz)@
m/sqrt(Hz)
Hz
10^0
10^-5
10^-10
10^-15
10^-20
10^-25
10^-30
10^-1
10^0
10^1

Coherence with Transmitted Power

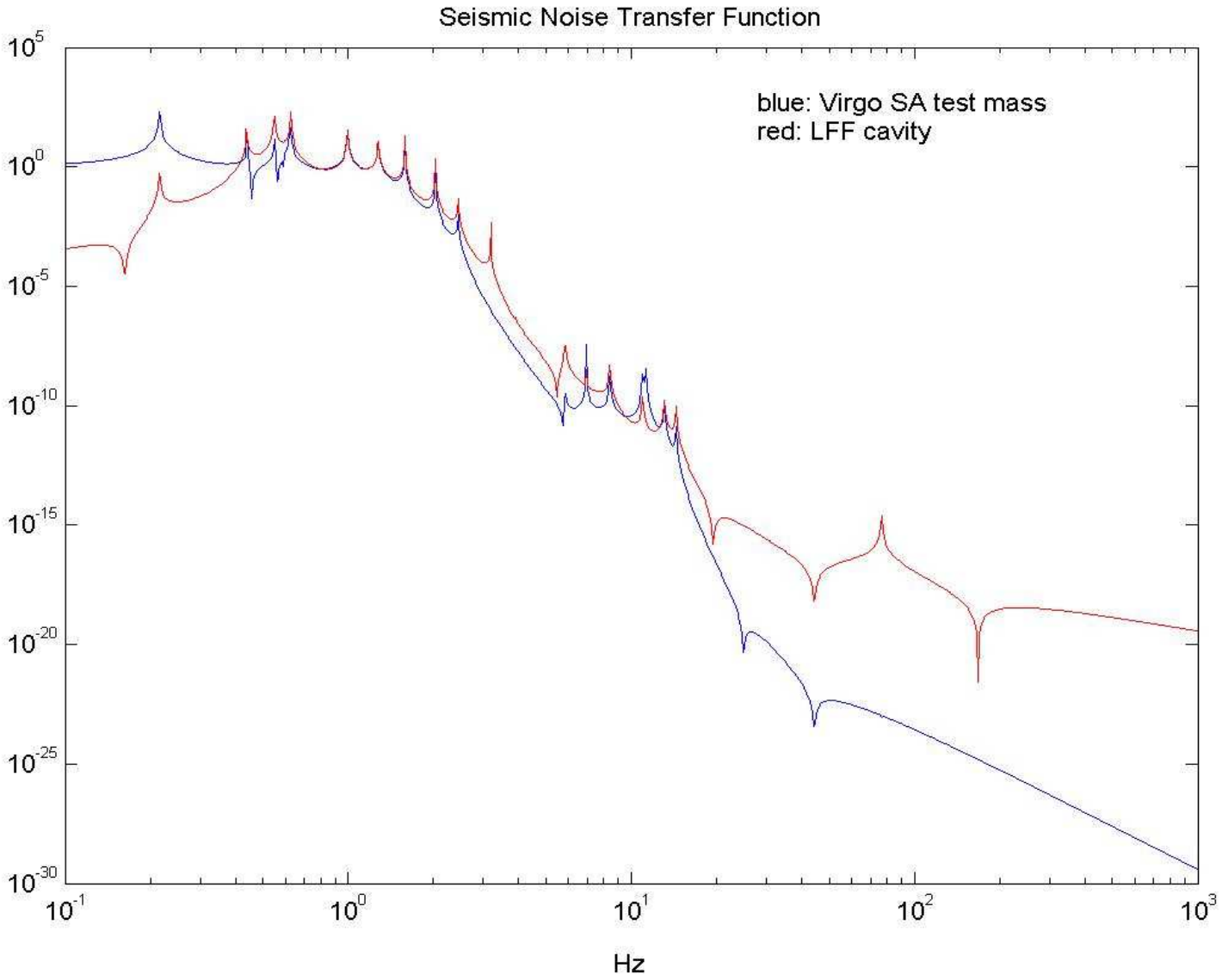




Coherence with the Seismic Noise

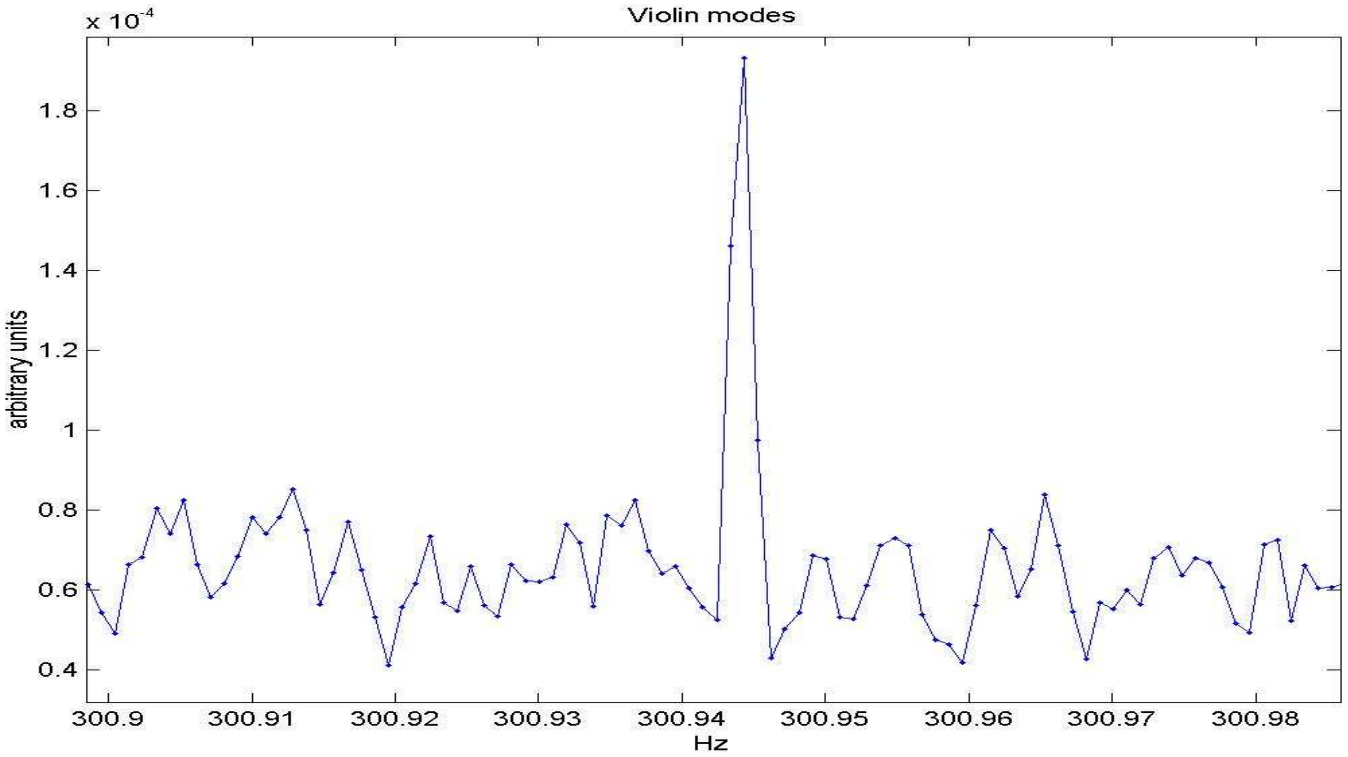


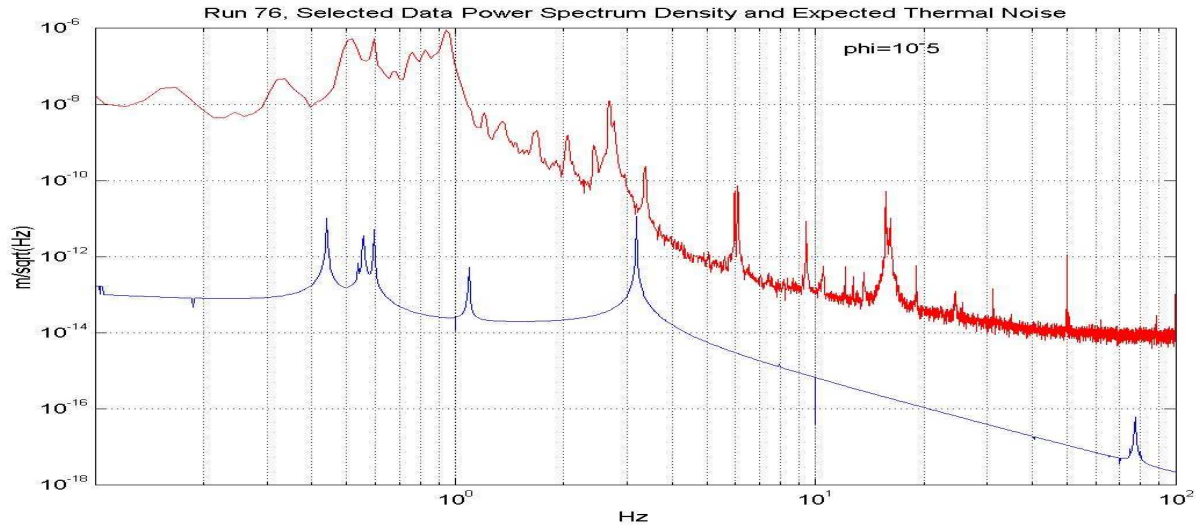
Virgo Mirror and LFF Cavity Seismic Noise Transfer Functions (preliminary)

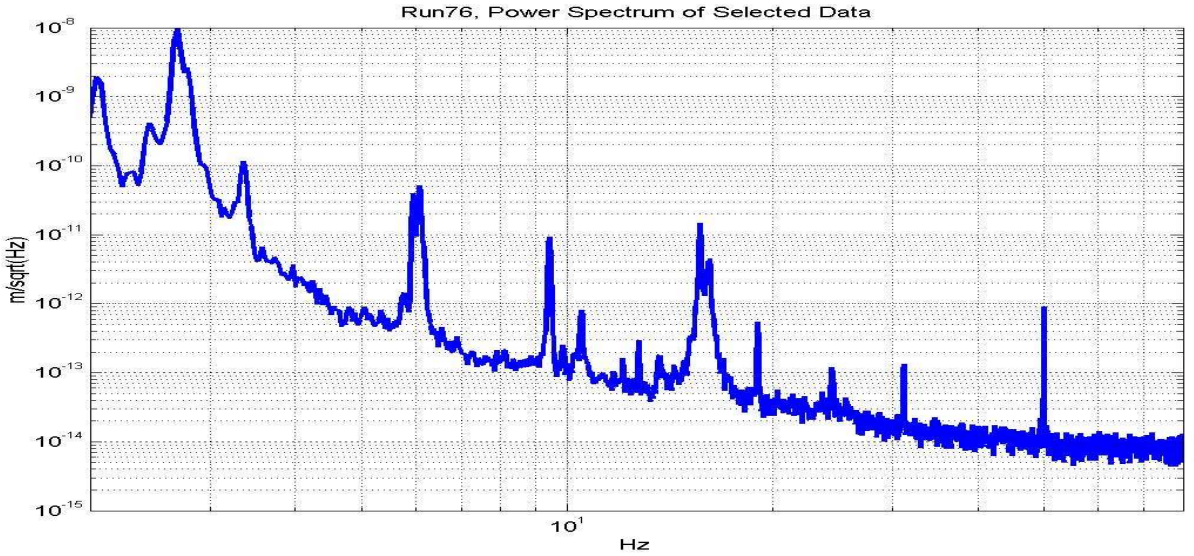


Thermal Noise ?

- Several peaks are evident, work is in progress....




Run 76, Selected Data Power Spectrum Density and Expected Thermal Noise
phi=10^-5
m/sqrt(Hz)
Hz


Run76, Power Spectrum of Selected Data
m/sqrt(Hz)
Hz

Main Problems

- Finesse is lower than expected (alignment?), Inertial Damping Performance is not as good as 1 year ago, more than 1 FSR is transmitted (A. Di. Virgilio et al, “The LFF cavity used as a speed meter” , Phys. Lett. A, 2003)

- Large common mode rotation of the cavity below 1 Hz

- Cavity is a bit shorter (9 mm) and Sidebands (13MHz) are too close to the resonance

- Large DC in the error signal

Future up to 2004

- Improve The Inertial Damping (new Inertial Damping)
- Improve angular alignment as much as possible
- Increase Frequency Modulation
- Decrease Coil Driver Noise
- Autoalignment?

- Late 2003, upgrading and restoring of the LFF