

Preliminary Analysis of the Gyrolaser G-Pisa

G-Pisa, a middle size ringlaser, inertial sensor based on the Sagnac effect, financed by INGN CV 3 years ago, has been recently installed in Cascina (Central Building)

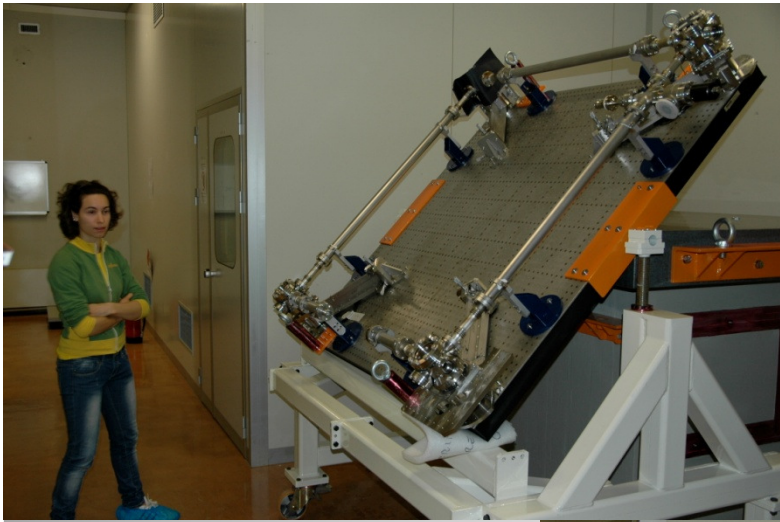
AIM: to measure tilts and rotations in the Central Building, and to give more precise informations on the tilts, and possibly to help the IP control

It has been possible to install G-Pisa in a very short time thanks to the support given by

- EGO-VIRGO side: M. Bazzi, A. Bozzi, F. Carbognani, R. Cosci, M. D' Andrea, V. Dattilo, Di Biase, G. Losurdo, H. Heitmann, R. Macchia, A. Masserot, F. Paoletti, P. Popolizio, A. Pasqualetti.....
- Pisa side: G. Balestri, J. Belfi, N. Beverini, F. Bosi, G. Carelli, D. Kolker, E. Maccioni, A. Soldani, R. Passaquieti, F. Stefaniand myself

publications

- A. Di Virgilio, M. Allegrini, J. Belfi, N. Beverini, F. Bosi, G. Carelli, E. Maccioni, M. Pizzocaro, A. Porzio, U. Schreiber, S. Solimeno e F. Sorrentino, "Performances of G-Pisa: a middle size gyrolaser", **Class. Quantum Grav.** **27, 084033 (9pp) (2010)**.
- J. Belfi N. Beverini, F. Bosi, G. Carelli, A. Di Virgilio, E. Maccioni, M. Pizzocaro, F. Sorrentino, F. Stefani, "Active control and sensitivity of the "G-Pisa" gyrolaser" **Nuovo Cimento B**, DOI **10.1393/ncb/i2010-10859-5 (2010)**. **SIF prize II best presentation to the SIF Bari Conference**
- J. Belfi, N. Beverini, F. Bosi, G. Carelli, A. Di Virgilio, E. Maccioni, M. Pizzocaro, "Rotational sensitivity of "G-Pisa" gyrolaser" , **IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control**, **57, (3), Pages: 618 622, (2010)**.
- Belfi Jacopo, Beverini Nicolo', Bosi Filippo, Carelli Giorgio, Di virgilio Angela, Graham Richard, Maccioni Enrico, Pizzocaro Marco, Porzio Alberto, Schreiber Ullrich, Solimeno Salvatore, Velikoseltsev Alexej, G-Pisa gyrolaser, Frequency Control Symposium, **2009 Joint with the 22nd European Frequency and Time forum. IEEE Intern**, pp **738-741, Besaçon**



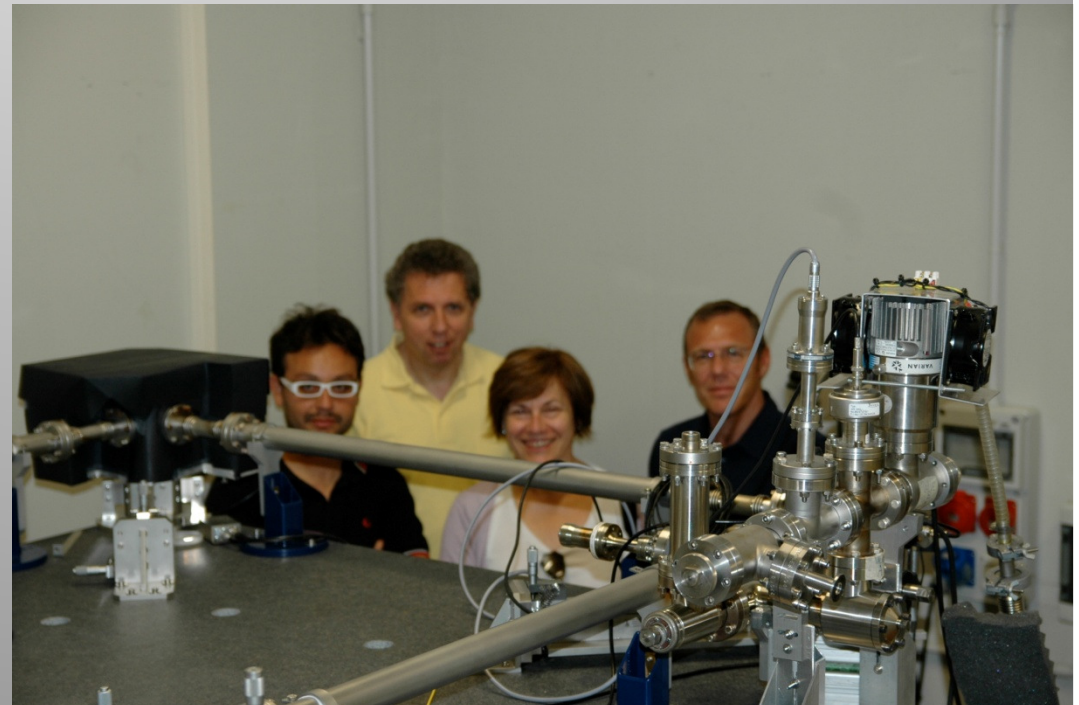


Thanks to Filippo Bosi engineering work finally G-Pisa has a 'respectable' support

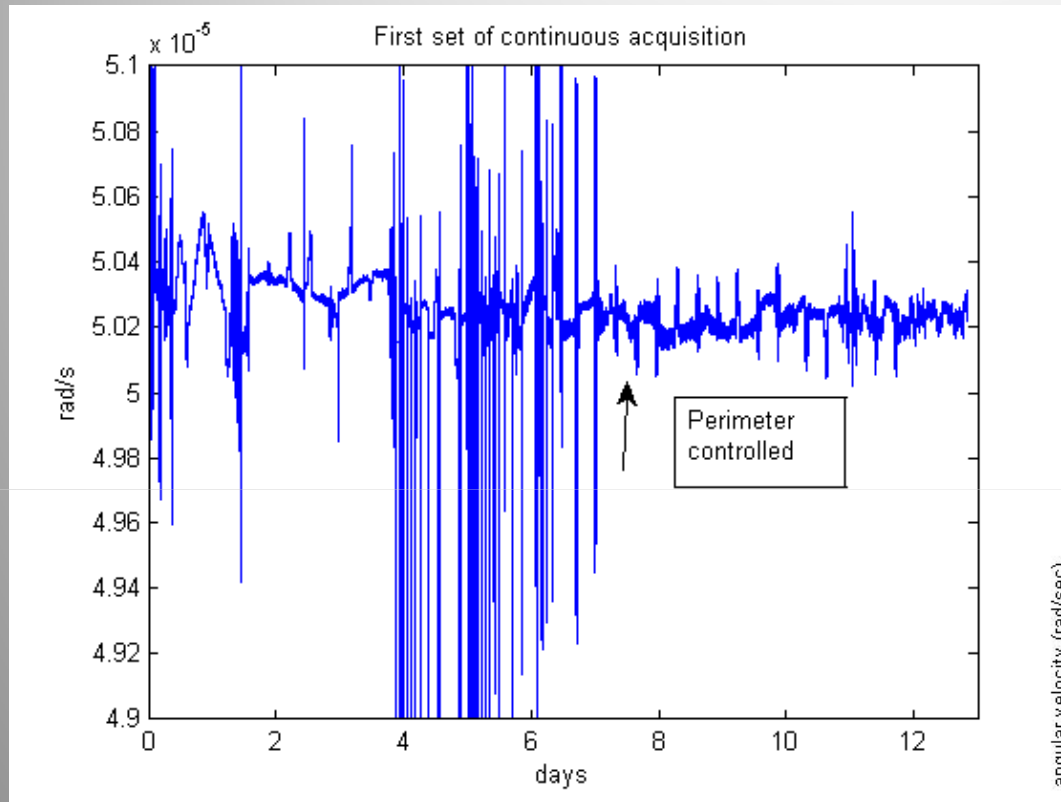
Two positions available:

Horizontal derivative of T_y and T_x

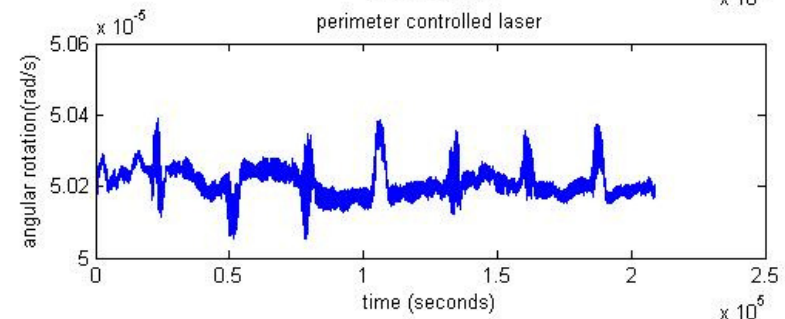
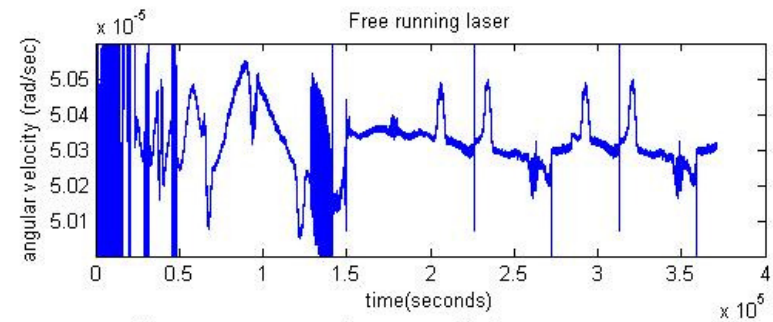
Vertical derivative of T_z and T_x



First 13 days of data



Since the 25 of June the perimeter control is working
Few improvements have been done since then and will be done as soon as possible
The laser is amplitude stabilized keeping fixed one of the two modes



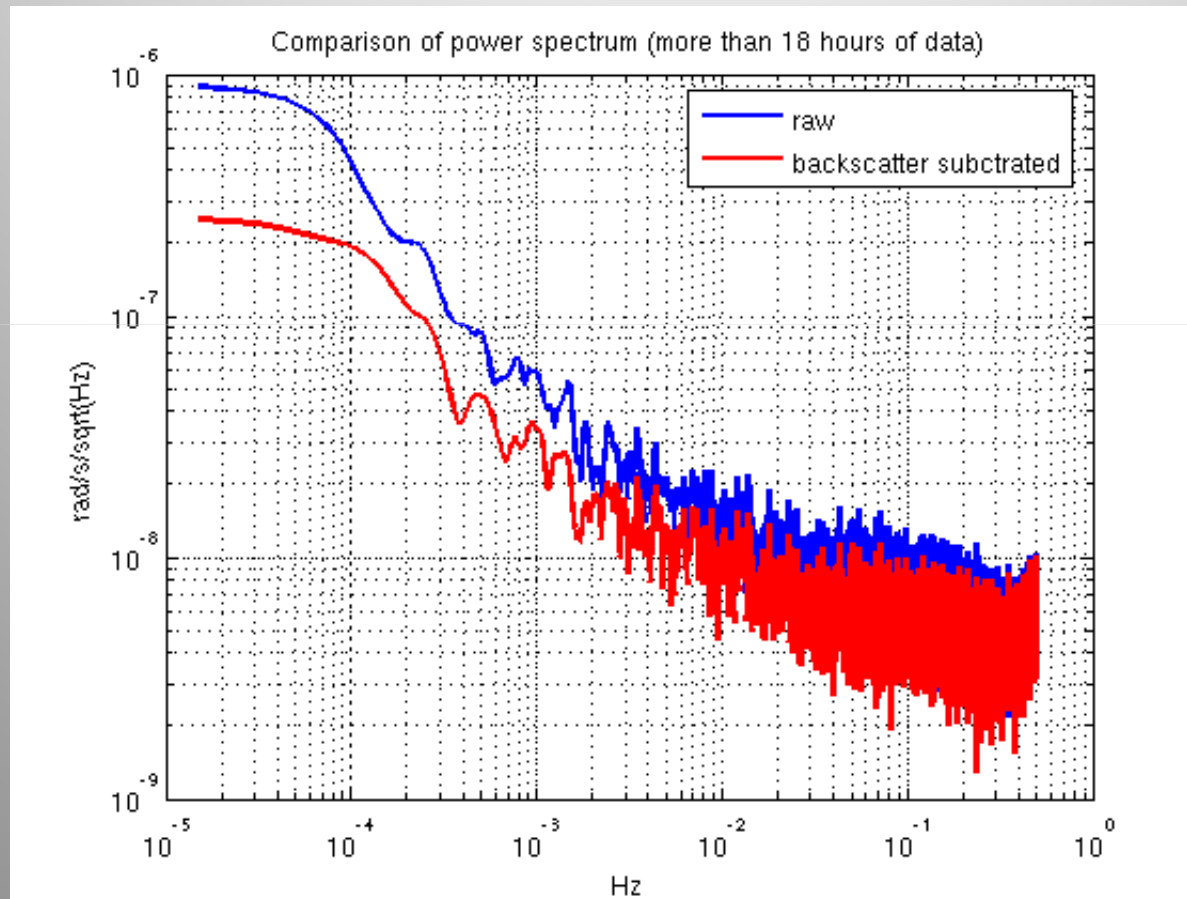
Signals

- Several signals are acquired at 1 Hz, some of them are related to the control loops
- GL_Sagnac_freq: proportional to rotation
- GL_Sagnac_AC: is above or around 1 V when the gyrolaser is working properly
- At 20kHz are acquired the beat note (GL_SAGNAC) and the output powers of the two modes. It would be good to acquire this channel at 2kHz, since we have already checked that above 2 kHz the signal is dominated by the noise of the ADC. In Matlab to reconstruct this signal:
`unwrap(angle(hilbert(filter(b,a,GL_SAGNAC))))`
The filter should be a bandpass around 107 Hz

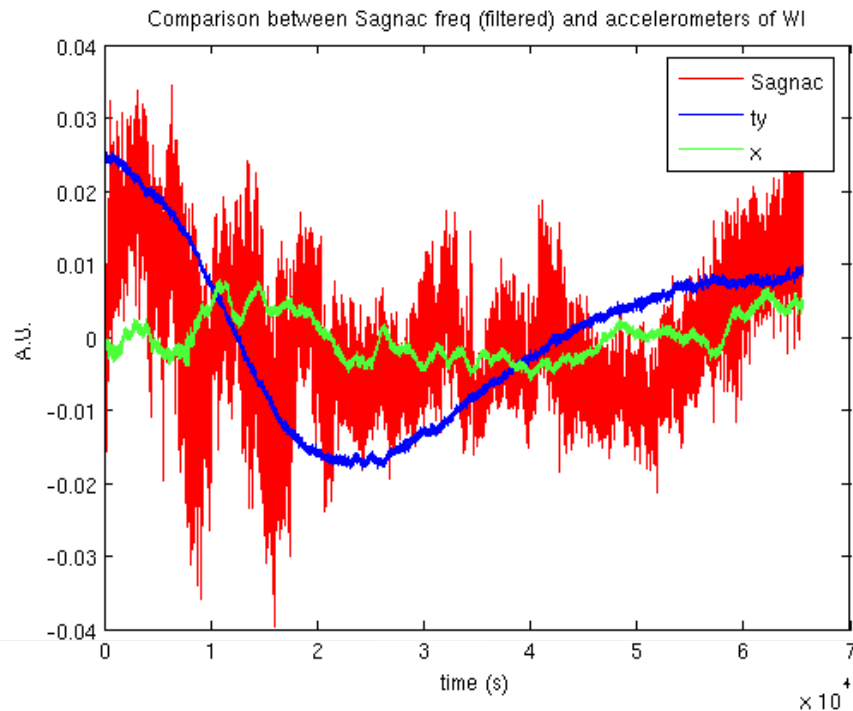
Some preliminary analysis

- Slow channel
- Fast channel

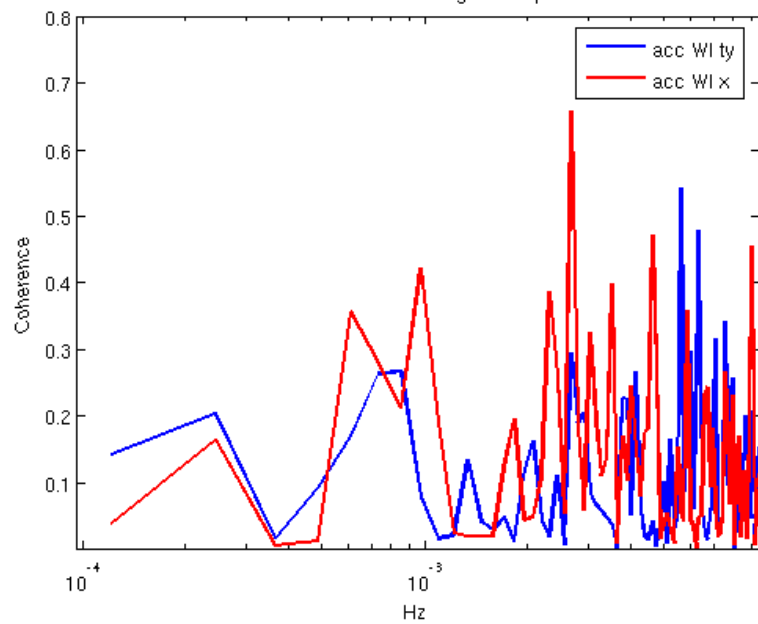
18 hours of continuous data have been compared with some FO accelerometers



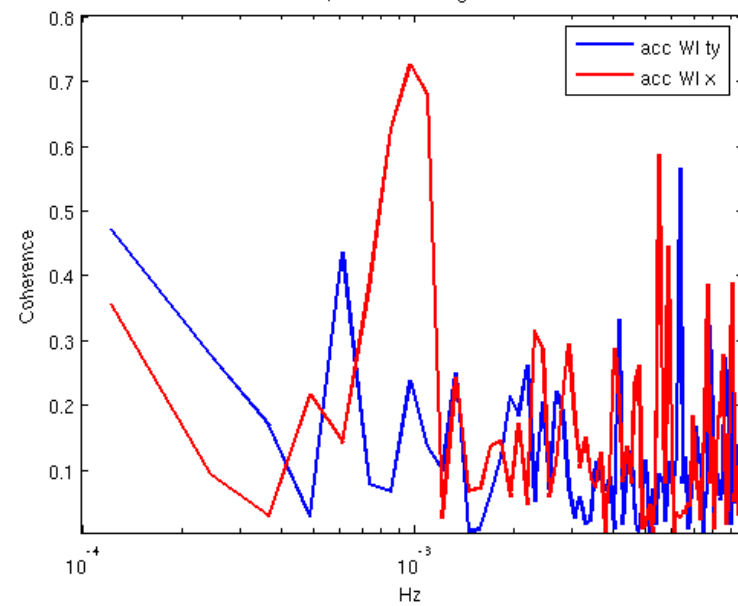
18 hours of data

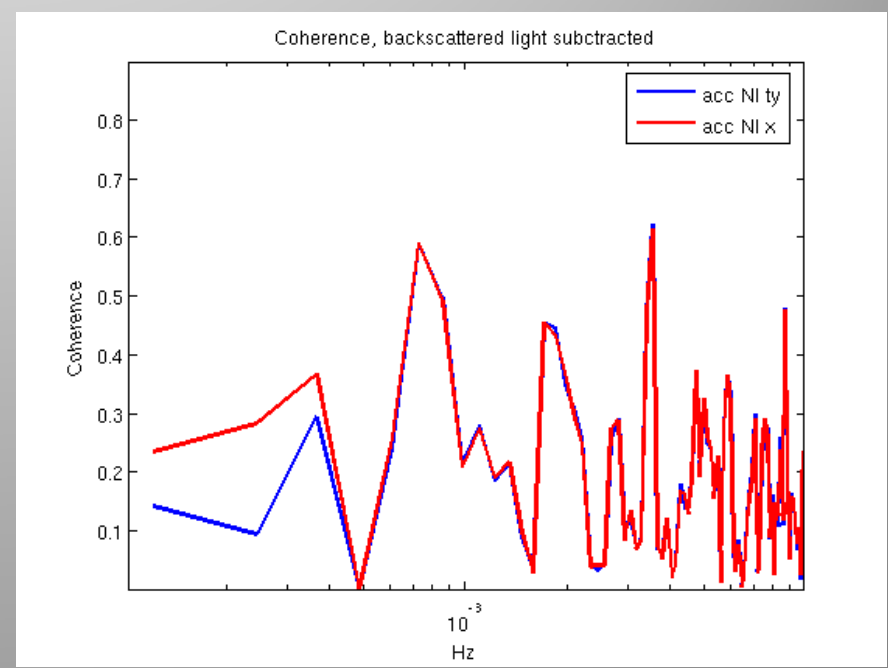
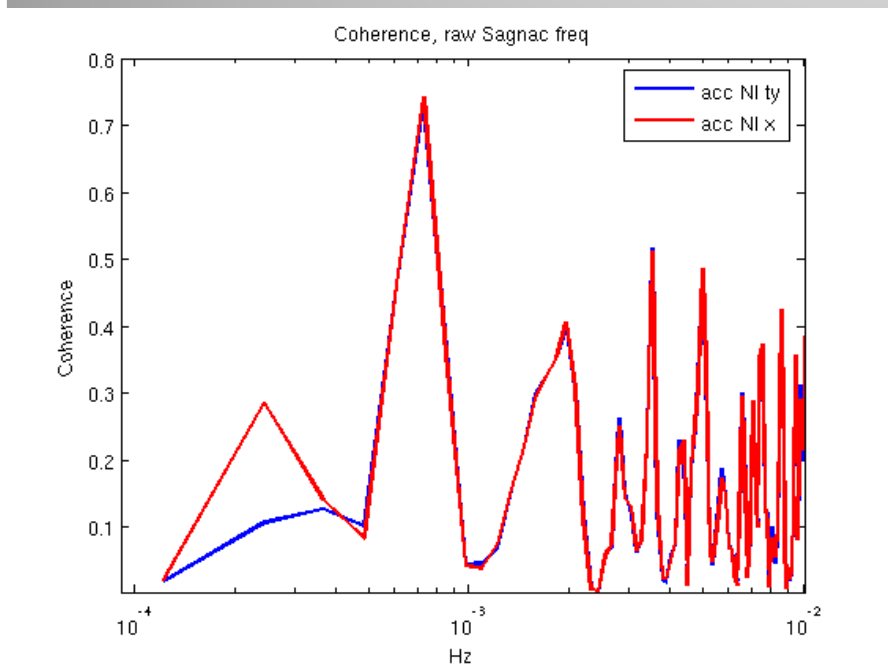
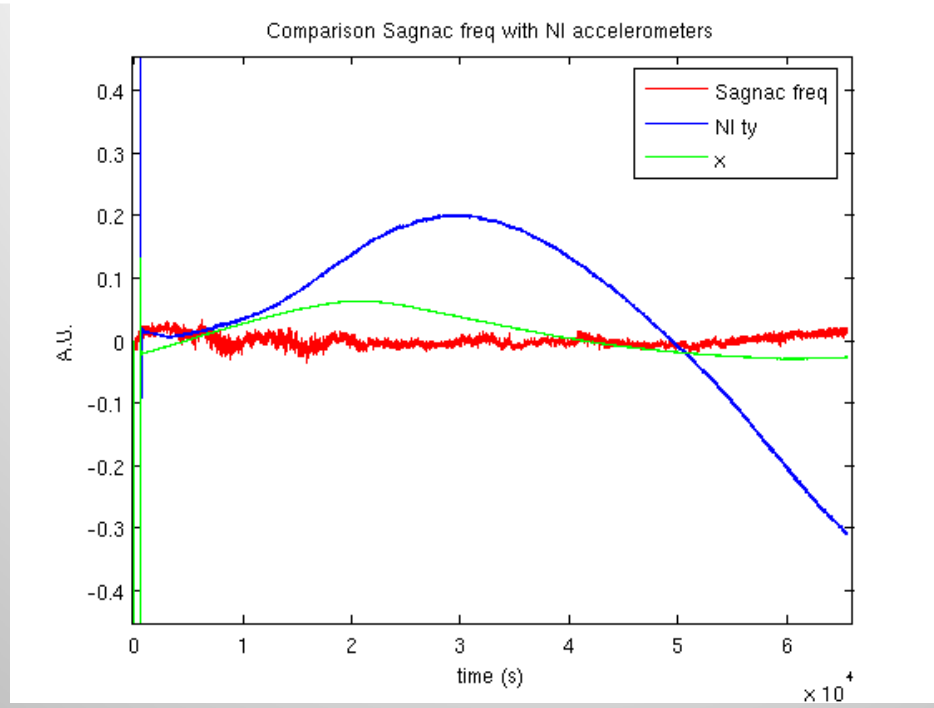


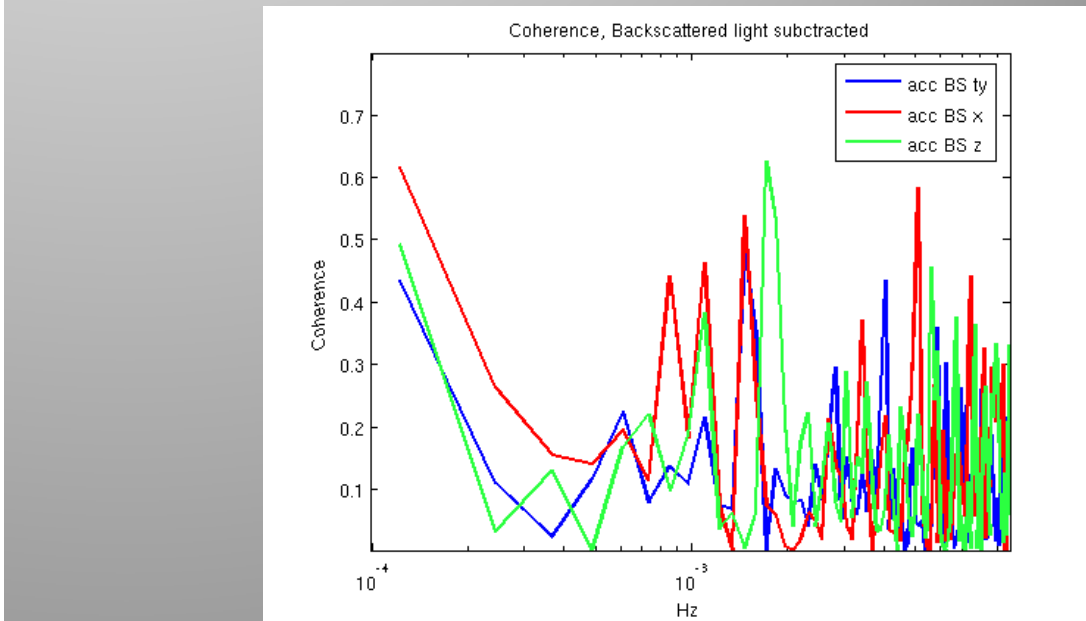
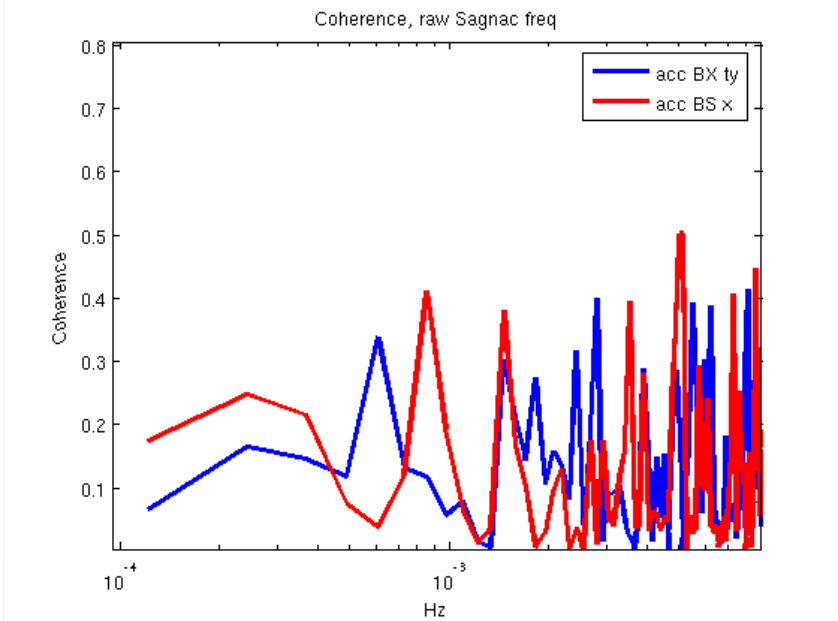
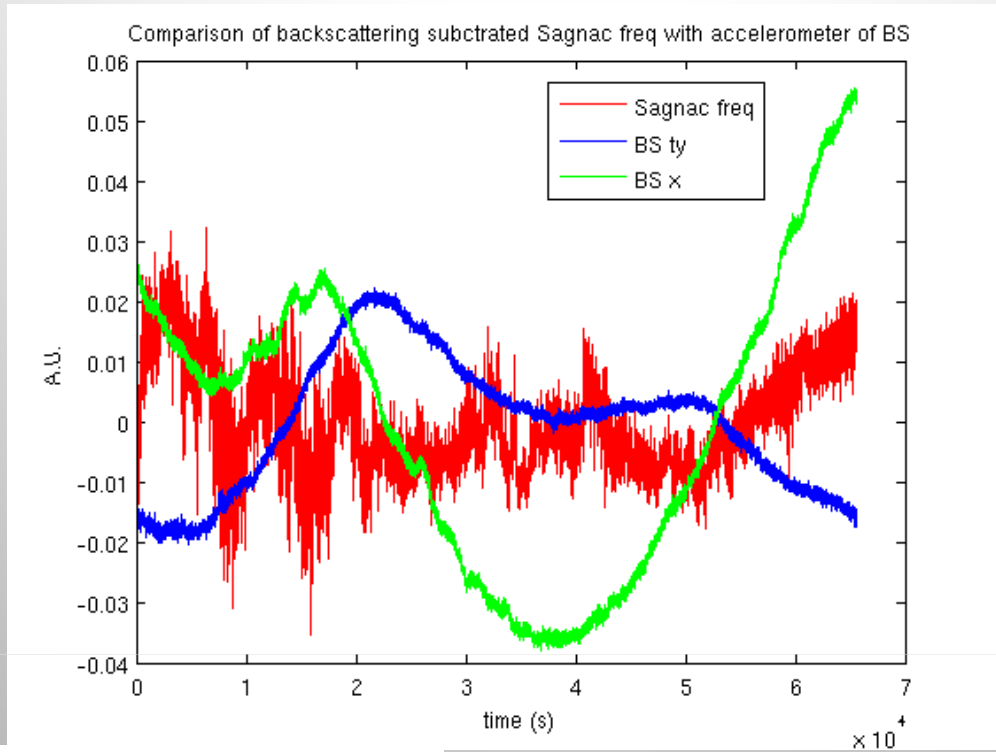
Coherence raw Sagnac freq

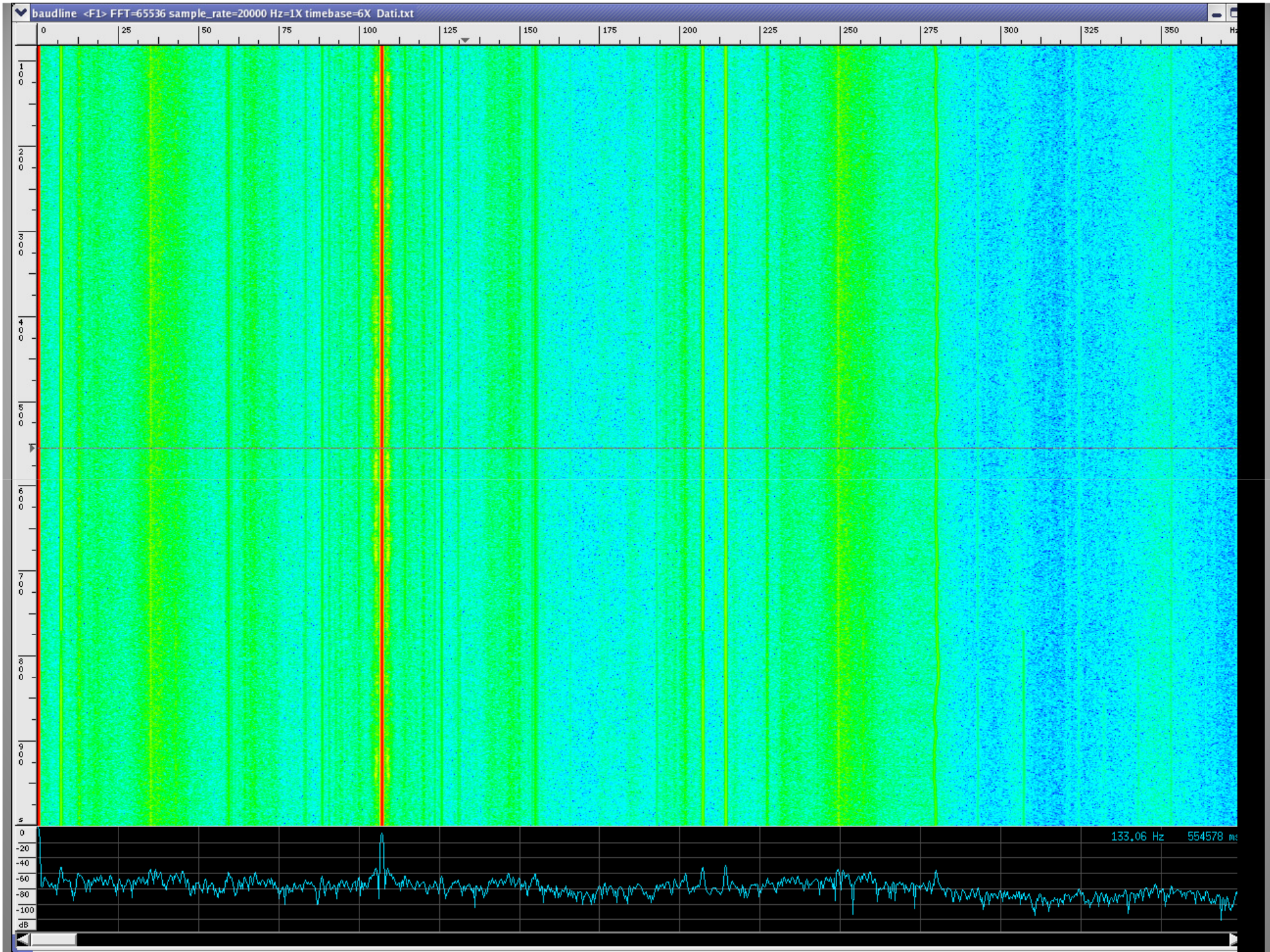


Coherence, backscattered light subtracted

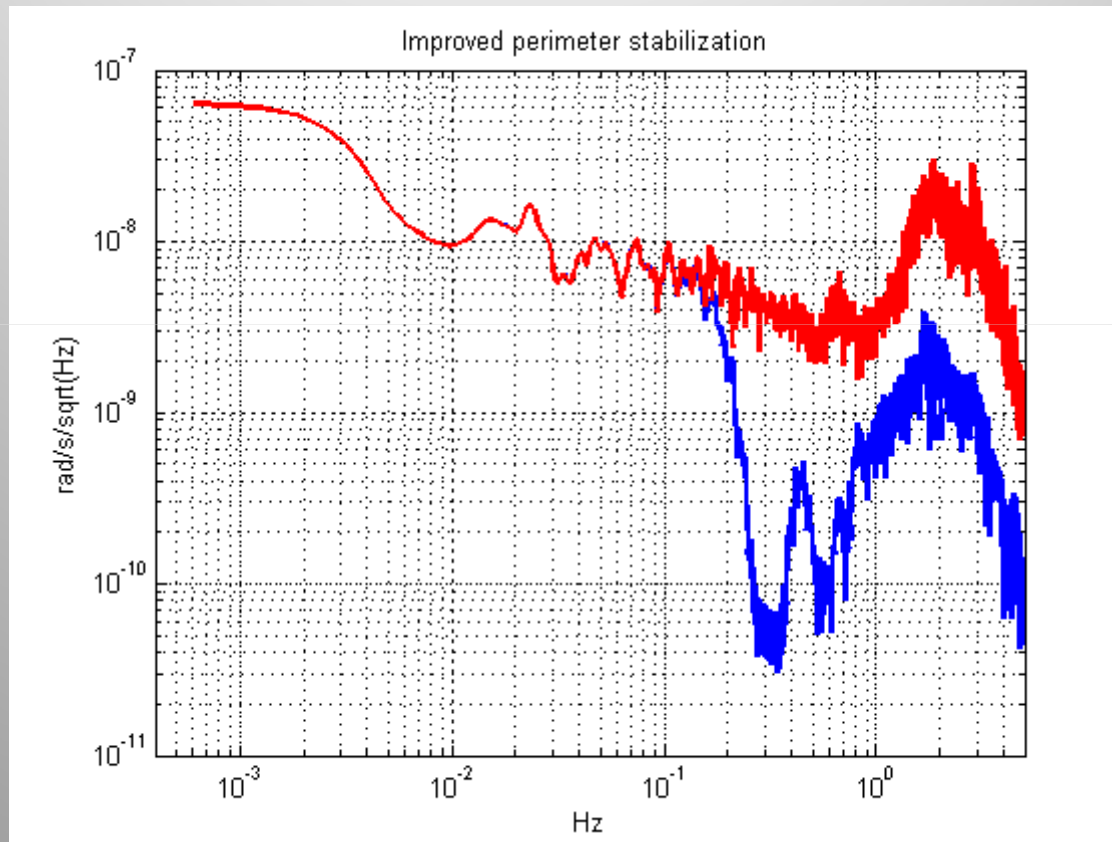


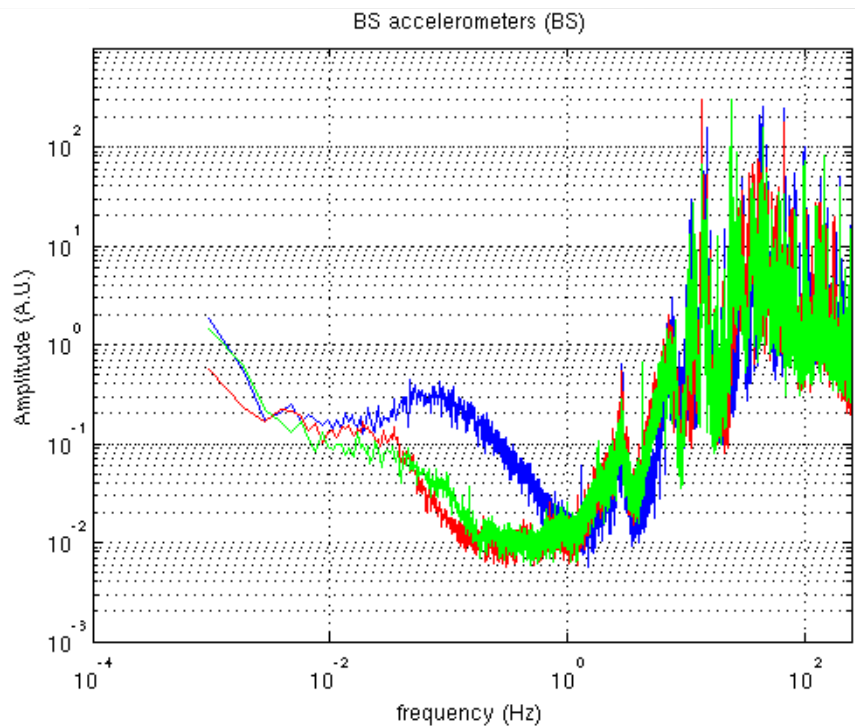
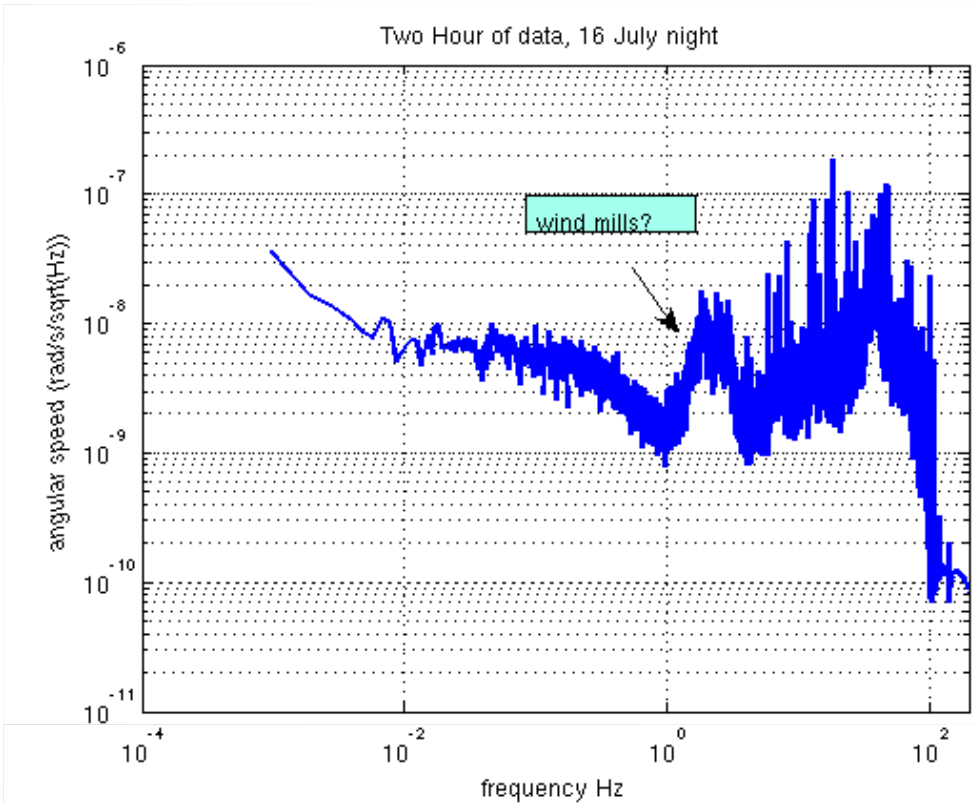




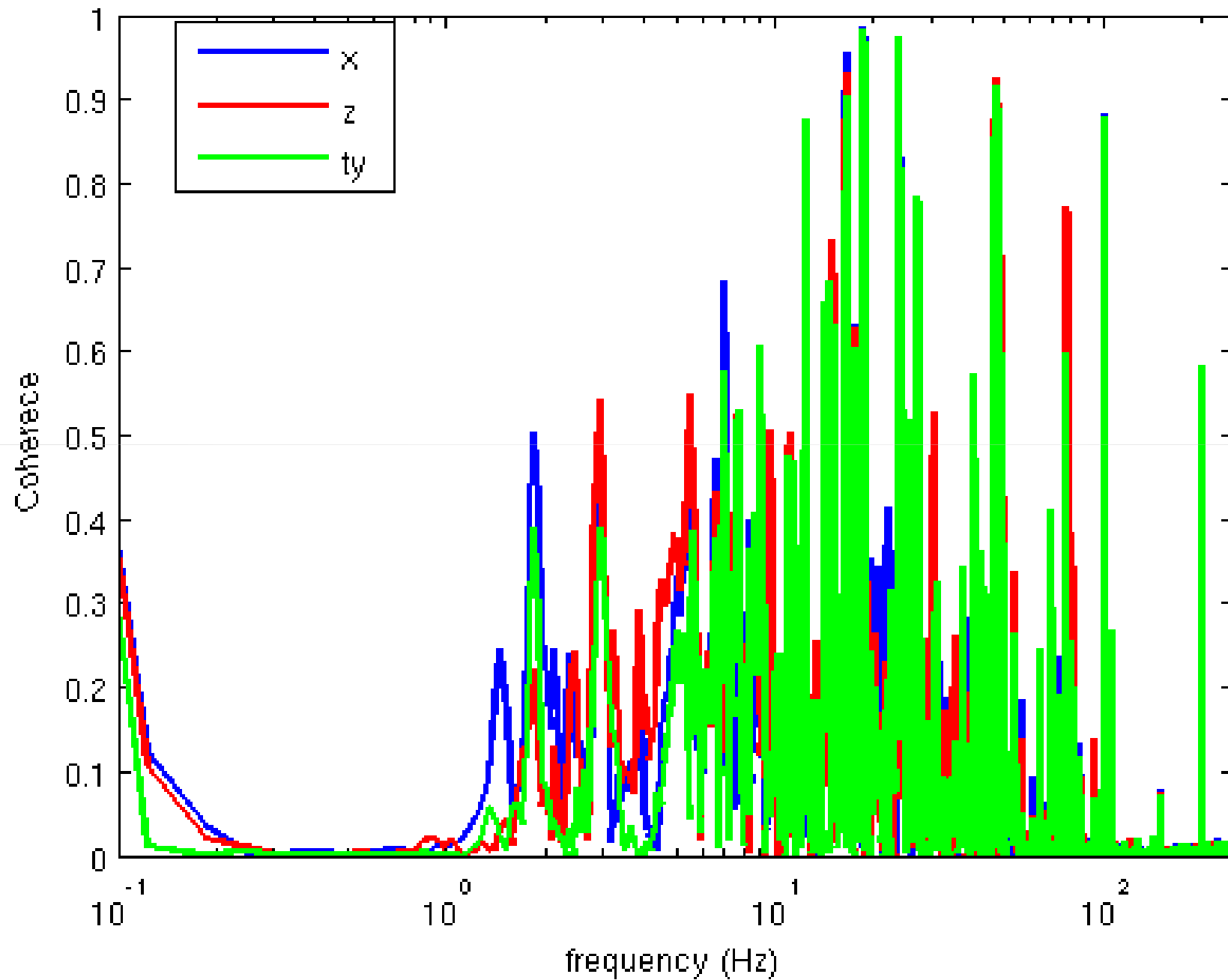


Power spectrum





Coherence with accelerometers F0 BS
gps=963273615, 2 hours



- G-Pisa works fine, routinely with a sensitivity higher than the one required by AdVirgo
- We will continue our work to refine the comprehension of the instrument at low frequency. To investigate effects of backscattered light etc.
- **G-Pisa provides good clean signals which are potentially very powerful to investigate noises of seismic (or acoustic) origin**
- we cannot guarantee our presence all August, but G-Pisa is very robust, and it should remain working all the time
- As soon as possible, but not before September, we are ready to flip it vertically: ½ day to flip, and a week of ‘soft work’ to recover stable operation of the system
- *Please contact us if you are interested in using the fast channels, we can arrange a dedicated seminar this week*