

PRESENT SCIENCE RUN OF EXPLORER AND NAUTILUS

June 20-24, 2005
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Kise Nago, Okinawa
Japan

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CNR – IFN Roma

INAF – IFSI Roma

CERN - Geneve



ricerca onde gravitazionali
gravitational wave research

OUTLINE OF THE TALK

- Description of NAUTILUS and EXPLORER
- Present performances and data quality
- Future upgrades
- Data analysis

EXPLORER CERN - GENEVA



Bar Al 5056 $M = 2270 \text{ kg}$
 $L = 2.97 \text{ m}$ $\varnothing = 0.6 \text{ m}$
 $\nu_A = 915 \text{ Hz}$ @ $T = 3 \text{ K}$
Cosmic ray detector

NAUTILUS LNF - FRASCATI

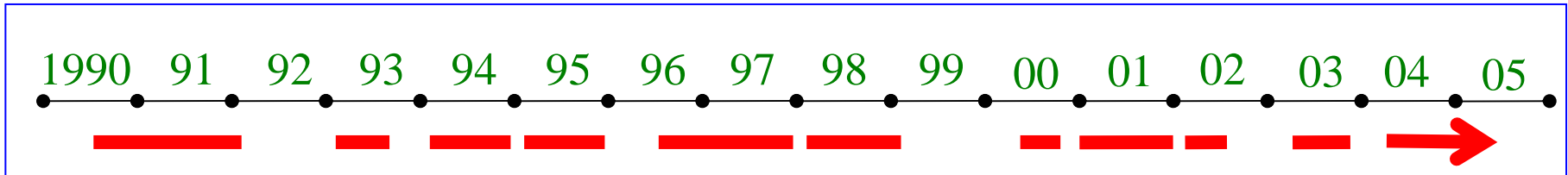


Bar Al 5056 $M = 2270 \text{ kg}$
 $L = 2.91 \text{ m}$ $\varnothing = 0.6 \text{ m}$
 $\nu_A = 935 \text{ Hz}$
 $T = 3 \text{ K}$ (130mK dilution refrigerator)
Cosmic ray detector



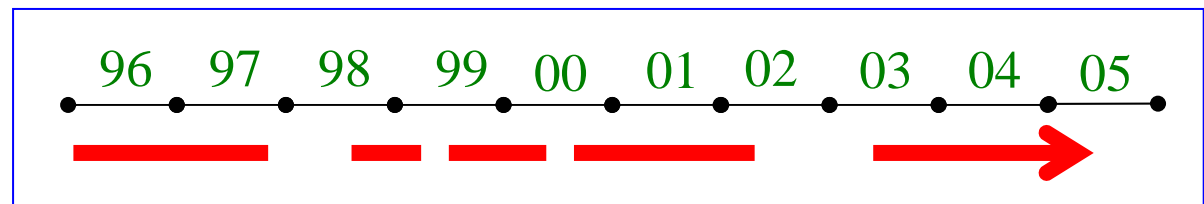
DATA TAKING DURING THE LAST 15 YEARS

EXPLORER



h from 10^{-18} to $3 \cdot 10^{-19}$

NAUTILUS



h from 10^{-18} to $3 \cdot 10^{-19}$

EXPLORER STATUS

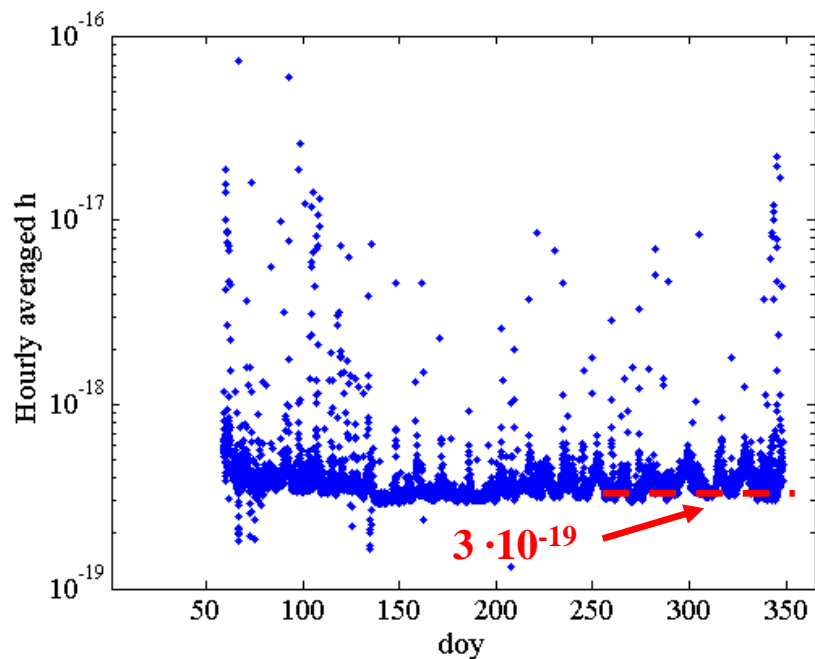
- The present run started on March 2004. During the first period it worked with an effective temperature of about 4 mK corresponding to $h = 5 \cdot 10^{-19}$. Since March 2005, increasing the electrical field in the transducer, the sensitivity has reached 2mK corresponding to $h = 3.5 \cdot 10^{-19}$. The duty cycle is larger than 85%.
- Last winter the data taking was not interrupted during the Christmas closure of CERN.

NAUTILUS STATUS

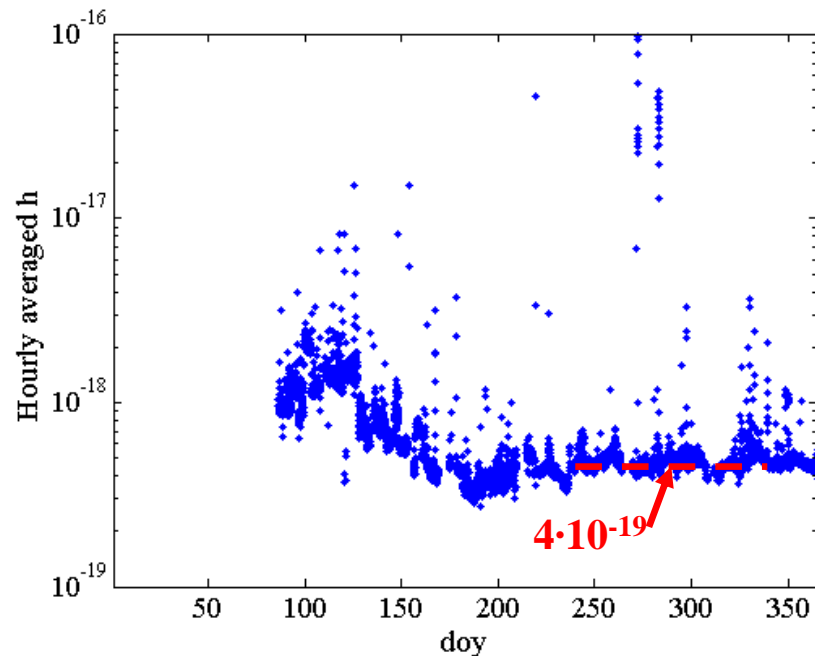
- NAUTILUS has resumed operations in March 2003. At present it is working at 3.5 K with a duty cycle larger than 85%. The effective temperature is now around 2 mK corresponding to $h \sim 3.5 \cdot 10^{-19}$
- Further improvement is possible by changing the experimental parameters (temperature, electrical coupling etc.).

DATA TAKING DURING 2003

EXPLORER



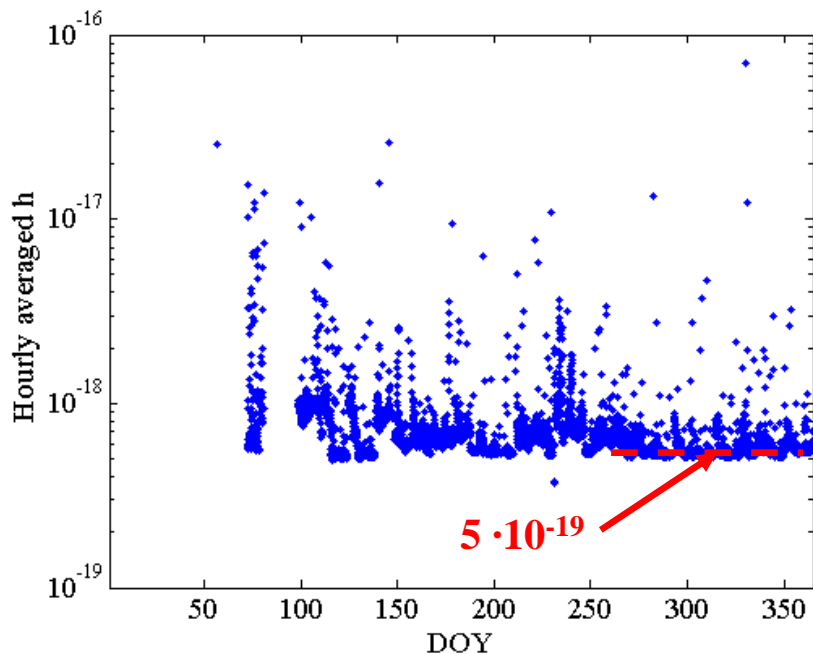
NAUTILUS



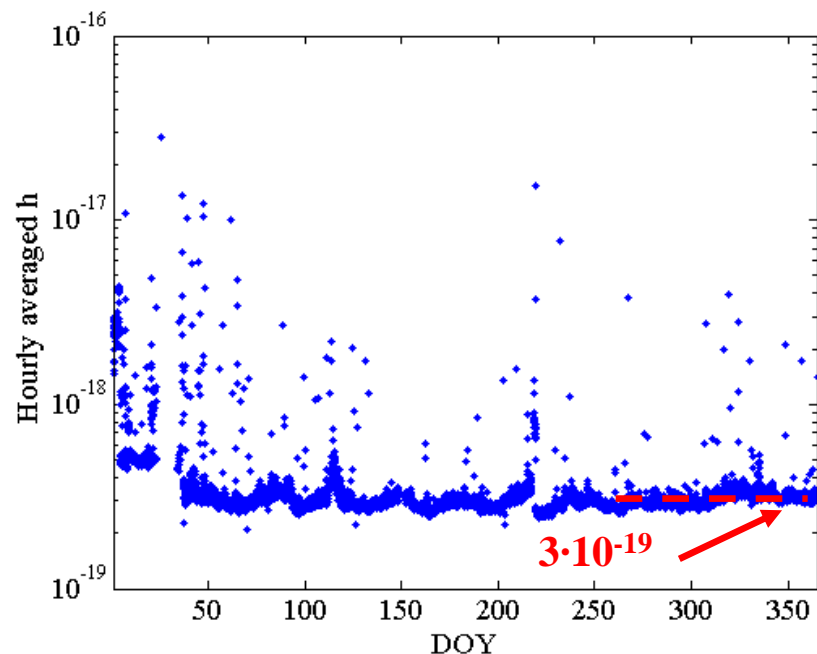
- Tomorrow: talk about these data by Eugenio Coccia

DATA TAKING DURING 2004

EXPLORER



NAUTILUS

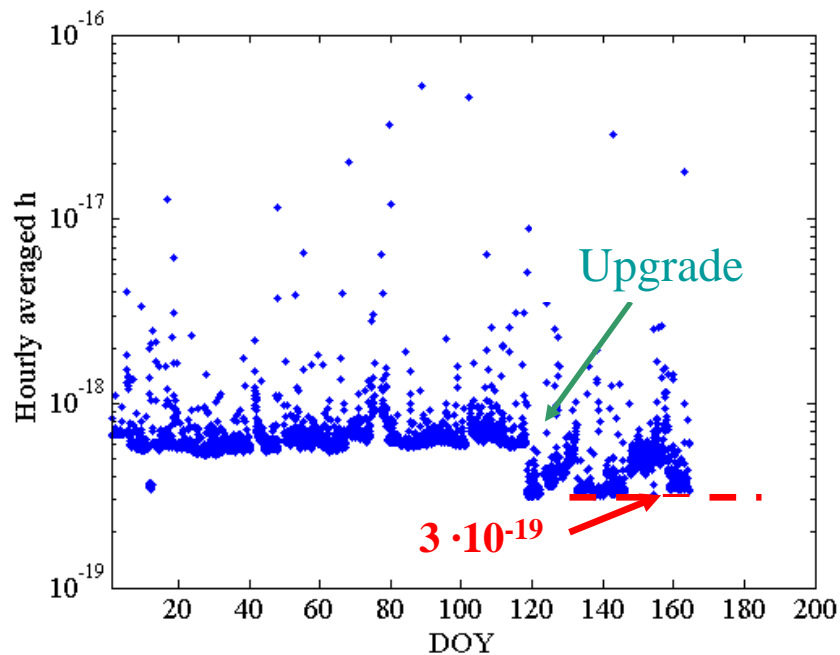


No veto applied

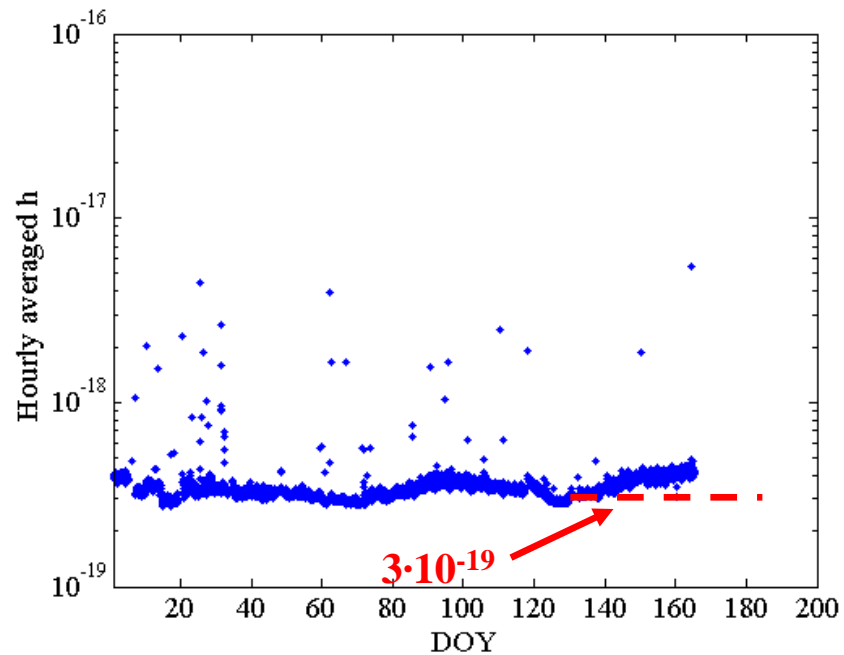
- These data (since May) will be also used for IGEC2 analysis

DATA TAKING DURING 2005

EXPLORER



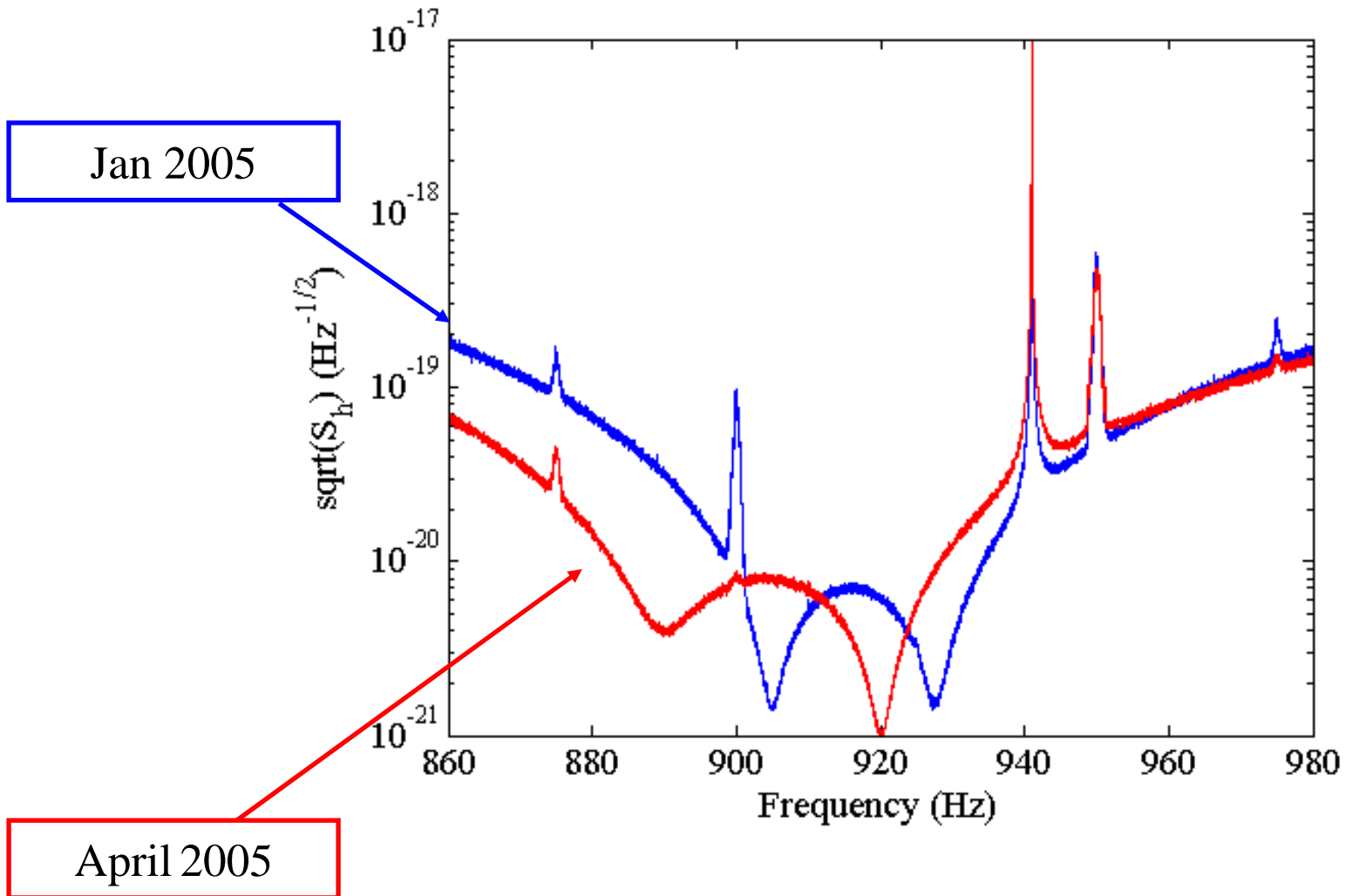
NAUTILUS



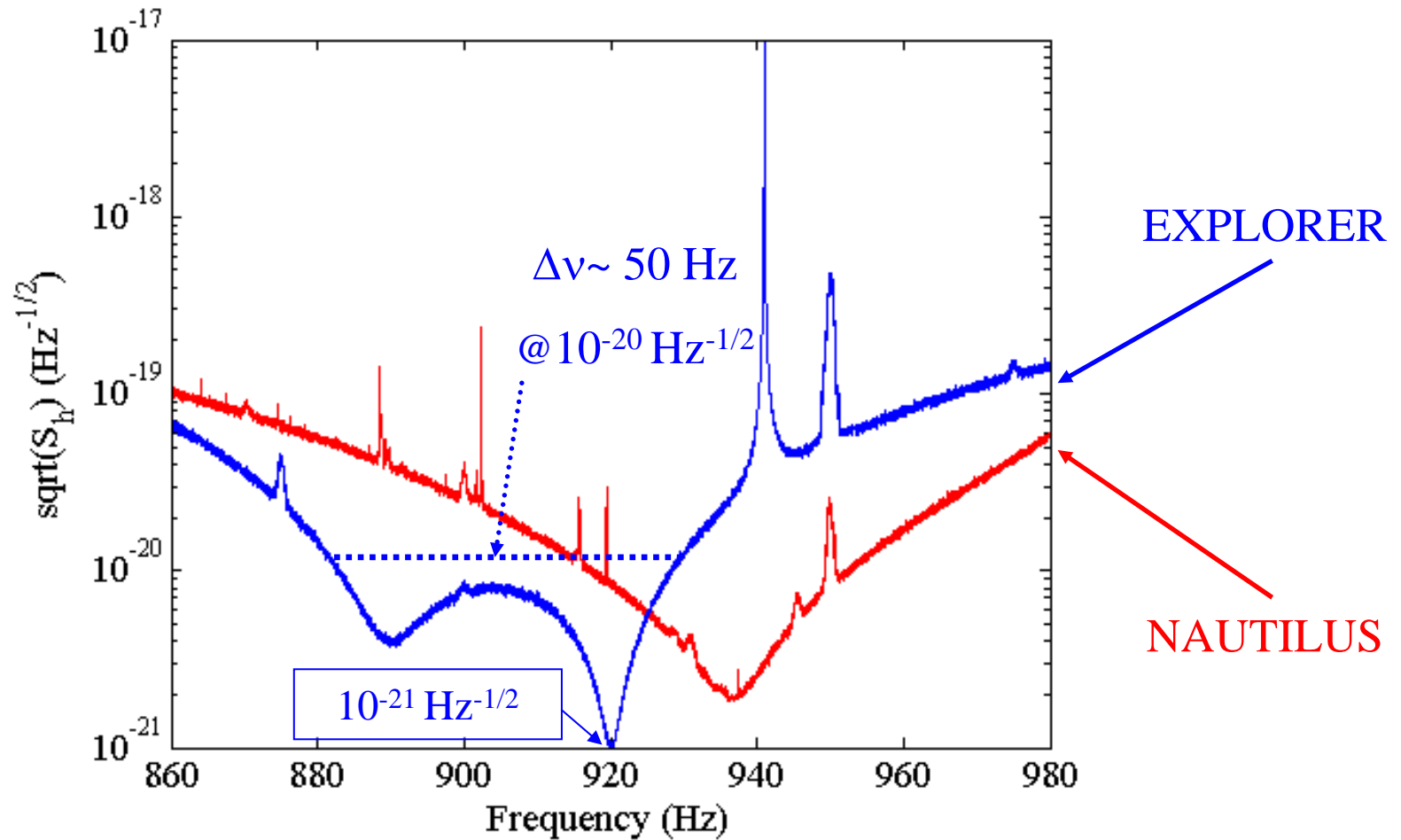
No veto applied

- Also this data will be used for IGEC2 analysis

CHANGES IN EXPLORER



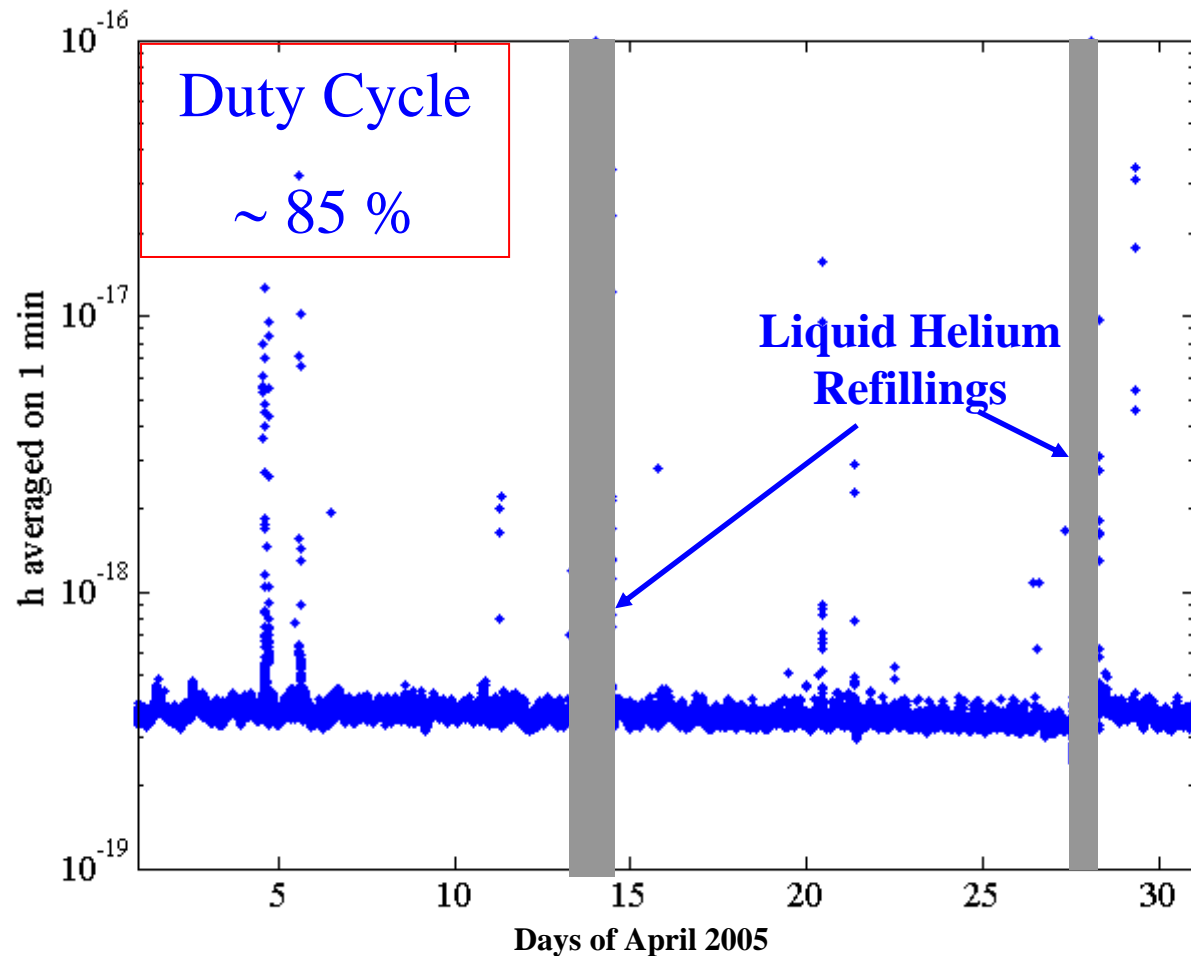
EXPLORER and NAUTILUS - May 2005



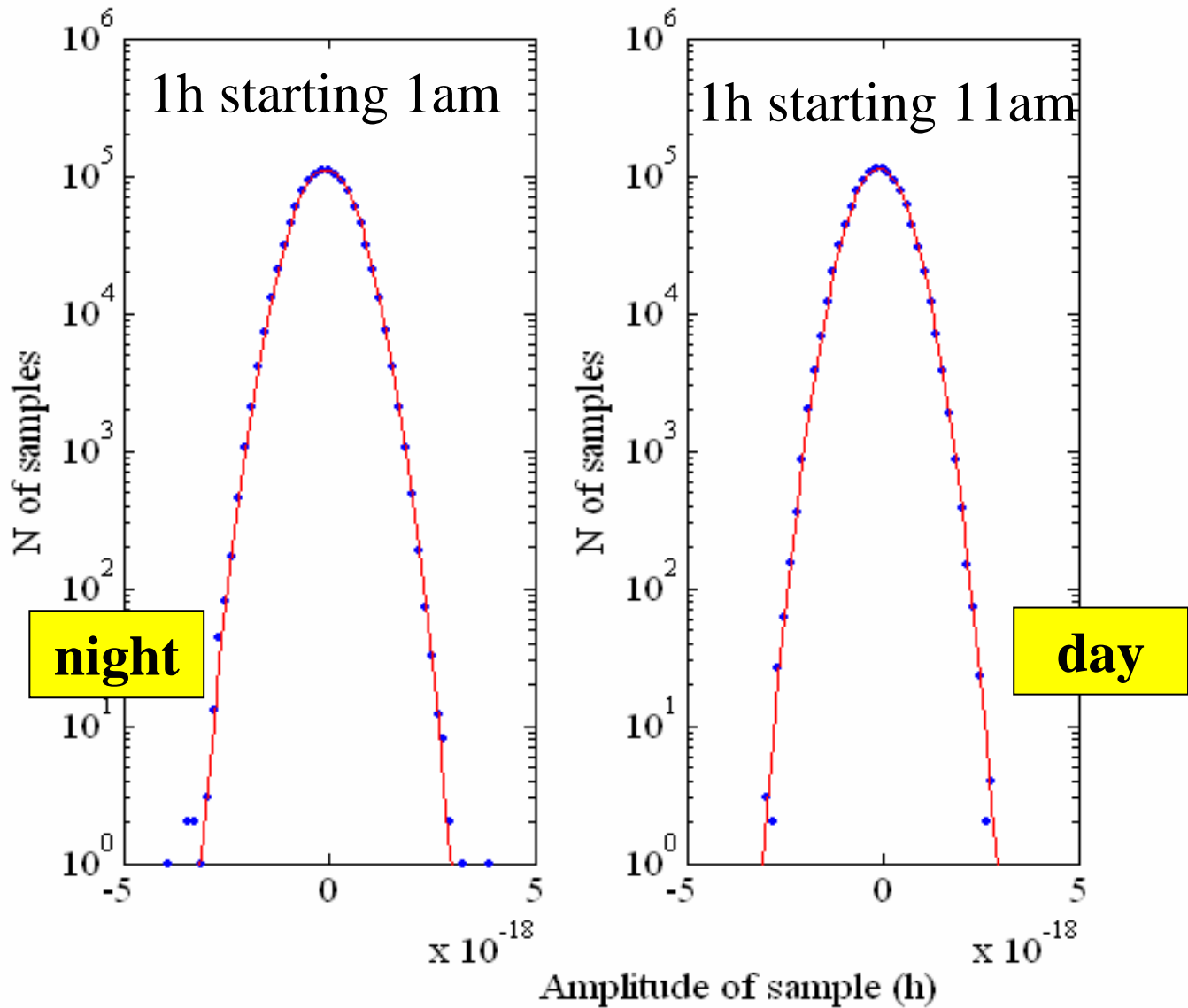
STATIONARITY OF THE EXPERIMENTS

- The duty cycle is limited mainly by cryogenic operations and for most of the time is higher than 90%
- The two apparatus show constant performances.
- The data are not affected by human activity in the lab.

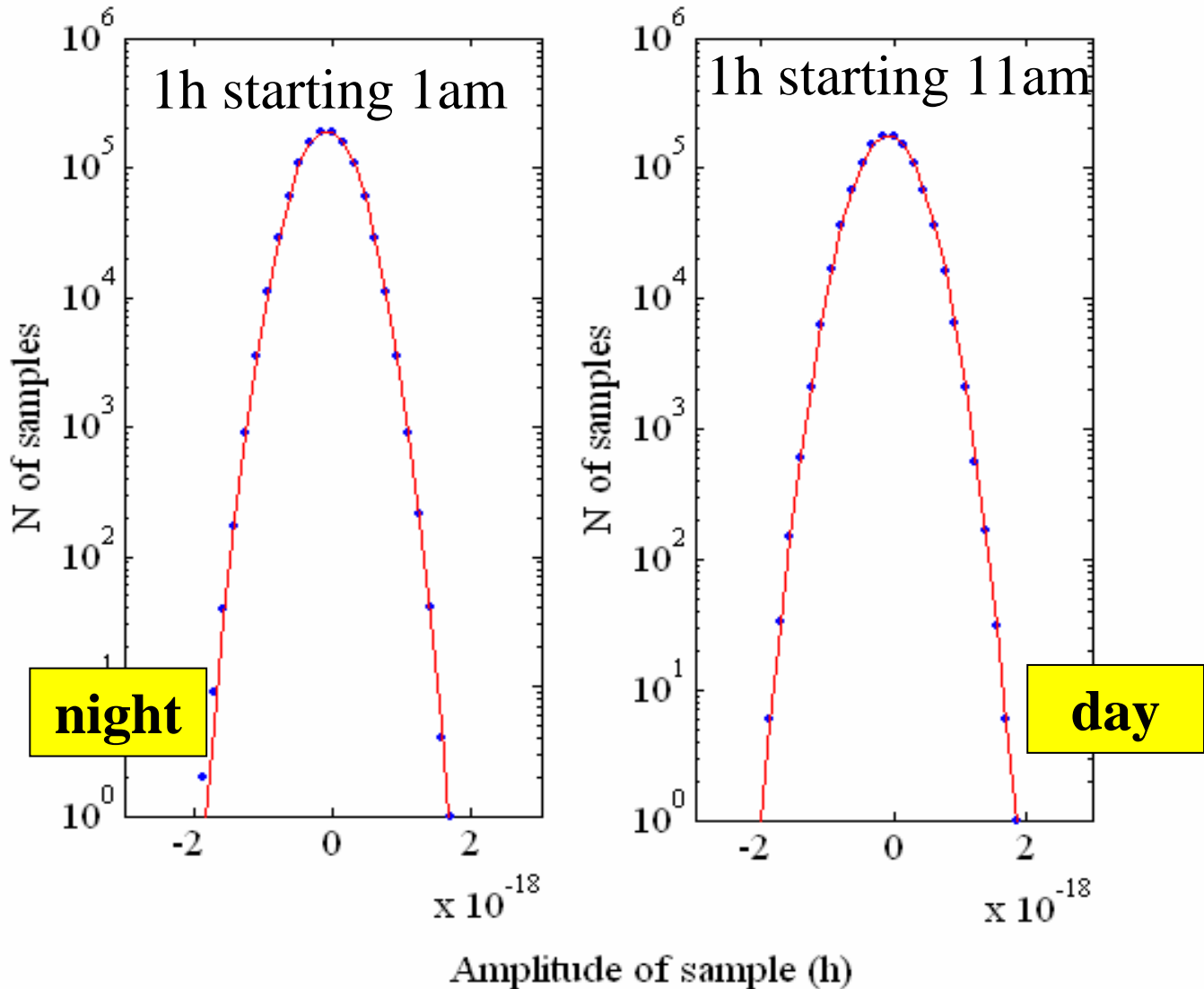
NAUTILUS OPERATIONS DURING April 2005



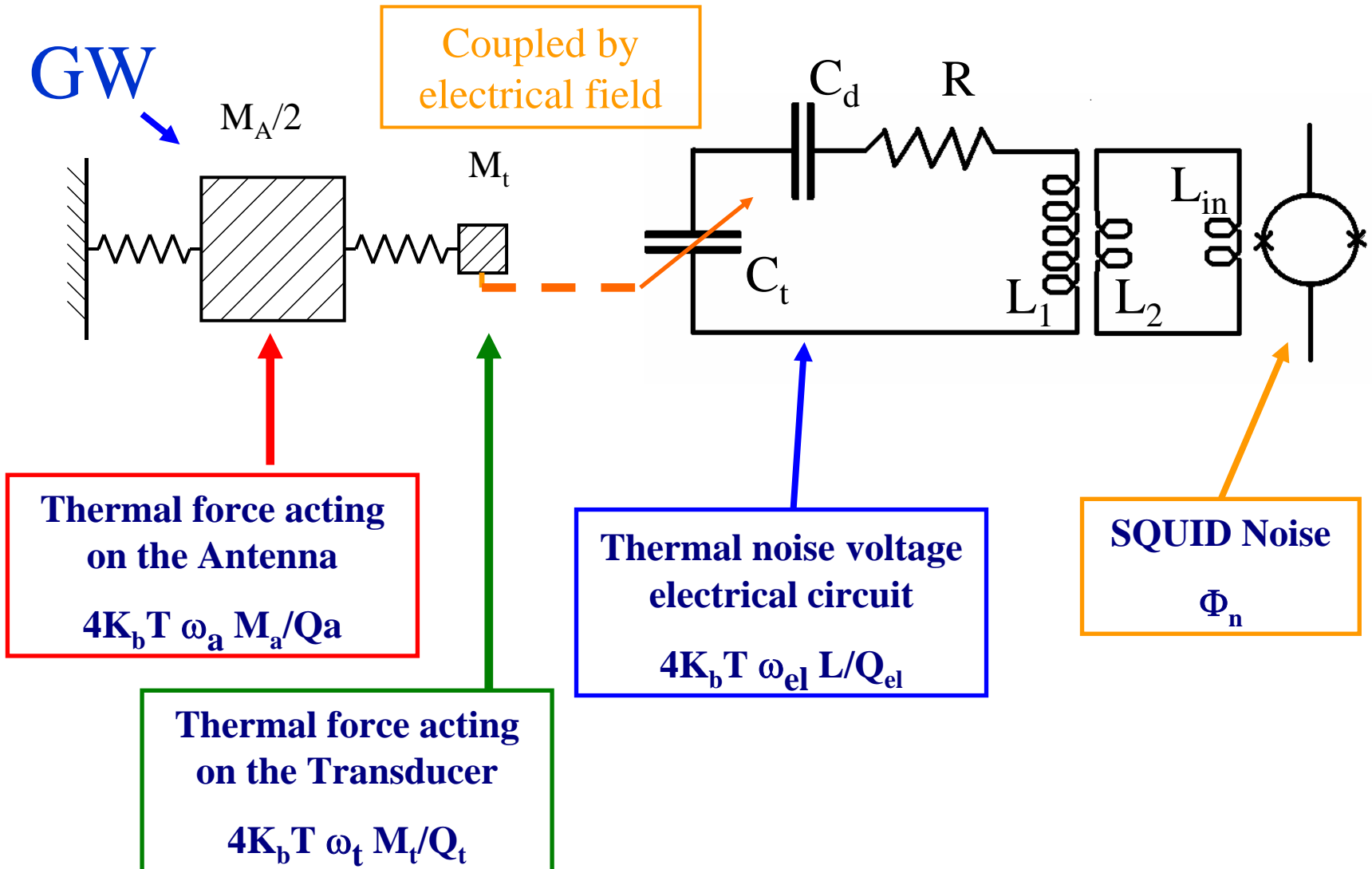
EXPLORER - 5 April 2005 – a working day



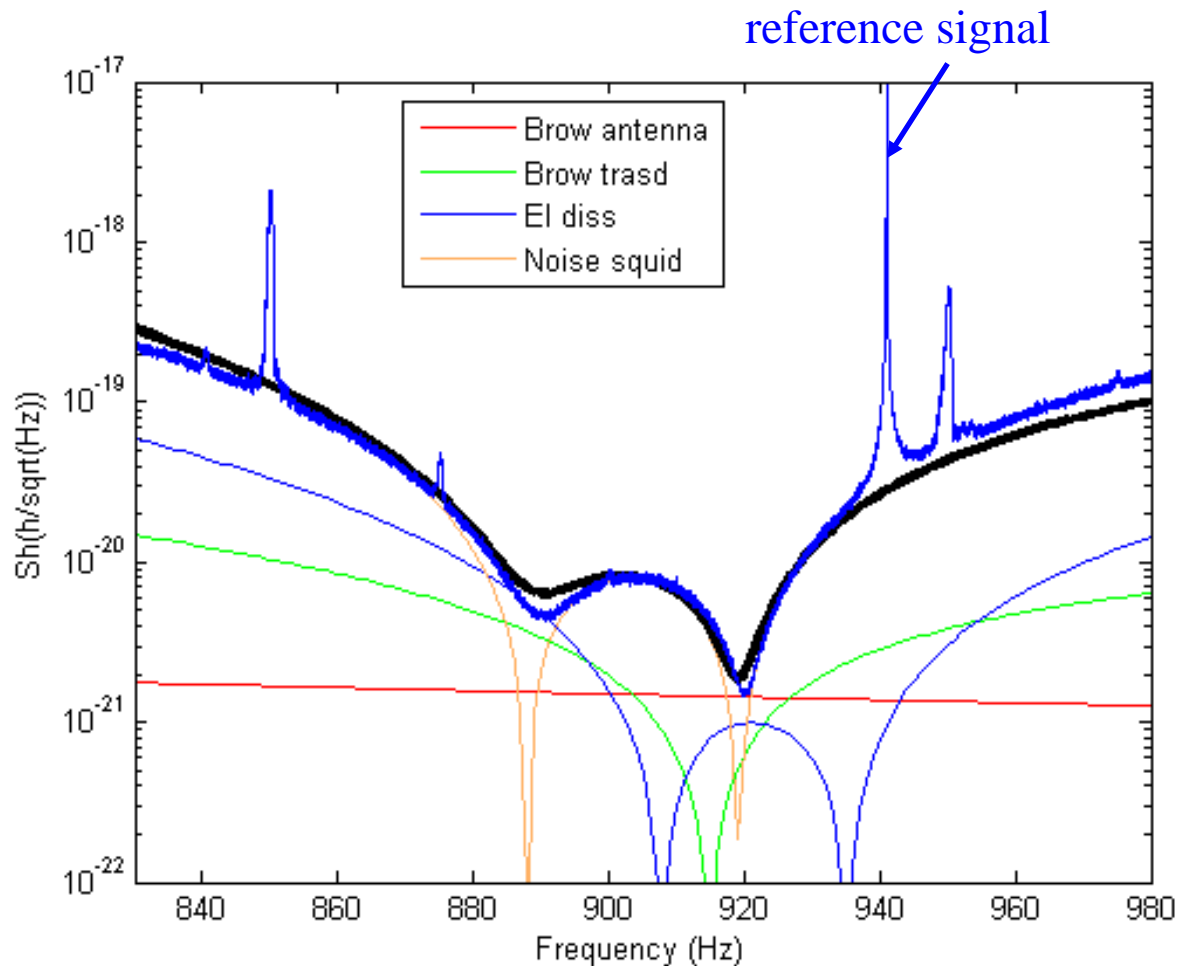
NAUTILUS - 5 April 2005 – a working day



SOURCES OF NOISE



Present Status of EXPLORER

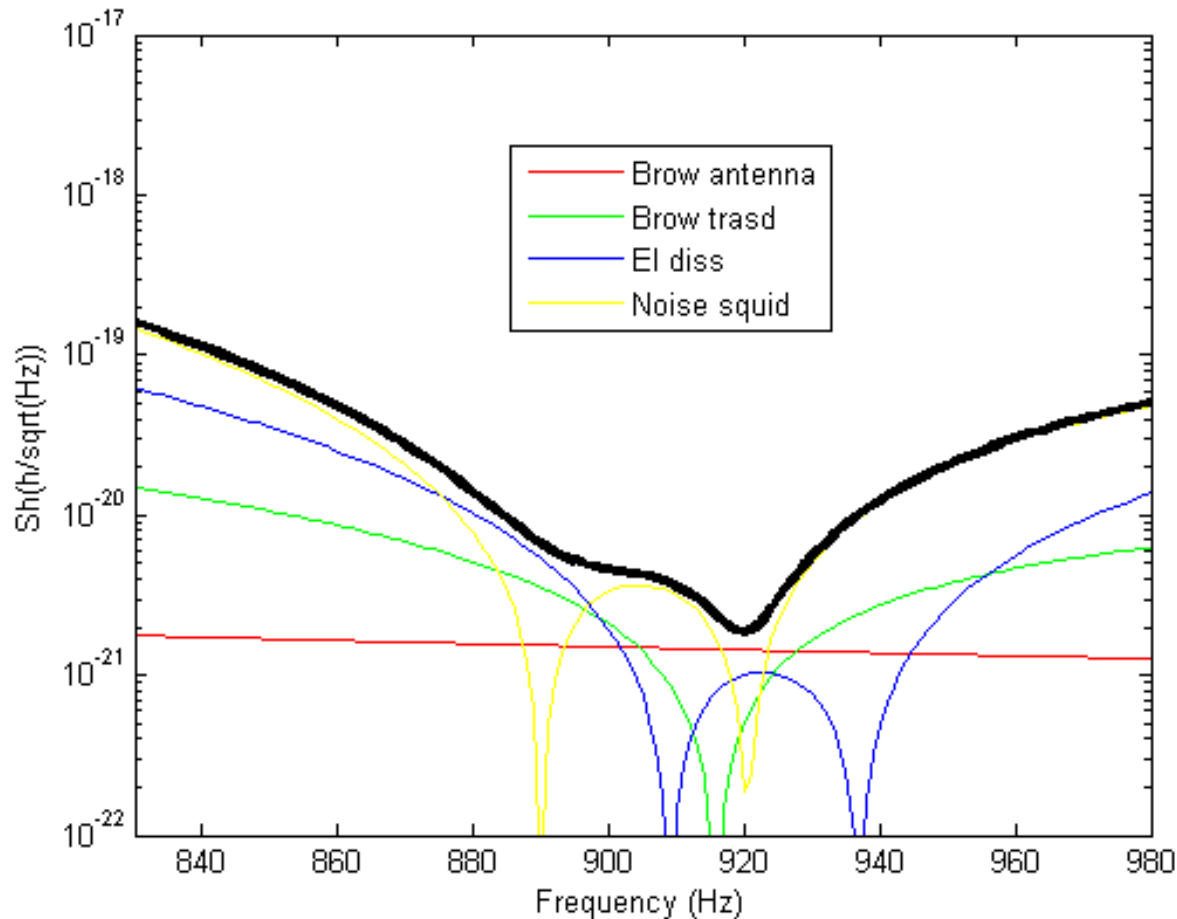


- Present limit from amplifier noise
- Similar situation in NAUTILUS

$$T_{\text{eff}} \sim 2\text{mK}$$

$$h \sim 3 \cdot 10^{-19}$$

Possible Improvements - EXPLORER



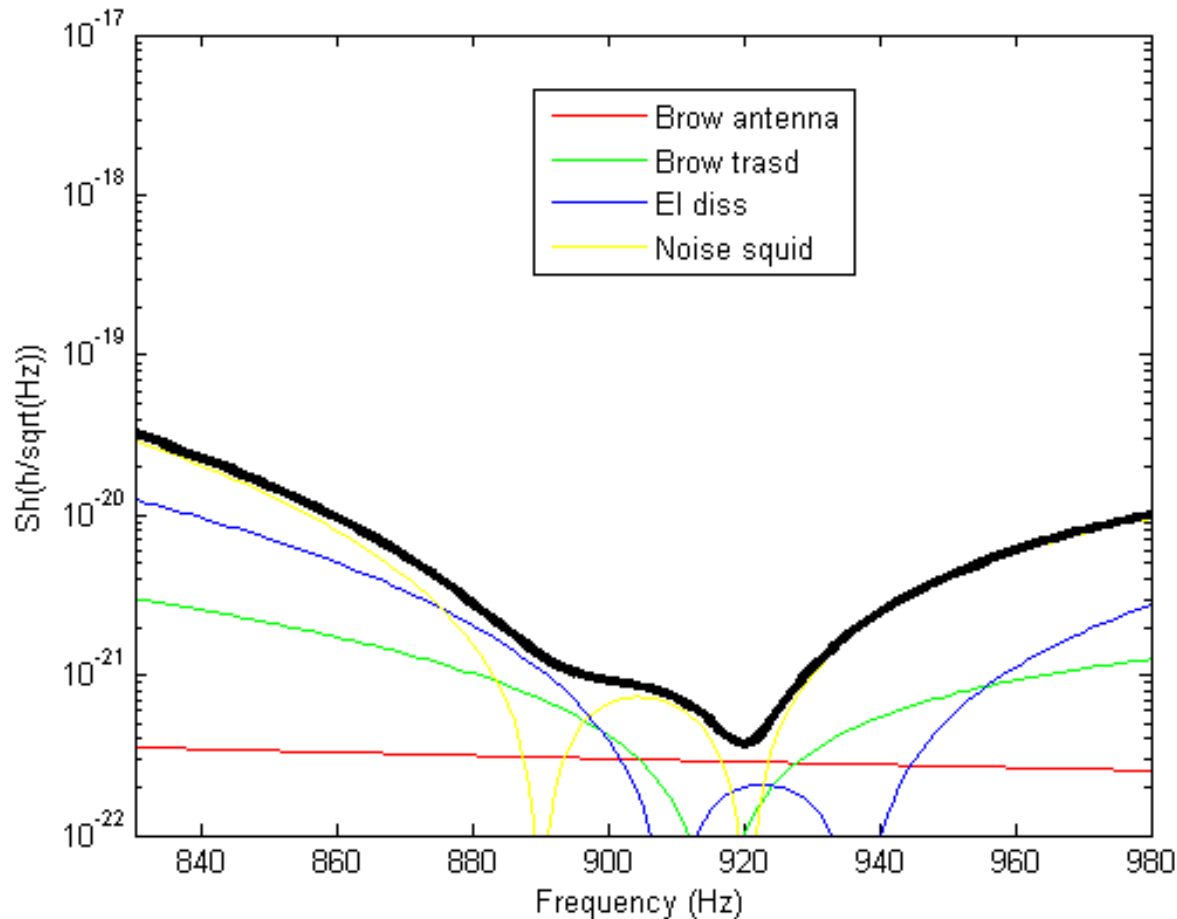
•In this regime, sensitivity scales linearly with SQUID noise.

$$T_{\text{eff}} \sim 1\text{mK}$$

$$h \sim 2 \cdot 10^{-19}$$

•An improvement in such noise can be achieved by acting on R.T. electronics

NAUTILUS with a new amplifier



•SQUID amplifiers 100 times better than present ones are becoming available

•Implementing such a device on Nautilus cooled at 0.1 K would yield:

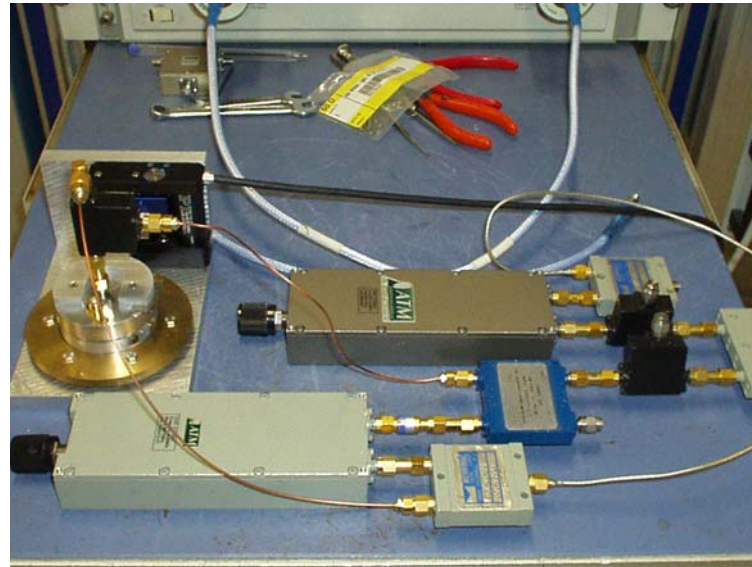
$$T_{\text{eff}} < 50 \mu\text{K}$$

$$h \sim 5 \cdot 10^{-20}$$

STUDY FOR NEXT READOUT

A continuous effort is devoted to improving the read-out

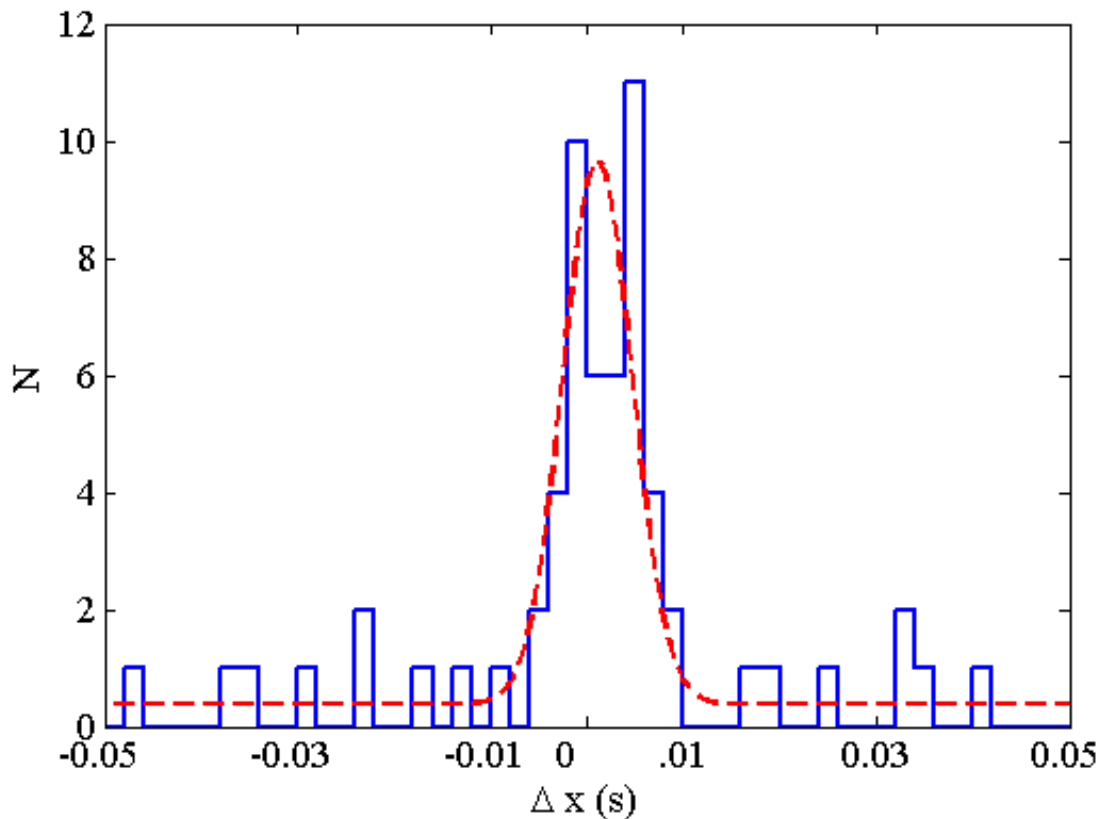
- Development of new read-out based on a double dc-SQUID $\varepsilon = 70 \hbar$ (talk of A. Rocchi this afternoon)
- Development of a high performance parametric transduction scheme (two posters about transducer and electronics)



DATA ANALYSIS

- Search of coincidence using data collected by the two experiments during 2003 and 2004 is in progress (tomorrow: talk by E.Coccia about 2003 data)
- The data of 2004 – 2005 will be used for IGEC2 analysis (talk by G. Prodi on Thursday)
- Studies of response to signals of given shape (talk by S. D'Antonio on Thursday)
- A study for burst signals and stochastic background with Virgo and Auriga is in preparation
- Search for continuous sources is underway (in collaboration with Virgo group and A.Krolak group - talk on Thursday)
- Coincidence with cosmic rays

TIME RESOLUTION AND EVENTS FROM COSMIC RAYS - EXPLORER 2003



Cosmic rays are a powerful tool to measure the time resolution