

# Status of Virgo

*GWDAW12*

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**On behalf of the Virgo Collaboration**

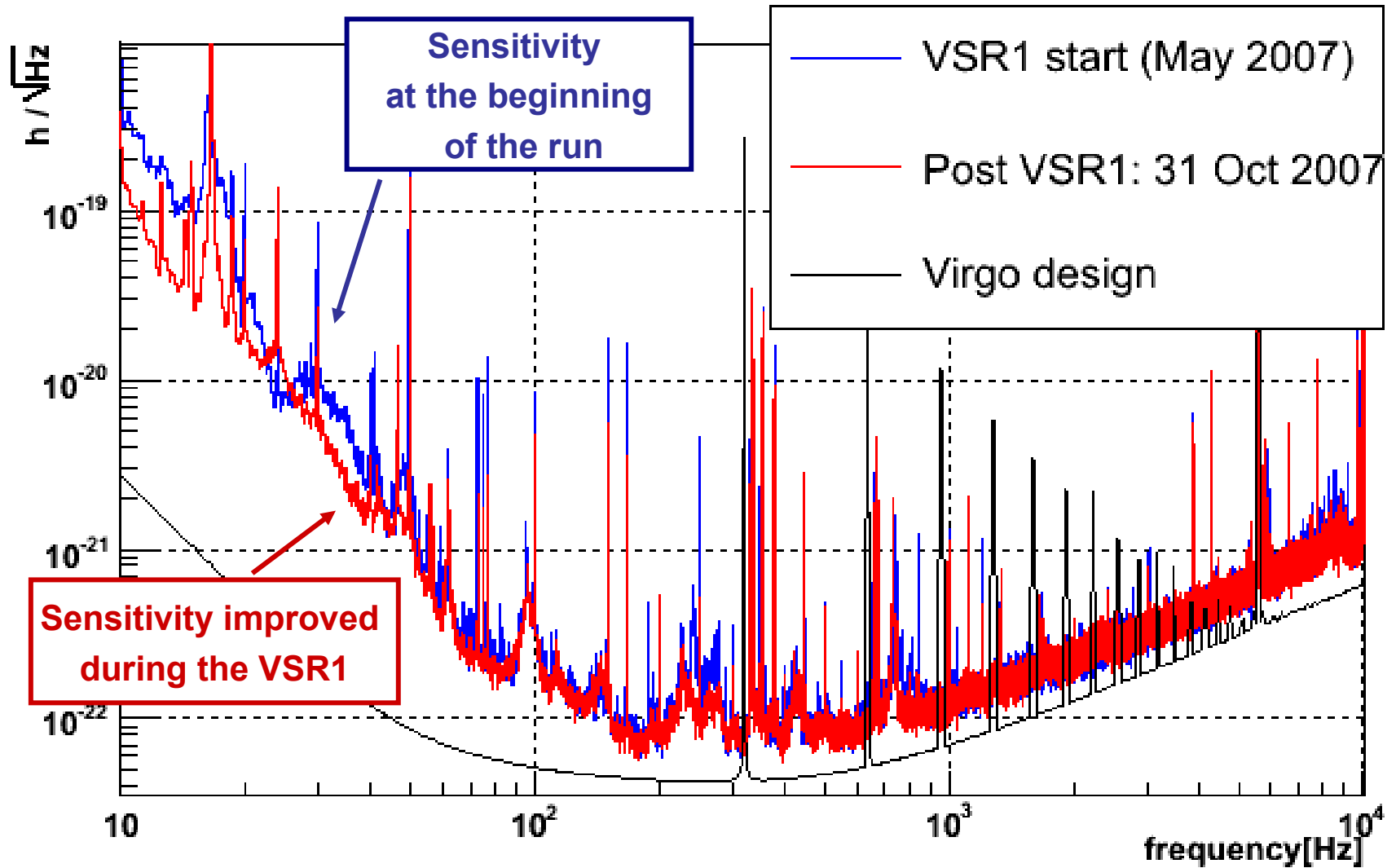
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# Virgo Scientific Run (VSR) 1 organization

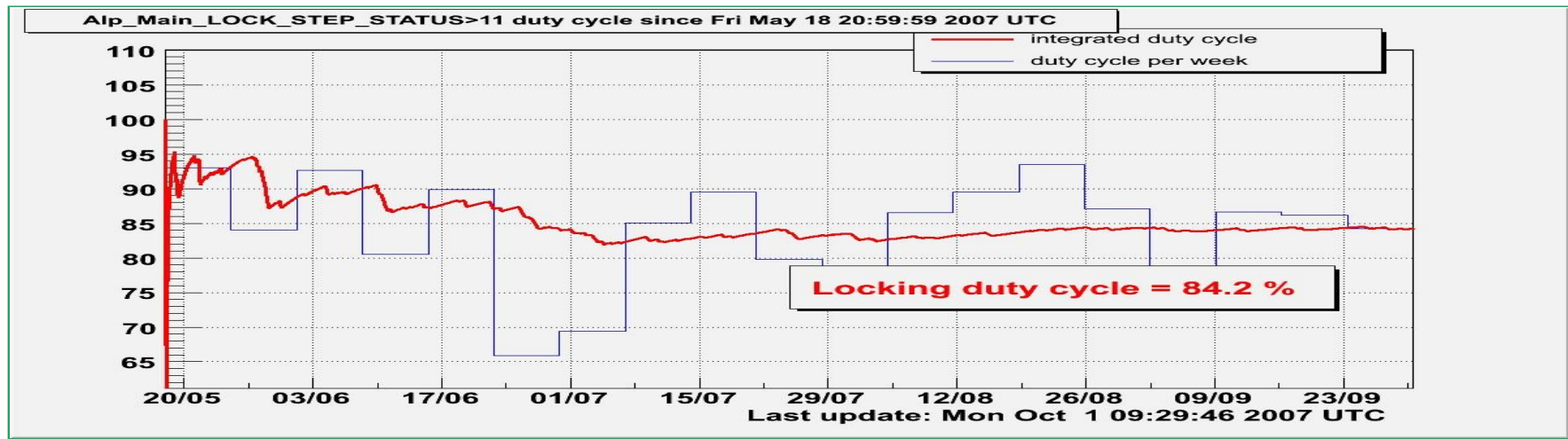
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- **Scientific run:**
  - started on 18<sup>th</sup> May, ended on 1<sup>st</sup> Oct (4.5 months)
- **Organization:**
  - 3 shifts/day: 1 operator + 1 physicist
  - 1 weekly coordinator
- **Periodic operations:**
  - Calibration: ~1.5h/week
  - Maintenance: 4h/week
    - vacuum + infrastructures + commissioning technical fixes or investigations
  - Commissioning: ~6h/week
  - Hardware injections

# VSR1 Virgo sensitivity



# VSR1 duty cycle statistics



- Duty cycle: 84% ITF locked and 81% in science mode
- Long locks: **20 locks** longer than **40 hours** + longest lock: **94 hours**
- **197 unlocks** from “Science Mode”
- Average Unlocks/Day: 1.8
- Main unlock reasons:
  - Technical
    - Maintenance + Commissioning
    - Global control software crash
  - Environmental:
    - Earthquakes
    - bad weather

# VSR1 duty cycle improvements

At the **beginning** of the run:

- *Several unlocks per week due to earthquakes*
- After unlocks suspensions get very excited  $\Rightarrow$  takes a couple of hours to recover a normal condition

At the **end** of the run:

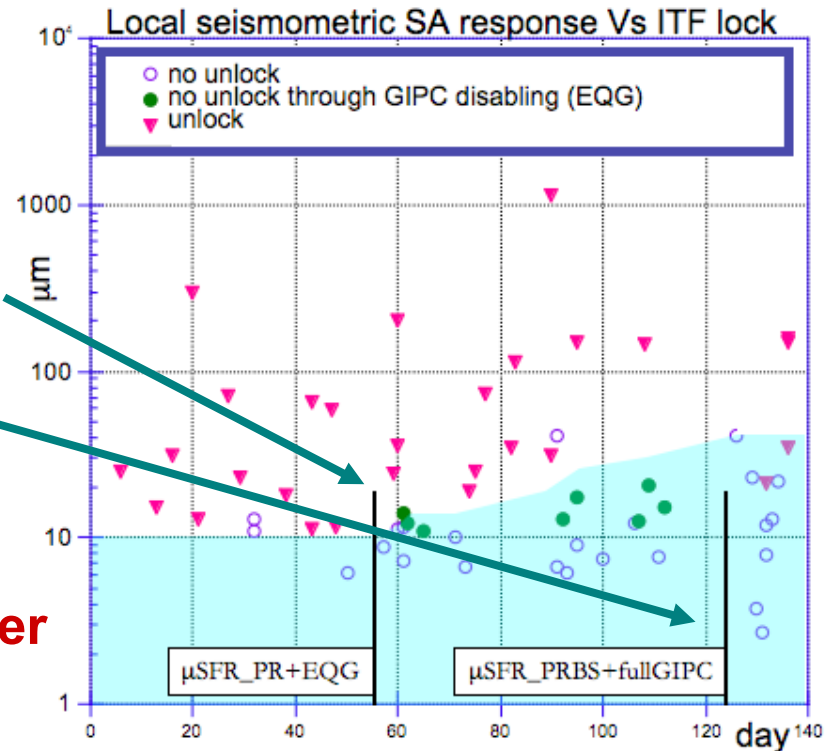
- Improvements of the suspension control had been implemented in several steps

$\Rightarrow$  **Earthquake unlocks  $\leq 1$  per week**

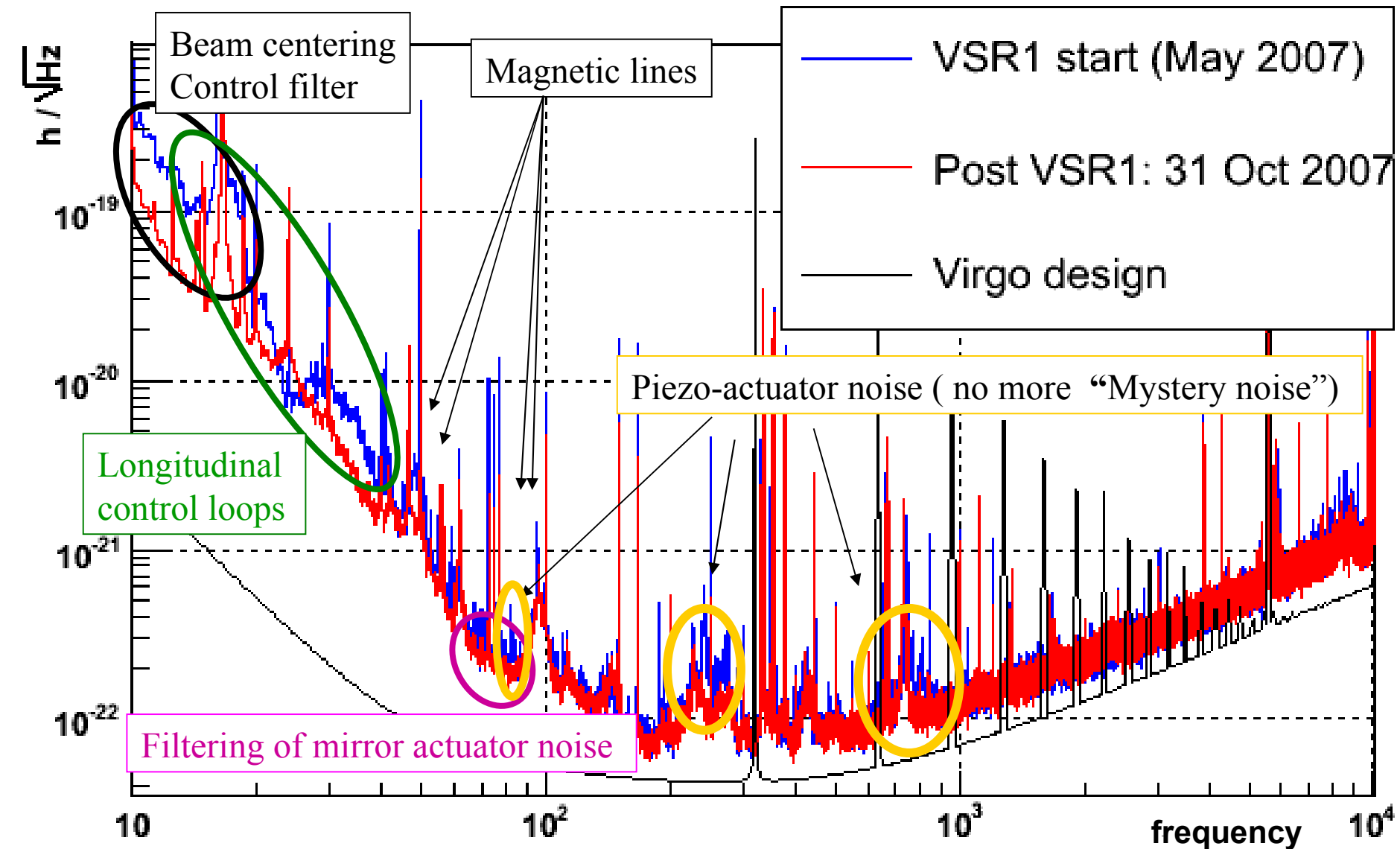
- **Earthquake guardian:**  
 $\rightarrow$  automated switch to more robust control
- 2. **Suspension differential control:**  
 $\rightarrow$  immune to common displacements



**Survive to displacements 2-3 times larger**

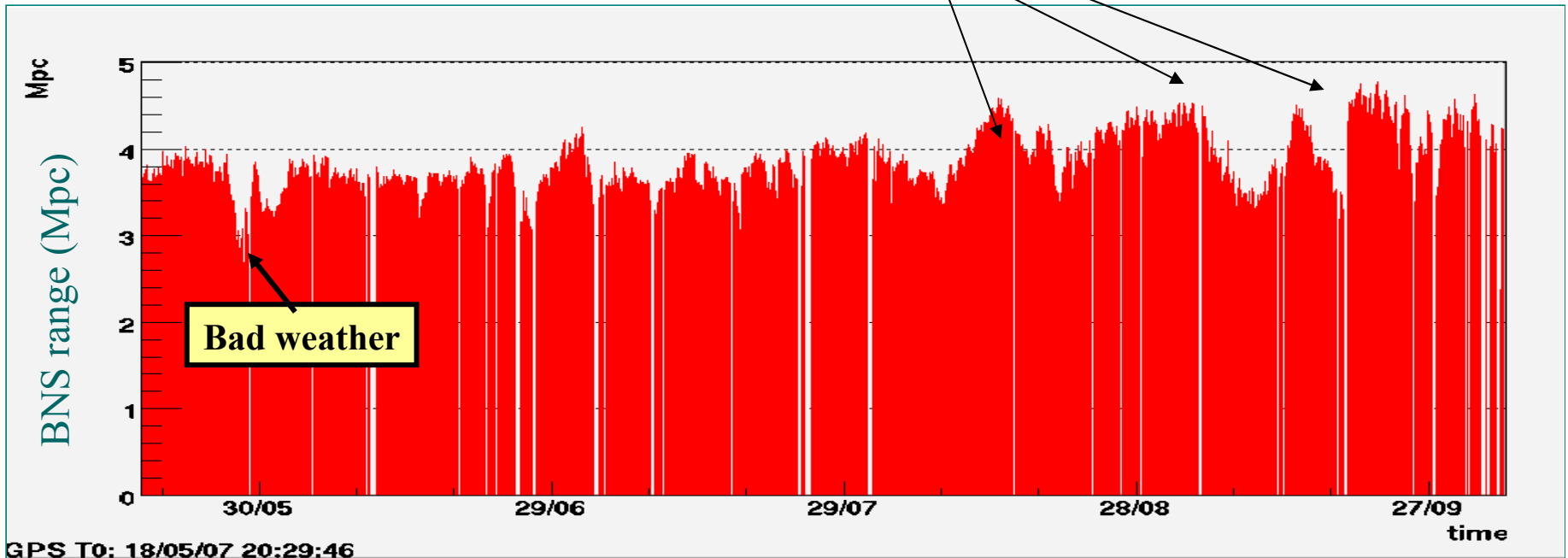


# VSR1 sensitivity improvements summary



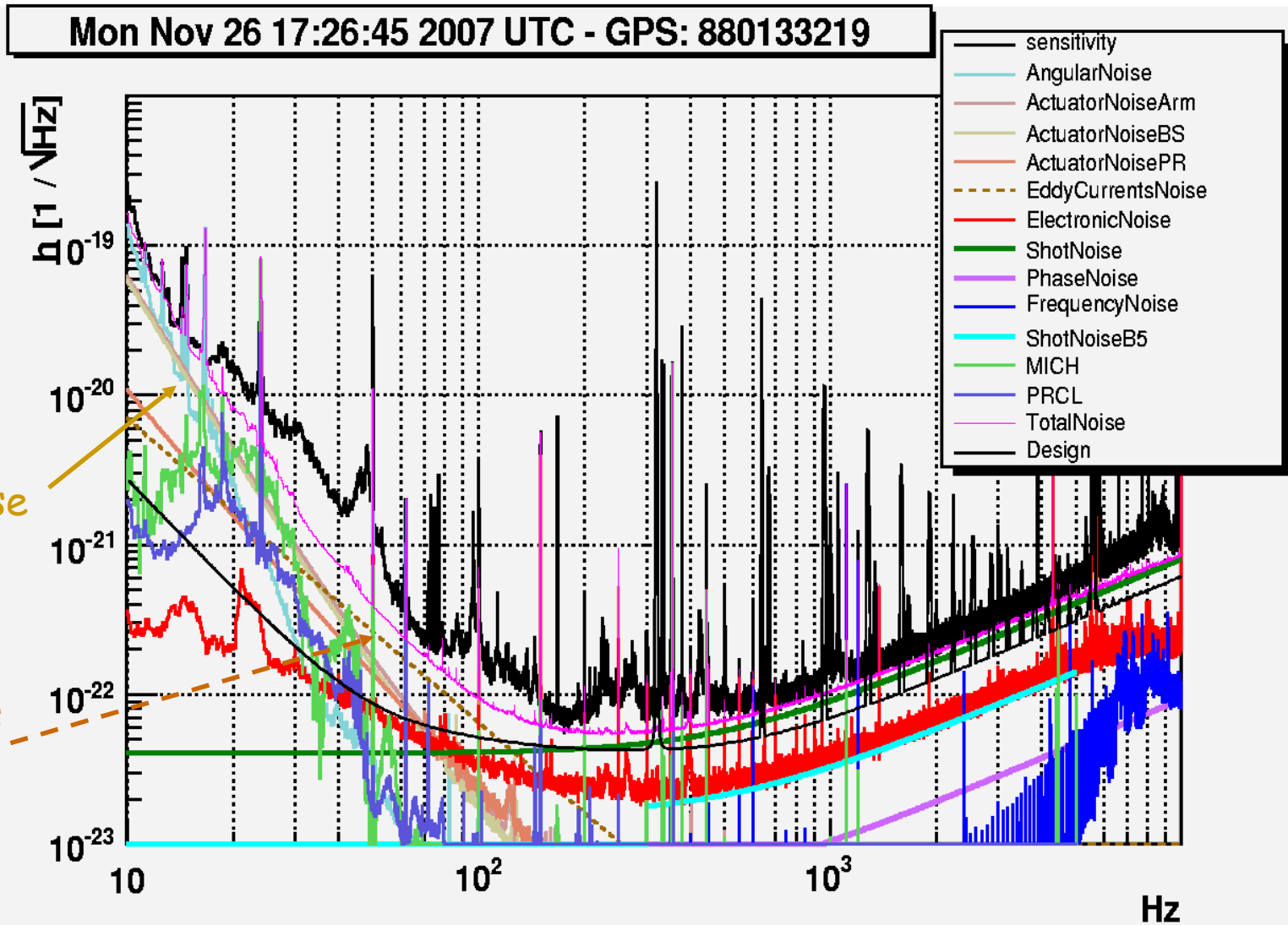
# VSR 1 BNS Horizon

- The VSR1 horizon
  - It was **3.7 Mpc** at the beginning of the run
  - And it was increased **above 4Mpc** at the end of the run



- Main causes of horizon variations:
  - bad weather
  - ‘Thermal effects’ combined with control noise
  - non stationarities due to alignment fluctuations

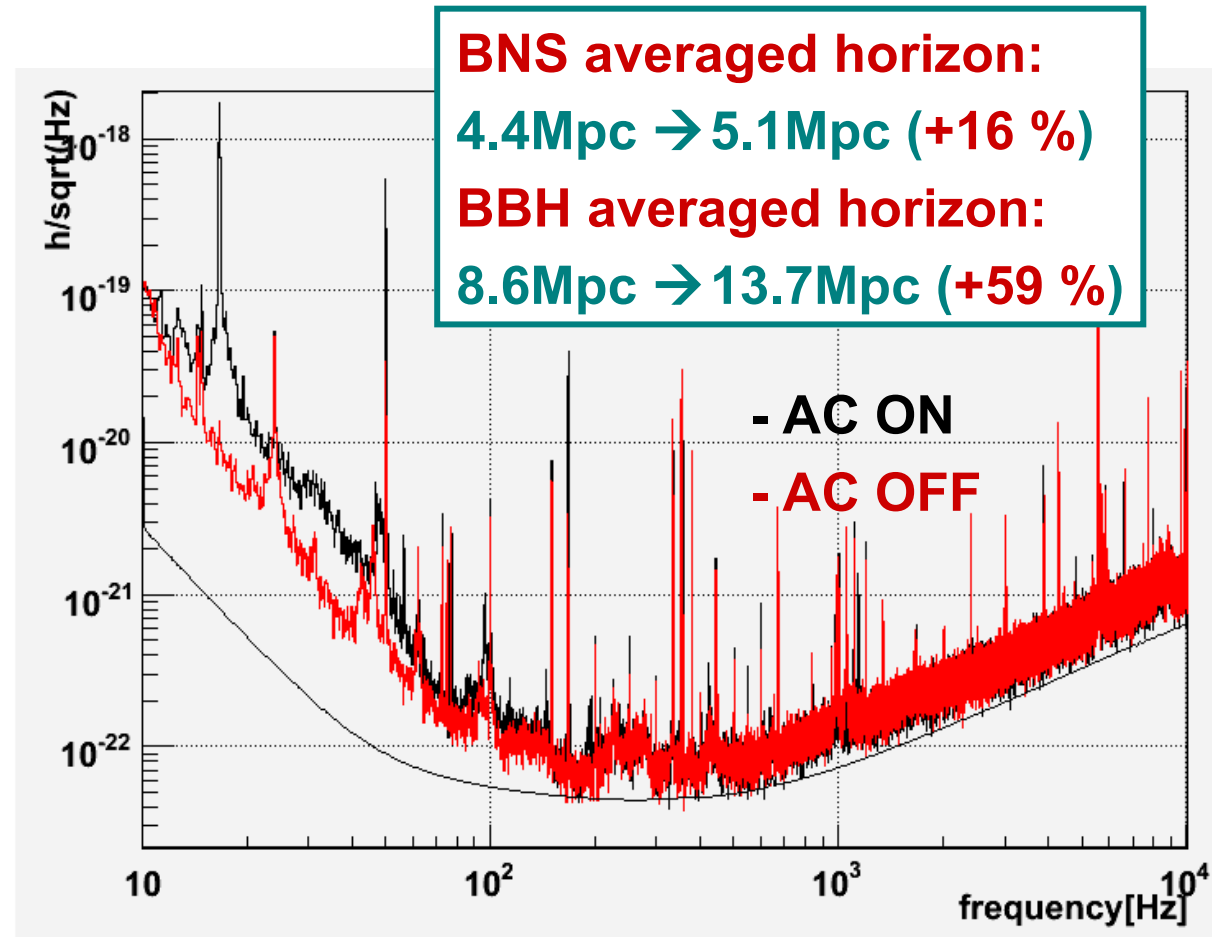
# After VSR1 Commissioning activity: control noises reduction





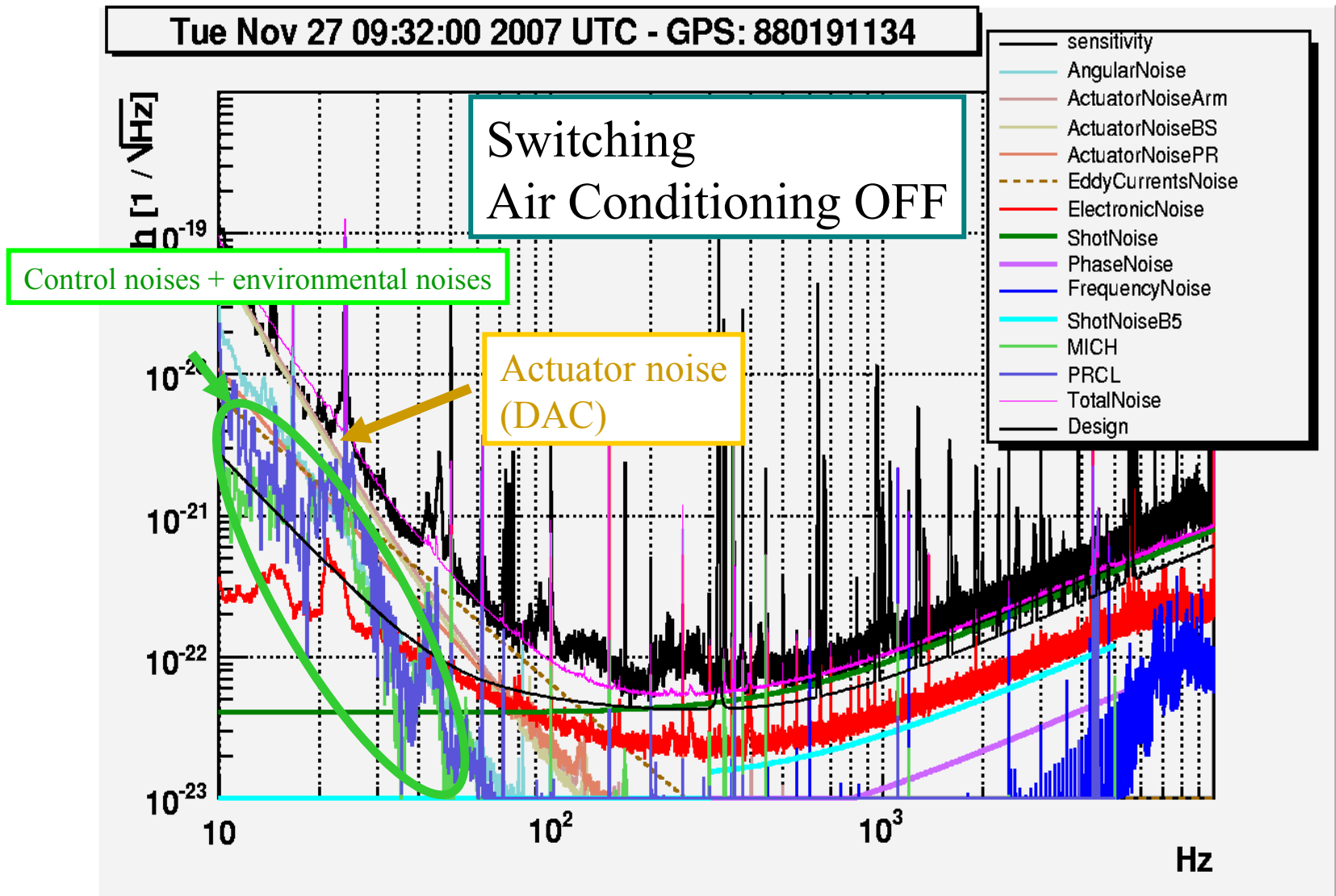
# After VSR1 Commissioning activity: Environmental noises – the main limitation

- Now we know environmental noises are the main sources of disturbance
  - For example we made a test switching OFF the air conditioning devices
  - There are other possible sources of noise, like the electronic racks close to the towers or in laser lab
- Now we are working in order to reduce the environmental noise and understanding the noise coupling path.



\*Horizon estimated with (15;15) Ms BH

# After VSR1 Commissioning activity: Environmental noises – noise budget



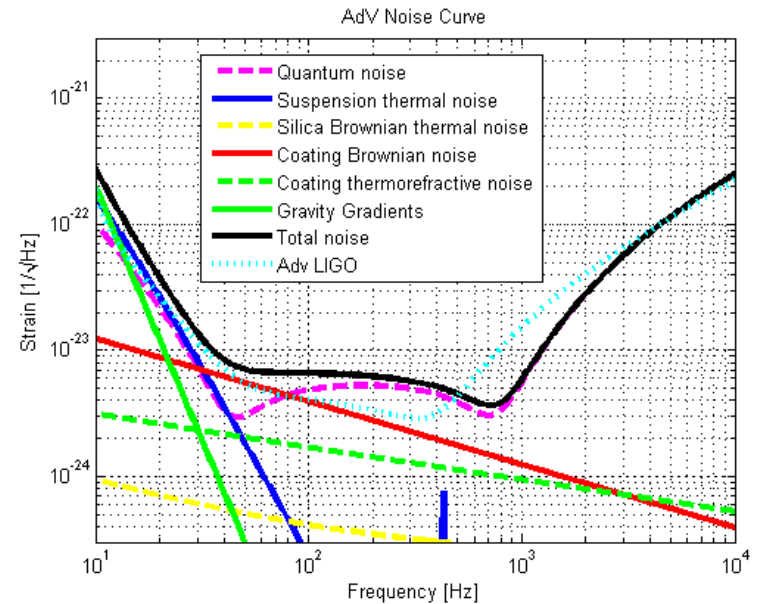
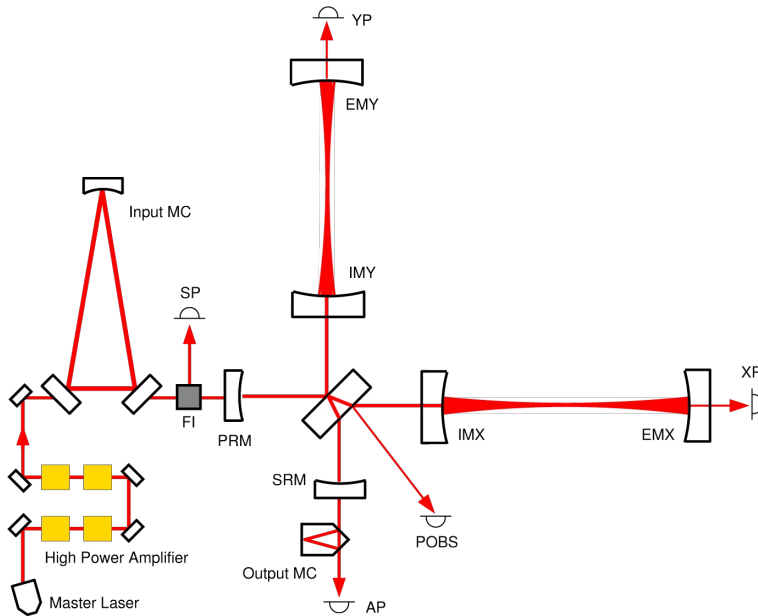
# From VSR1 to Virgo+ Plan

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- **Priority target**
  - **Virgo+ online at the same time as eLIGO (mid-2009) with matching sensitivity**
- **Post VSR1/fall 2007:**
  - Few months of commissioning (low and mid frequency)
    - Control noises and environmental noise
- **2008**
  - Environmental noise mitigation
  - Thermal compensation
  - Virgo+ upgrade (May+June 2008)
    - New DAQ and control electronics
    - Laser Amplifier (50W) and Injection system optics for the 50W
    - New mode cleaner end mirror and payload
  - Global commissioning (from mid 2008)
- **2009**
  - Global commissioning
  - Start the second Virgo Science Run (VSR2) around mid-2009

# Beyond Virgo+ ADVANCED VIRGO

- **GOALS:**
  - Sensitivity: about 10x better than Virgo
  - Timeline: be back online with AdvLIGO
- *Conceptual Design and Preliminary Cost Plan and Project Execution Plan* submitted to the STAC and the funding agencies
- The EGO Council supports the Advanced Virgo project



# Conclusions

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- VSR1 completed with:
  - duty cycle of 84% ITF locked and 81% in science mode
  - BNS avg horizon about 4Mpc
- Virgo sensitivity had been improved during the VSR1, thanks to the strategy to keep hours for commissioning activities during the run.
- In the post-VSR1 commissioning activity we already have important improvements:
  - Reduction of control noise
  - Understanding of the environmental noise sources
- The Environmental noises are now the main concern
  - E.g. switching off the air conditioning, the horizon increases from 4.4Mpc to 5.1Mpc for BNS and from 8.6Mpc to 13.7Mpc for BBH
- Commissioning is going toward the Virgo+ upgrades