


# Virgo+ Commissioning Status

## Main upgrades and activities

- Laser system: from 10 → 25 watt output power at the IMC
- TCS: ring + Central Heating
- Electronics: ADCs and DSP replacement, Global Control
- Viewports replacement
- NE mirror replacement
- CB electrical net and Grounding
- Infrastructure works to noise reduction (EE room)

## Viewports replacement

- In Virgo the total number of viewports to be finally changed is 91 = 41 He-coated + 48 uncoated + 2 YAG coated
  - Taking into account delivery + installation time complete substitution → 15 December
  - Some are “historical viewports” for visual inspection, others will be no needed before some months (photon calibration)
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- Mounting only the really needed viewports for correct ITF working the number is reduced to 55 – these viewports are now all available IB, IMC, PR, BS, WI substituted - WE, NI, NE, DET expected to be ready for 15 October
  - Viewports no more in the critical path
  - NE mirror to be installed in second week of October





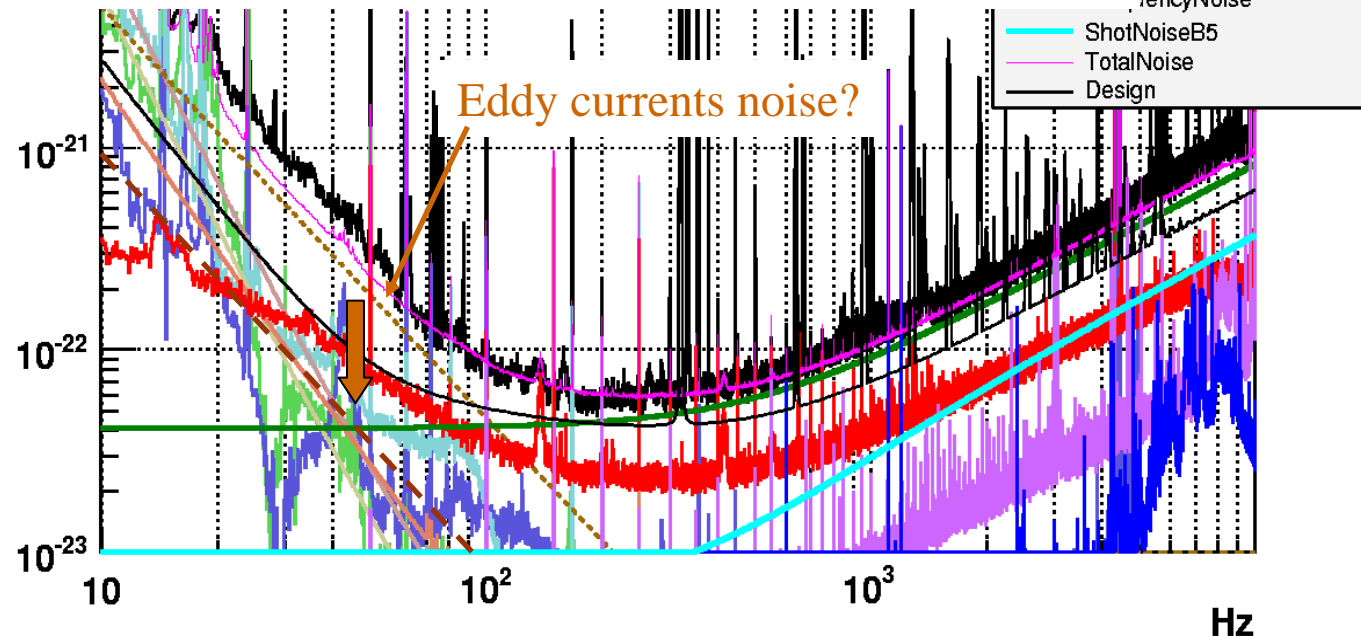




## May 2008 Virgo noise budget (8 watts no TCS)

Many environmental noises and control noises below 50 Hz are near Virgo design (magnetic and diffused light not shown here)  
 ⇒ could explain a large fraction of the noise at low frequency  
 ⇒ to be further worked on at restart

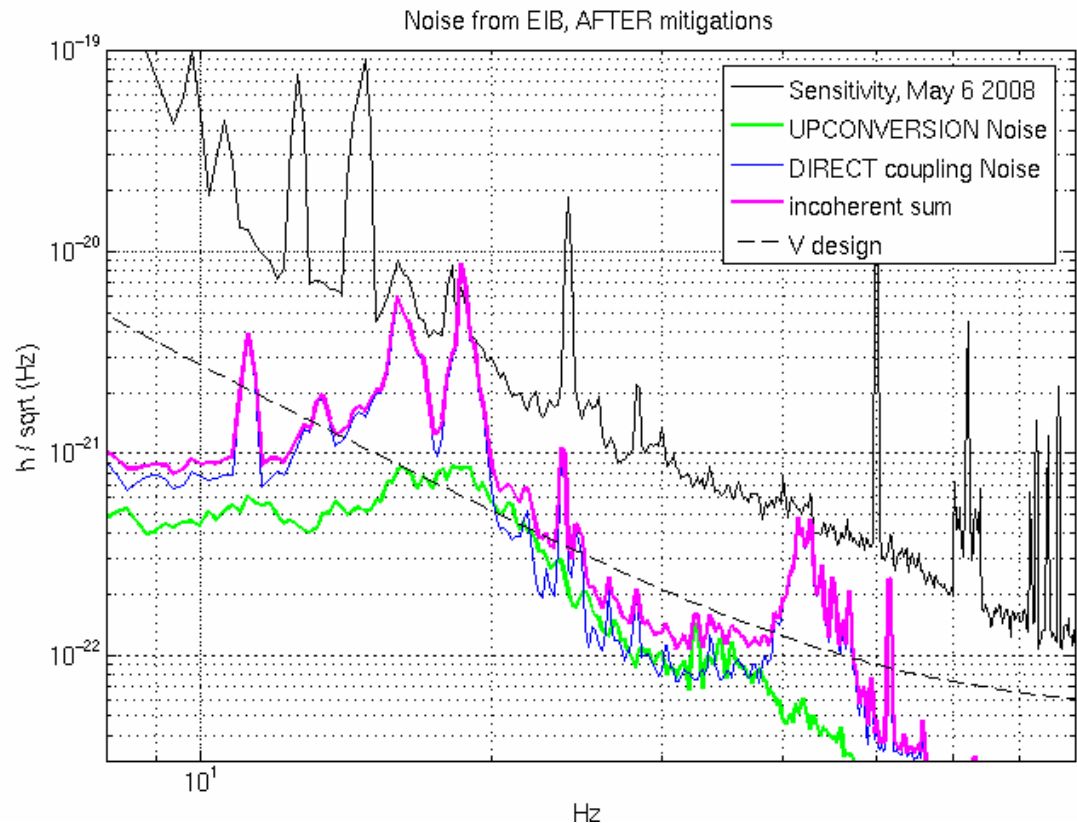
Eddy currents noise (if any) will be reduced with smaller magnets



# Environmental noises

- Good modeling of the coupling of diffused light to DF  
=> Non negligible contribution <math>< 4f</math> Hz
- Improvements planned:
  - Optics:
    - Continue 'cleaning'
    - Better beam dumps
    - NE transmission /4
  - Reduce the motion of benches:
    - ⇒ Improve benches mechanics
    - ⇒ Resonance dampers
    - ⇒ **Electronics racks remove from Laser Laser in the new EEroom**
  - Improve AC: shutdown work in central building

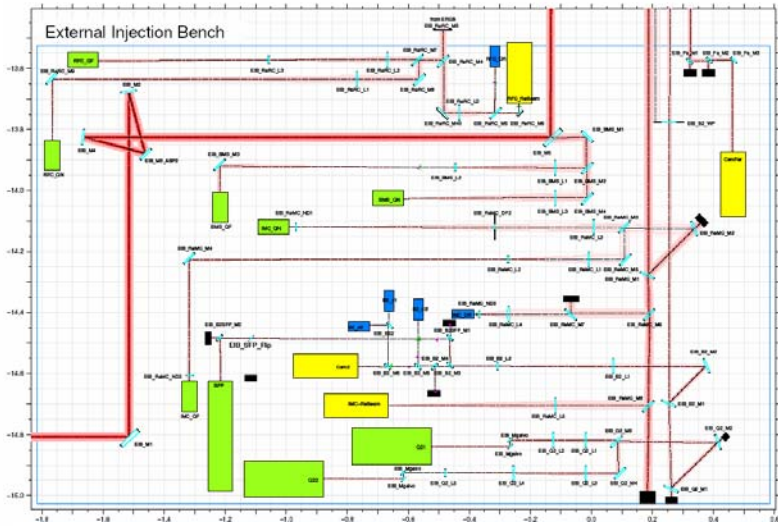
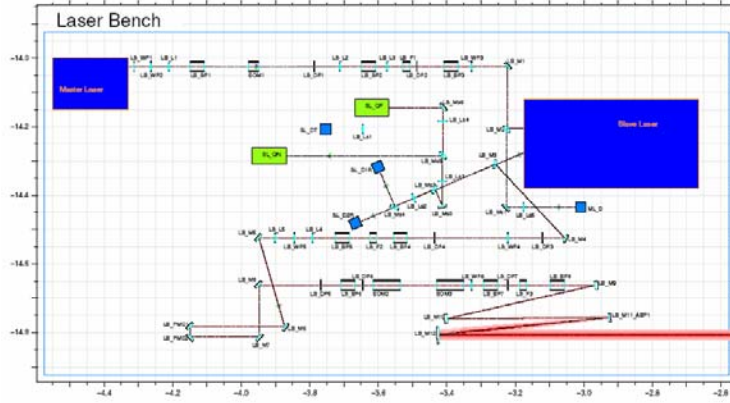
## Noise from EIB (May 6th)



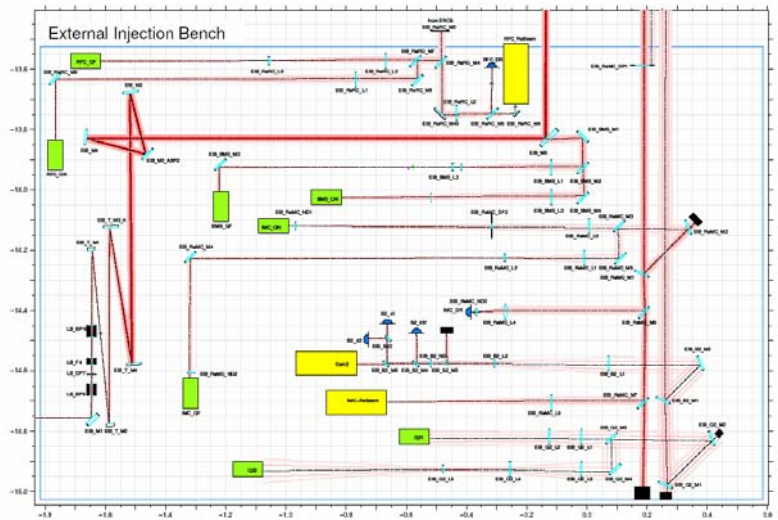
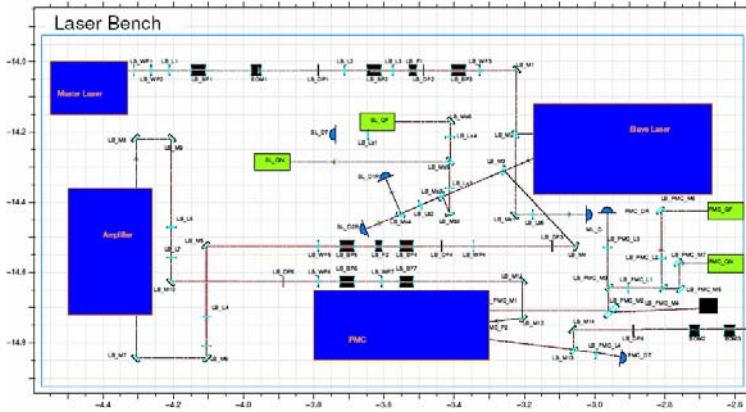
See talk by I. Fiori



## VIRGO



## VIRGO+



Goal : Increase the laser power up to 50 W (at the output of the laser bench).

Virgo+ new laser and ISYS (part of) installation sequence : done so far.

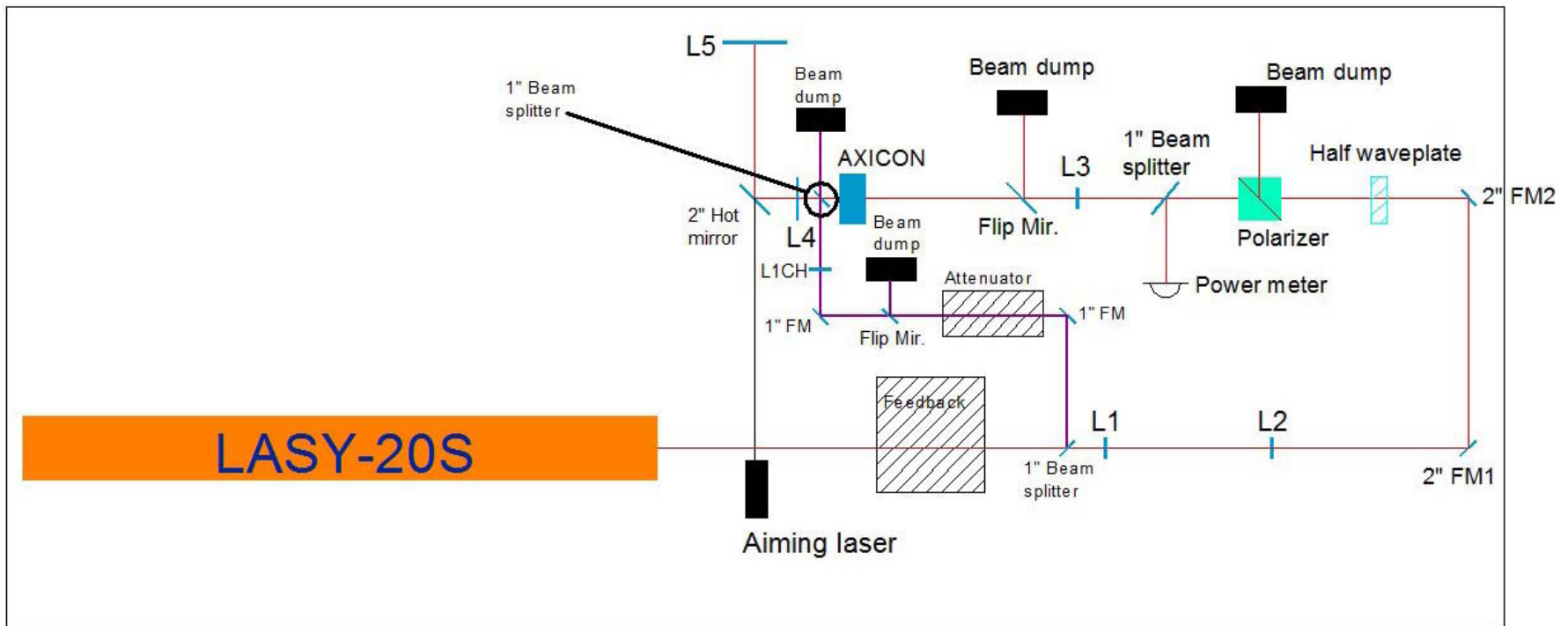
- Laser amplifier integration (end of may)
- **Pre Mode-Cleaner cavity integration (june)**
  - **Seed power = 19W  $\Rightarrow$  Power incident on PMC = 60.3W  $\Rightarrow$   $T_{\text{PMC}}=87.7\% \Rightarrow P_{\text{outPMC}} = 52.9 \text{ W}$ .**
- New IMC end mirror has been installed (beginning of july)
- TF measurements - Local control re-design and IMC locked
- **The commissioning of ISYS loops has started (BMS, IB AA and MC AA up to maximum power (27 W transmitted by the IMC)).**
- New tie-rods installation under the EIB to rigidify the bench (analysis going on).
- Input power remote tuning system installation (after EIB faraday isolator).
- IMC matching fine adjustment (contrast defect 8% with 15W at the IMC input port).
- MC AA new filters implementation.

## Plan for ISYS end of installation and commissioning

- BMS, IB and MC AA loops commissioning (1W, 8W and full power), IMC cavity characterisation: OLTF (measurements with different powers), Finesse, losses, ...
  - **IMC and SIB faraday isolator thermal effects checks.**
  - Laser, amplifier and Pre Mode-cleaner alignment optimisation (due to laser pumping diodes displacement in EEroom).
  - IMC remotely controlled loop gain adjustment installation (to ensure to keep the IMC locked from low power up to high power).
  - **SIB Faraday isolation improvement by adding an halfwave plate between the first polarizer and the Magneto-optic crystal (2 weeks are needed).**
- ⇒ ISYS commissioning should be completed by the end of october.

# TCS

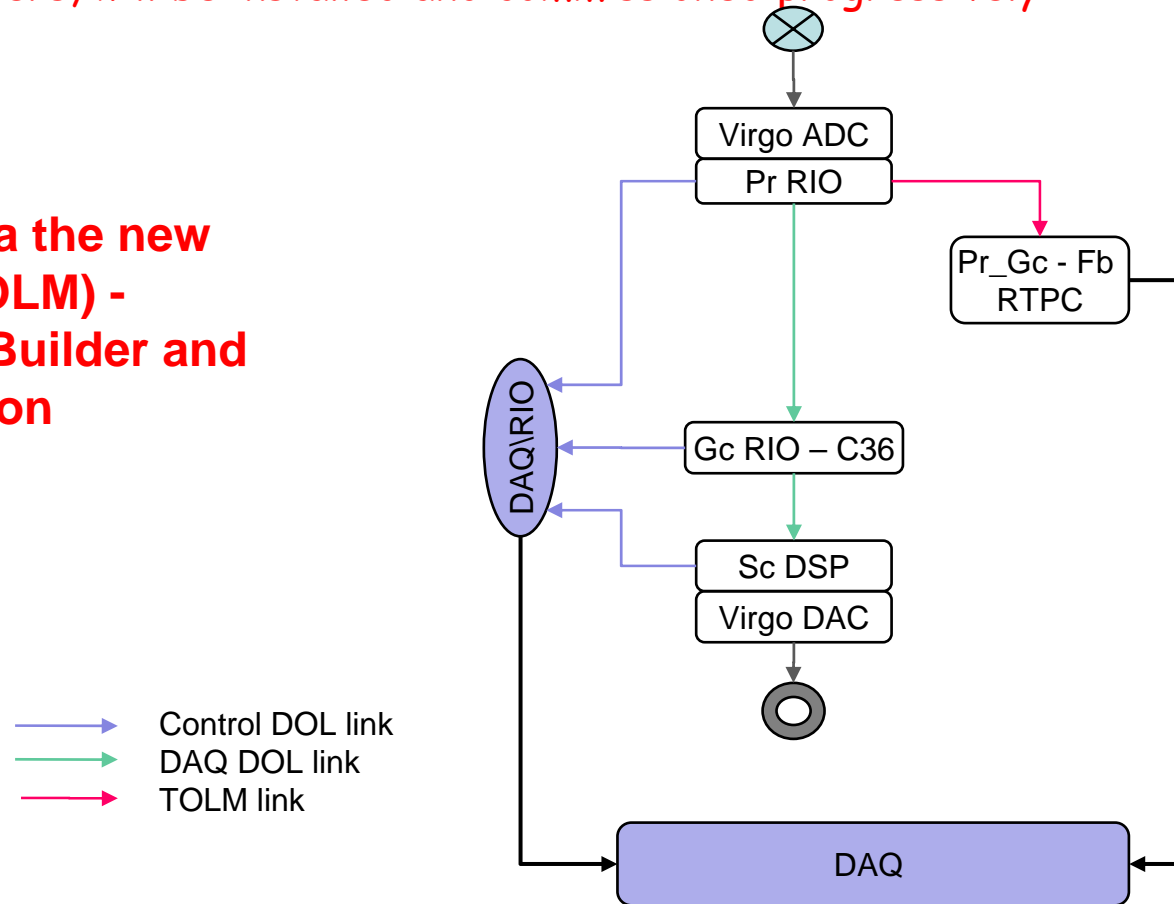
- Use of the central heating
- Install first the TCS with only the ring heating



# Electronic upgrades

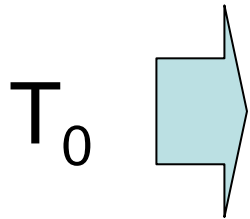
- New control electronics:
  - Functional tests of whole chain (ADC, Gc software, timing)
  - Put in use and validate ADCs for monitoring channels (October)
  - Install a DSP in the WI tower and test - Inertial Damping - (October)
  - The rest of electronics : ADCs for angular and longitudinal controls, new DSP on all towers, will be installed and commissioned progressively

**Signals sent via the new Optical link (TOLM) - Test of Frame Builder and Global control on Real Time PC**





## Definition of $T_0$



- ISYS commissioned
- All needed viewports installed
- NE new payload installed
- TCS ring heating installed
- Env. ADCs installed, new DSP under test in WI tower, new GC under test

A detailed plan can be found in

[http://wwwcascina.virgo.infn.it/collmeetings/D  
Mwebpages/](http://wwwcascina.virgo.infn.it/collmeetings/D<br/>Mwebpages/)

**$T_0$  is expected to be at 31th of October**

## **Main steps toward VSR2**

- 1) Hot ITF reasonable sensitivity
- 2) Standard configuration (Compensated 8 watt)
- 3) High sensitivity @full power

## 1 – Reasonable hot ITF sensitivity

- 1) Retuning of demodulation phases for locking up to step 8.  
Retuning of locking and alignment phases and gains. **(2 weeks)**
- 2) Reaching step 8 (1 week)
- 3) Output Mode cleaner recovering – step 9 (1/2 week)
- 4) Low noise locking filter retuning –step 10 (1/2 week)
- 5) Force reallocation on the marionette and low noise on suspensions – step 11 - (1/2 week)
- 6) Retuning of noise control suppressions ( $\alpha, \beta, \gamma$ ) – step 12 – (1/2 week)
- 7) Noise hunting towards a reasonable sensitivity – (3 weeks)**

**Total time to reach status 1 → 8 weeks.** Notice: **in this scheme it is assumed that the GC used is still the old one, as well as control and sensing ADCs.**

## 2 – Standard configuration

- **TCS commissioning and standard configuration.** The goal is to reach a status of the interferometer defined as the working at 8 watt power and with fast lock recovering. This configuration is called standard. Tests up to 25 watts
- **2.1) Characterization of cold interferometer. The input power is 1 watt. The goal is to define the working point of the ITF, measure the sidebands aberrations in cold state, compare with simulations.**
  - 2.1.1) Locking Phases and gains retuning to reach step 8 – 1 week –
  - 2.1.2) Sidebands aberrations measurements. Maps of working point – 1/2 week
  - 2.1.3) Optical characterization and ITF working point definition – 1/2 week
  - 2.1.4) TCS Transfer function measurement and characterization – 1 week
- **2.2) Power rising to 8 watts maintaining the ITF controlling aberrations. Implementation of central spot for fast lock recovering → standard configuration**
  - 2.2.1) Input power rise to 2 watt. Thermal effect measurement and TCS control with annular and central spot – 1 week
  - 2.2.2) Power to 4 watts. Thermal effects and fast recovering - 1/2 week
  - 2.2.3) Power to 8 watt. Thermal effects control. – 1/2 week
  - 2.2.4) Thermal effect control at 8 watts. Tests at 16 watts – 1 week
  - 2.2.5) Power to 8 watt - Fast recovering procedure identification. 25 watts tests – noise hunting - 1 week
  - 2.2.6) Standard configuration definition. 25 watts tests- noise hunting - 1 week -

**Total time to reach status 2, the standard configuration → 8 weeks.**

## Hardware upgrades

Hardware to be upgraded:

- New coil drivers
- Installation of ADCs for detection and control
- New DSPs
- Photodiodes under vacuum
- Phase camera
- **AC noise mitigation (see talk of I. Fiori)**

Total time: 6 weeks of non-parallel works (exclusive ITF use)

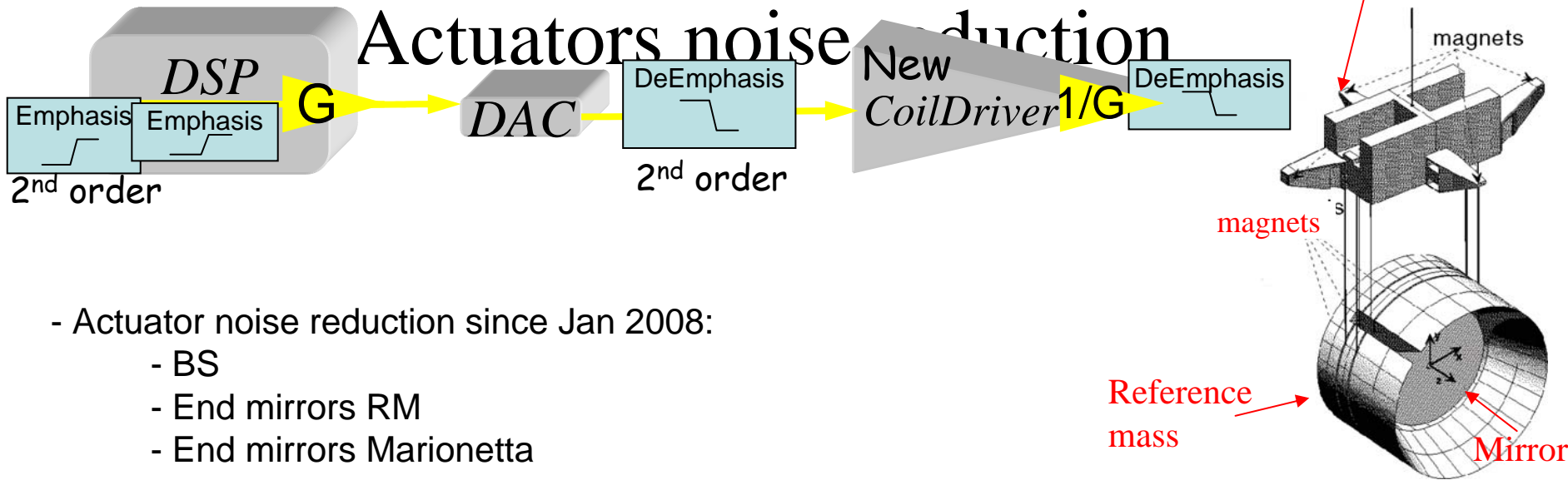


## 3 – High sensitivity @ full power

- **Low noise full power. Science Mode definition.** The activities will be devoted to obtain a 25 watt input power configuration in ITF working point as defined by standard configuration.
- 3.1) 25 watt - annular thermal effects control. Noise hunting – 2 weeks
- 3.2) Fast lock recovering. Noise hunting - 2 weeks
- 3.3) Noise hunting and SM definition– 6 weeks
- **Total time to reach status 3, ITF in SM → 10 weeks.**

## Conclusion

- The highest uncertainties concern the periods of noise hunting. Considering the previous time schedules the VSR2 should start at the end of June.



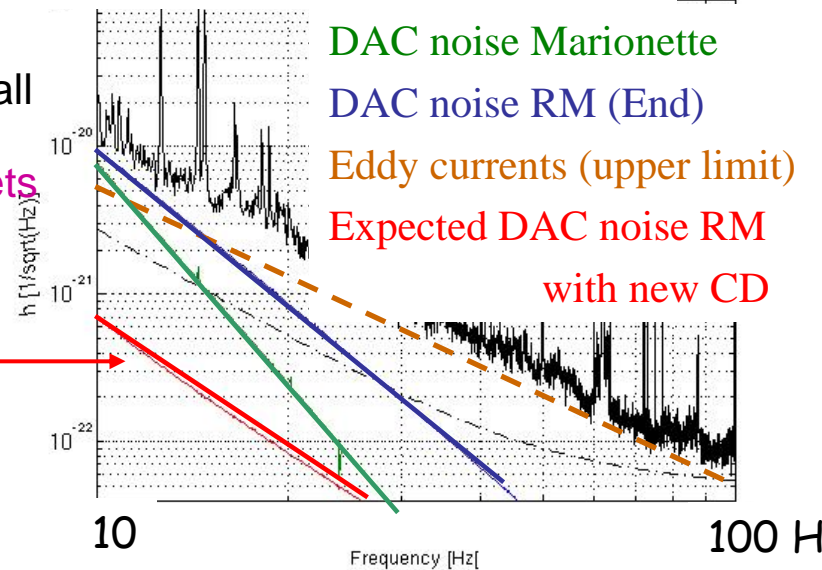
- Actuator noise reduction since Jan 2008:
  - BS
  - End mirrors RM
  - End mirrors Marionetta

- New coil drivers:
  - validated in the lab
  - improved filtering defined and tested with small magnets on NI

⇒ to be used at the restart with the smaller magnets on end mirrors

- Next:
- 1/ use new CD on end mirrors
  - 2/ use new CD on all RM (priority: BS)
  - 3/ further reduce marionetta actuator noise

Actuator noise projection (May 5th)



- The new viewports installed in the basic configuration: this will allow the complete commissioning of Virgo+. Not allowed photon calibration and some visual inspections of mechanical parts of the towers.
- The NE payload will be mounted, the SA retuned and local control recommissioned.
- The injection system will be commissioned. Also the Faraday Isolator remote tuning will be commissioned. The ITF is roughly aligned.
- The TCS will have the installations of the annular compensation in both the input towers. The central spot and power stabilization will not be installed at T0.
- Sensing Electronic: monitoring ADCs will be installed. Not yet installed the Control ADCs and Detection ADCs. Whole timing system characterized. The cabling and suspension tuning for under vacuum photodiode installation will be performed. A new DSP prototype being tested with Inertial Damping in a tower.