

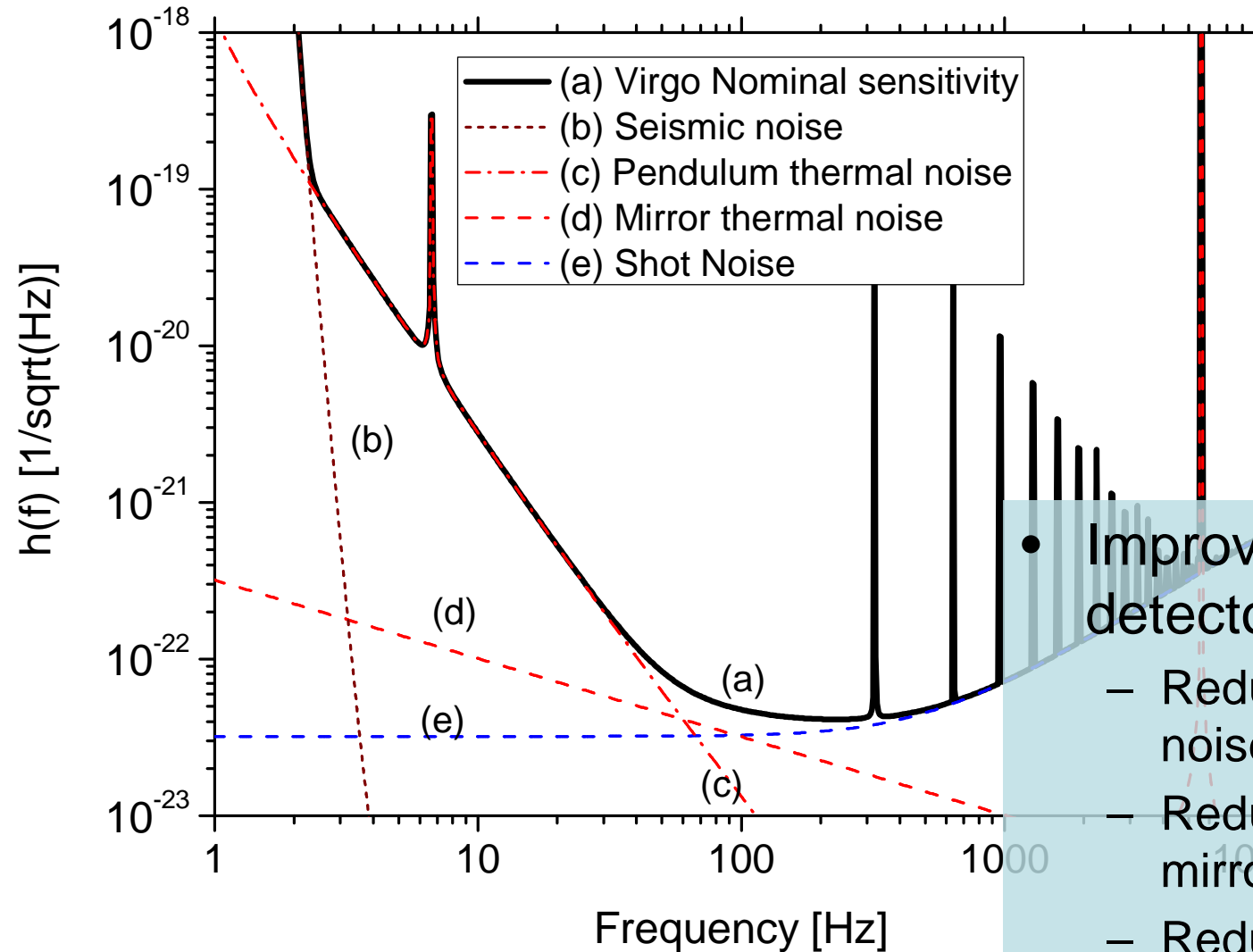
Evolution of the Virgo detector: The Virgo+ plans

Michele Punturo

Virgo collaboration

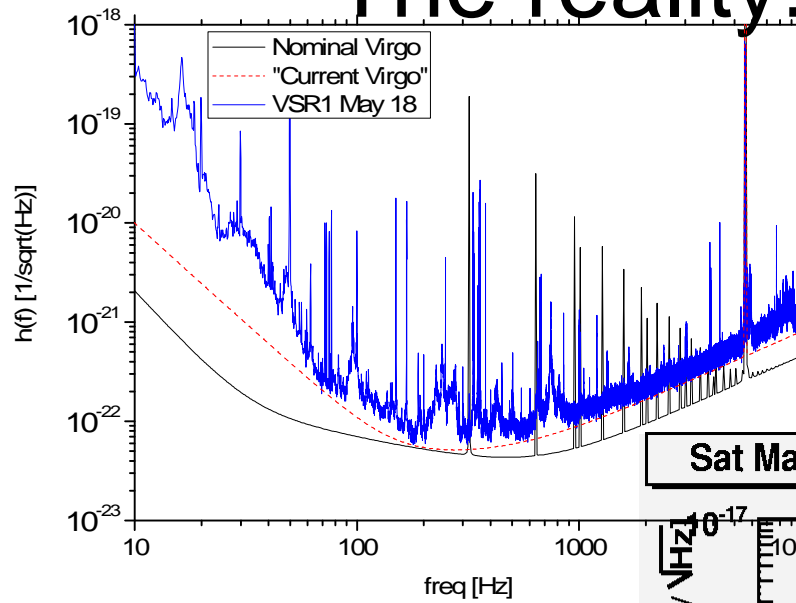
LIGO-G070335-00-Z

The theory: The Virgo nominal sensitivity



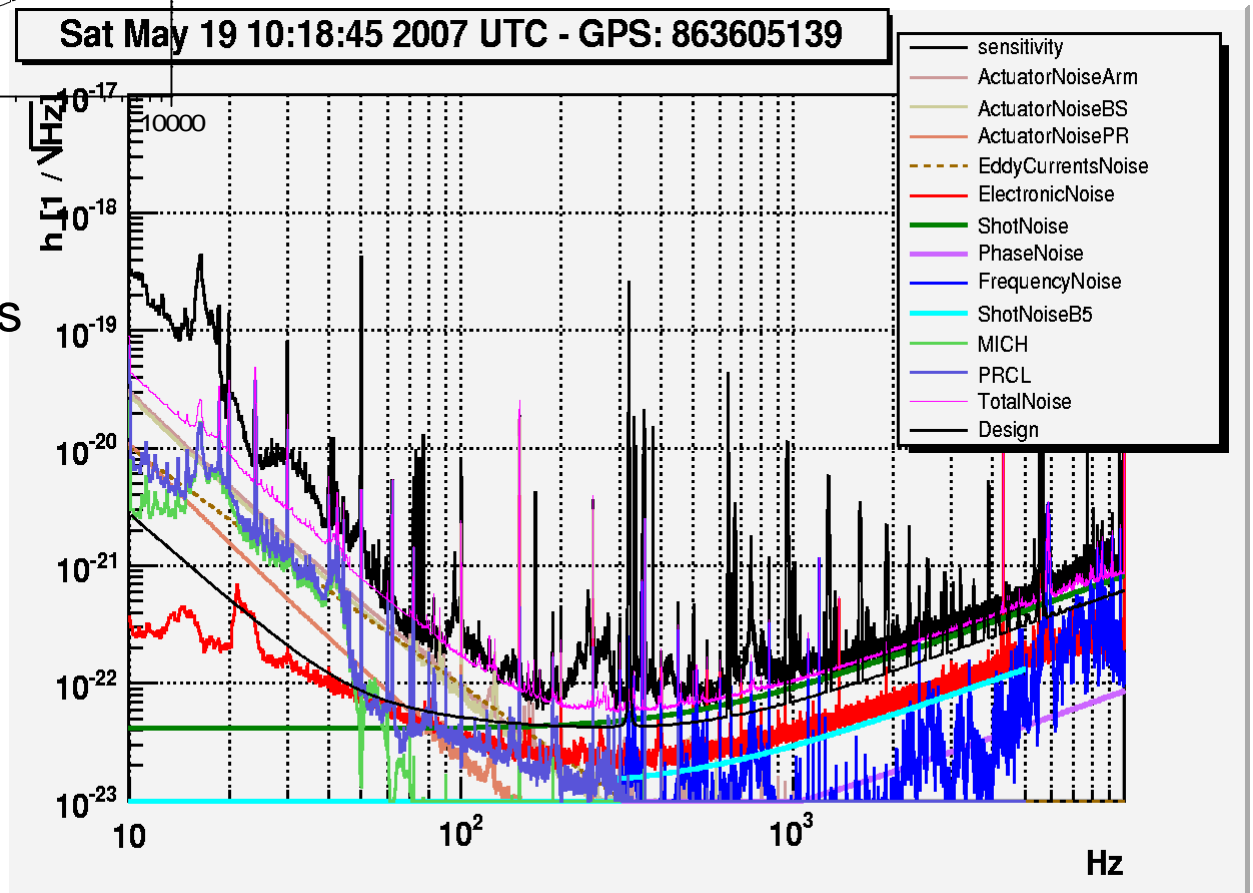
- Improvement of the detector:
 - Reduction of the shot noise
 - Reduction of the mirror thermal noise
 - Reduction of the suspension thermal noise

The reality: The Virgo noise



- “Actual” Virgo
 - 7.9W injected instead of 10W
 - $G=40$ instead of 50
 - Eddy current effects
 - Perfect OMC

- Real life: technical noises
 - Actuation and control loops noises at low frequency
 - Un-modeled noises in the central frequency range

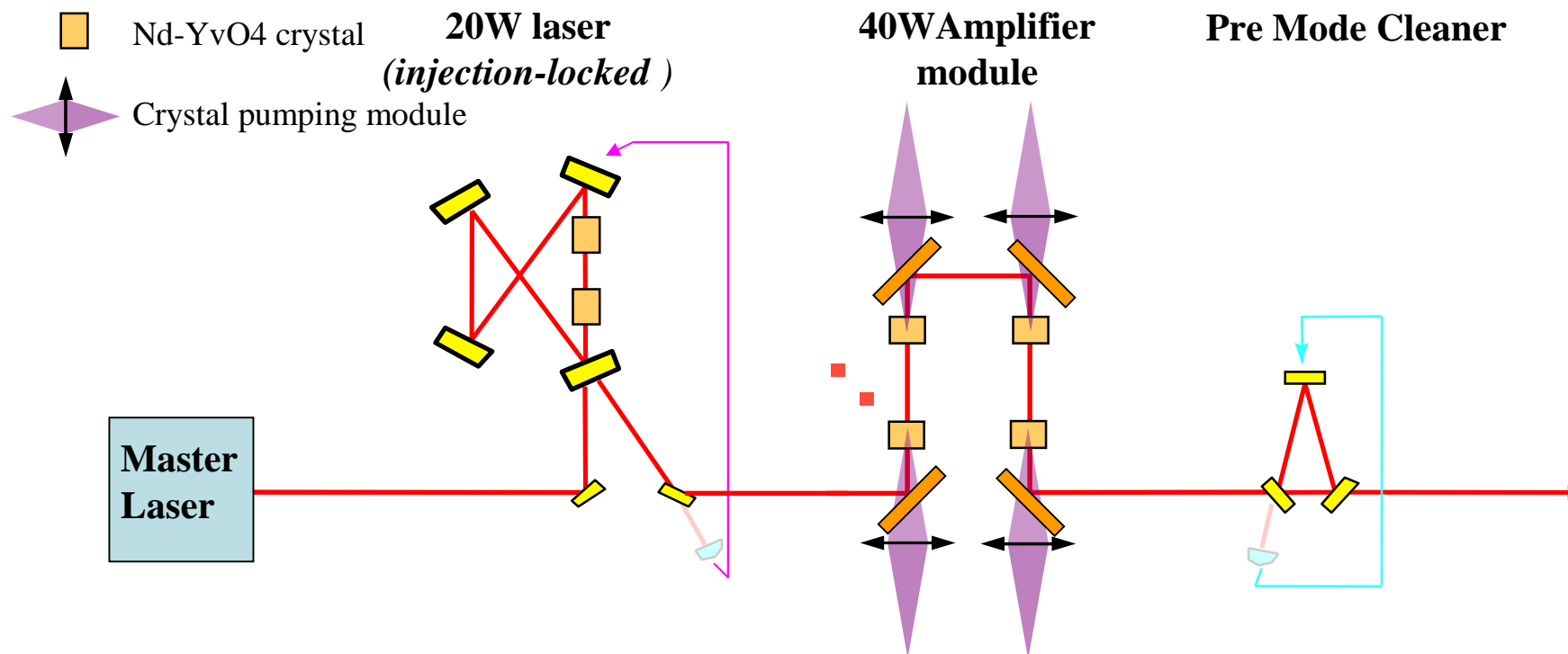


Building up the Virgo+ plans

- The upgrade plan must take in account the two “visions”:
 - Reduction of the “fundamental” noises
 - Higher laser power
 - Lower suspension (thermal) noises
 - Identification and mitigation of the technical noises
 - A series of “limited” upgrades, already foreseen before the Virgo+ project, entered in the Virgo+ global planning
- Long commissioning phase after the joint VSR1-S5 run
 - Recovering of the intermediate frequency sensitivity
 - Scattered light
 - Actuation noise
 - Recovering of the low frequency noise
 - Control loops noise investigations
 - MSC further investigations
 - Eddy current possible mitigation
 - Installation of small upgrades

Virgo+ upgrades: new laser amplifier

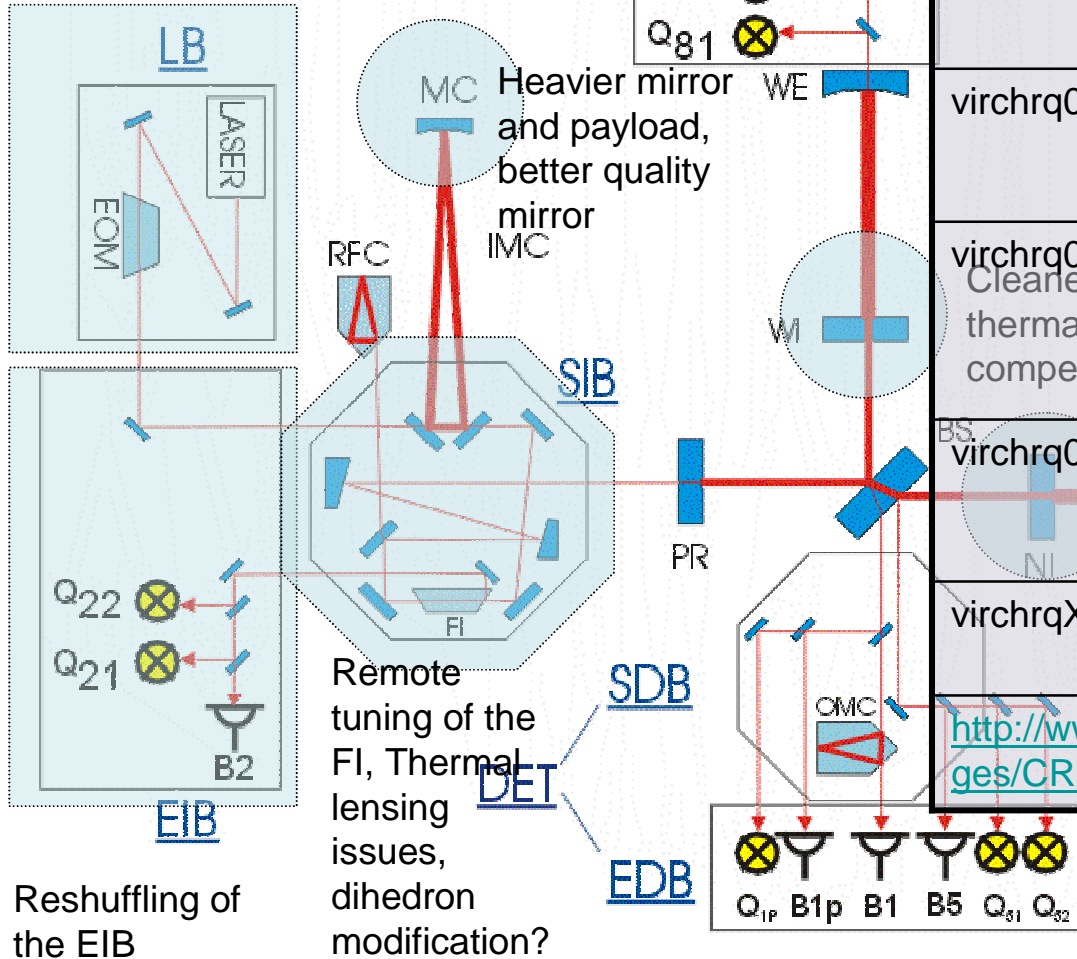
- A 50W laser amplifier (produced by LZH) is already under test in the Virgo-Nice lab



Cascade effect on the ITF

- Obviously the laser power increase will affect all the ITF

Reshuffling of the LB: Pre-MC, new FIs, remote tuning of the injected power



Code	responsible	Title
virchrq0022005	P. La Penna, N.Man	Laser Improvements WP for Virgo+
virchrq0032006	(now) J. Van den Brand	Replacement of the Virgo MC payload
virchrq0012007	P. La Penna	Suspended Injection Bench Faraday isolation remote adjustment
virchrq0042007	P. La Penna	ITF input power remote tuning
virchrqXXXXXX	V.Fafone	Thermal compensation

<http://wwwcascina.virgo.infn.it/collmeetings/DMwebpages/CRE/index.html>

New Last stage suspension

- Suspension and mirror thermal noises are still far to be a limit for the current Virgo sensitivity, but:
 - “Scientific” Motivations
 - Reduction of the shot noise (and the increase of the cavity finesse from 50 to 150) will “discover” the mirror thermal noise
 - Virgo end mirrors are made in Herasil
 - Lower coating mechanical losses
 - Reduction of the suspension thermal noise will permit to completely benefit of the high filtering performances of the Virgo SA
 - “Technical” motivations
 - Suspension thermal “excess noise”, due to eddy currents in the RM could become quickly a limiting noise in the low frequency range
 - RM in Aluminum aren’t compliant with the Virgo design
 - Magnets intensity larger than the original design
 - Intervention on the input mirror payloads also required by
 - Wrong polarity of the magnets
 - Cleaning of the mirror (is situ?)

Monolithic suspension

- A fused silica monolithic suspension design is under development in Virgo
 - Joint effort of the Perugia, Roma 1, Firenze labs with the EGO and LMA support
- Keywords
 - Monolithic FS suspension
 - Silicate bonding of the fibers to the standard (new) Virgo mirrors
 - Metallic marionette (fully compatible with the current SA)
 - Metal-to-fused silica clamps
 - Dielectric reference mass
- Current status:
 - See H.Vocca talk
 - One suspension trial successful
 - Design under development
 - New mirrors under polishing now
 - Realization foreseen in the Virgo+ scenario (big bet)

New DAQ & Control electronics

- R&D activity started before the Virgo+ project
- Now “fully” integrated in the Virgo+ plan
 - New coil drivers (to be installed before the Virgo+ shutdown)
 - New DSPs
 - Huge computational power
 - See A.Gennai Talk
 - Ready before Virgo+ shutdown, possible some preliminary test installation
 - New timing electronics
 - GPS receiver
 - Timing distribution box
 - See A.Masserot talk
 - New ADCs
 - See A.Masserot talk

TBD activities

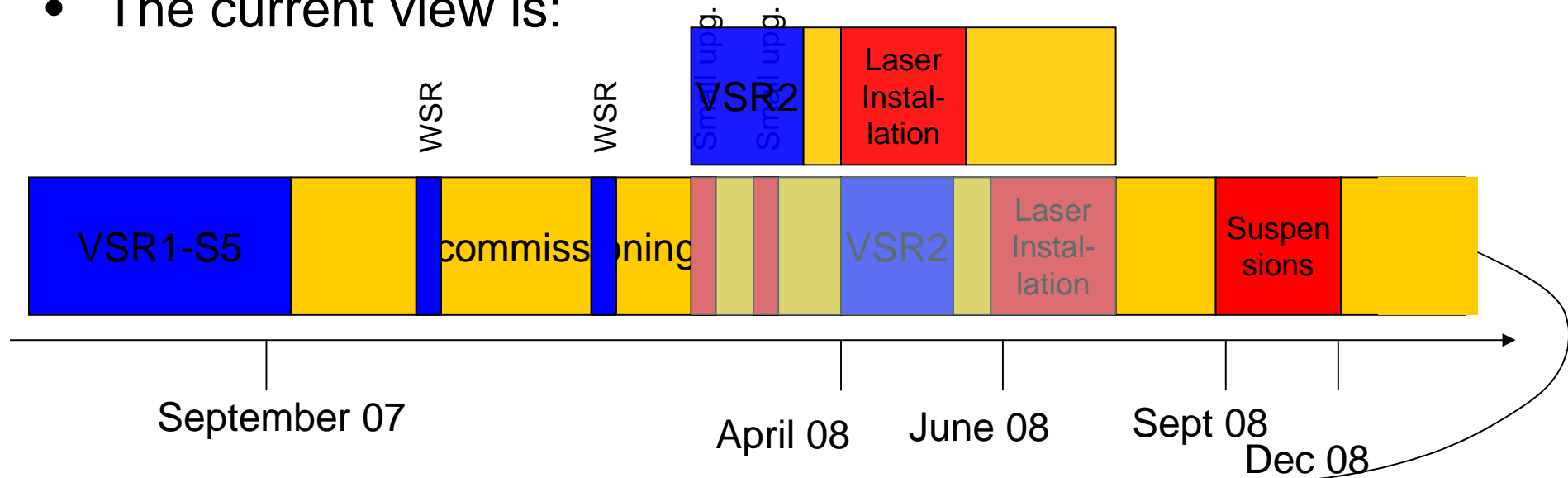
- Other developments are under investigations but their planning still must be defined
 - DC detection (LIGO experience)
 - Tiltmeters
 - To improve the detector robustness against bad weather disturbances

Planning definition

- The Virgo+ planning is still under evolution and the milestones are defined through a series of reviews
 - 3rd of April:
 - First Virgo+ review
 - Definition of the preparation plan
 - <http://wwwcascina.virgo.infn.it/collmeetings/DMwebpages/firstVirgoplusReview.html>
 - November 2007
 - Second Virgo+ review
 - Selection of the mature upgrades
 - Definition of the installation plan
 - Detectors meetings

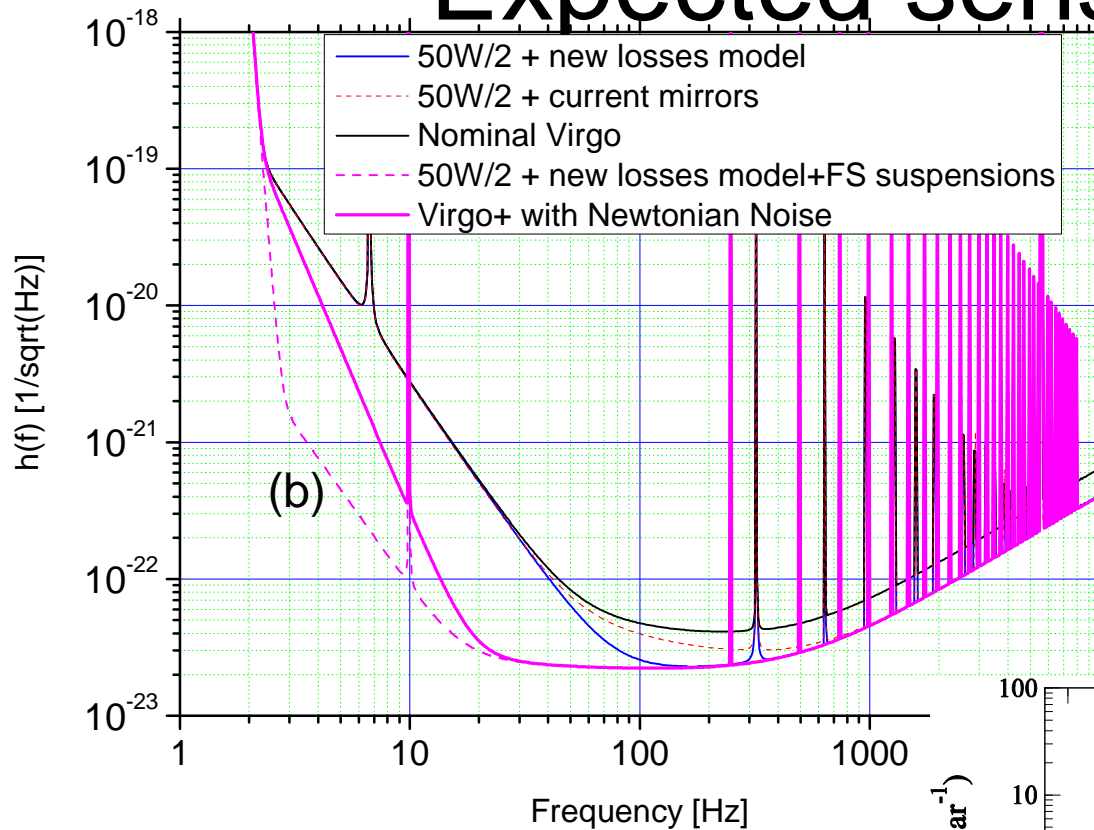
Current Plan

- A production and installation plan is currently available, but still under evolution
- The current view is:



Target:
To be back in science mode before the end of 2009

Expected sensitivity



	Virgo+ (NN) Mpc	Curve (b) Mpc
NSNS	114 (45.6)	121 (48.2)
BHBH	584 (234)	664 (265)

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