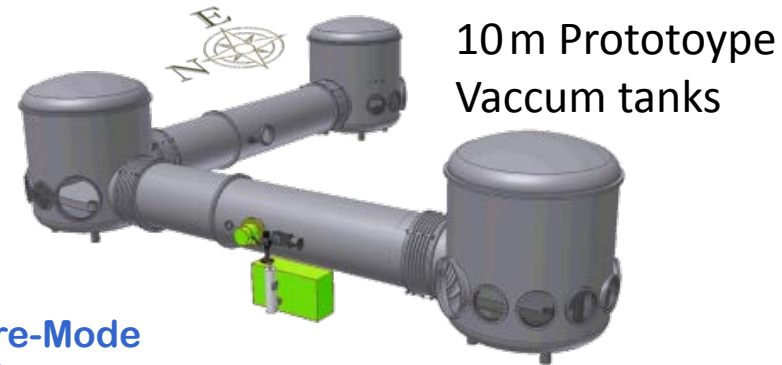# Servo design for the AEI-10m reference cavity

GEO-isc meeting

December 14, 2010
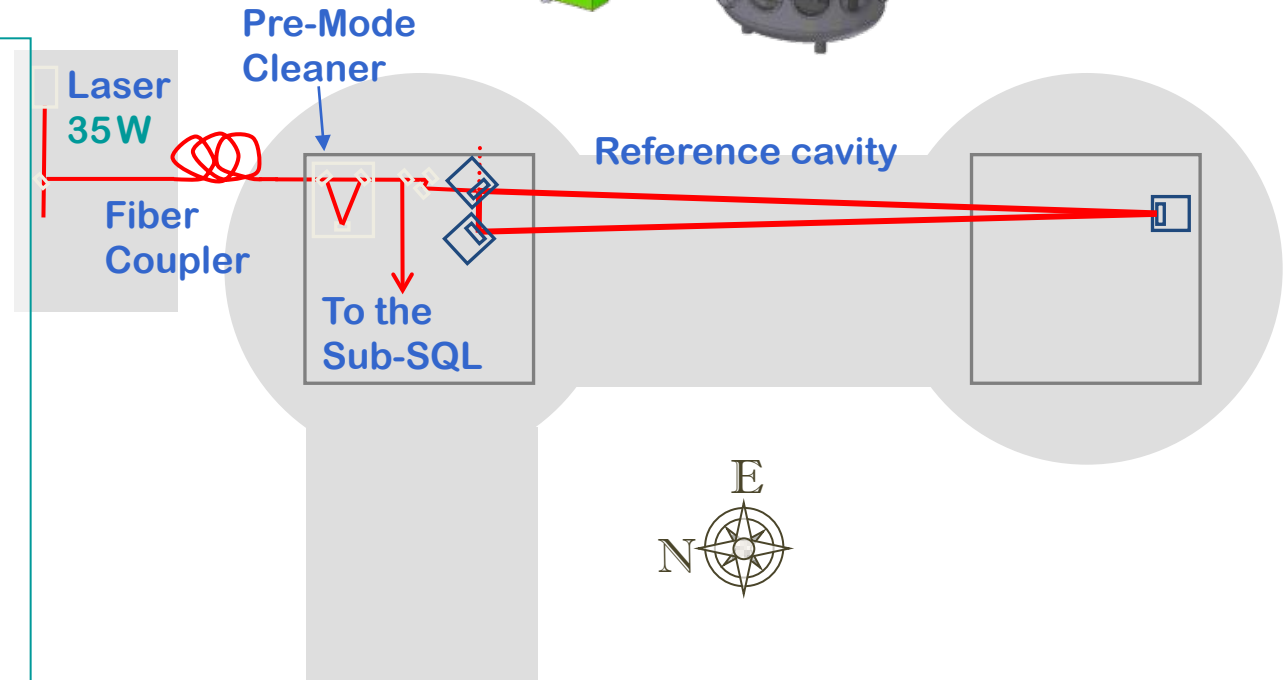
Fumiko Kawazoe

Reference cavity---Optical Layout
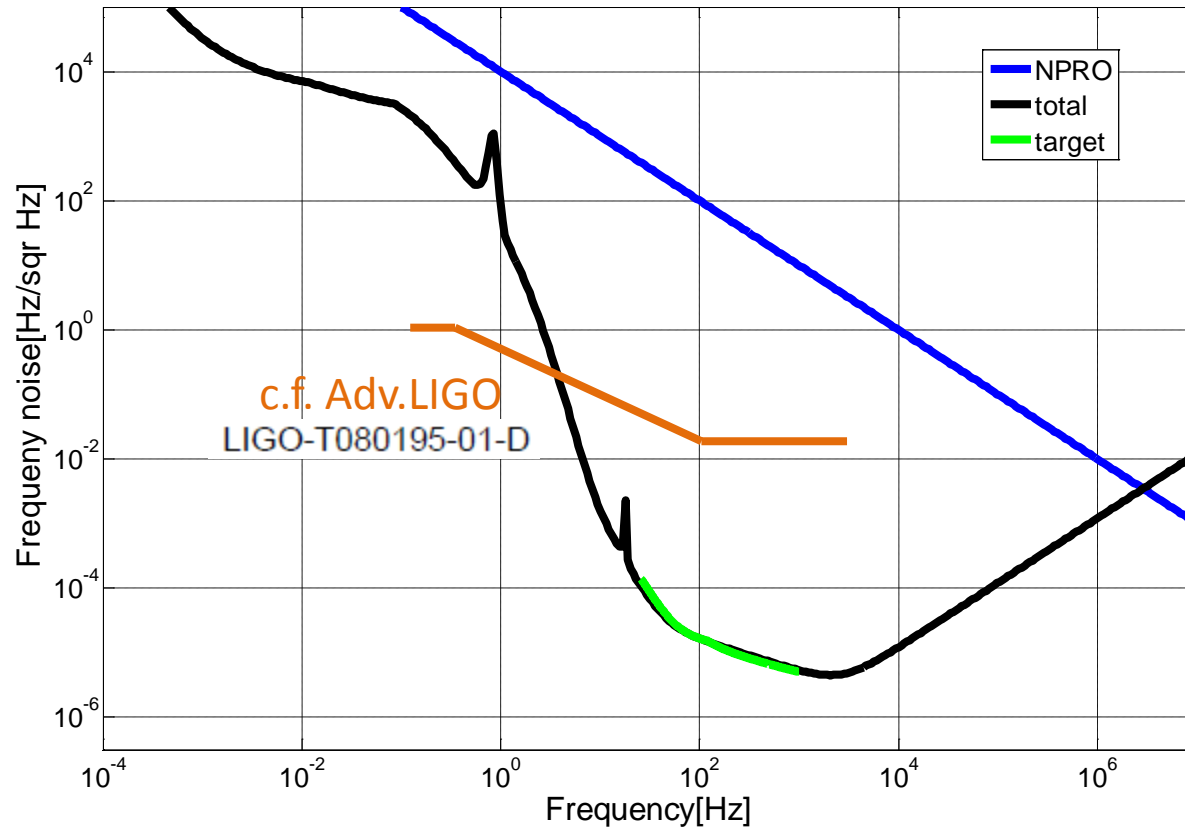
Parameters

Round trip length	21.2 m
Finesse	7300
Input power	133 mW
ROC	37.5 m
g-factor	0.72
Waist size	2.40 mm
Mirror mass	850 g

10 m Prototoype
Vaccum tanks

Laser 35 W

Fiber Coupler

Pre-Mode Cleaner

Reference cavity

To the Sub-SQL

Frequency stabilization target

Target gain

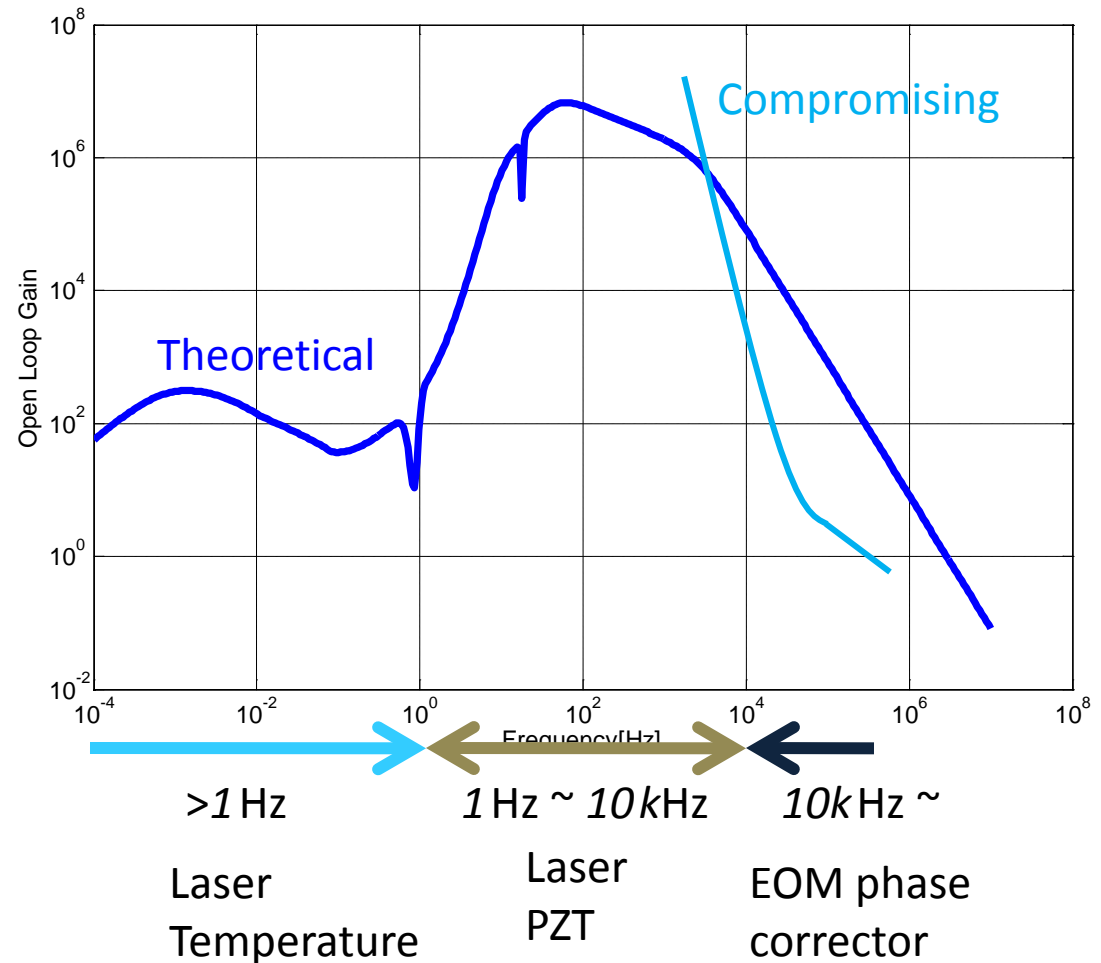**Theoretical target**

f_{ug}=1MHz
       +
 40 deg. phase lag

= impossible

Where
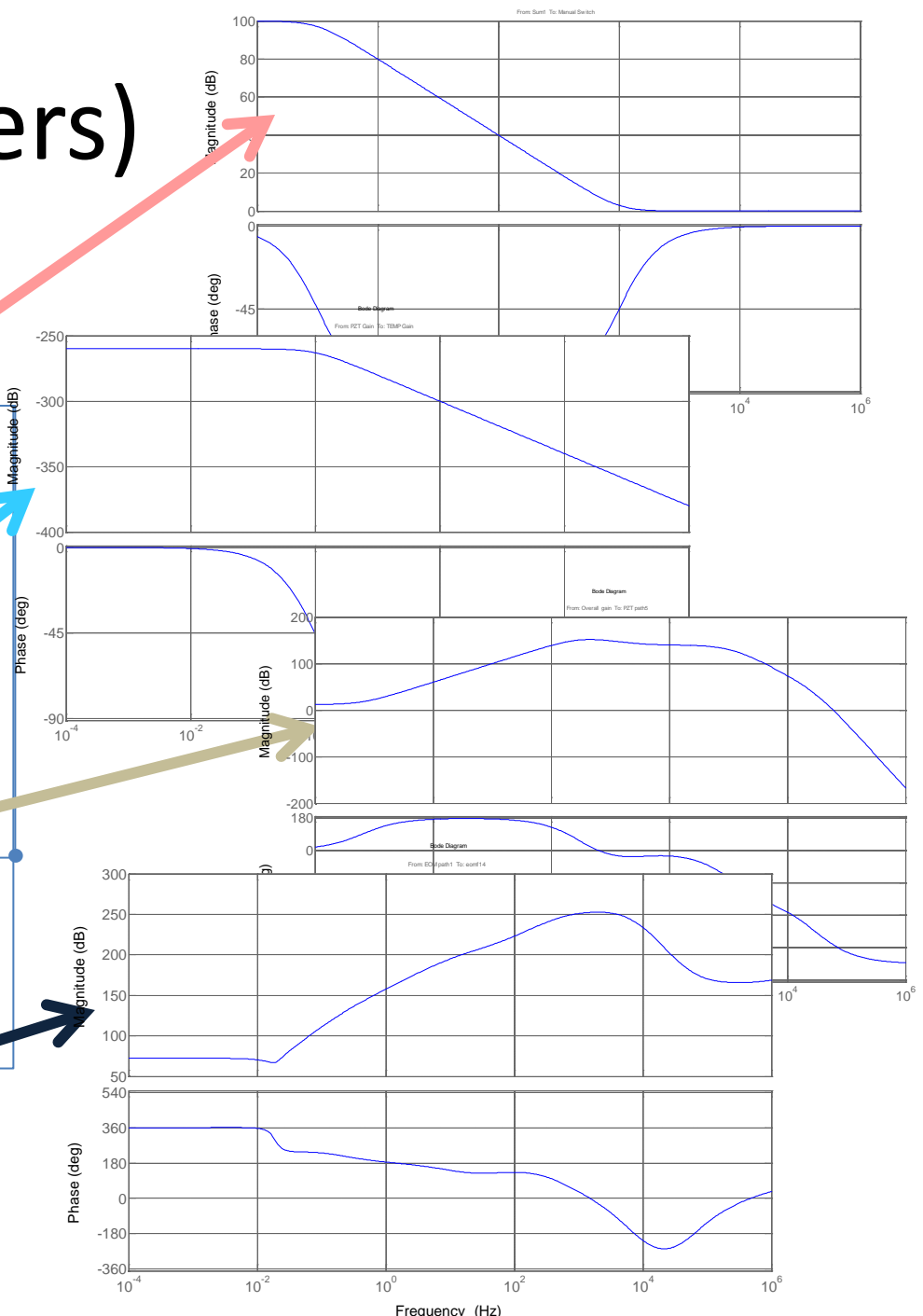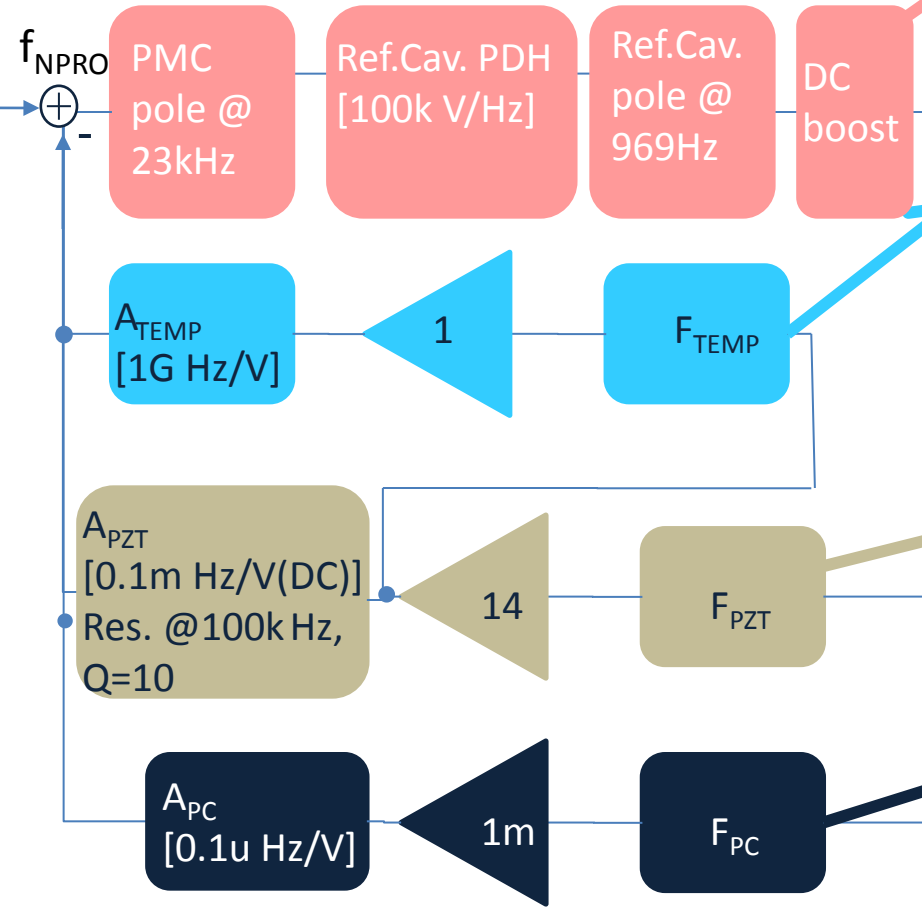Mixer lowpass filter,
PD resonant circuit, etc.
will be included.

Compromising target

f_{ug}=250kHz

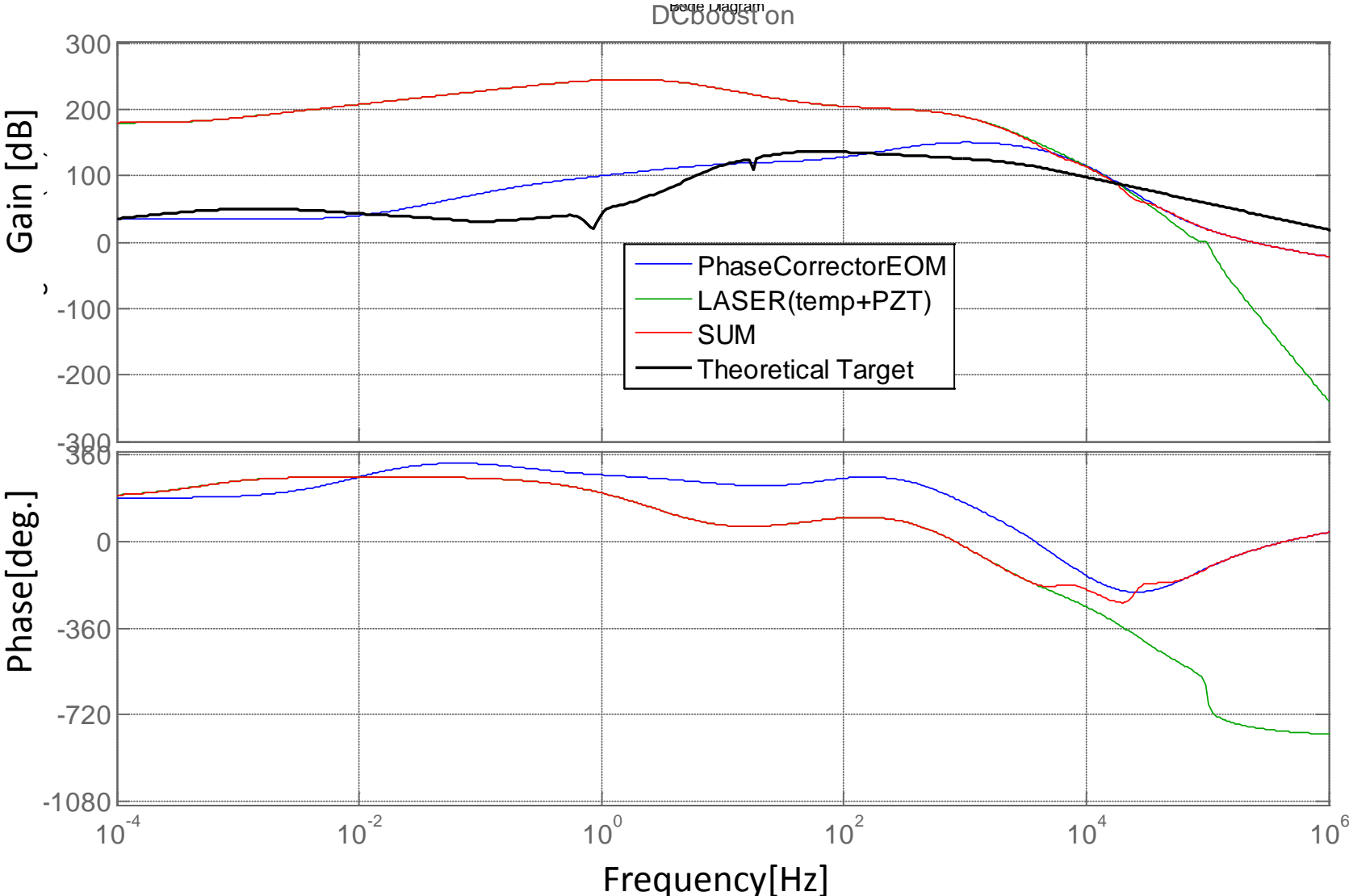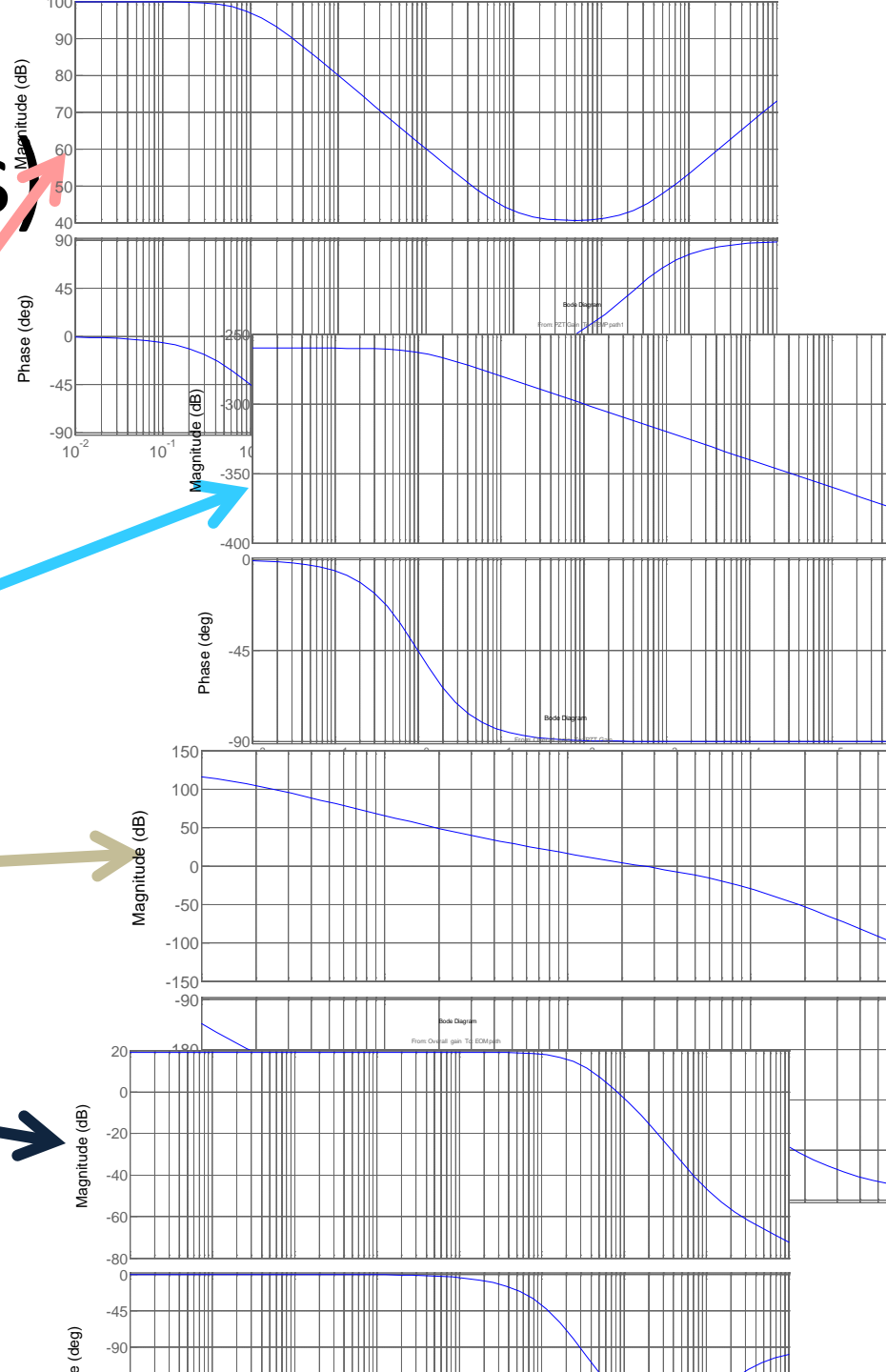
Open Loop Gain

Compromising

Theoretical

Frequency[Hz]

>1 Hz

Laser
Temperature

1 Hz ~ 10 kHz

Laser
PZT

10k Hz ~

EOM phase
corrector

Model 1 (many filters)

Model 1 Overall gain
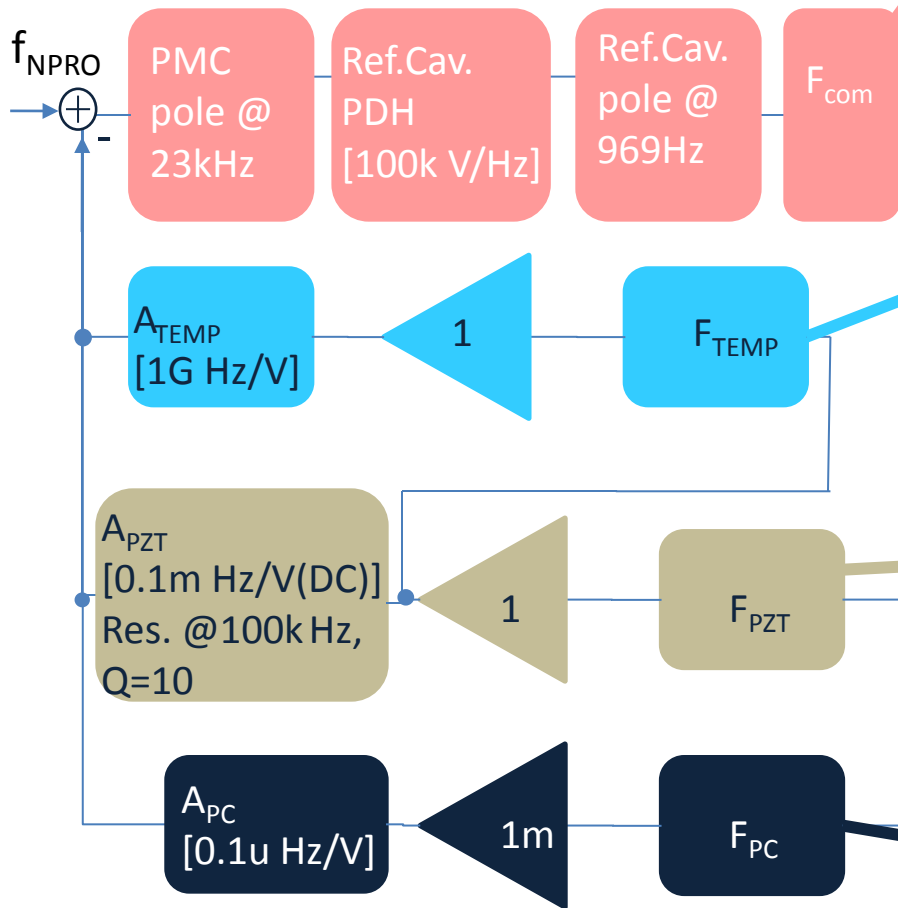
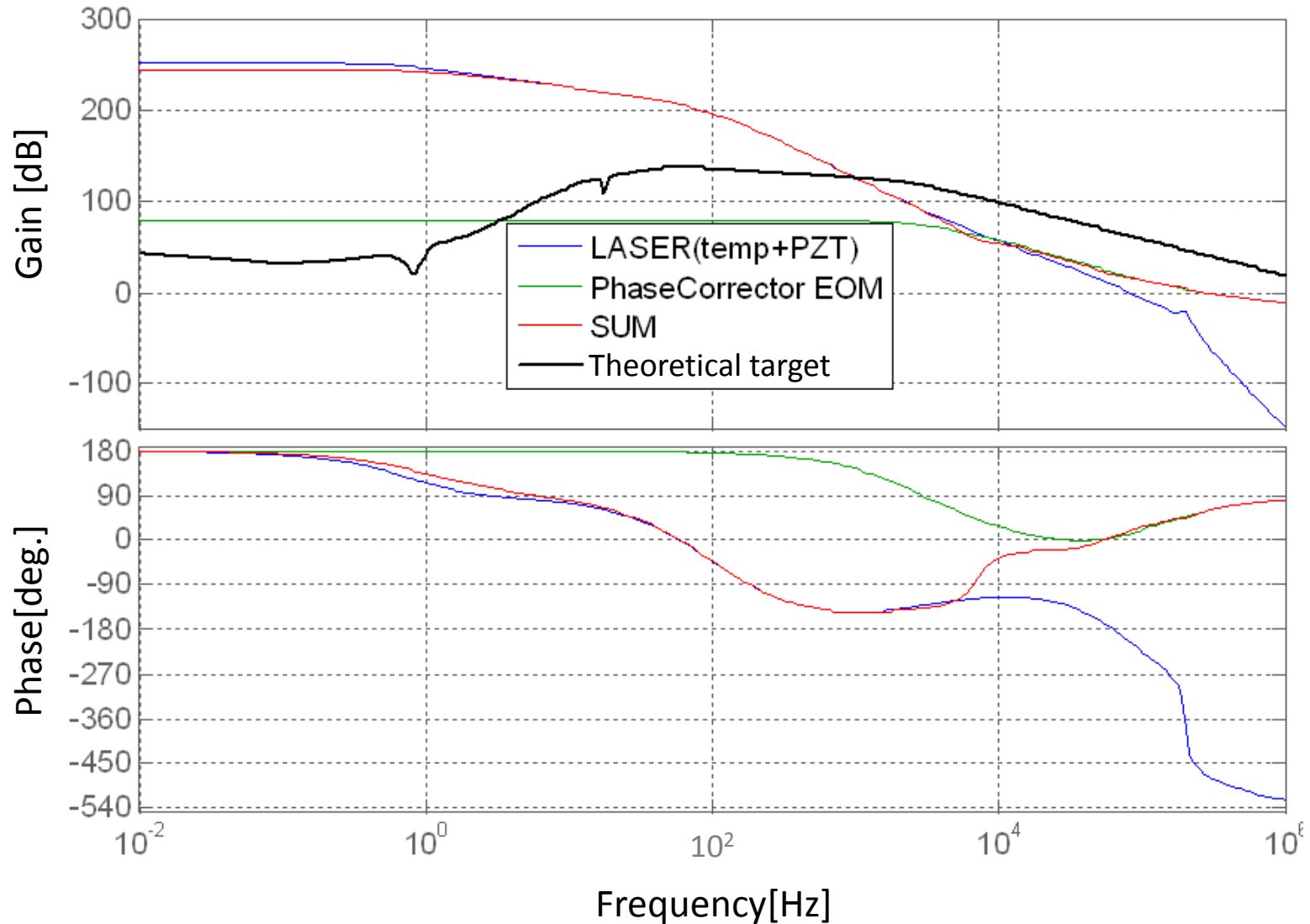Bode Diagram
DCboost on

Legend:
- PhaseCorrectorEOM
- LASER(temp+PZT)
- SUM
- Theoretical Target

Model 2 (less filters)

f_{NPRO}

$+$ $-$

| PMC pole @ 23kHz | Ref.Cav. PDH [100k V/Hz] | Ref.Cav. pole @ 969Hz | F_{com} |

A_{TEMP} [1G Hz/V] ◄ 1 F_{TEMP}

A_{PZT} [0.1m Hz/V(DC)] Res. @100k Hz, Q=10 ◄ 1 F_{PZT}

A_{PC} [0.1u Hz/V] ◄ 1m F_{PC}

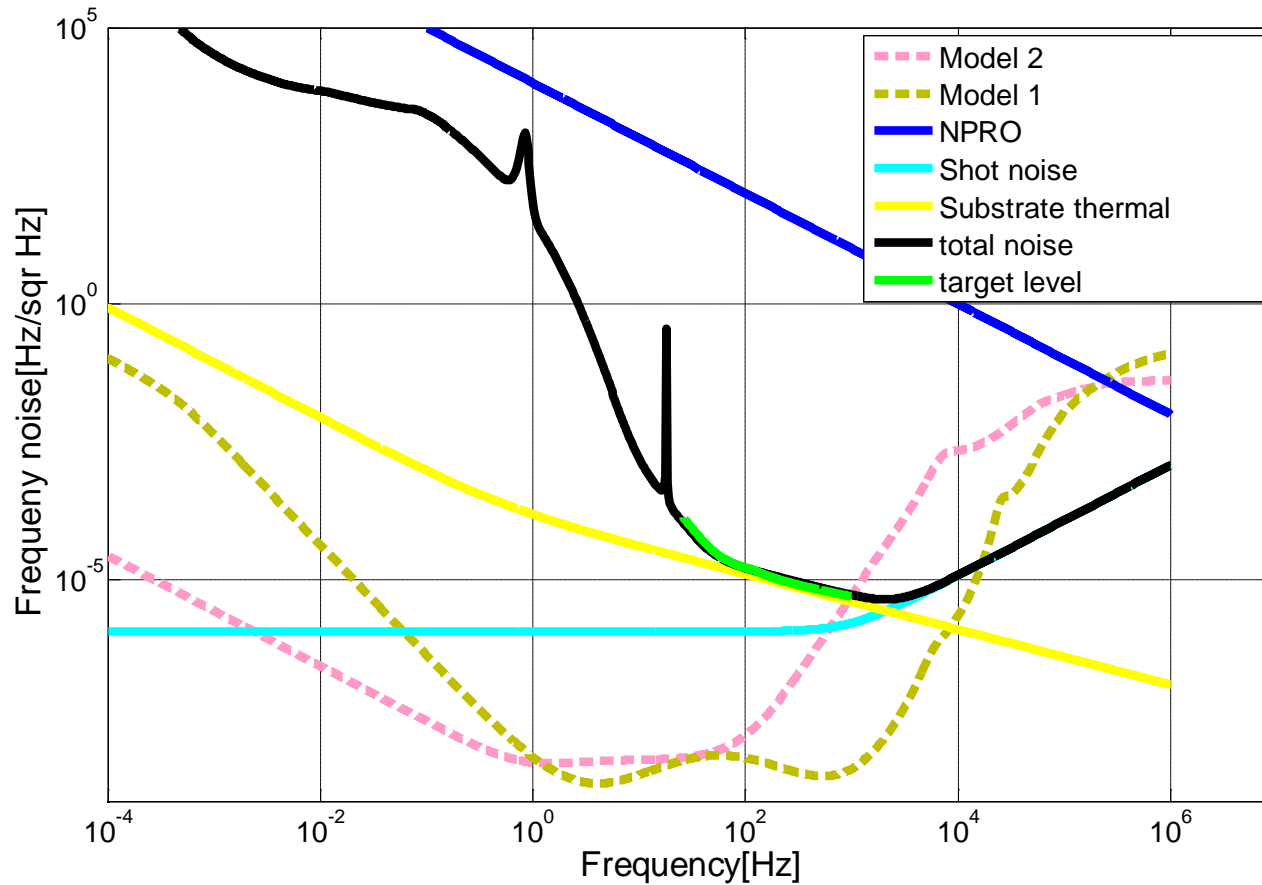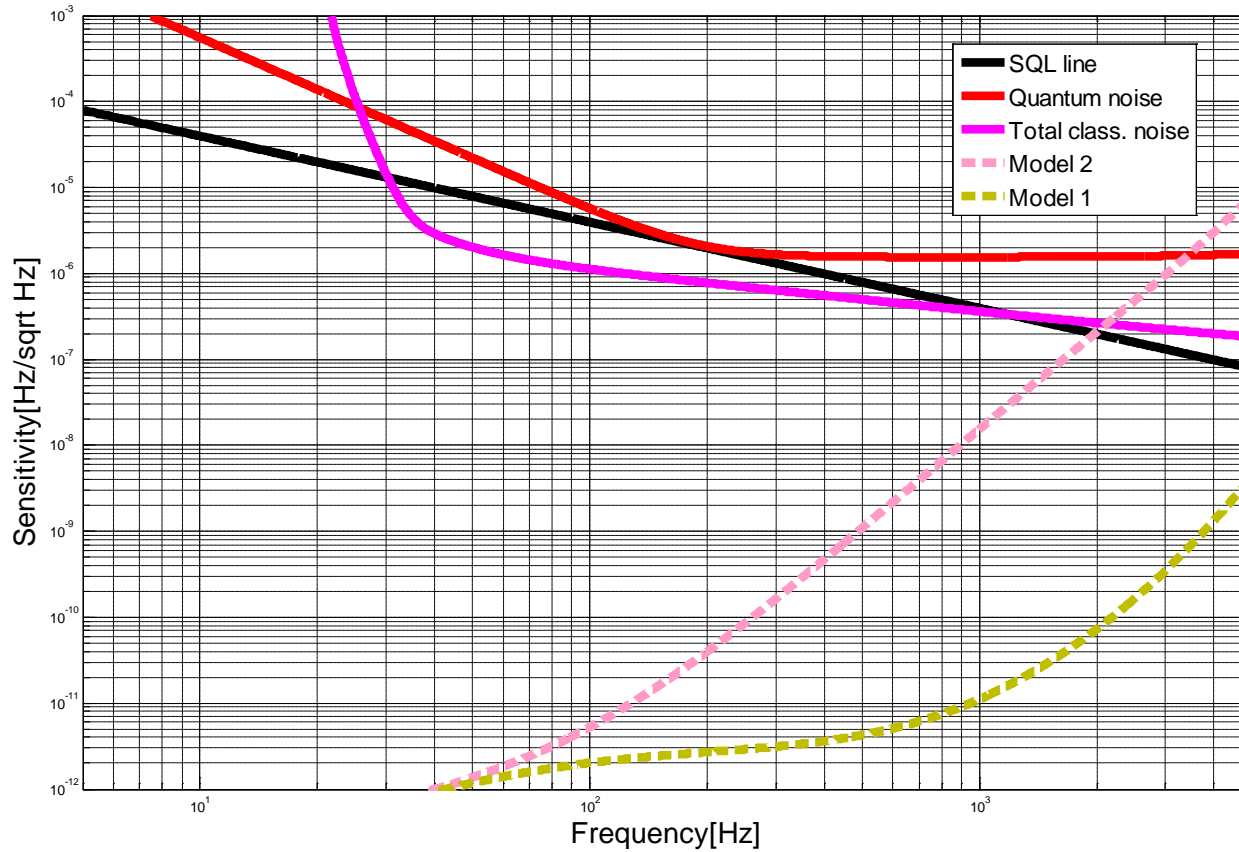# Model 2 Overall gain

c.f. Adv.LIGO Overall gain
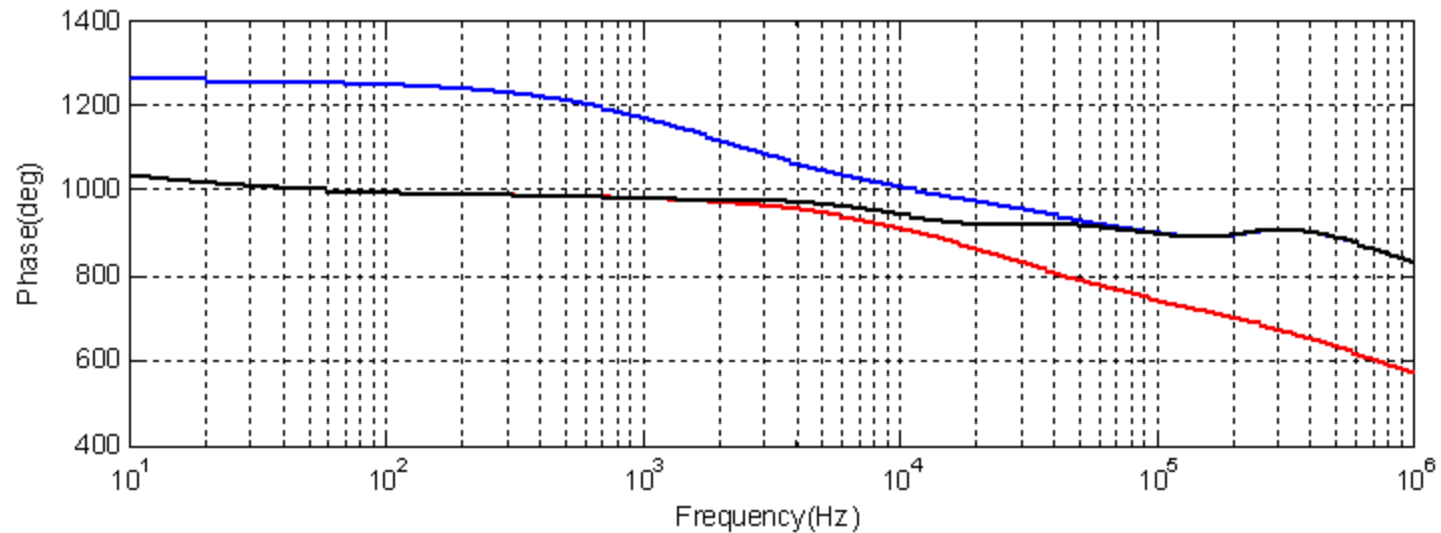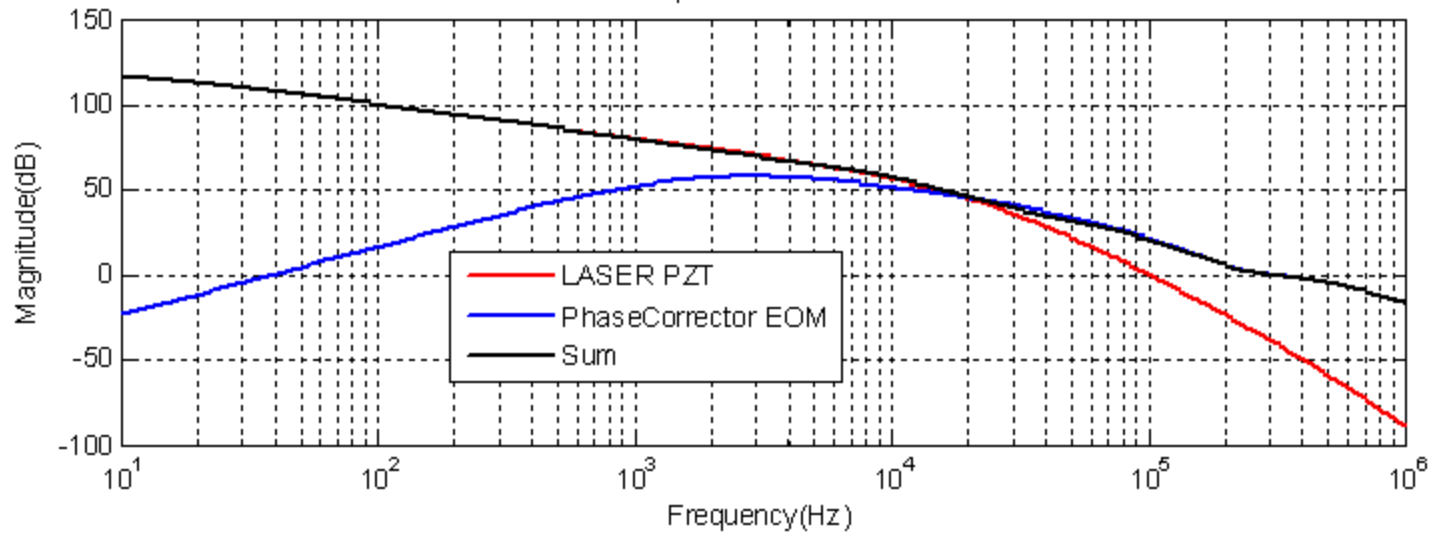
Frequency noise level
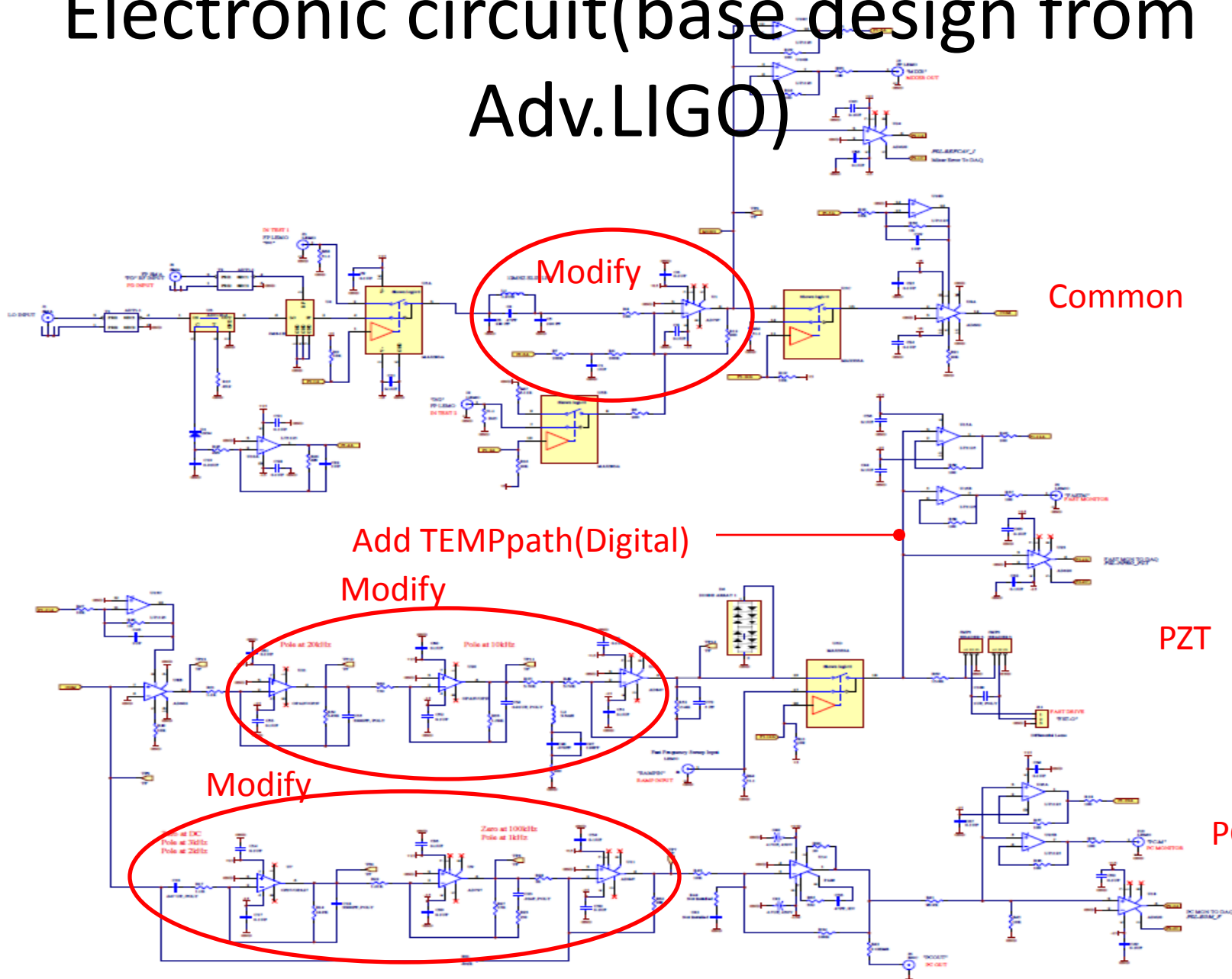

Ref.cav. nosie curves

Frequency noise on Sub-SQL output

Sub SQL IFO noise curves

Electronic circuit(base design from Adv.LIGO)

Modify

Common

Add TEMPpath(Digital)

Modify

PZT

Modify

PC EOM

Other requirements

- Optical signal gain drop <25%(so that it safely satisfy the stablity condition) ....misalignment 800n [rad] (easy)

- Others...???

Tasks not mentioned

- Finalize modulation frequency

(Sub-SQL design dependent)

- EOM design (in Vacuum)

- Finalize locations

(many other subsystem dependent)