The 1st Kagra-Virgo-3G Detectors Workshop

Perugia, February 14th-15th, 2019

Development of audio-band frequency-dependent vacuum squeezer for Advanced Virgo Gravitational Wave detector

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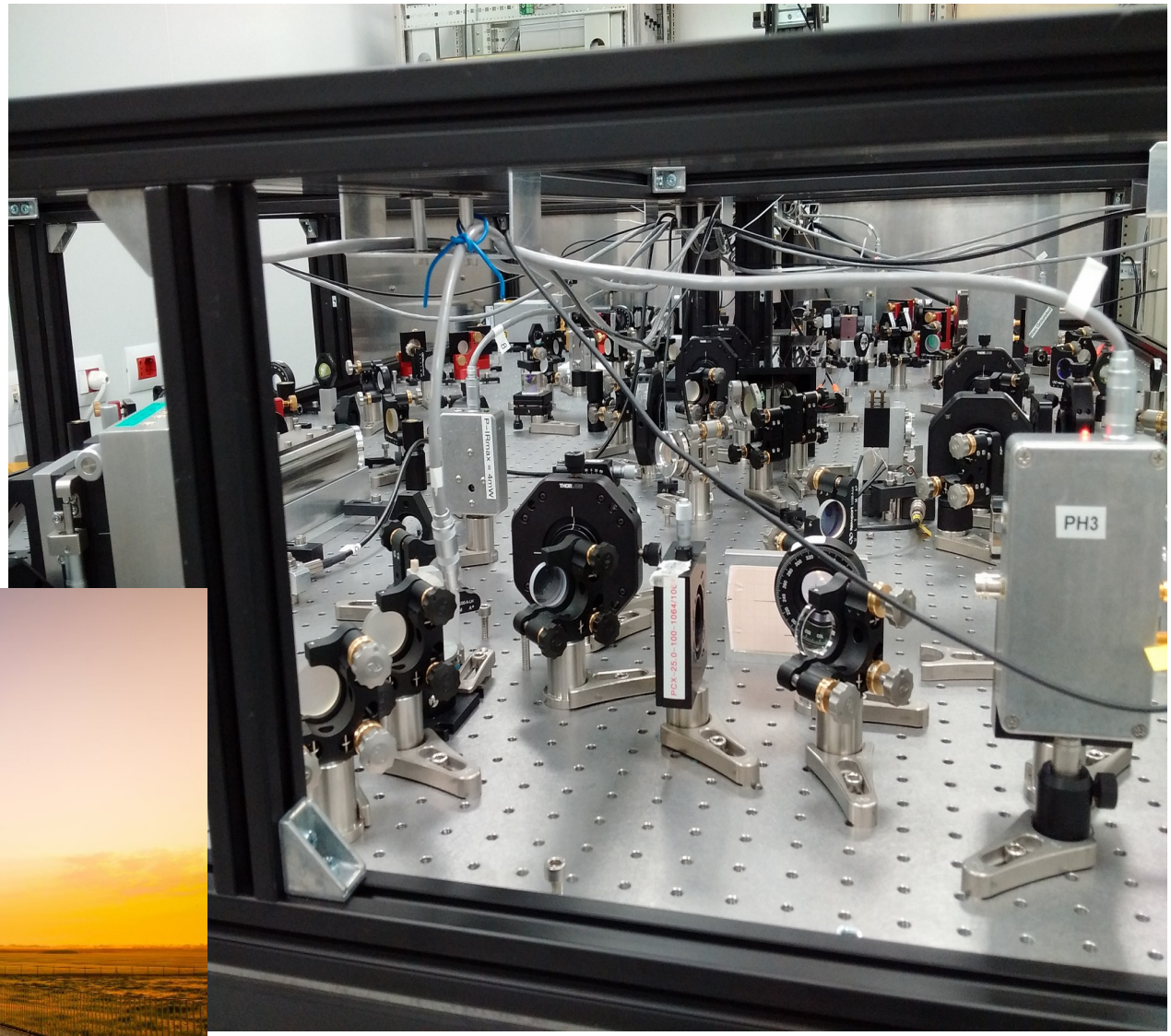
VIRGO

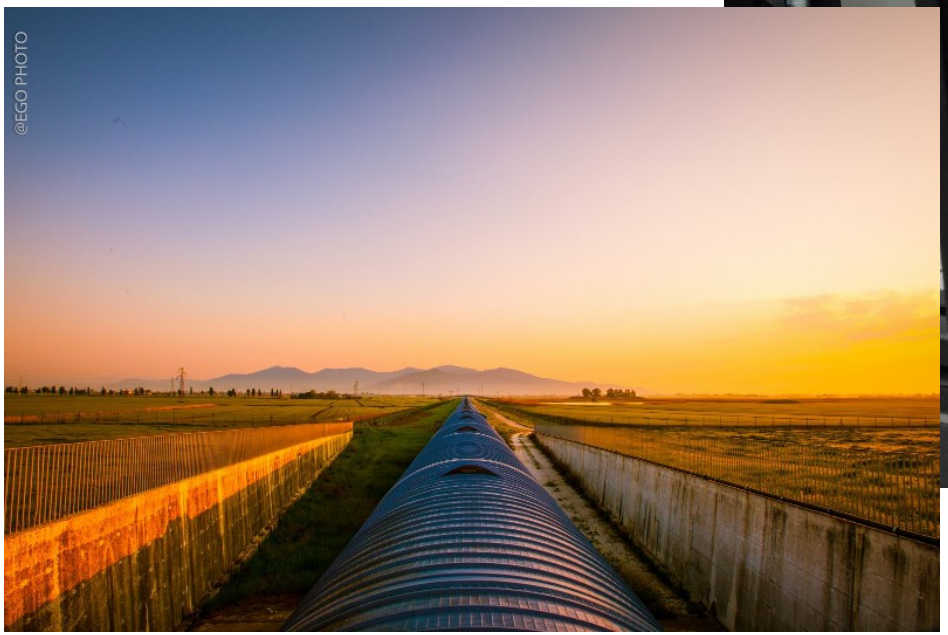
INFN Sez. di Perugia

Squeezing group

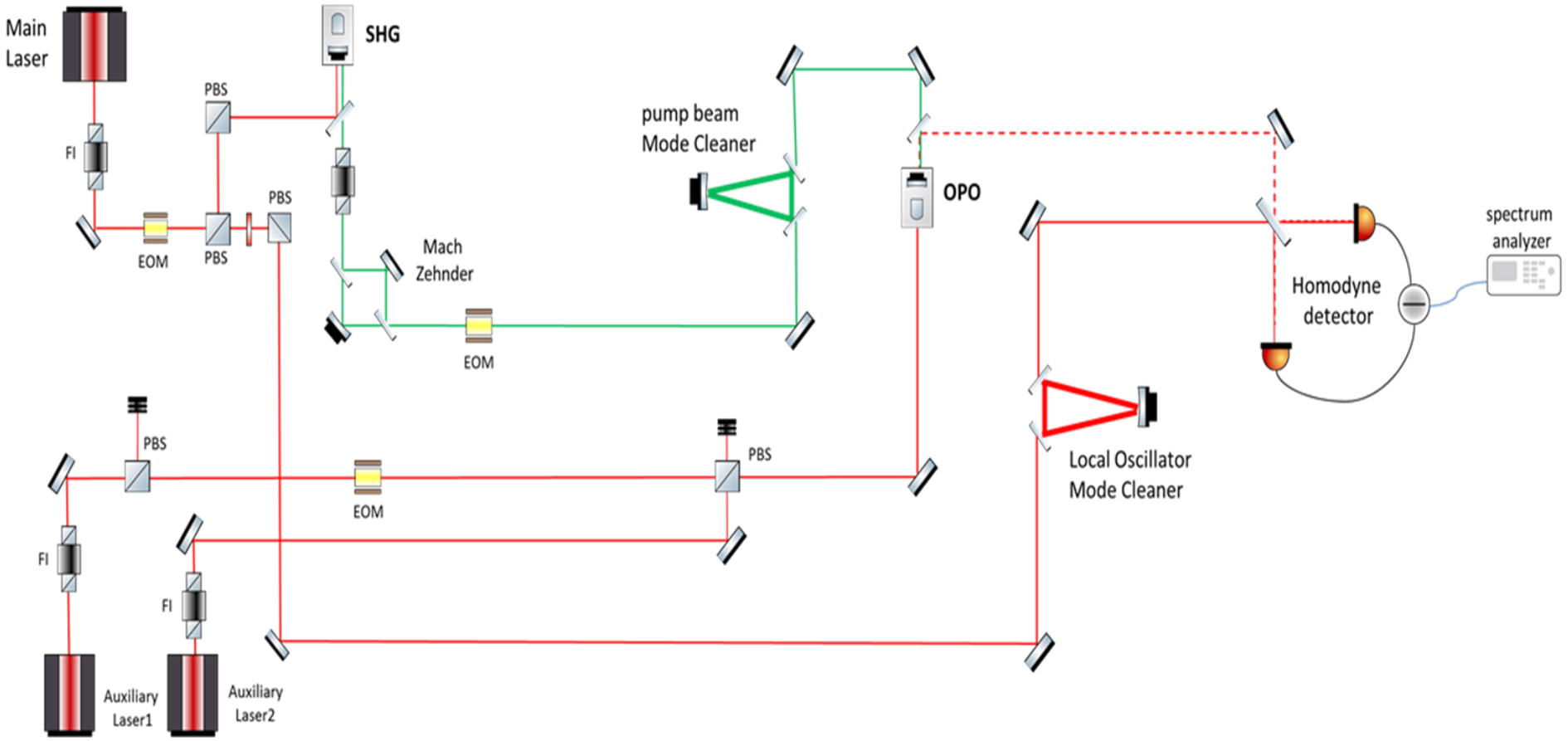
INFN
- Padova/LNL
- Genova
- Perugia
- Napoli
- Roma 1
- Roma 2

APC/CNRS Paris

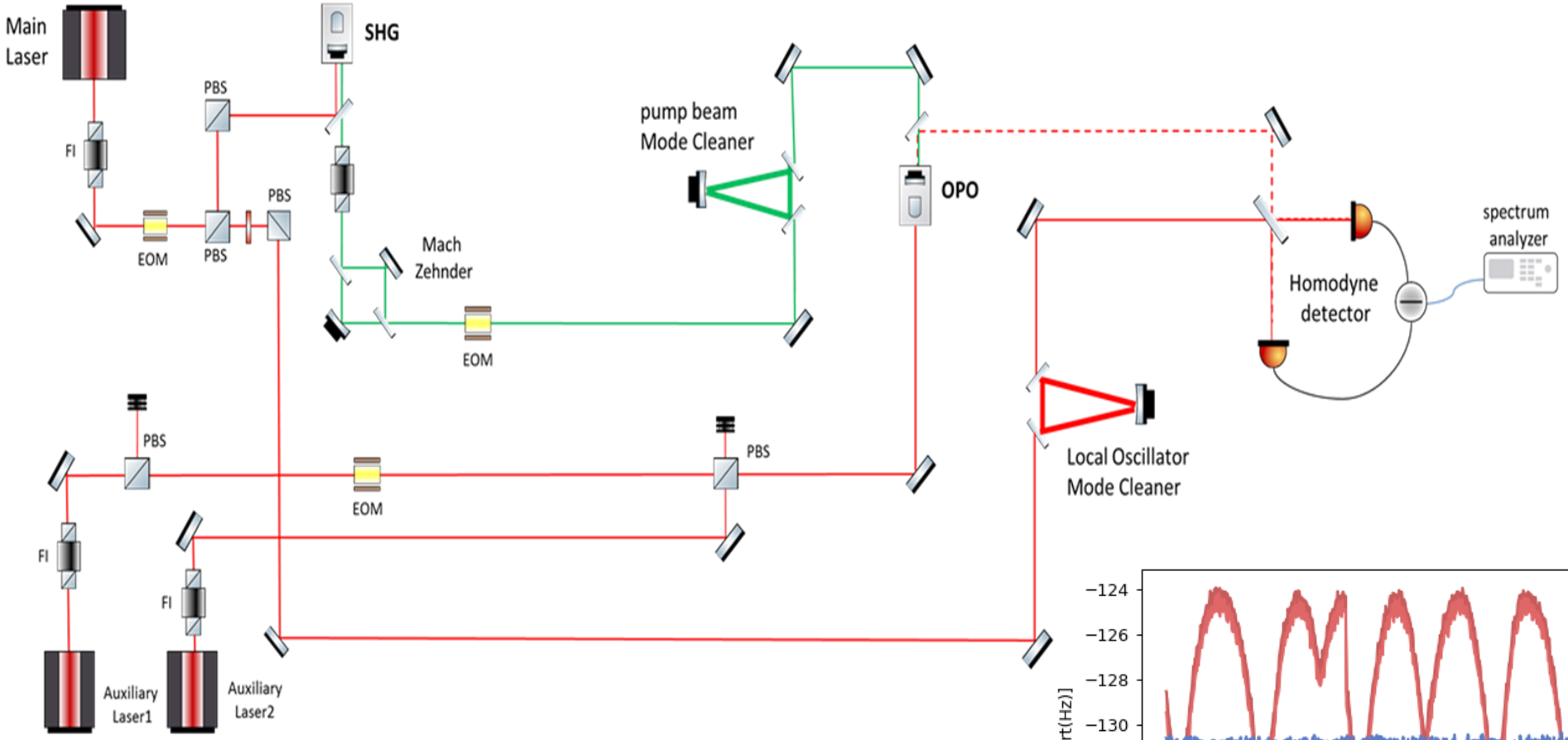




Squeezing bench



Squeezing bench



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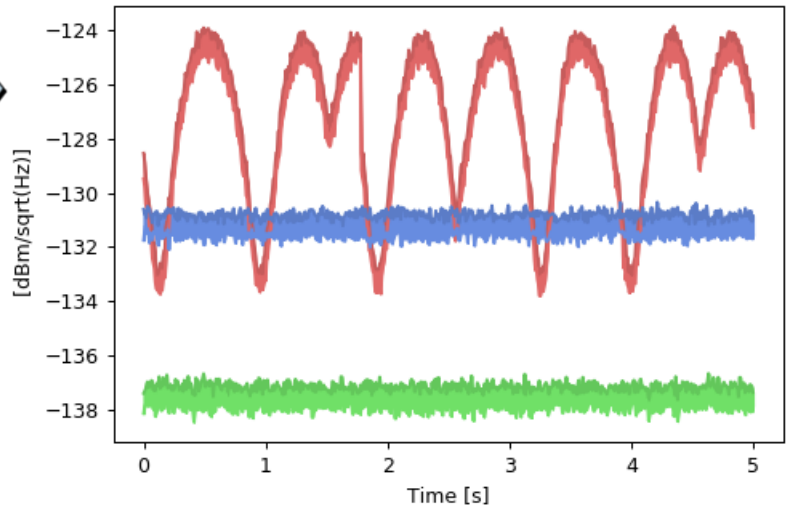
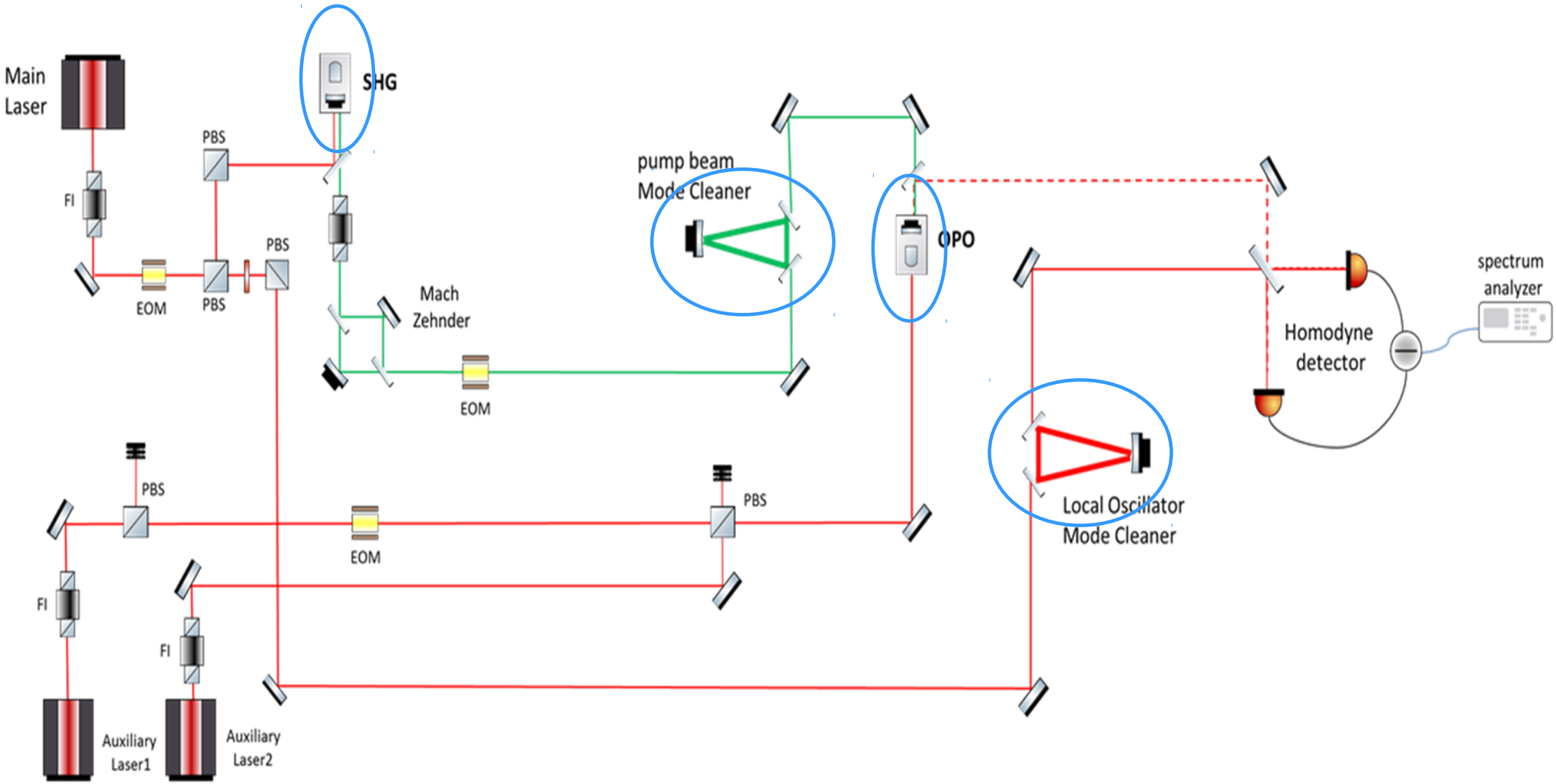


Squeezing

Squeezing bench



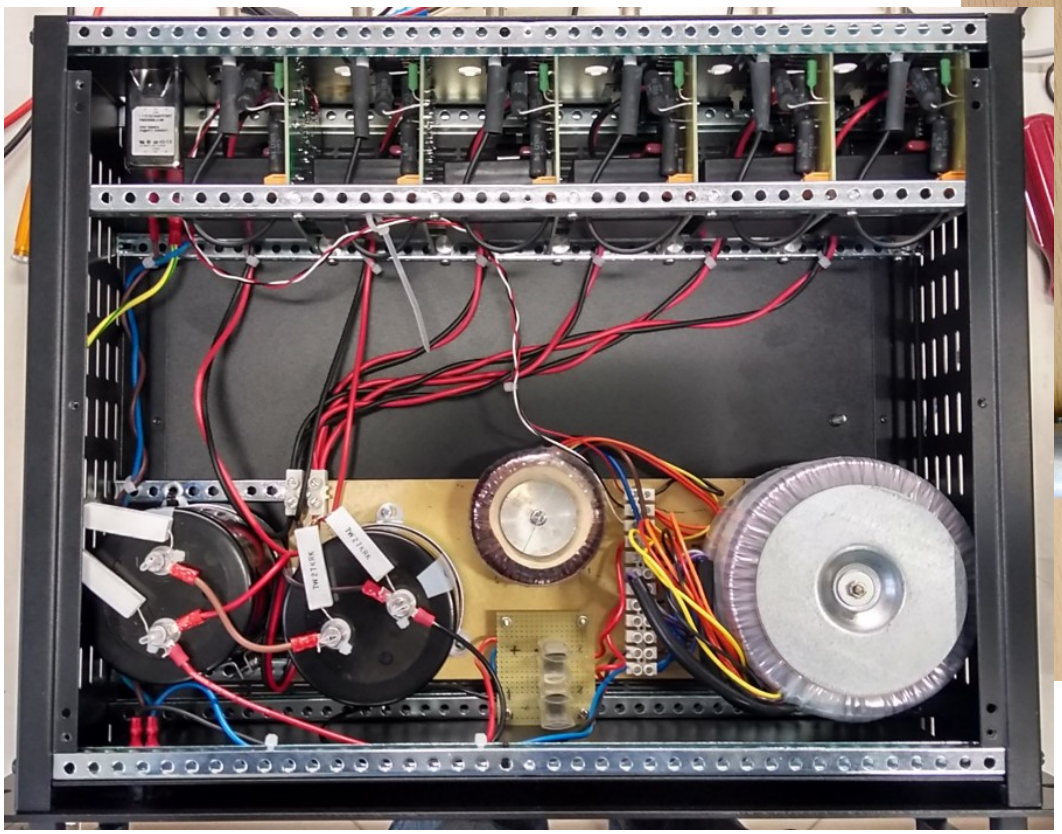
Improvements in electronic equipment

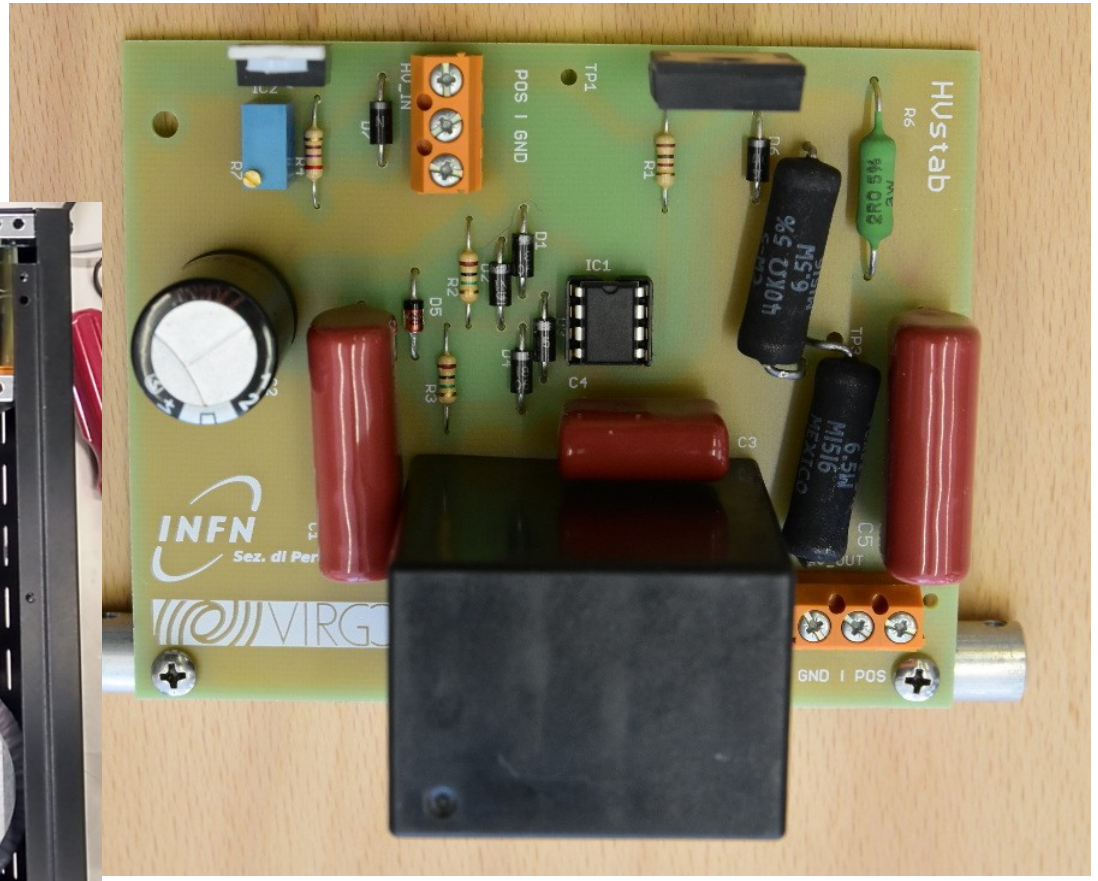
- High voltage drivers for piezoelectric stacks
- Fast photo-detectors
- Homodyne detector
- Lock acquisition stability improvement and automation

High voltage drivers

Goals

- Lowering piezo driver output noise by power supply modification
- Eliminating 50Hz power line oscillation

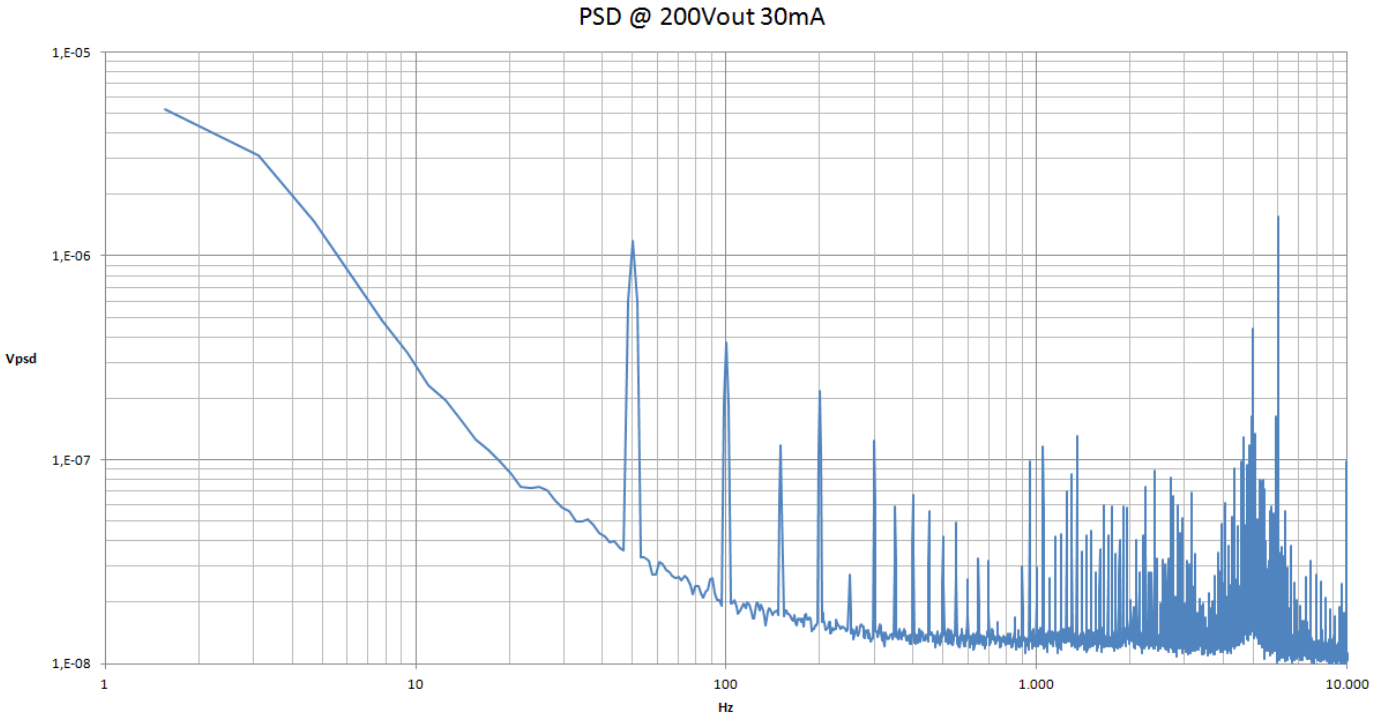




High voltage drivers

E_{out} = 3uV/sqrt(Hz)
@ 200Hz corner

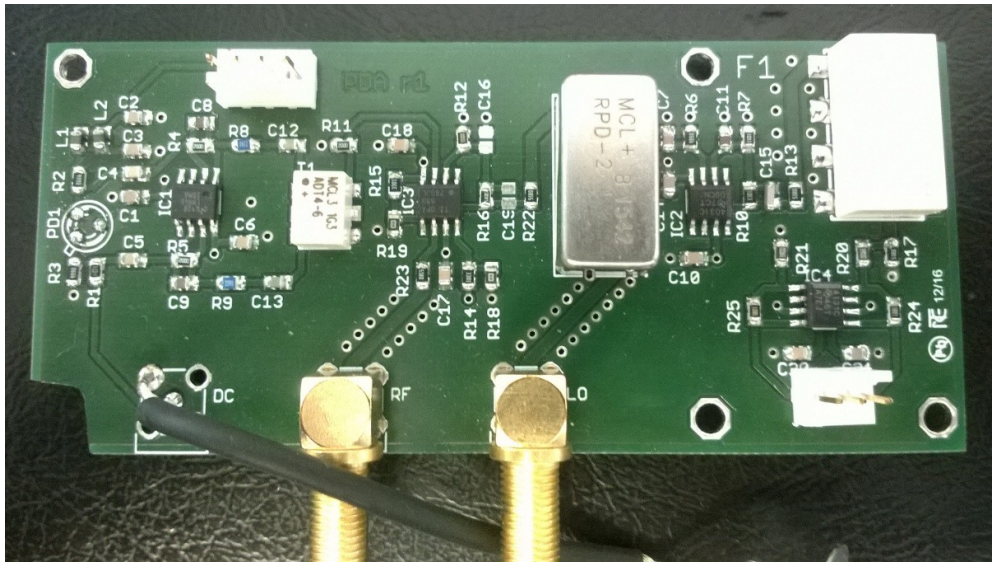
Power supply noise

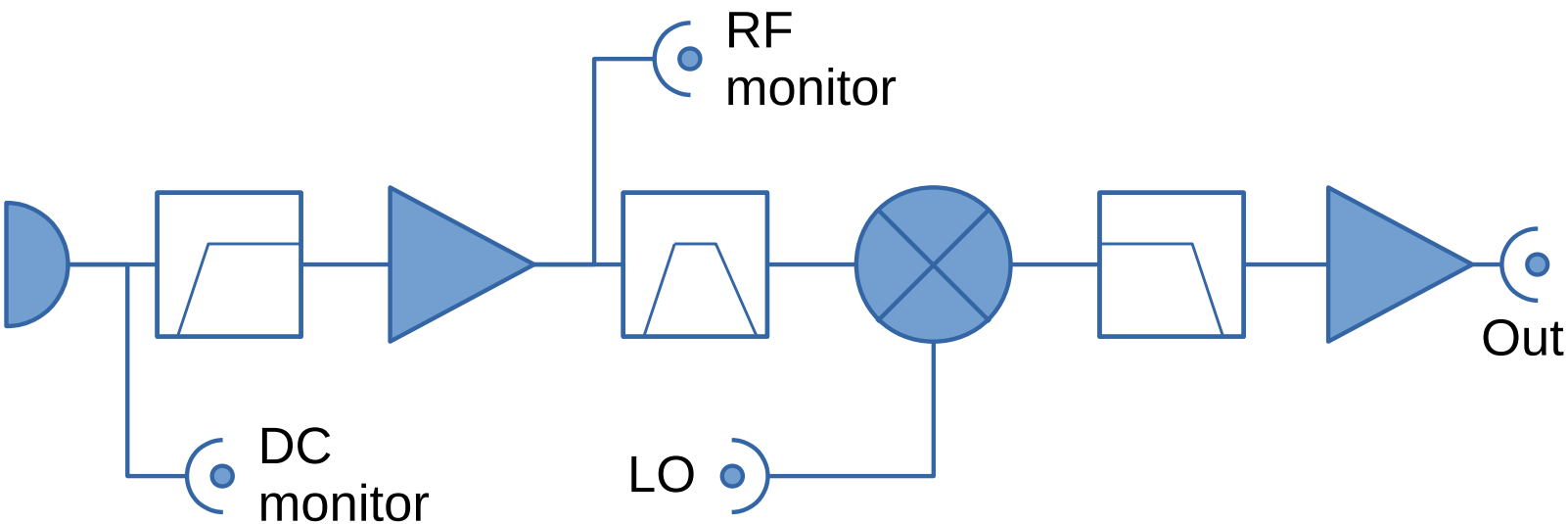


V_{RMS} = 4,85uV

Fast photo-detectors

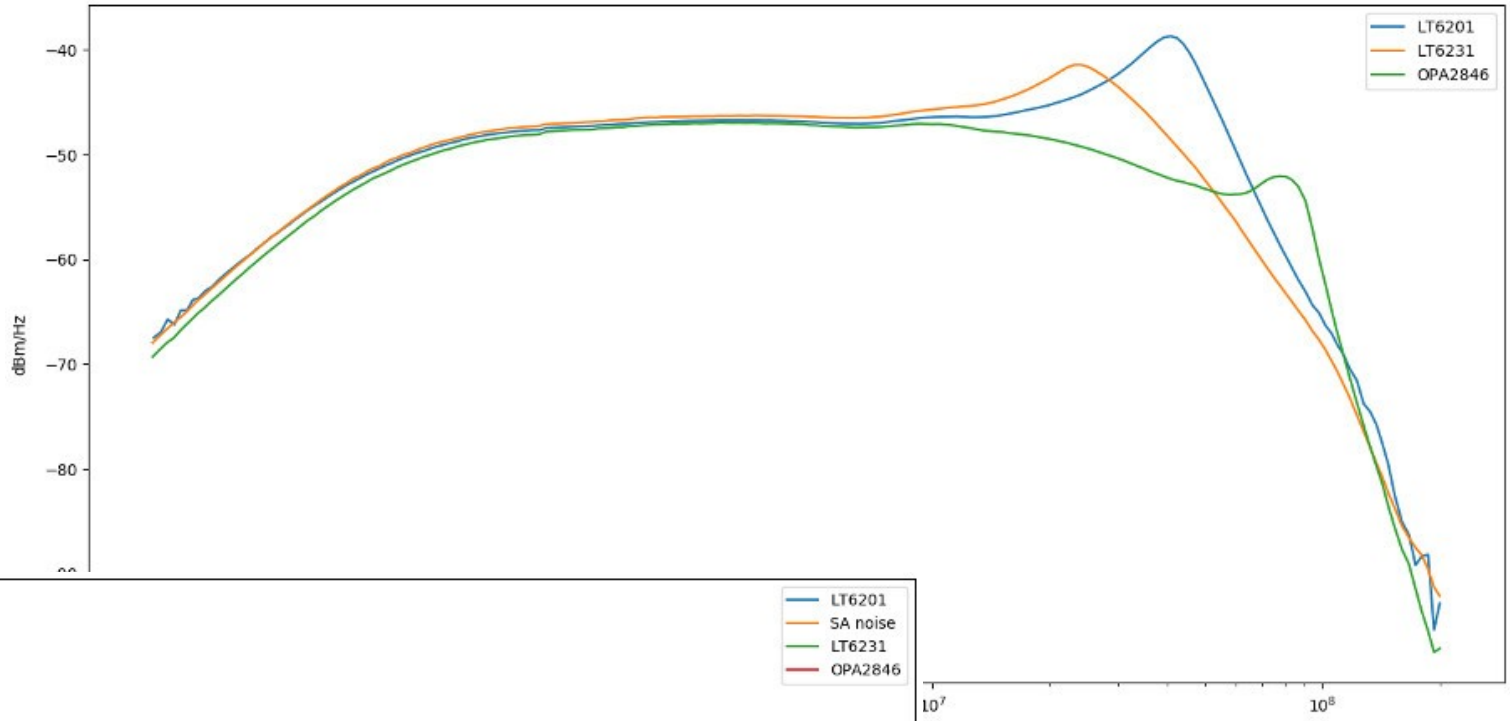
- On-board demodulation
- Differential outputs
- Bandwidth:
  80MHz for d=0,5mm
  120MHz for d=0,3mm



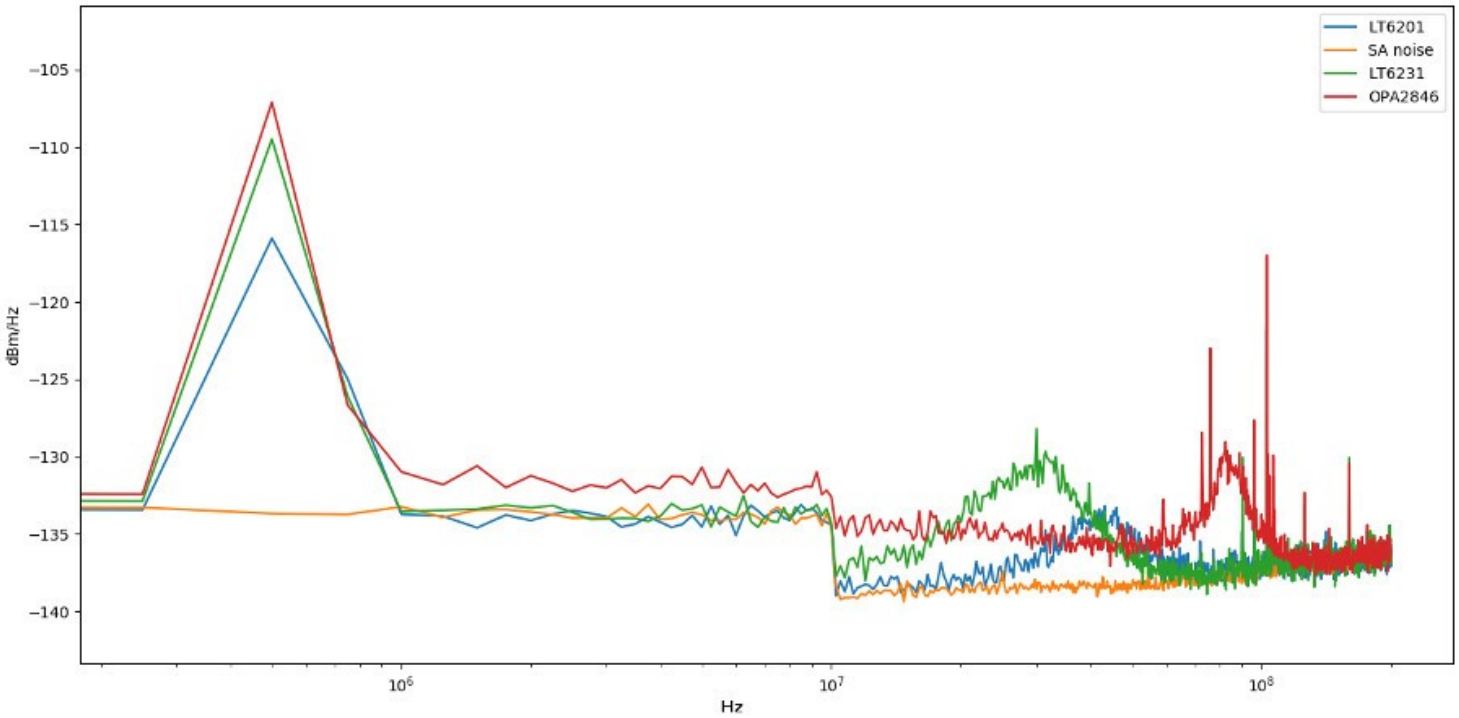


Fast photo-detectors

RF bandwidth



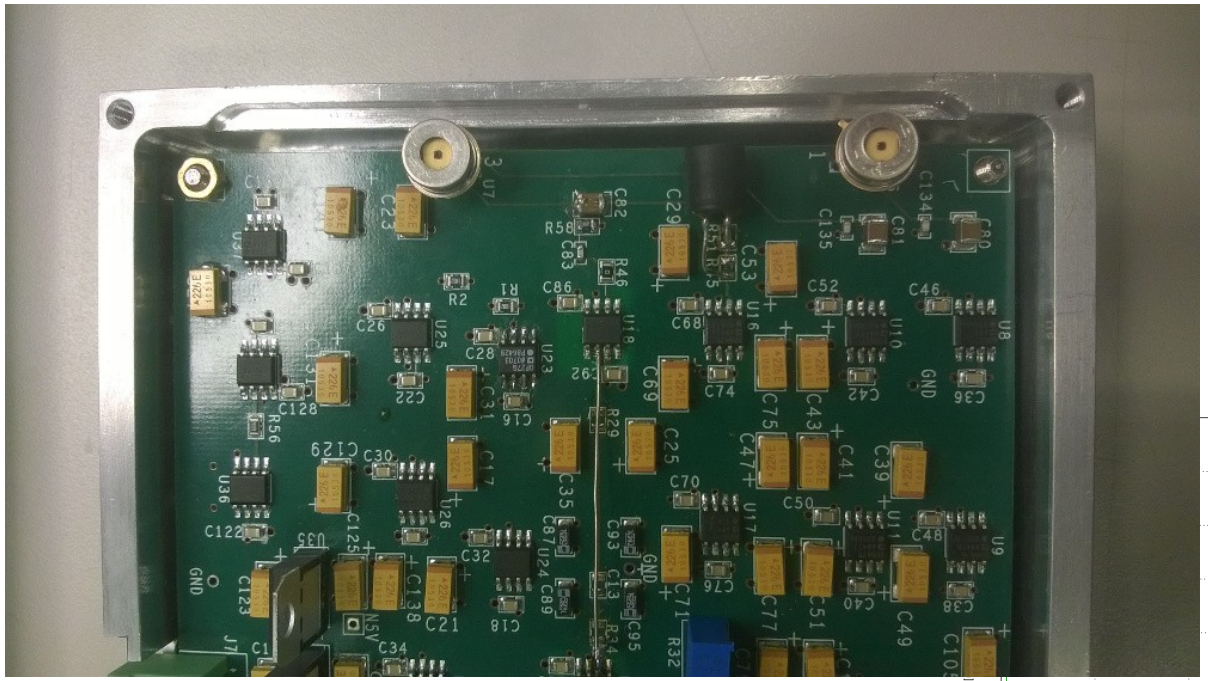
RF monitor output noise



Measurements with:
Hamamatsu G8376-05
d=0,5mm

Homodyne detector

- Improvements in the electric circuit design
- Improved mechanical stability
- Improved noise characteristics
- Measured 82dB of CMRR (at 270Hz)



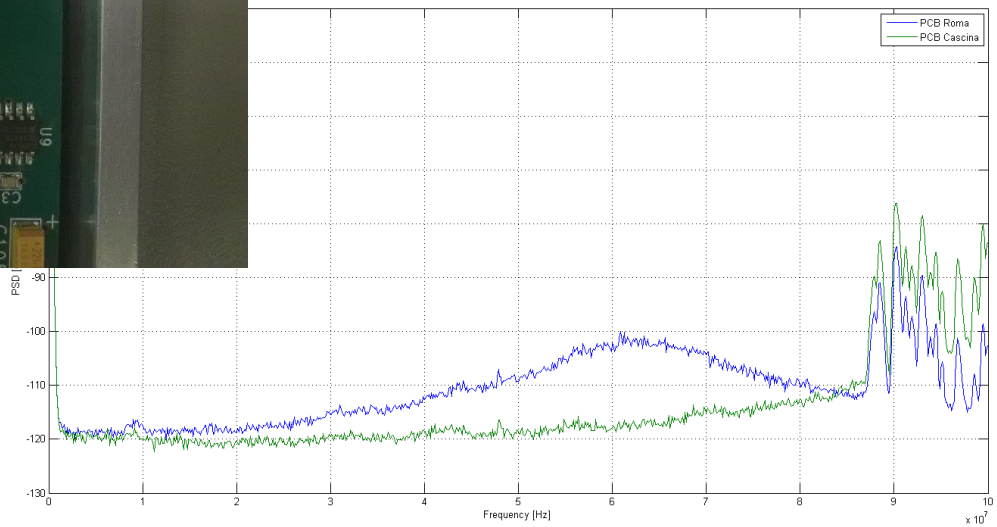
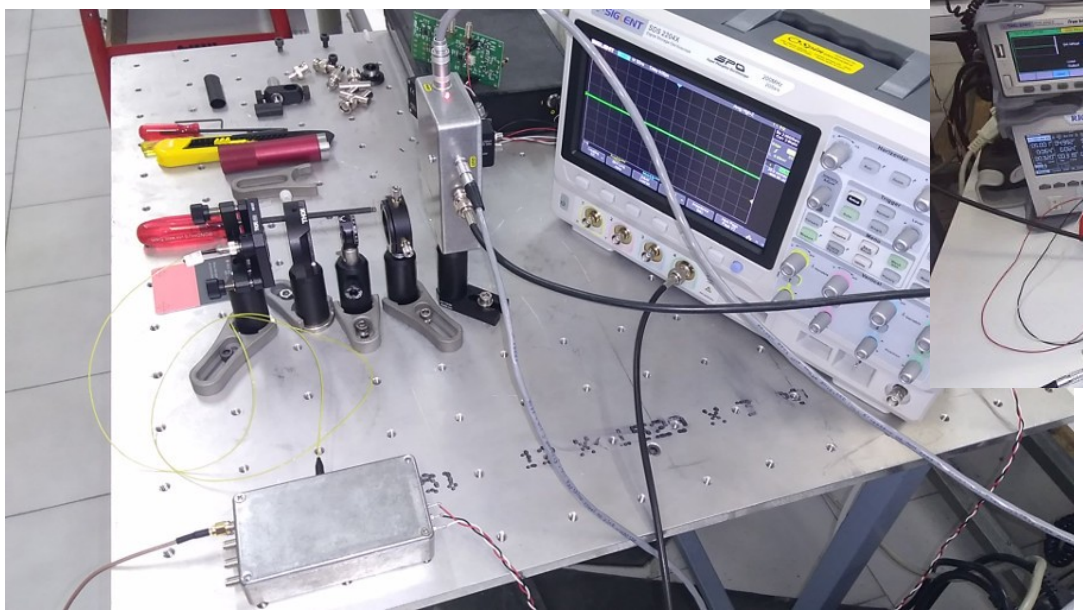
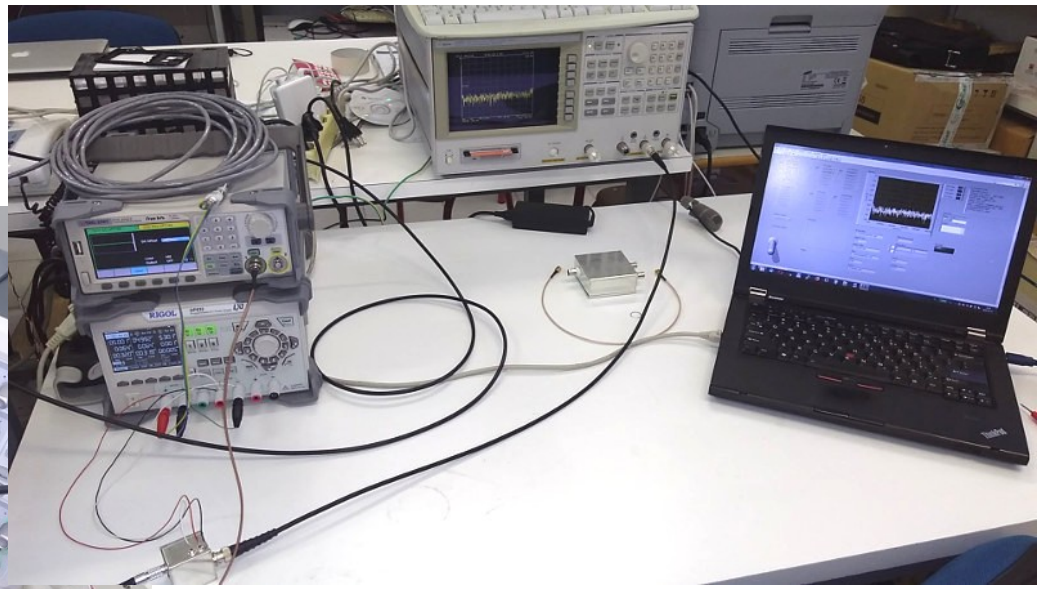


Photo detector testbench

Components:

- Amplitude modulated laser up to 300MHz
- Optical bench + optical components
- Spectrum/Network analyzer
- Dedicated piece of software for quick spectra visualization and comparison

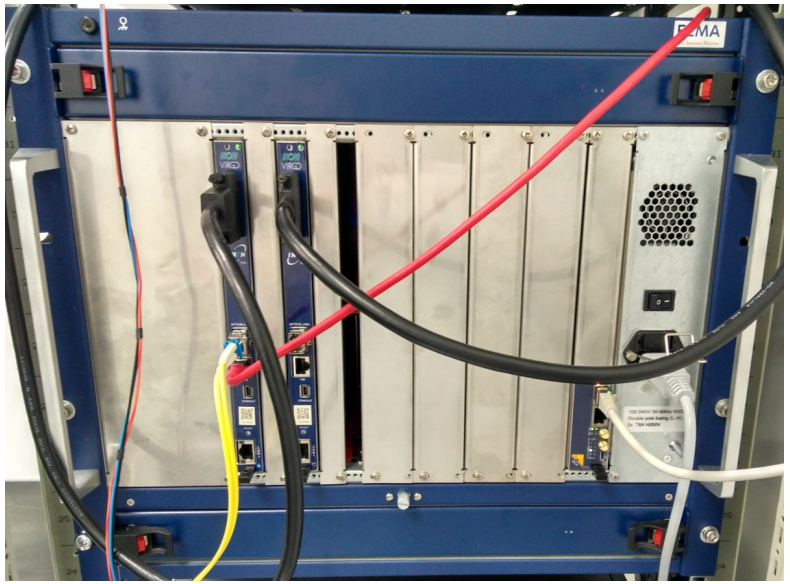




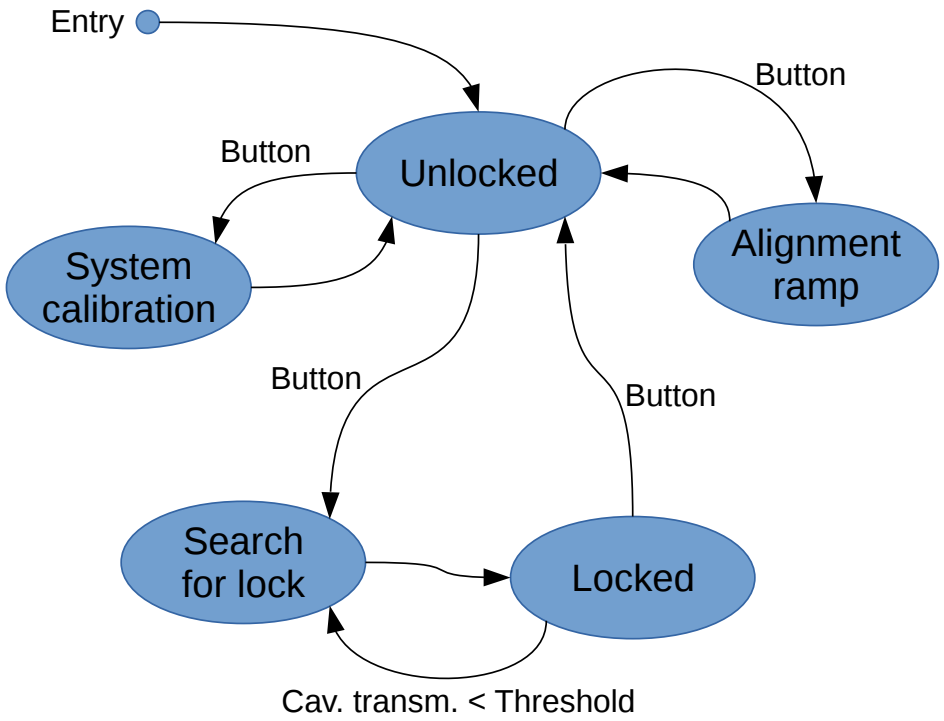
Automation

Development platform

- DSP accelerated DAQ system
- supporting Finite State Machines implementation



Single cavity lock logic scheme

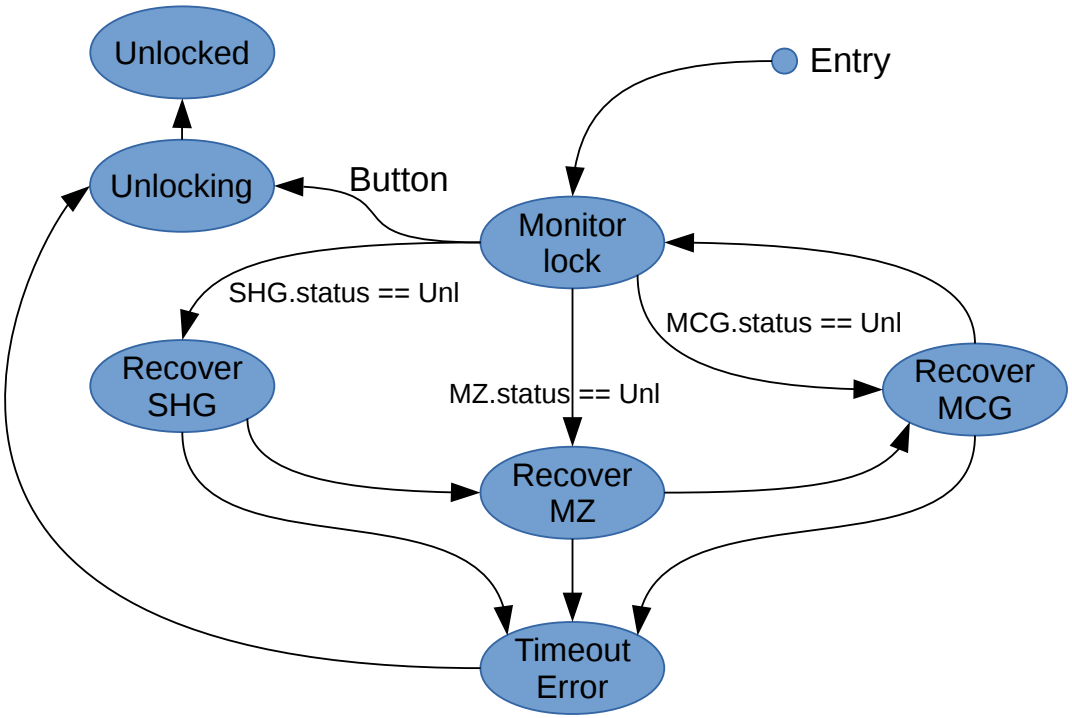


Requirements

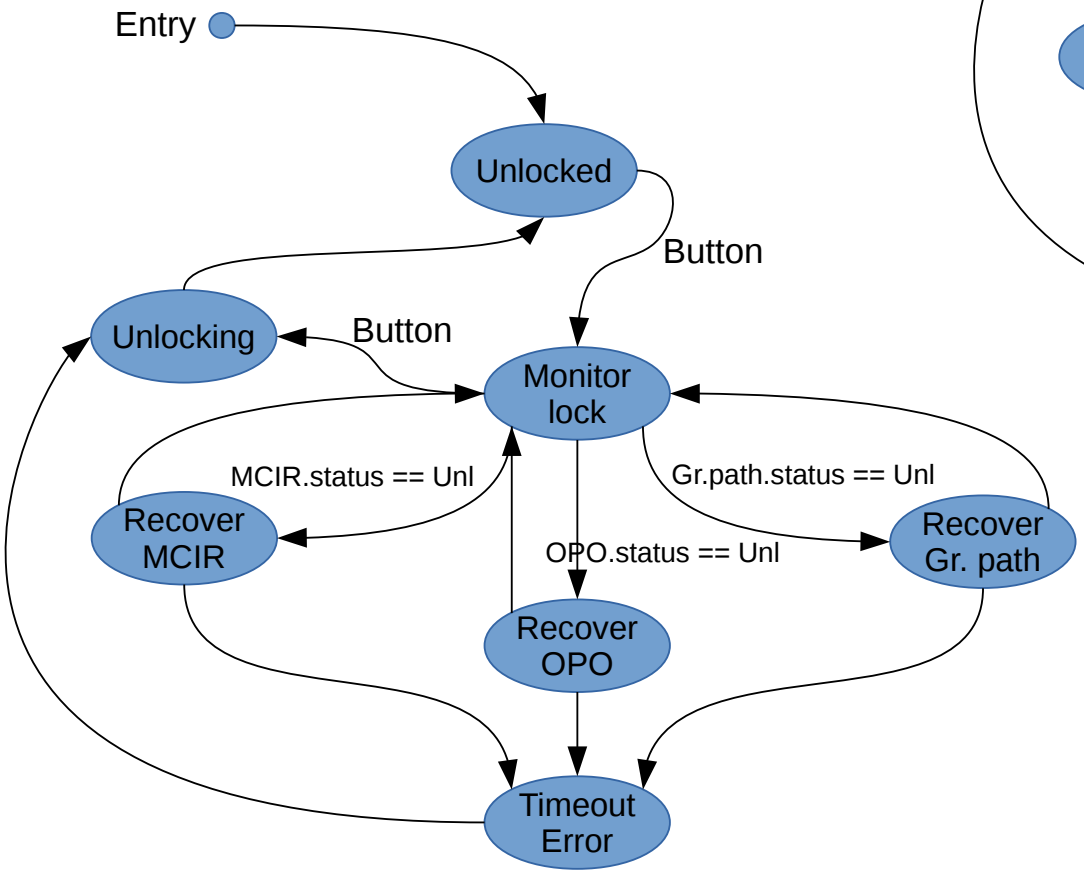
- High lock stability
- User friendly and autonomous operation

Automation

Green path recovery scheme



Squeezing bench control scheme



Summary

- We implemented hardware modifications in the high-voltage section of the control system
- We built the test-bench where we developed the new version of our photo-detectors
- We developed new logic of the automated system of bench control

Next steps:

- We keep working on the software reliability
- We need to verify mechanical stability of all optical mounts in the system