

Diagnostic of the AdvLIGO PSL

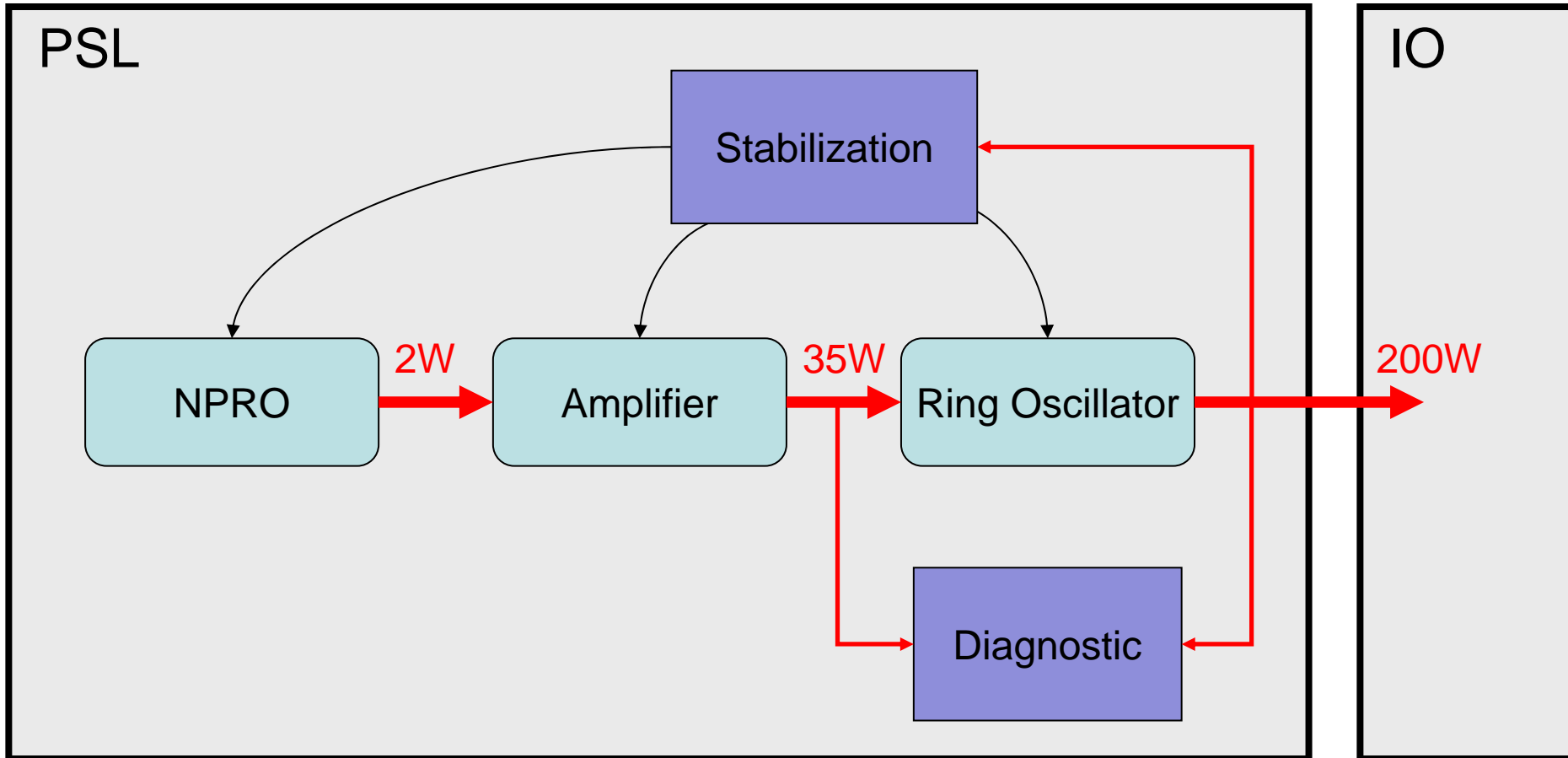
Instrument Science Plenary, 24 Oct 2007

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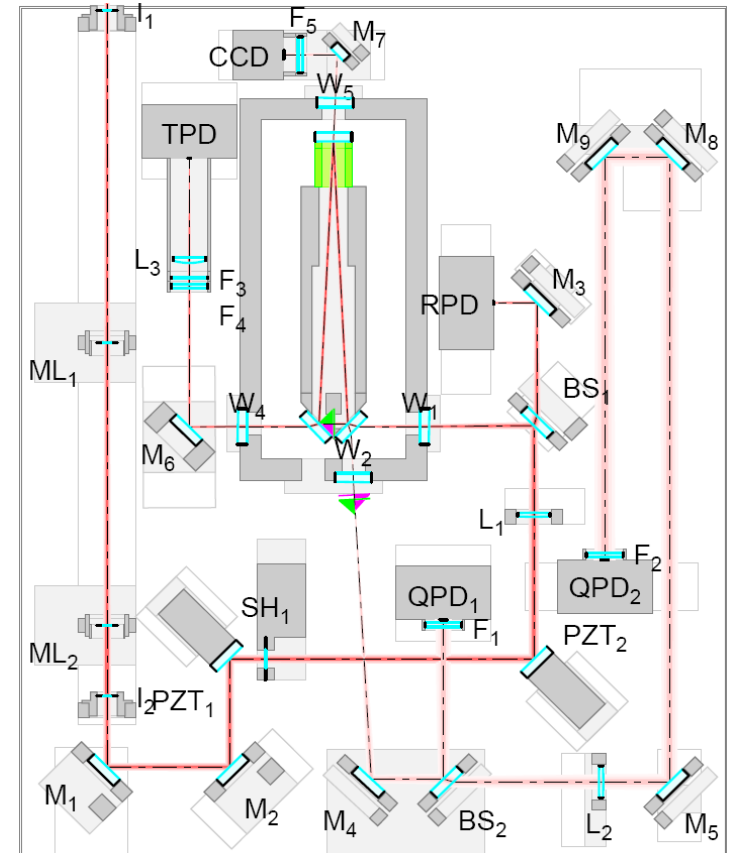
AdvLIGO PSL Overview



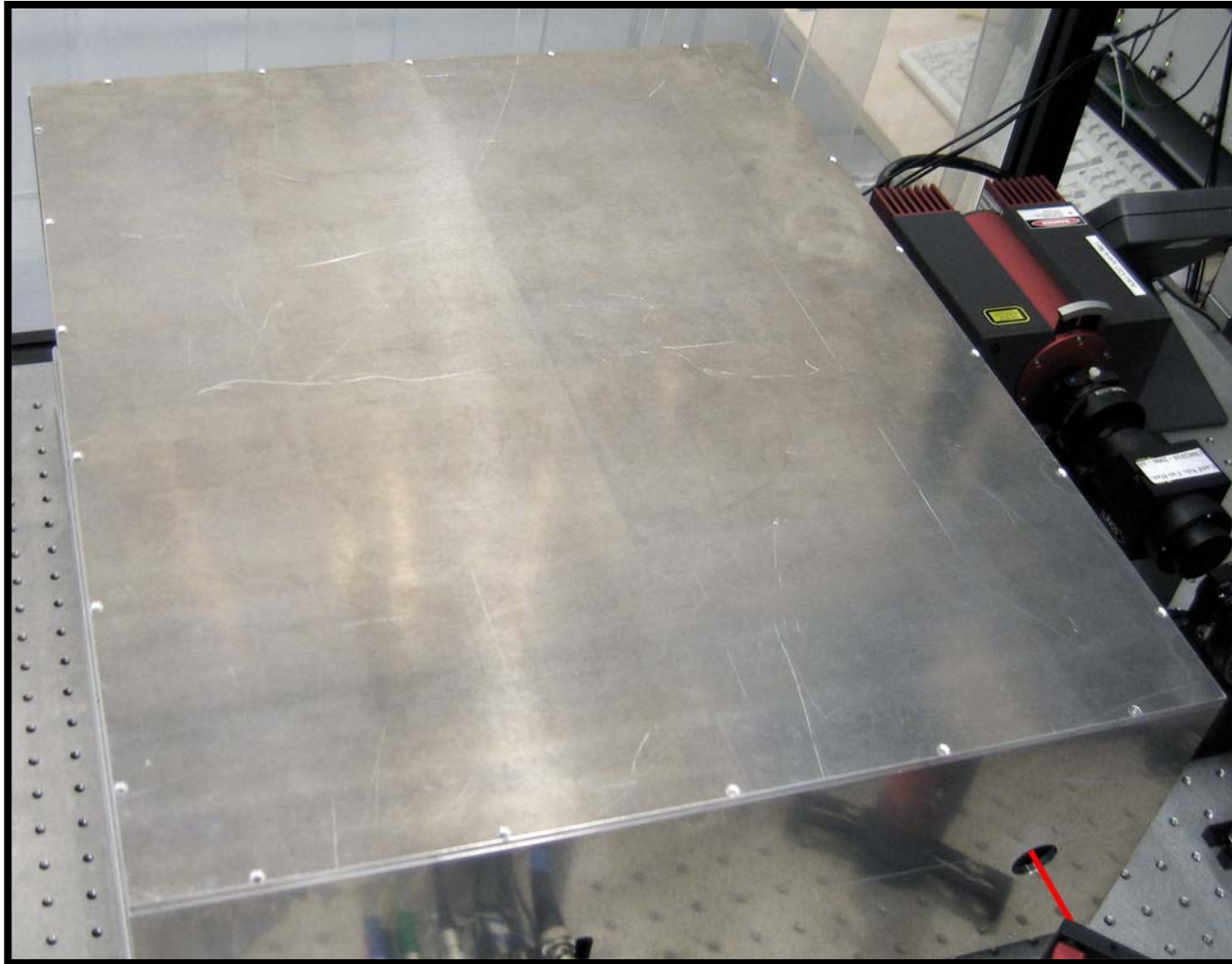
Diagnostic Breadboard



- Compact general purpose laser beam characterization breadboard
- Characterization of...
 - RIN, RF-RIN
 - Frequency Noise
 - Beam Pointing
 - Beam Quality

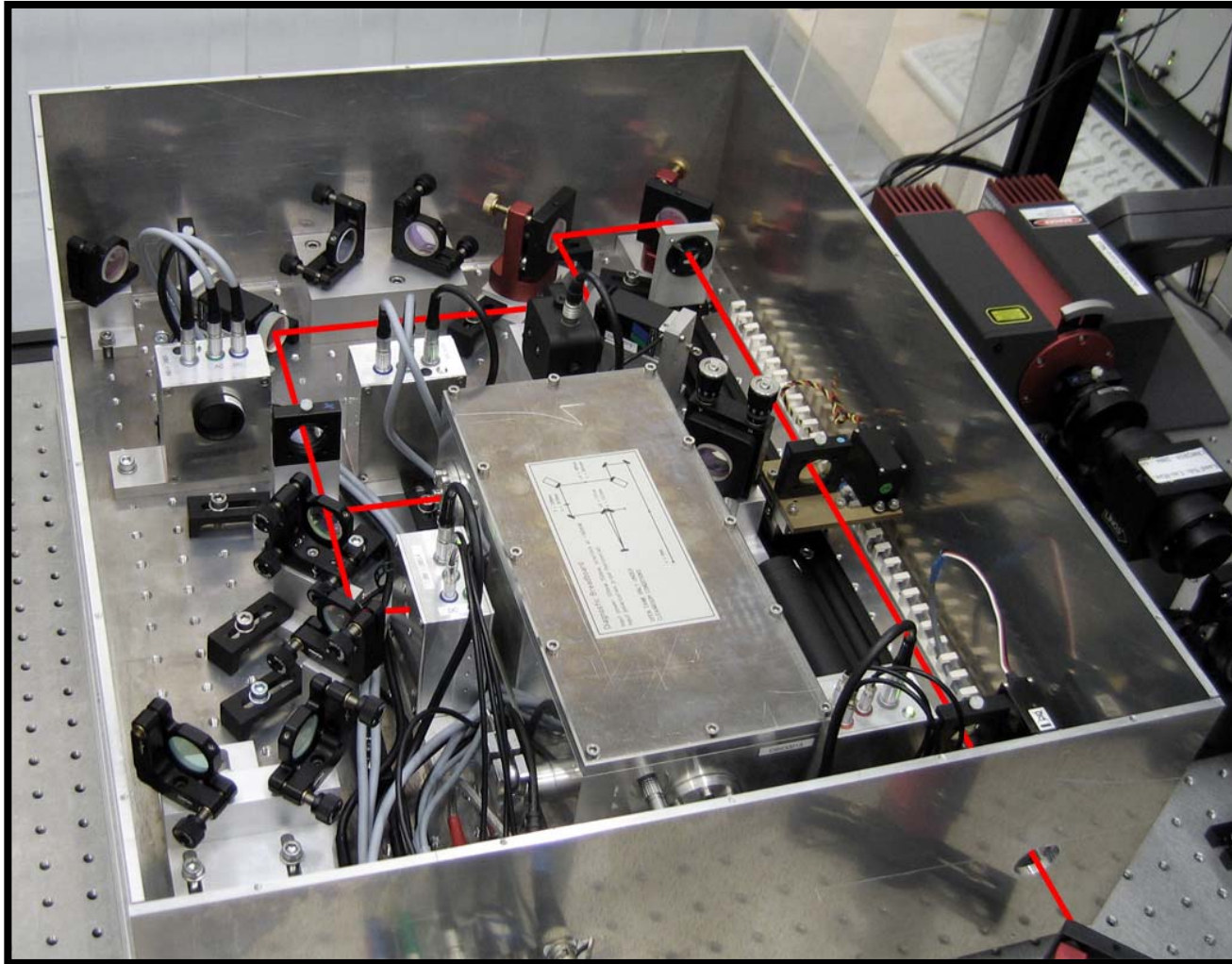


Diagnostic Breadboard



- Box 61x50cm
- 140mW Input Power

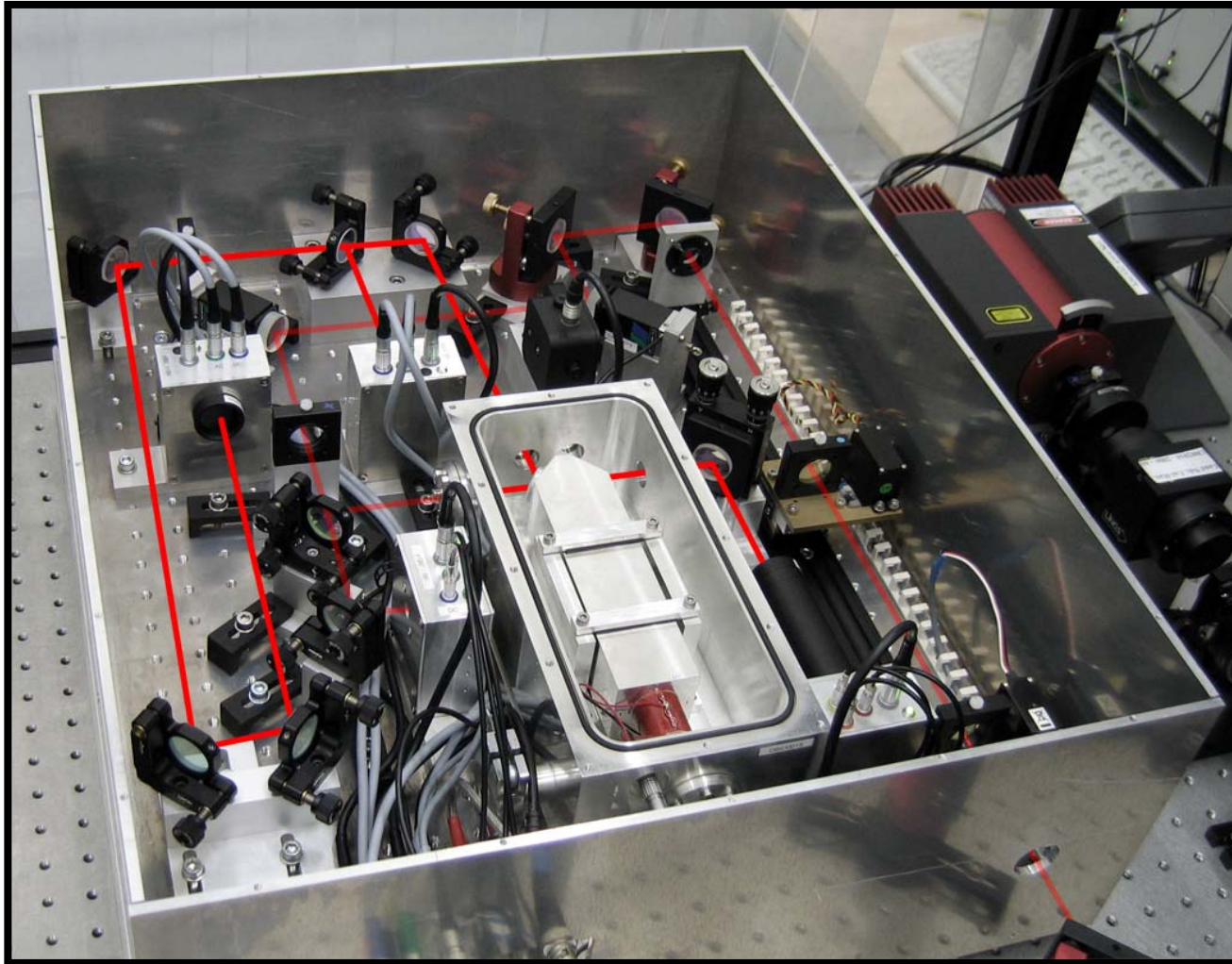
Diagnostic Breadboard



RIN / RF-RIN

- High Power PD
- 50mA photocurrent
- 50MHz bandwidth

Diagnostic Breadboard



Frequency Noise

- PMC, $F=360$
- Acoustic shielding
- Dither lock @ 1MHz

Pointing

- DWS, 2 QPDs

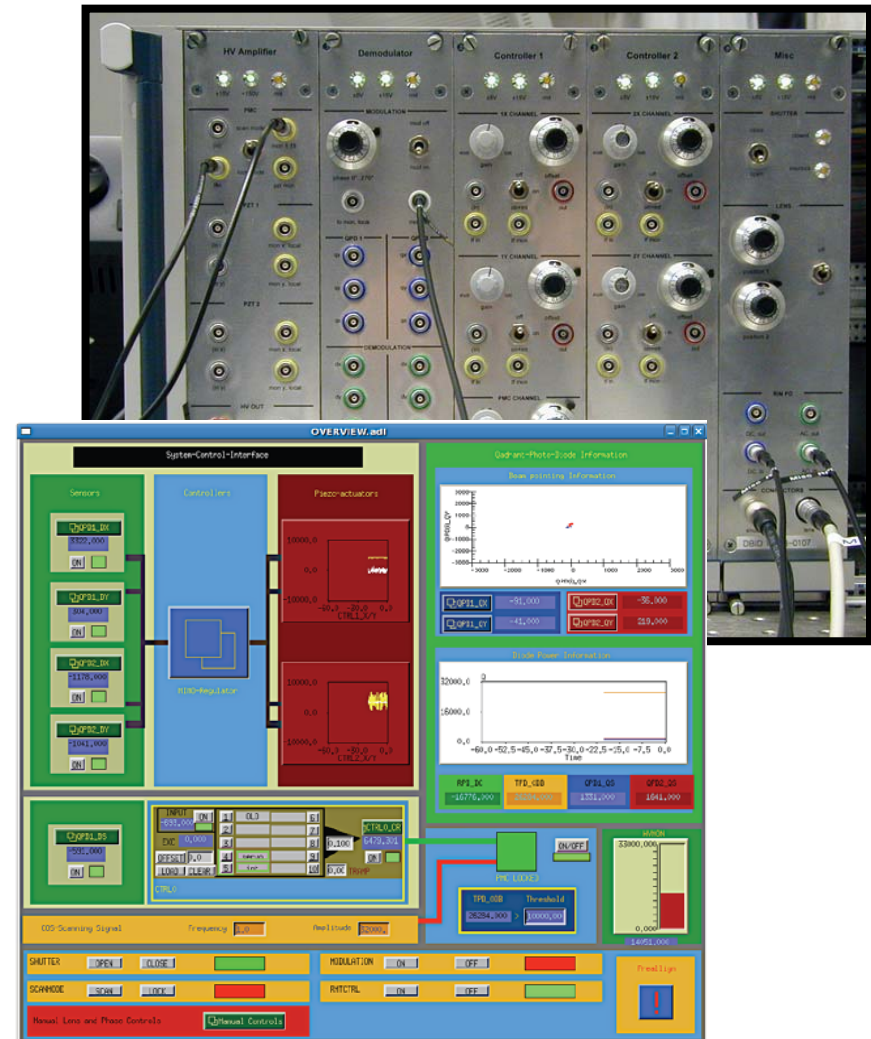
Beam Quality

- Mode scan

Kwee et al., *Laser beam quality and pointing...* , RSI 78(7) 2007



- Analog Feedback Loops
- Local Operation Mode
 - Only Spectrum Analyzer necessary
- Remote Operation Mode
 - Everything controllable by analog and digital signals on the crate bus
 - Low cost Control and DAQ System with Windows PC
 - CDS/EPICS interface



- Documentation
 - Construction manual
 - Testplans
 - Instruction manual
- One DBB already built
 - LZH, Characterization of 35W & 200W Laser
- Two more are built at the moment
 - AEI, Reference System
 - eLIGO

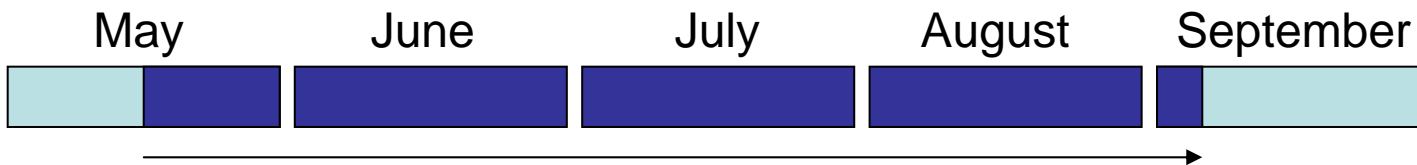


- 7 NPROs characterized

- Functional Prototype
- Engineering Prototype
- Reference
- Observatory 1
- Observatory 2
- Spare 1
- Spare 2



- “Spare 2” characterized for > 2600 hours

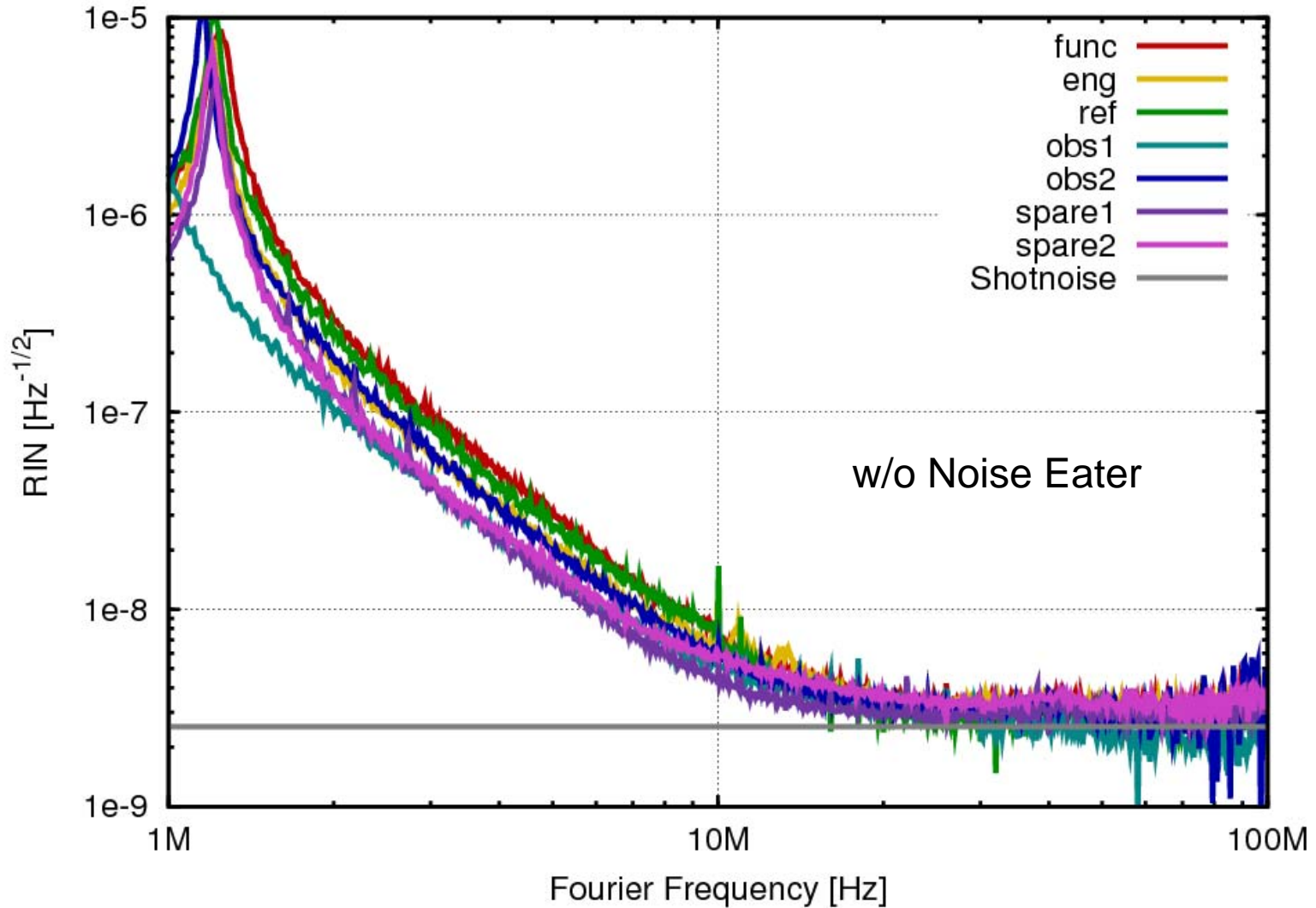


Power		All NPROs	Long term
1	Output power slope	●	
2	Output power	●	
3	Relative output power trend		●
4	Output power fluctuations, rms, 0.6mHz..1Hz	●	●
5	RIN, 1Hz..100kHz, with Noise Eater	●	●
6	RIN, 1Hz..100kHz, w/o Noise Eater	●	
7	RIN trend at selected frequencies		●
8	RF RIN, 1MHz..100MHz, with and w/o NE	●	
9	Relaxation oscillation frequency	●	

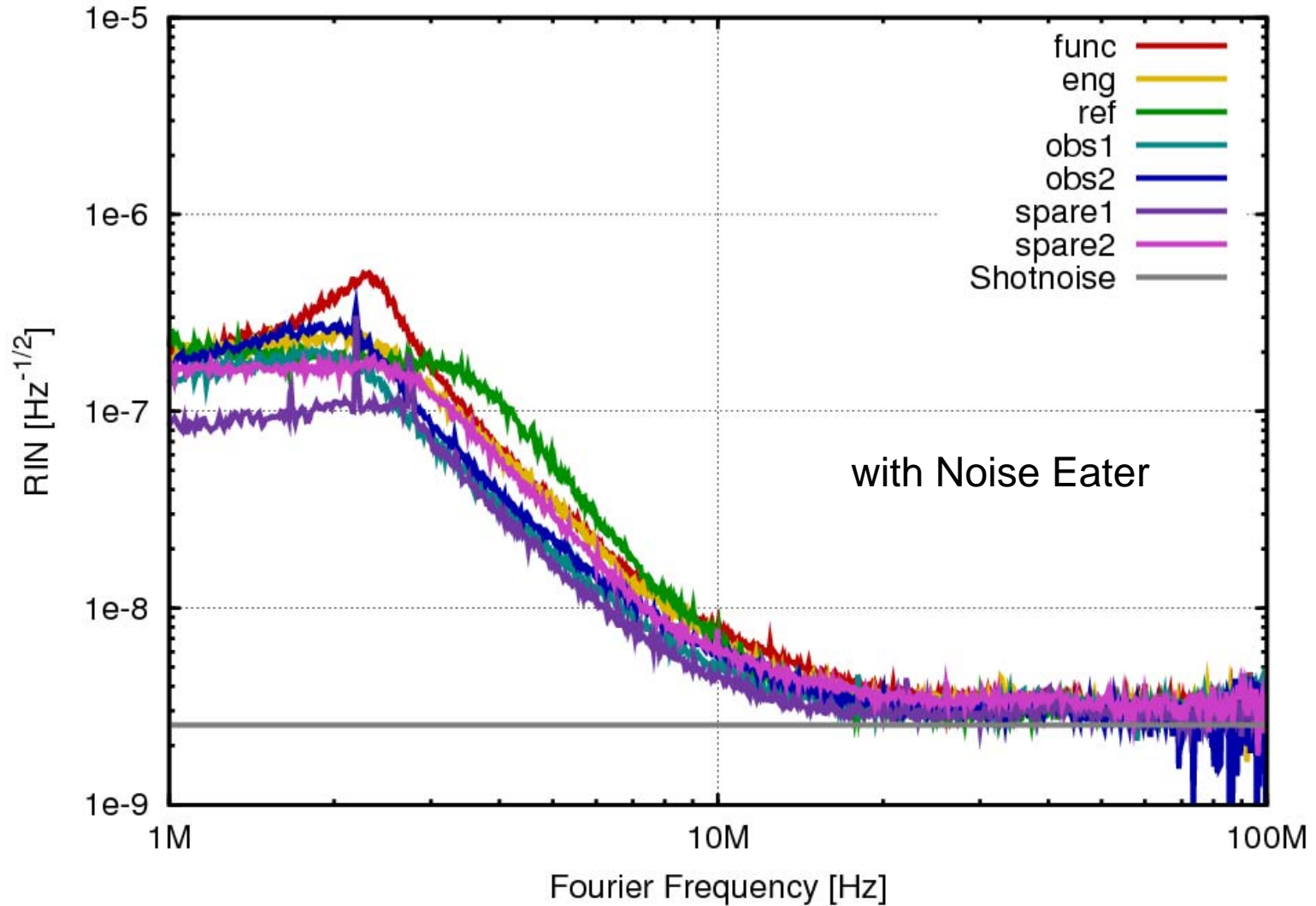
Frequency		All NPROs	Long term
10	Frequency noise, 1Hz..100kHz	●	●
11	Frequency noise trend at selected frequencies		●
12	PZT frequency actuator	●	
13	Temperature frequency actuator	●	

Mode		All NPROs	Long term
14	Pointing fluctuations, rms 0.6mHz..1Hz	●	●
15	Pointing, 1X, 1Y, 2X, 2Y, 1Hz...100kHz	●	●
16	Pointing trend at selected frequencies		●
17	Beam quality	●	
18	Beam quality trend		●
19	Relative ellipticity/astigmatism	●	
20	Mode matching trend		●

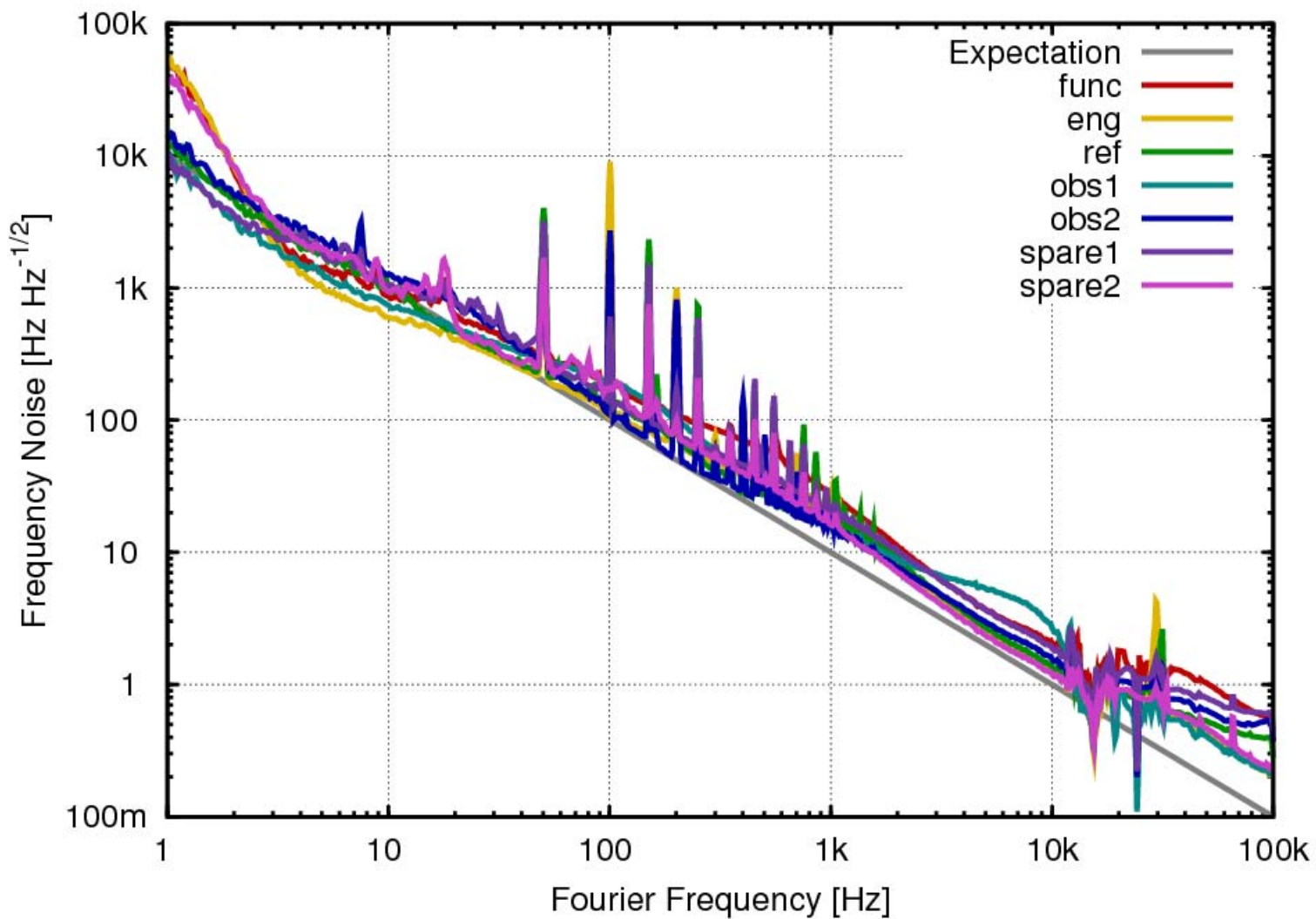
RF-RIN



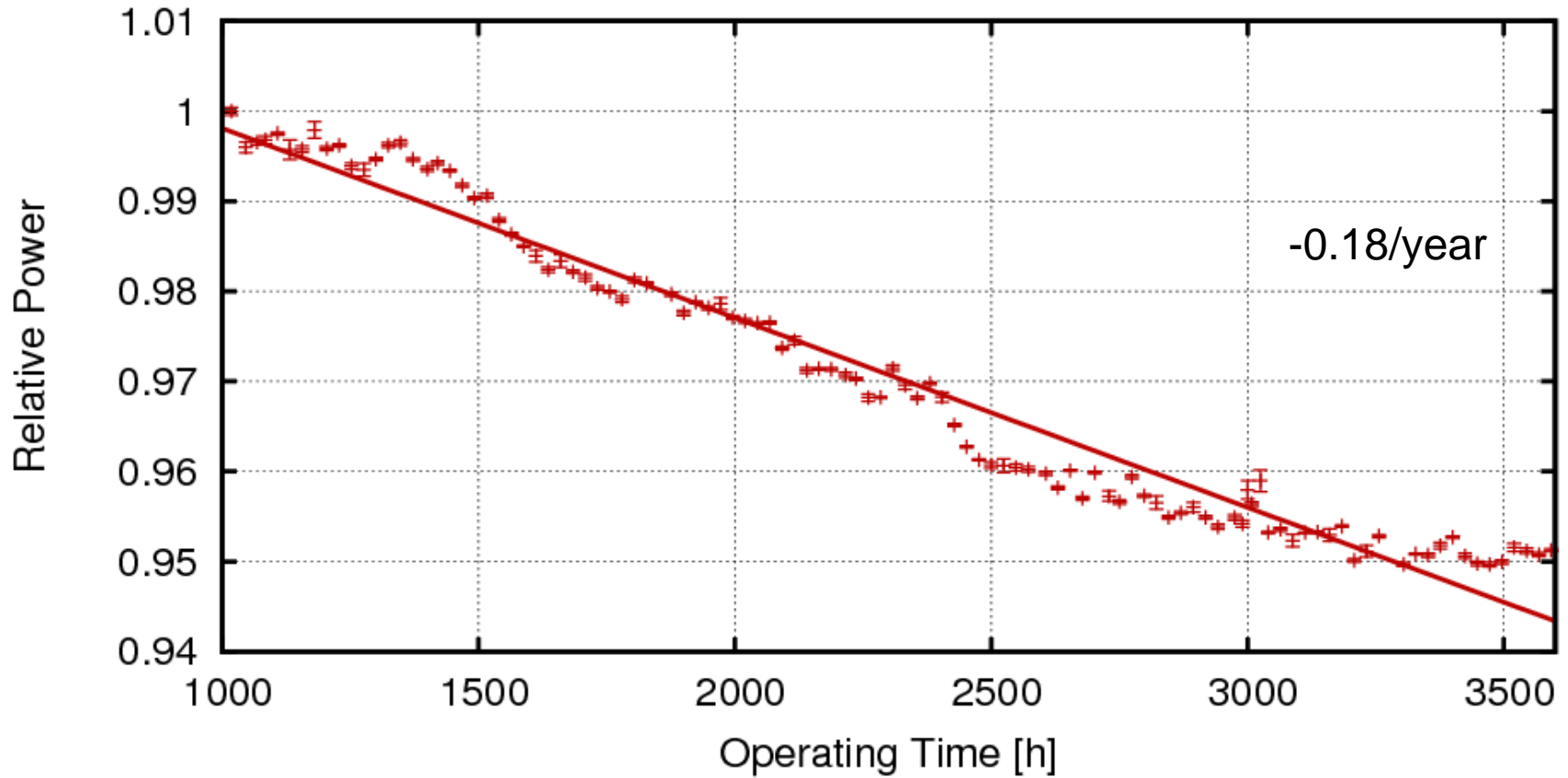
RF-RIN



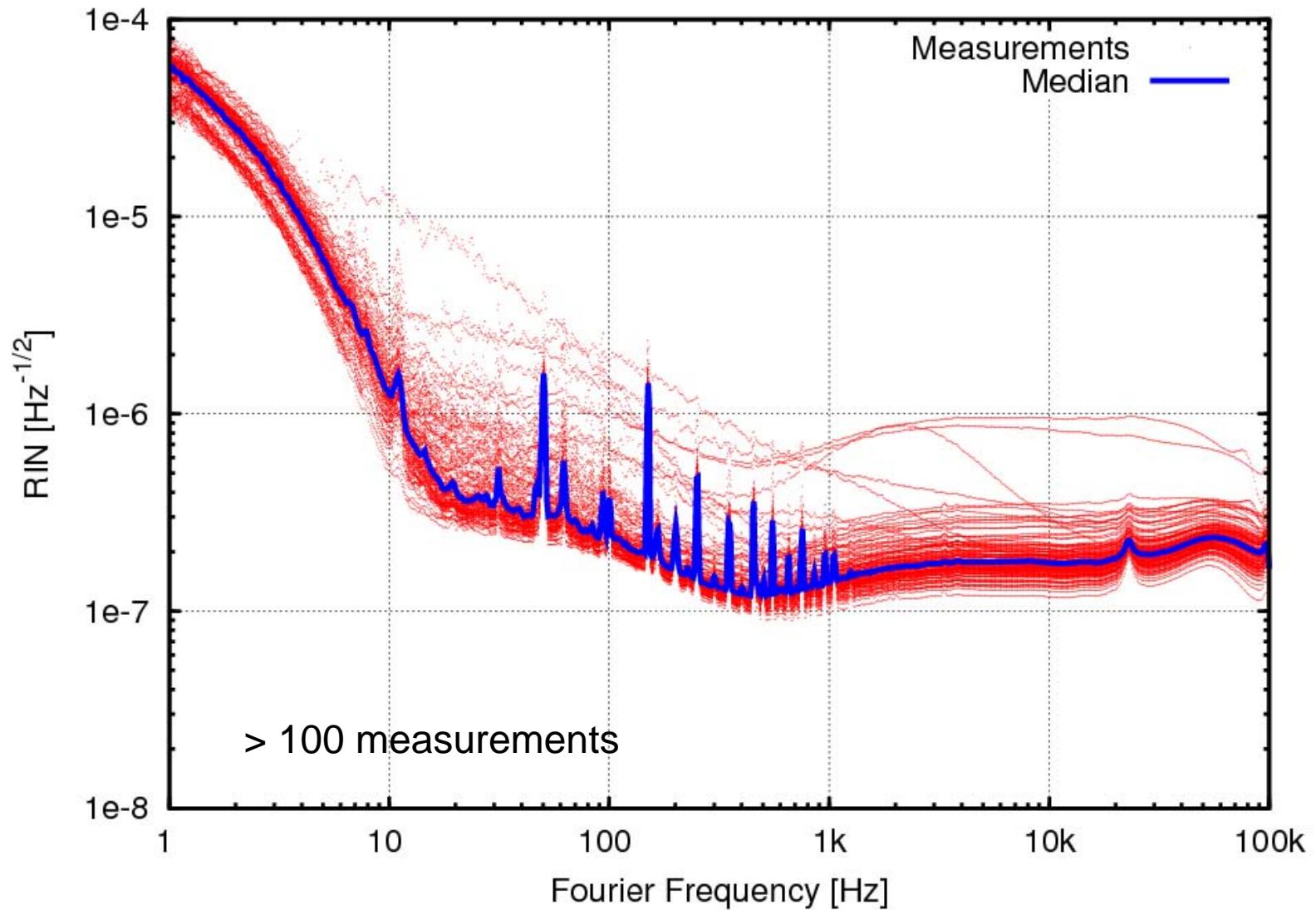
Frequency Noise



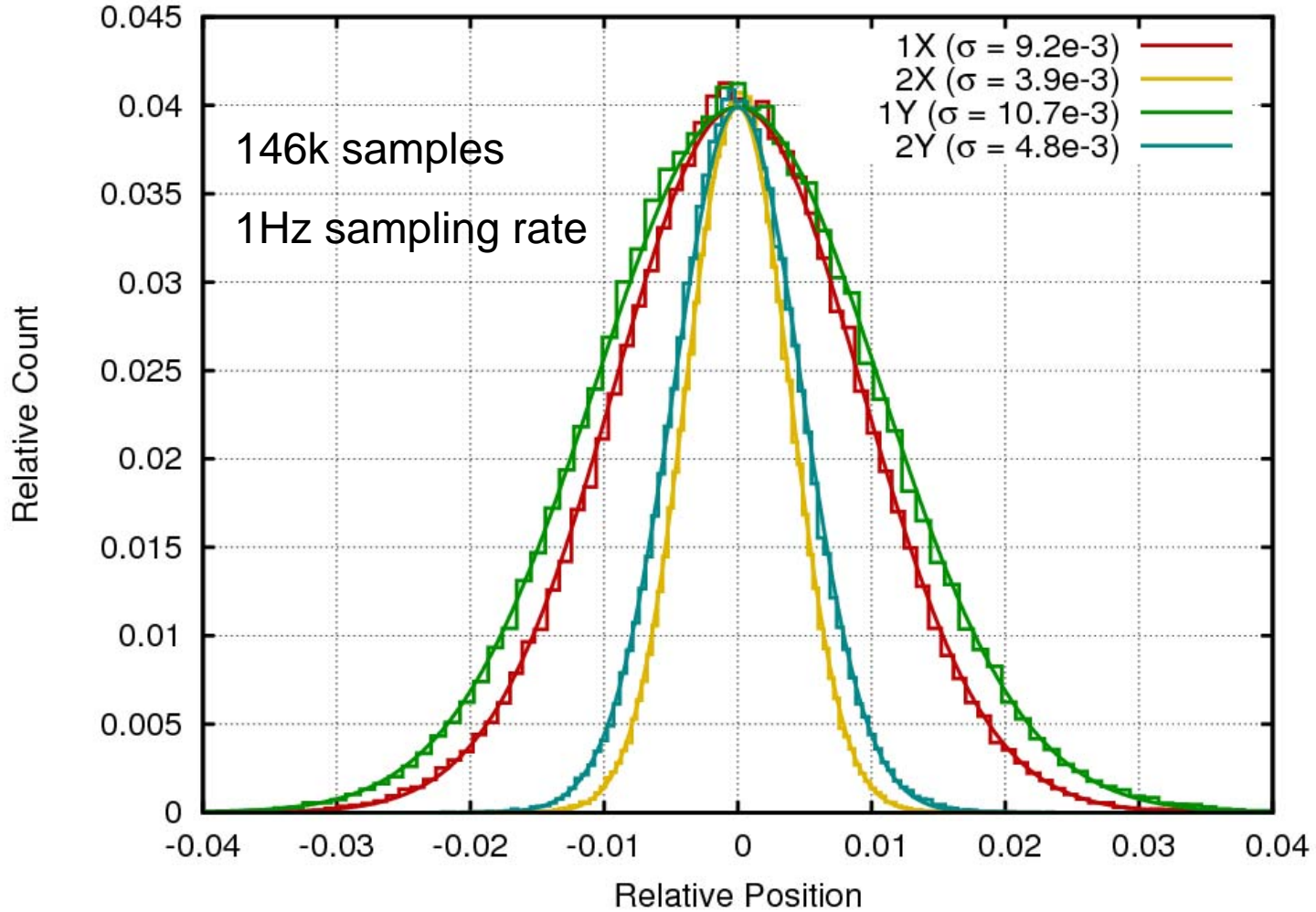
Output Power Trend



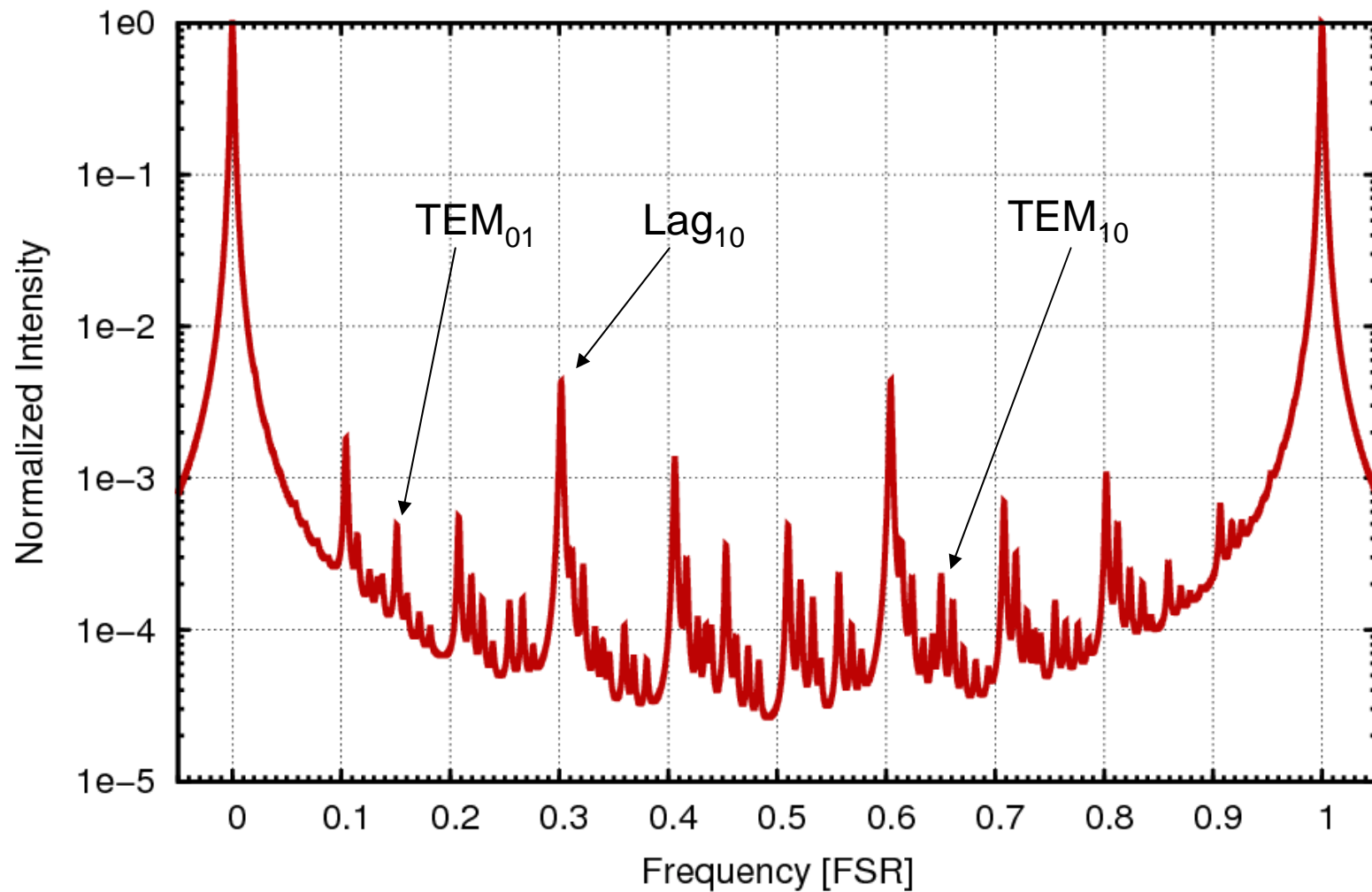
RIN



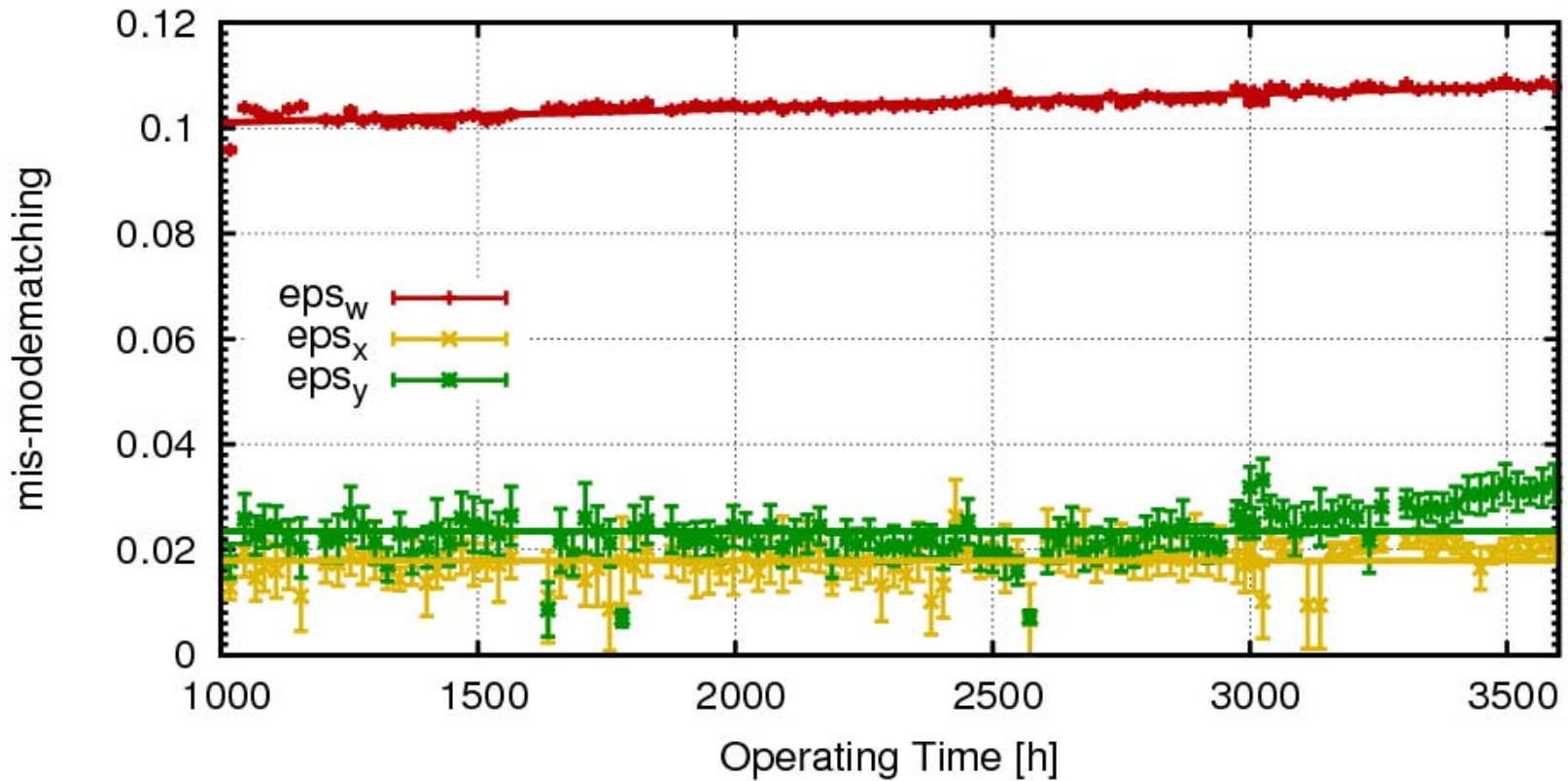
Pointing



Mode Matching Trend



Mode Matching Trend





Next Steps

- Characterization of 35W Frontends
- Long term characterization of Reference Frontend

Summary

- DBB key component of PSL Diagnostics
- DBB completely remote controllable laser beam characterization instrument
- Production of 3 systems started
- Successful automatic operation for > 2600h
- Characterization of 7 Master Lasers