Optical lever lasers -
To Fix or Not to Fix!!

Suresh Doravari

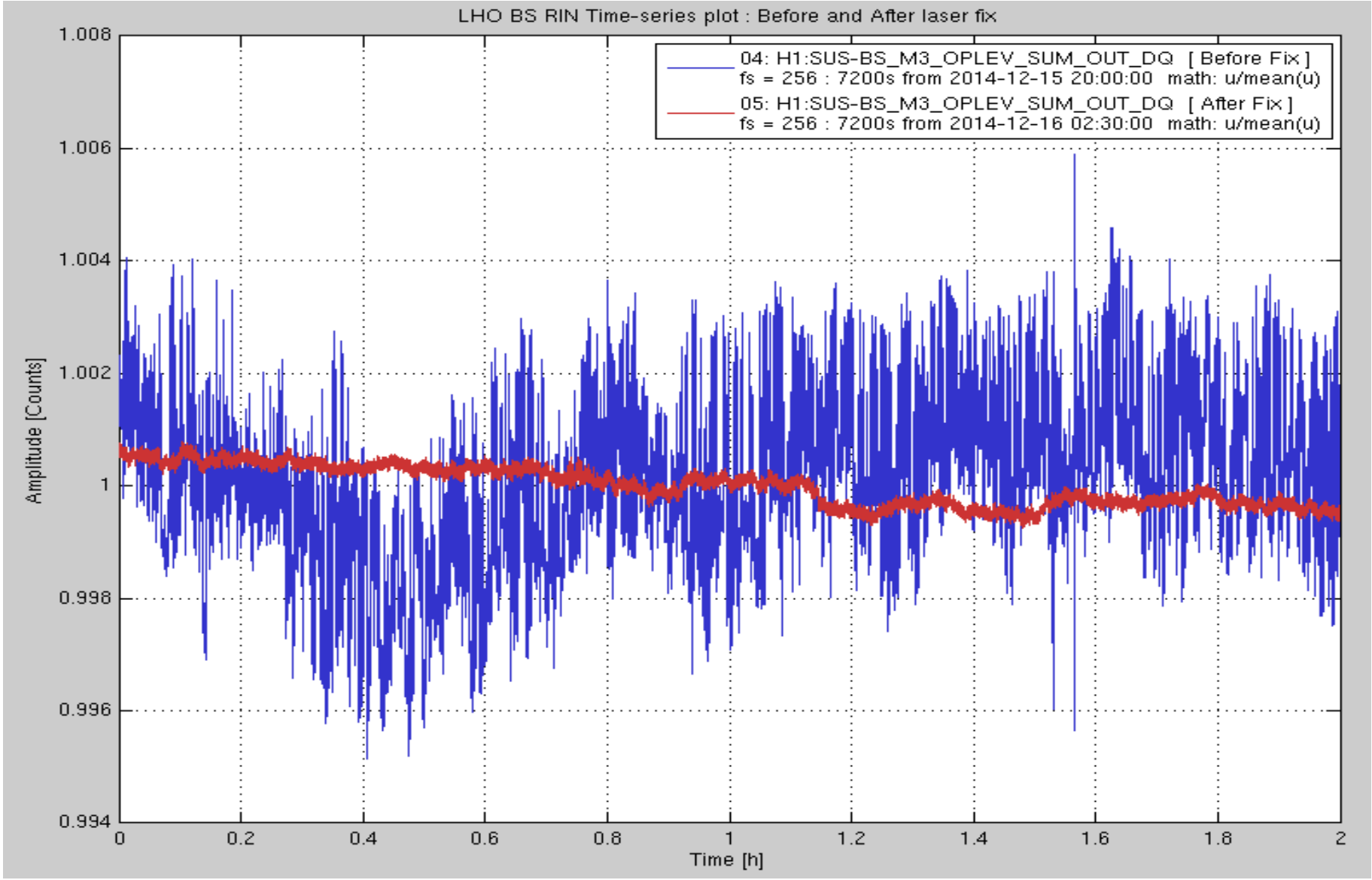
LIGO-G1500071

Optical Lever Lasers -
To fix or not to fix!

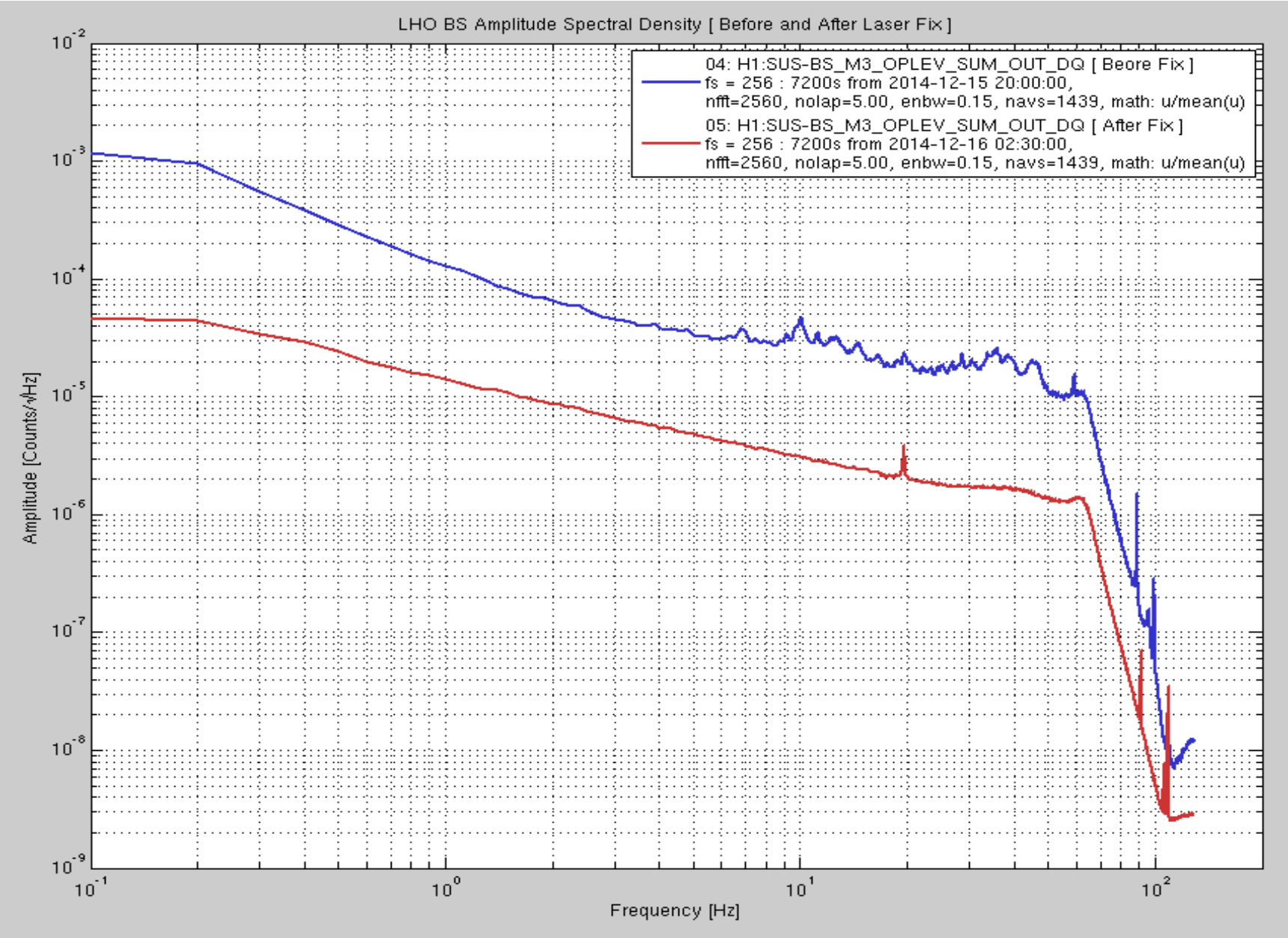
1. What do we mean by better performance?
2. Do we need better performance?
3. How do we obtain better performance?
4. A comparison of diode lasers and HeNe lasers
5. Options ahead of us
6. A possible plan of action

Our current oplev lasers can perform ten times better

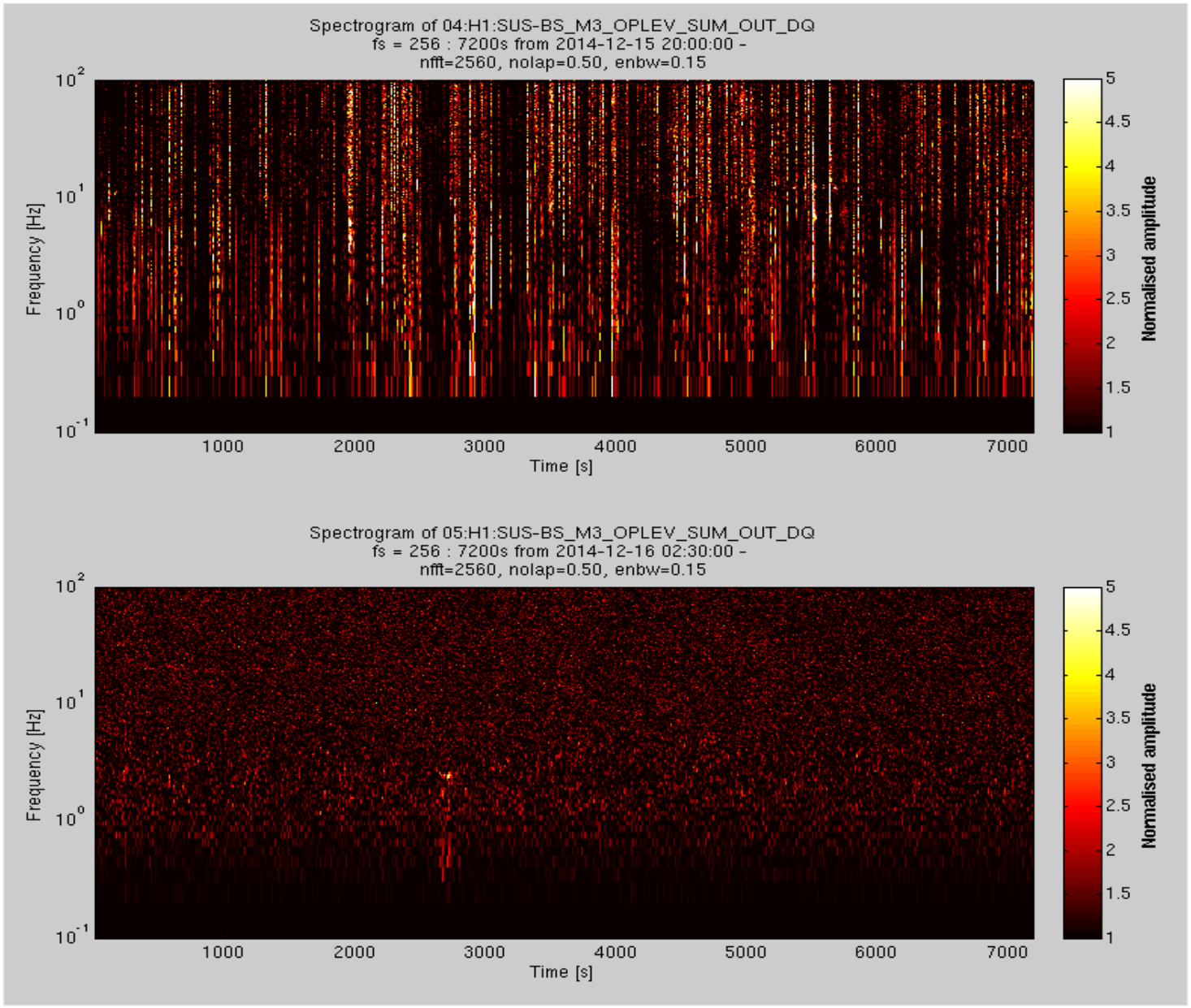
Oplev laser power fluctuations : factory spec RIN is 1% , after the fix < 0.1%



Lower noise across the entire spectrum by an order of magnitude



Spectrograms show an absence of glitches after the fix.



Do we need better performance?

School One

The oplevs are used to obtain lock and then the control is transferred to wavefront sensors.

So glitchy lasers are okay.

School Two

When the weather gets bad

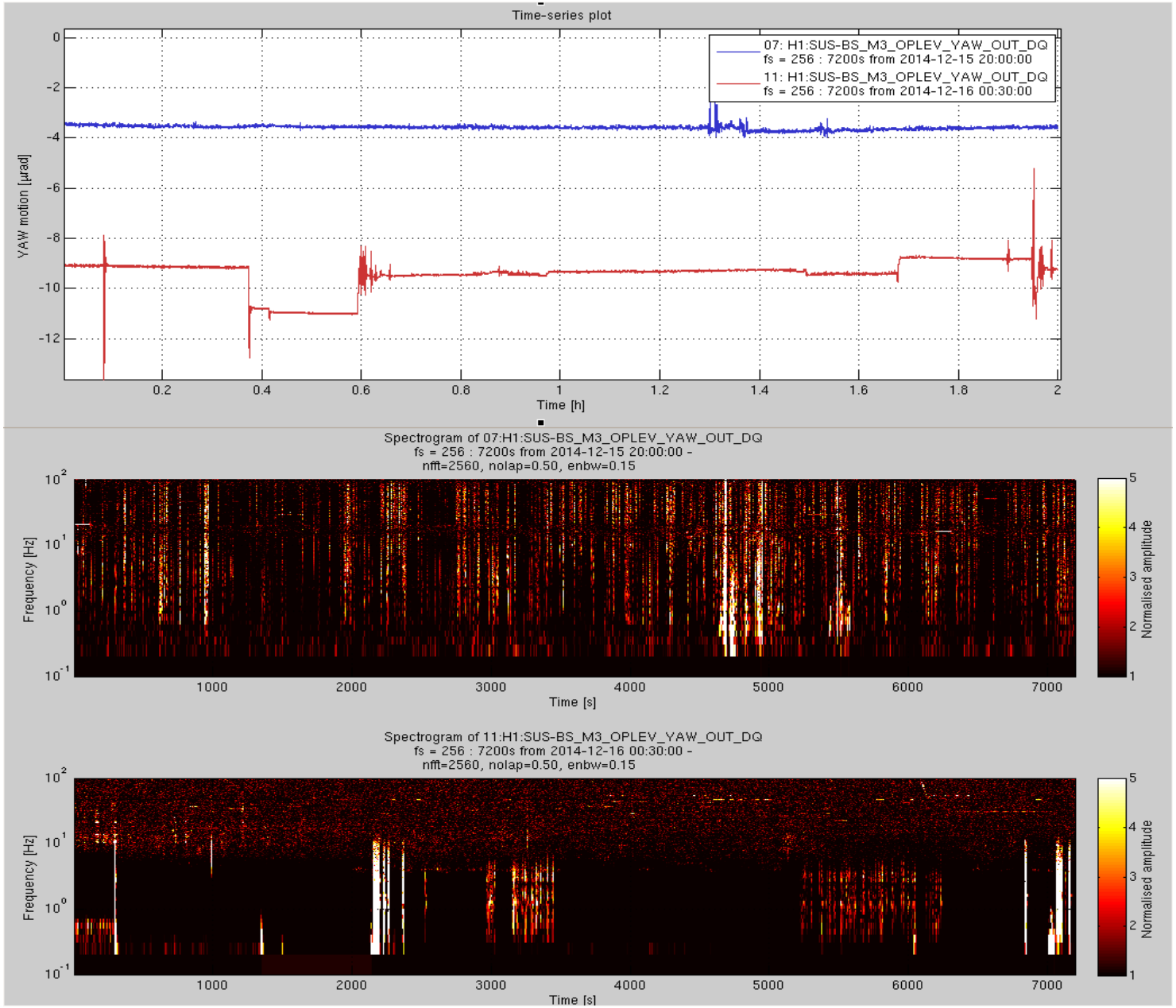
- High wind conditions in LHO
- Storms in LLO

We will need to engage oplev damping even during lock.

Even obtaining lock may be difficult if the oplev noise is high.

So we do need lasers which do not glitch.

An example of how laser power glitches kick the optic:

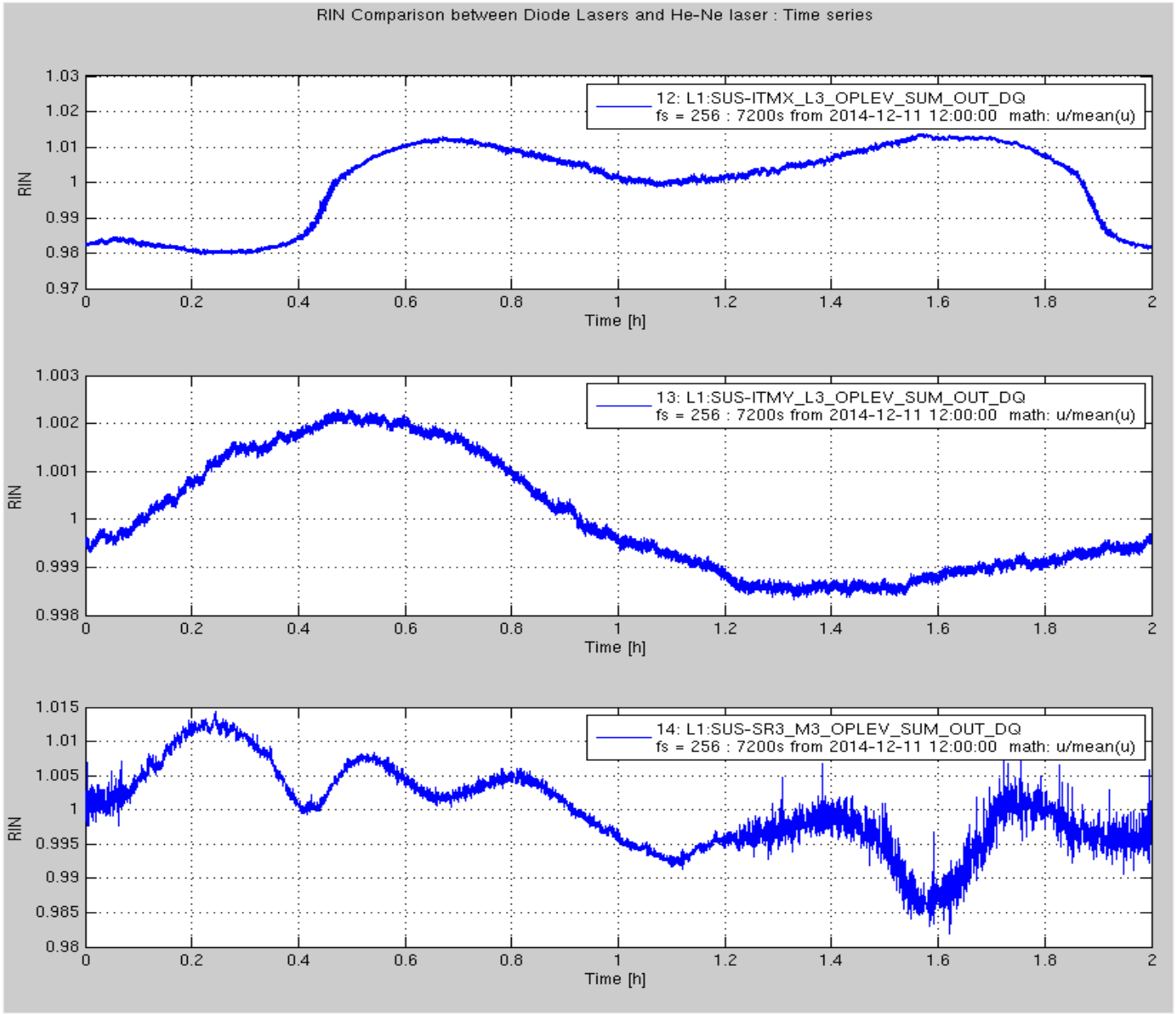


How can we obtain better performance?

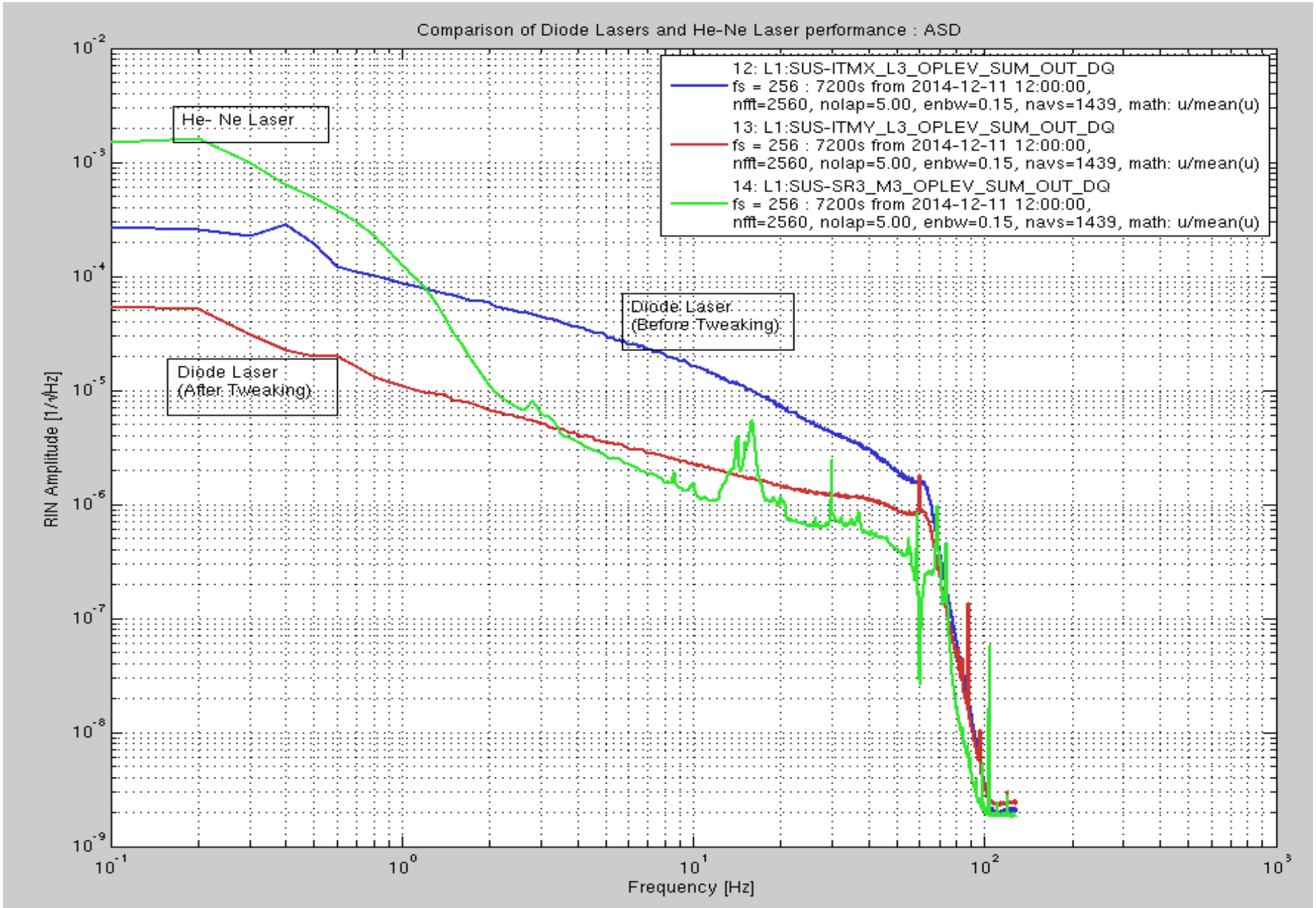
A. Fix the ones we have
    1. Tweak alignment to reduce optical feed back
    2. Tweak operating temperature set point
    3. Choose power level for glitch free operation
    4. Reduce fan speed
    5. Passive thermal shielding

B. Replace them with
    1. Better diode lasers
        I. Get the present supplier to deliver glitch free lasers
        II. Source from Thorlabs or another such standard company (will require some local tuning for glitch free operation)
    2. He-Ne lasers
        I. Fiber fed He-Ne laser with stabilisation

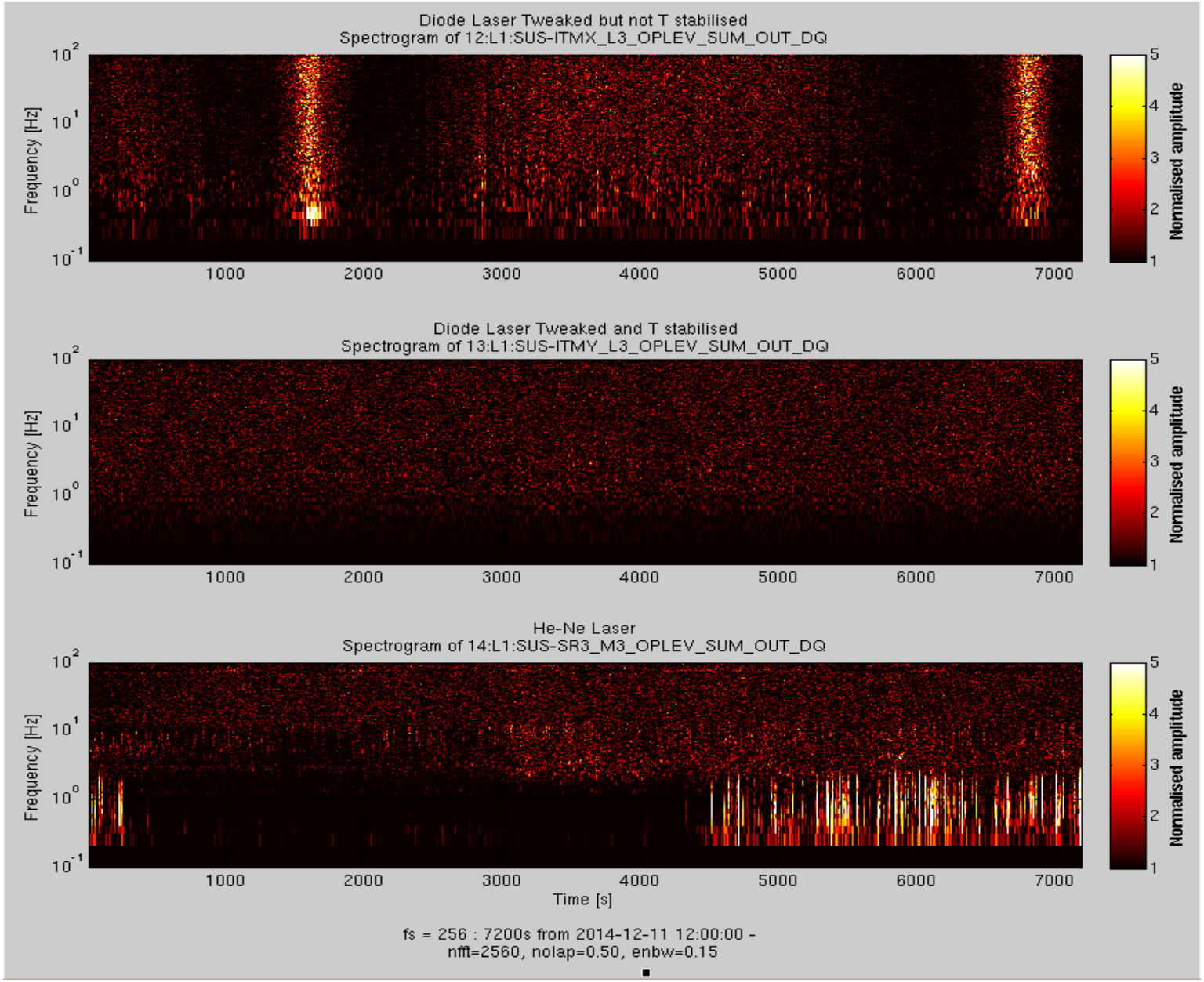
Comparison between He-Ne and Diode lasers



Comparison of He-Ne and diode lasers : Spectra



Comparison between He-Ne and Diode lasers : Spectrograms



Options ahead of us

1. Do nothing and live with the current glitchy lasers
2. Train the current supplier to build glitch free lasers
3. Obtain better engineered diode lasers another well established supplier (Thorlabs for eg.) and tune them for glitch free performance our selves
4. Switch over to He-Ne lasers (either fiber coupled or free space) and do the work needed to stabilize them

A plan of action

1. Fix the diode lasers currently with us and use them till their end-of-life (at least two years)
2. In the mean time explore and test other vendors and lasers
    1. Diode lasers from Thorlabs
    2. Stabilised HeNe Lasers with fibers couplers from Newport

    (Both these will require some in-house work for stable operation)
3. In a couple of years time replace the diode lasers as they die with the new solution