JGW-G1402200-v1

Type-A SAS Local Control Simulation (Current Status)

2014/01/22

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Local Control Strategy

(based on Virgo control scheme)

During interferometer operation:

- Resonances of pendulum modes are damped by IP control to reduce RMS.
- No longitudinal damping is applied at IM.
- Pitch & yaw of TM are controlled by optical levers.

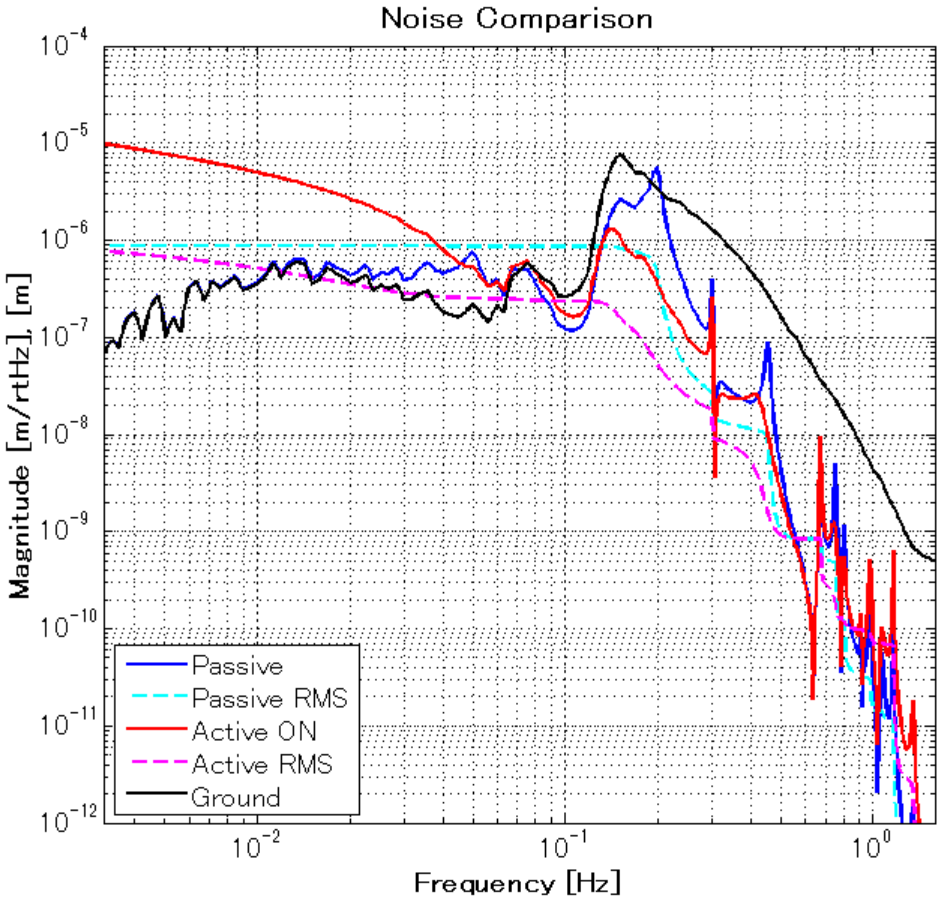
For lock acquisition:

- Resonances of internal modes are damped by using local sensors (OSEMs) at IM.

IP Control

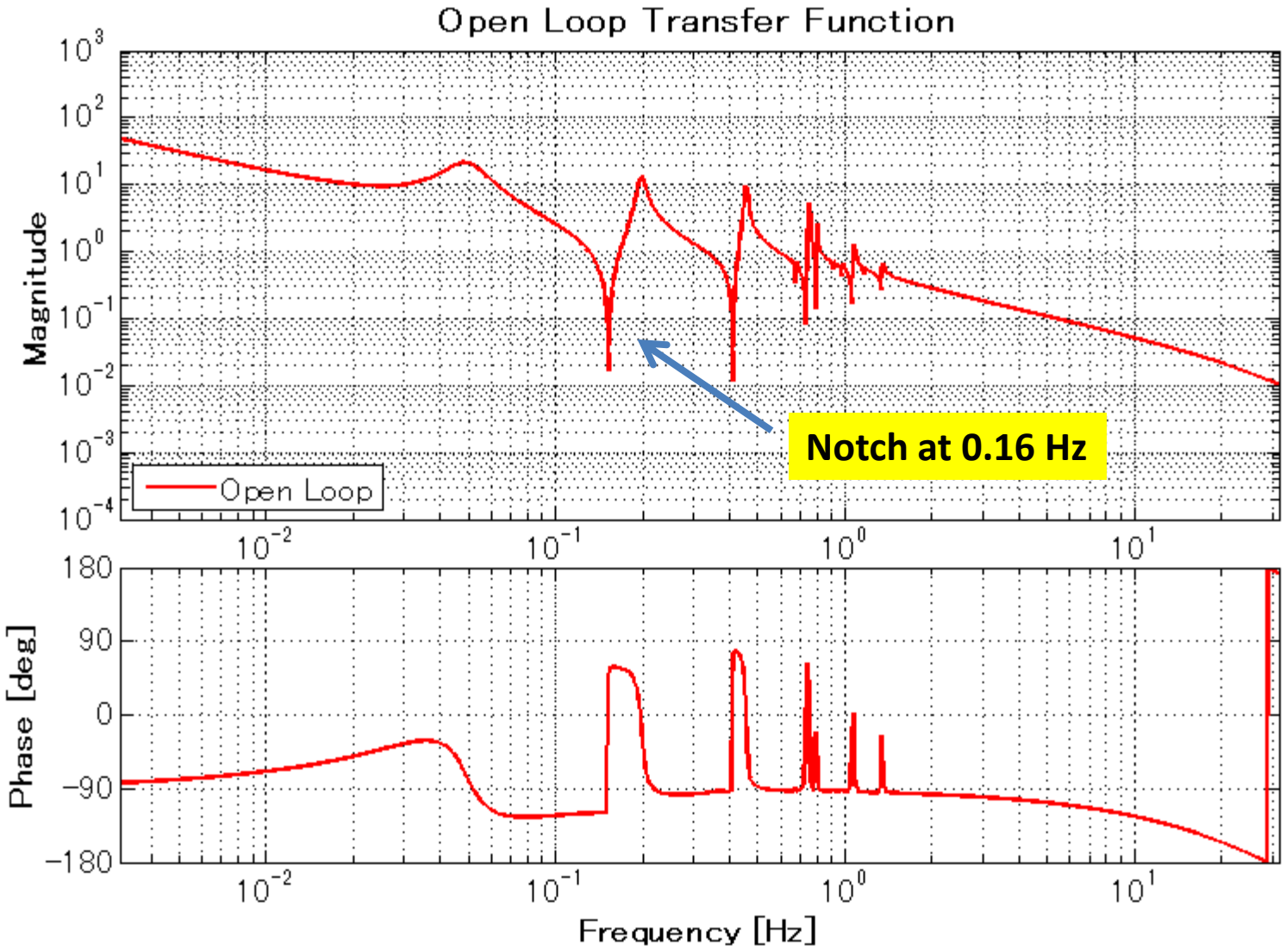
- We have not yet achieved required TM RMS displacement (= 1e-7 m).
- Two disturbing points:
  - Notch at 0.16 Hz in actuator response of IP
  - Glowing sensor noise of geophone at low frequencies

http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/DocDB/ShowDocument?docid=2132



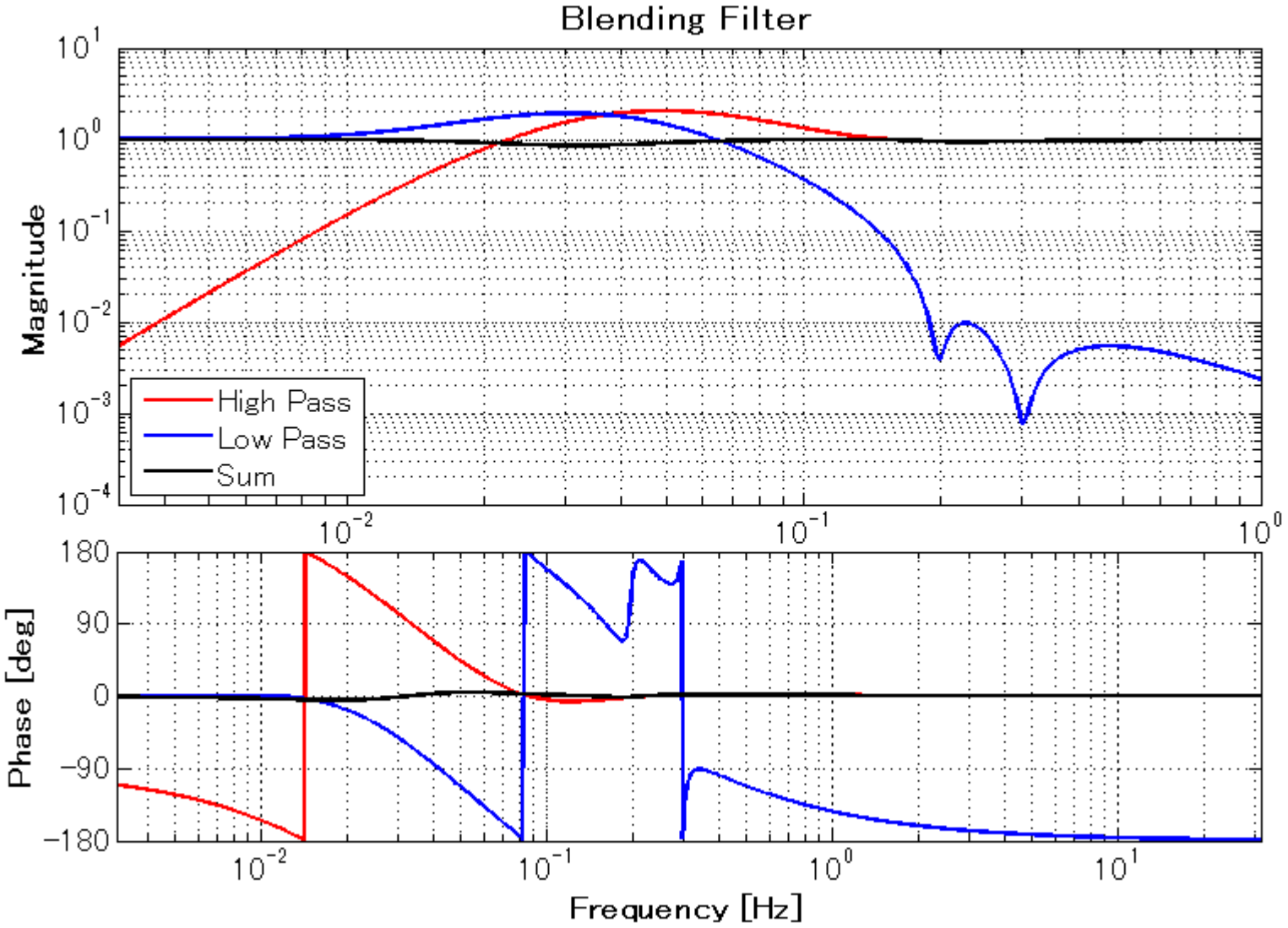
IP Control

- Open loop gain



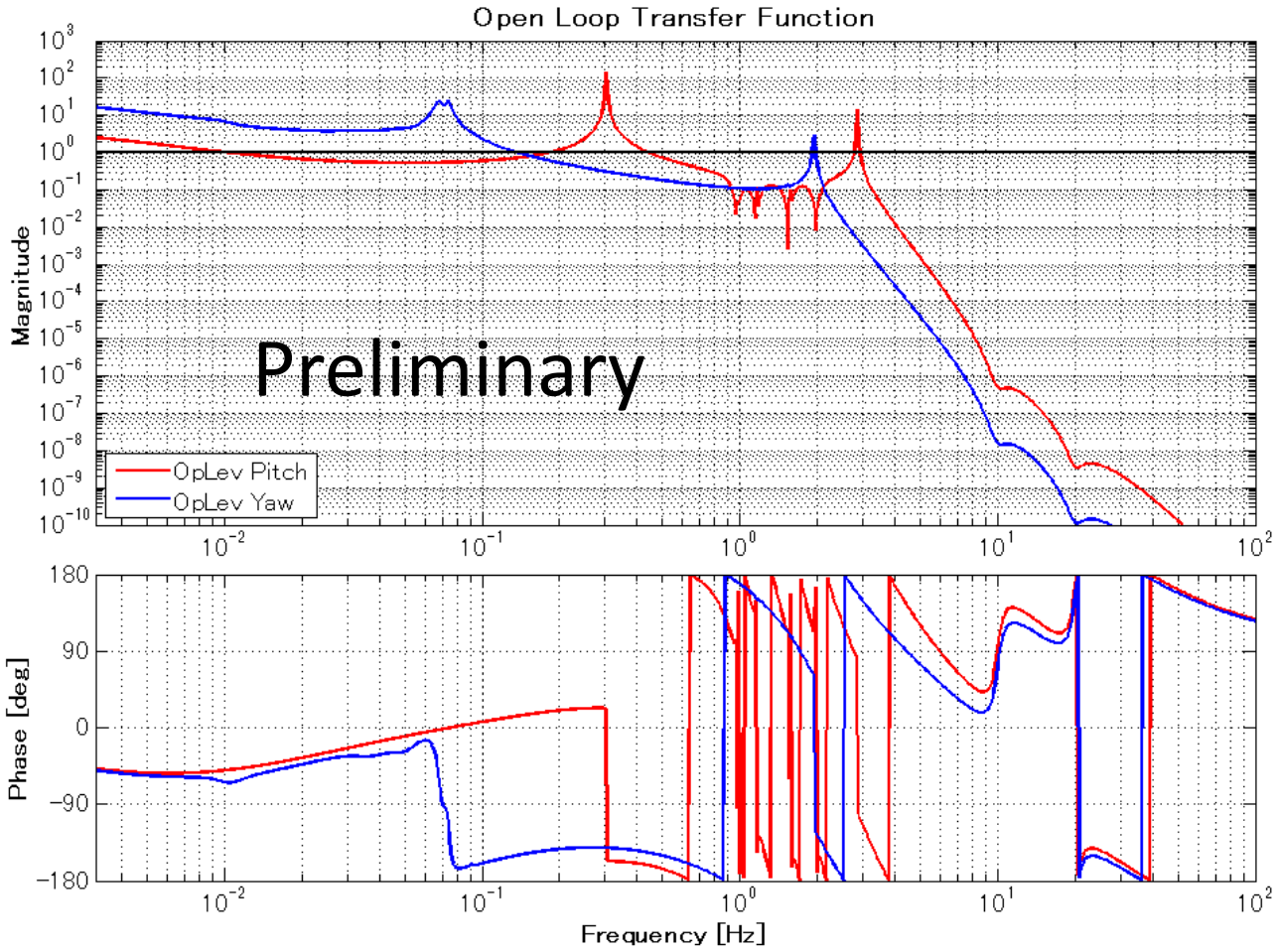
IP Control

- Sensor Blending



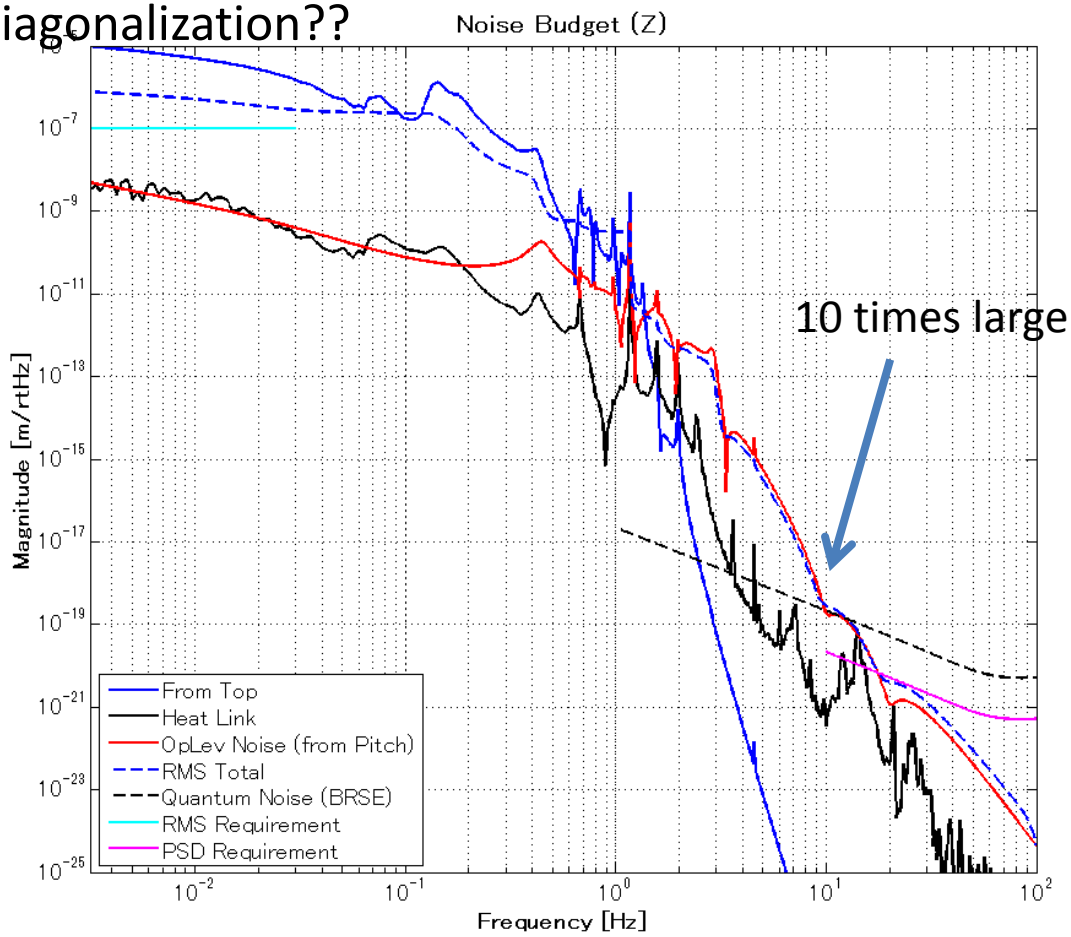
Optical Lever Control

- Optical lever control is applied to reduce RMS of mirror pitch & yaw:



OpLev Sensor Noise Contribution

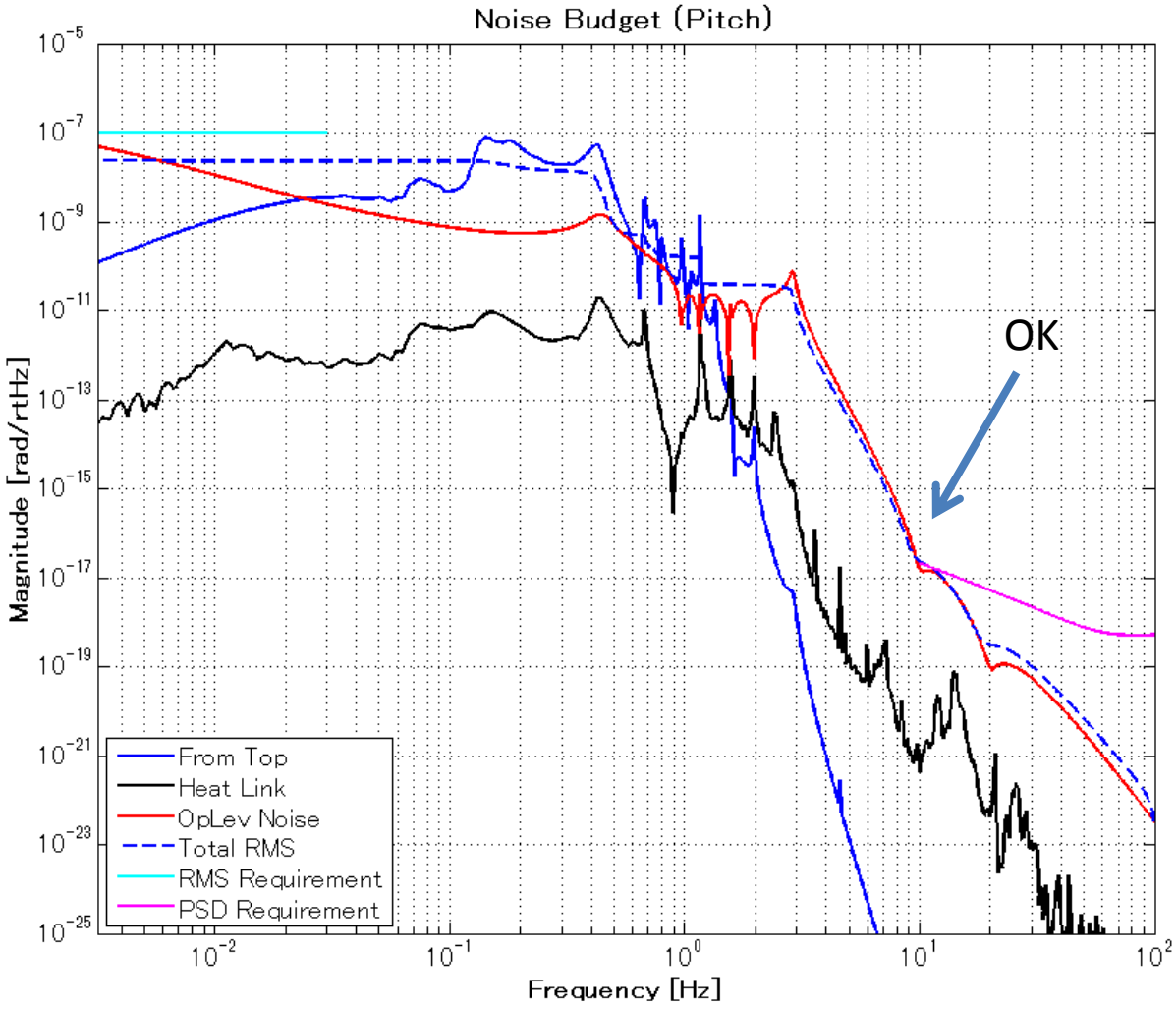
- Assuming optical lever sensing noise of 3e-11 rad/rtHz (at 10 Hz). (estimated from analogue electronics noise used in i-KAGRA)
- Pitch and yaw: OK, but noise coupling to Z is large.
- Large coupling from pitch actuation to zTM: can it be mitigated by actuator diagonalization??



10 times larger than requirement

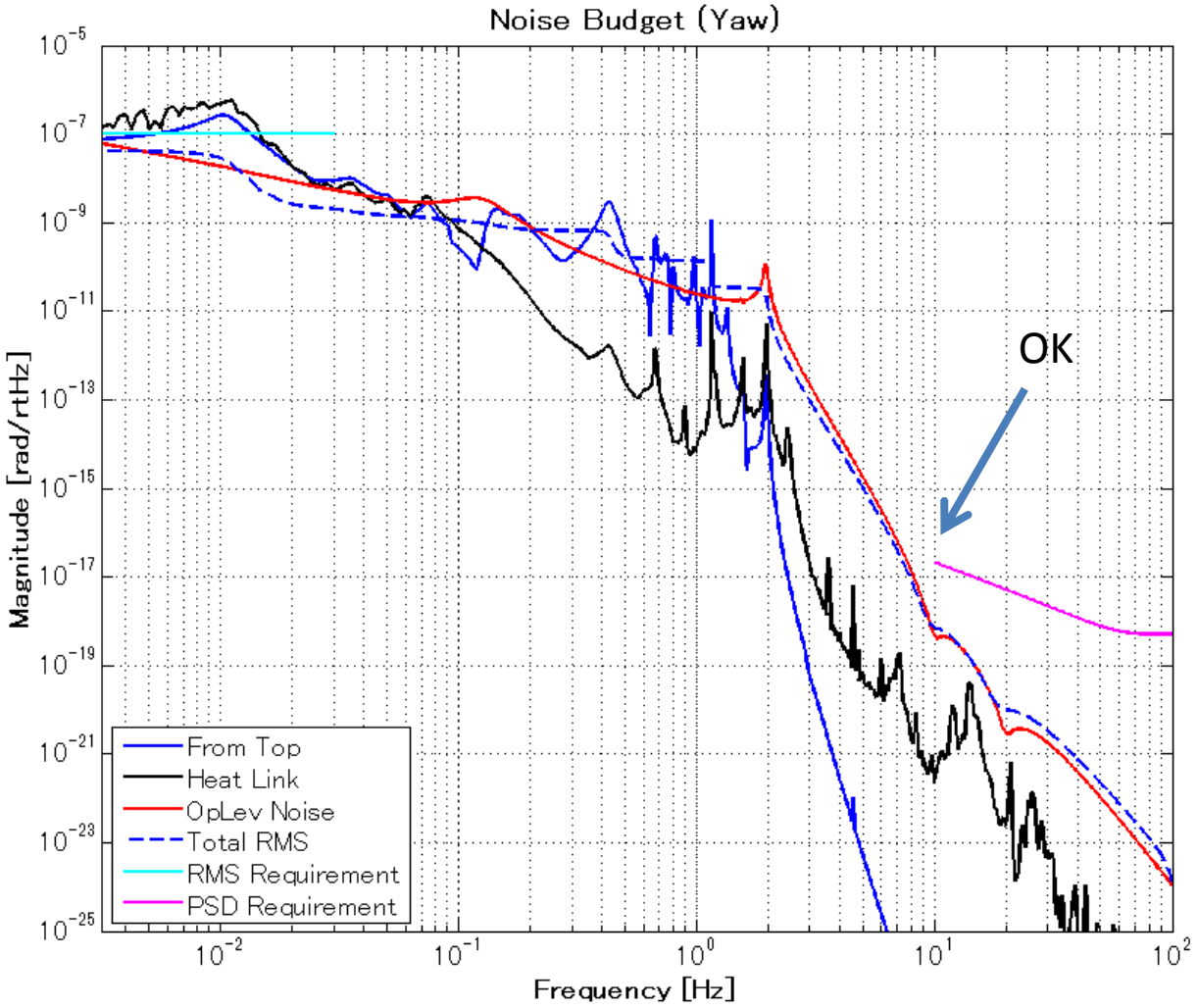
OpLev Sensor Noise Contribution

- Pitch



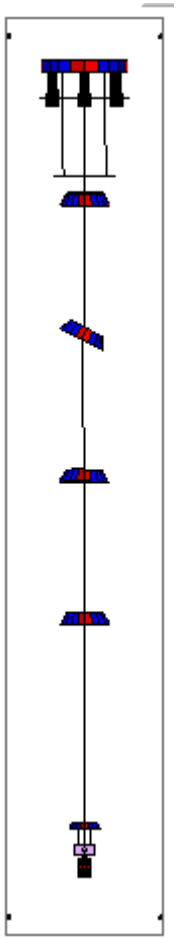
OpLev Sensor Noise Contribution

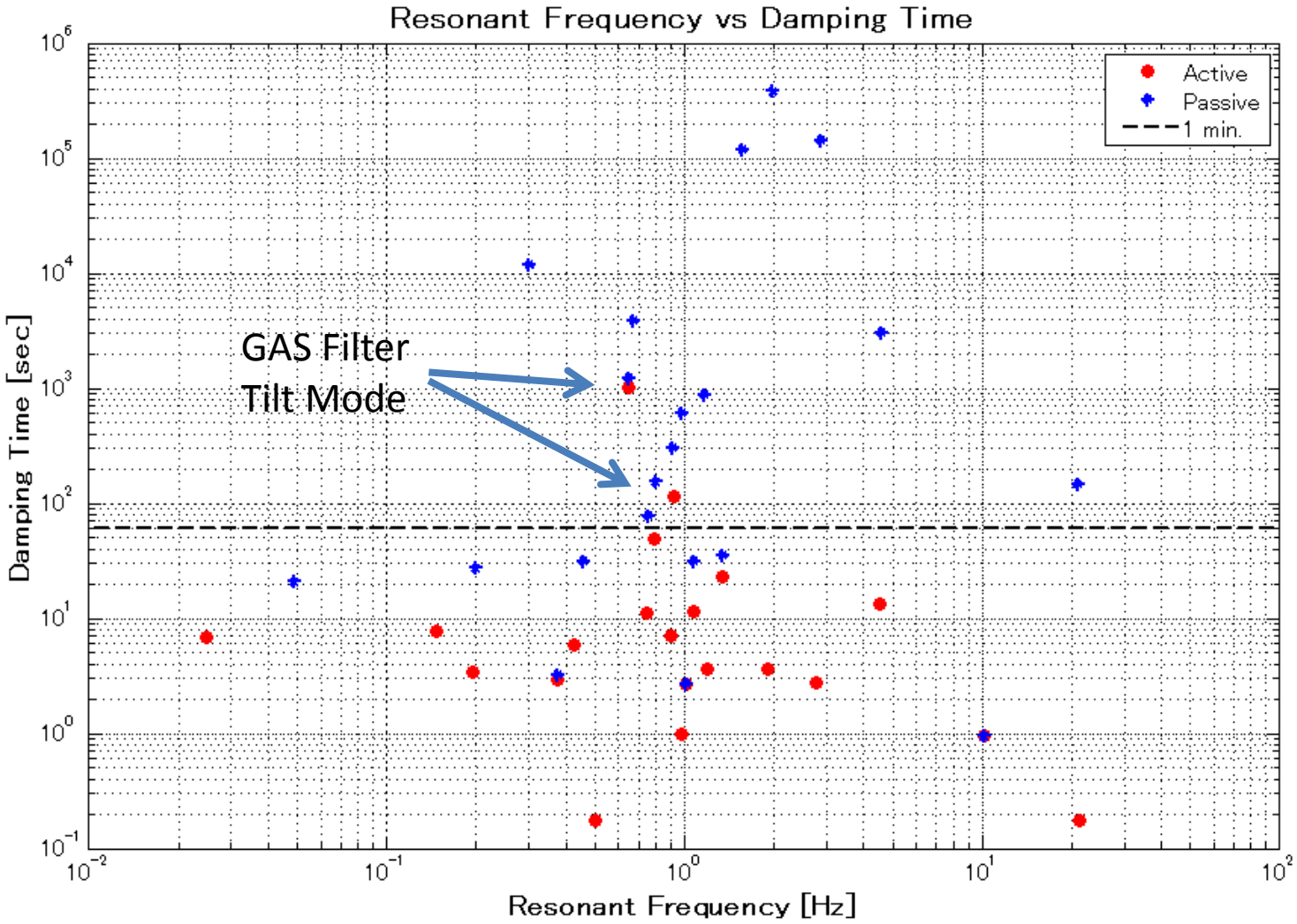
- Yaw



Local Damping with OSEM

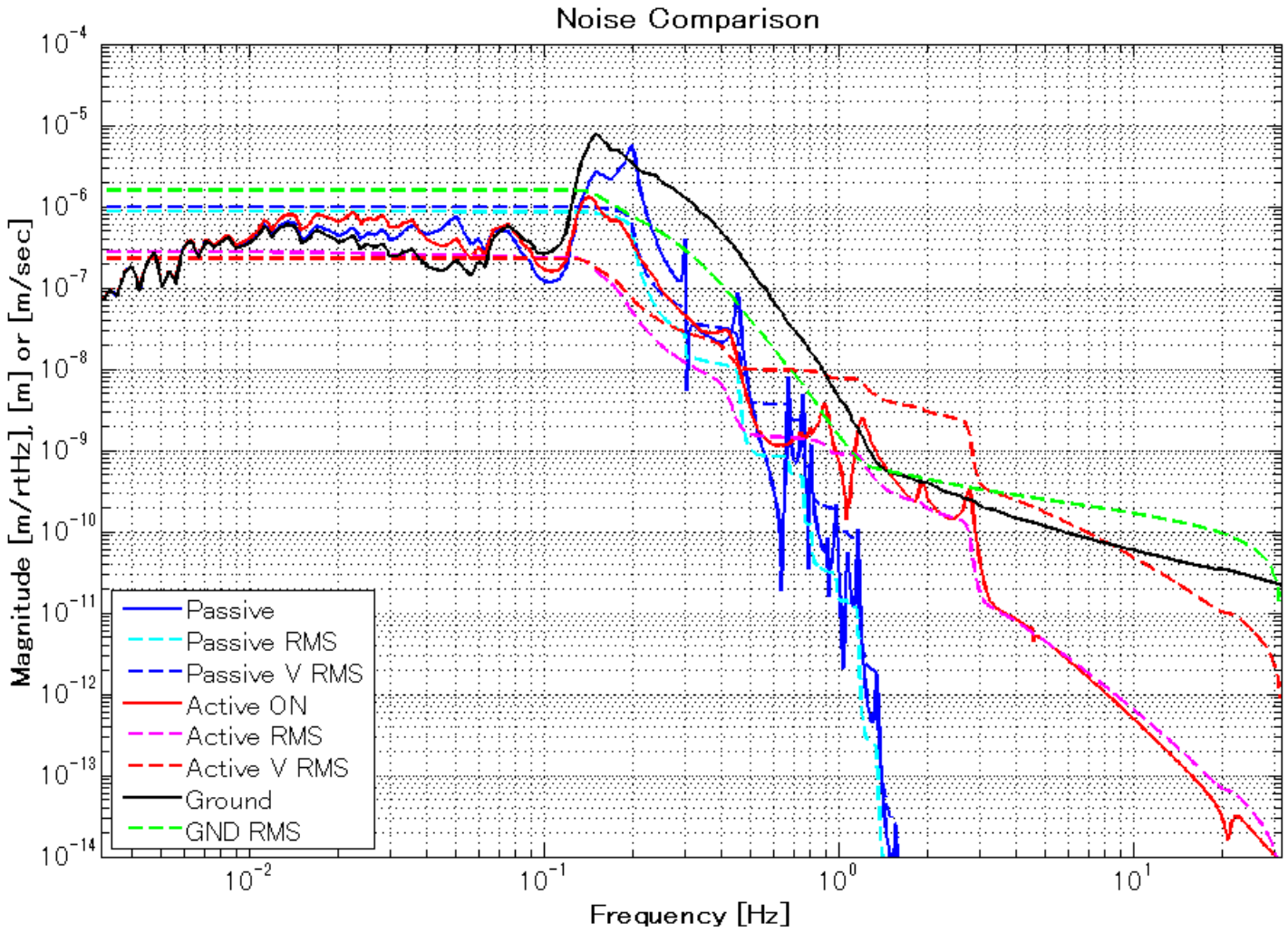
- Check damping time of resonances (Z and Pitch)





Displacement Noise During Damping

- Assuming OSEM sensitivity of 2e-10 m/rtHz @10 Hz (measured in prototype at room temperature)



Future Works

TBD

- Requirement for inertial sensor noise
- Requirement for local sensor noise at IM (used for damping)
- Requirement for actuator noise

- Simulation about other DoFs (transversal, vertical, roll, yaw)