Investigation of Crackling Noise in the vibration isolation system of KAGRA

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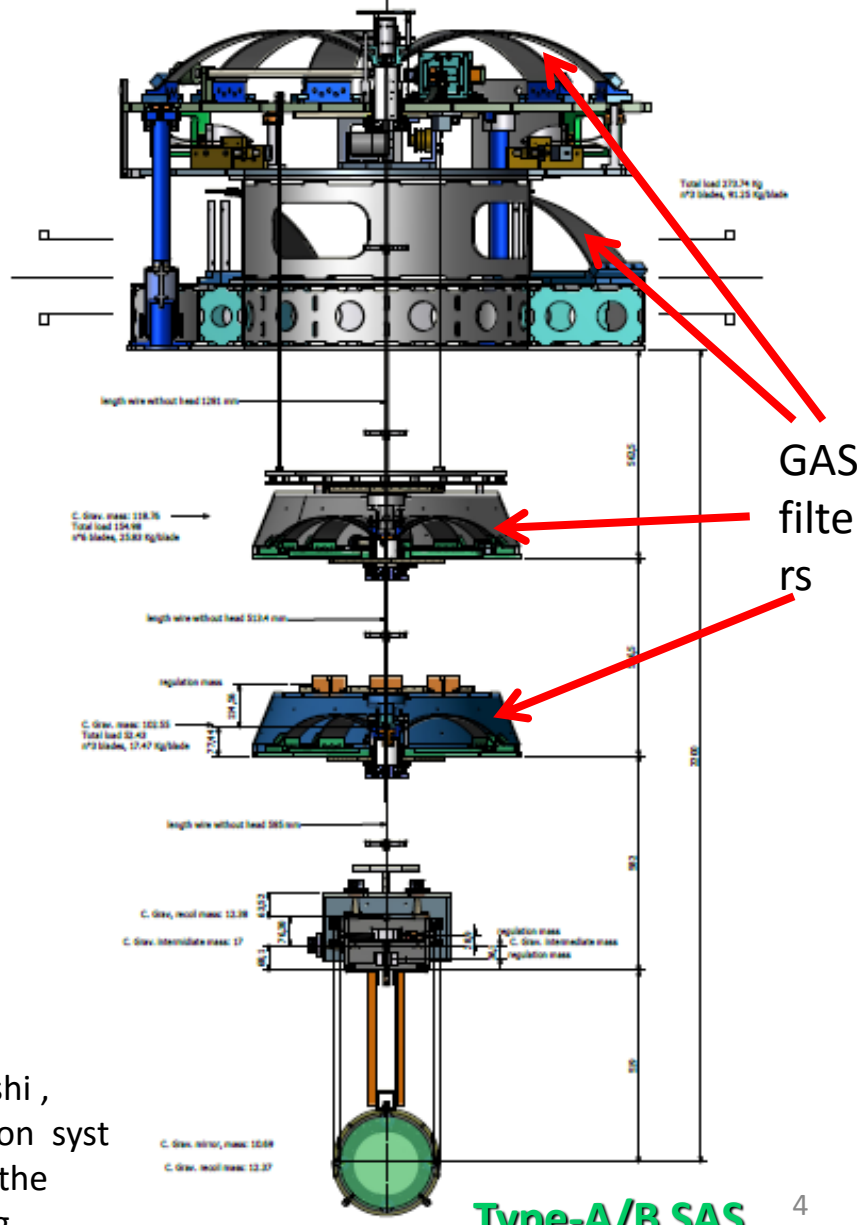
Outline

- Crackling noise in the vibration isolation system (VIS) of KAGRA
- What is crackling noise
- Prototype experiment
- New design
- Summary

KAGRA

Crackling noise in the VIS of KAGRA

- We don’t know where crackling noise will arise…
- But it is suspected that crackling noise may arise in GAS (Geometric Anti-Spring) filters.



Ryutaro Takahashi , Vibration isolation system for KAGRA, the 11th f2f meeting

What is crackling noise

In a wide variety of physical systems, when the response to a changing condition behaves:

- Discrete
- Impulsive

Crackling noise happens!

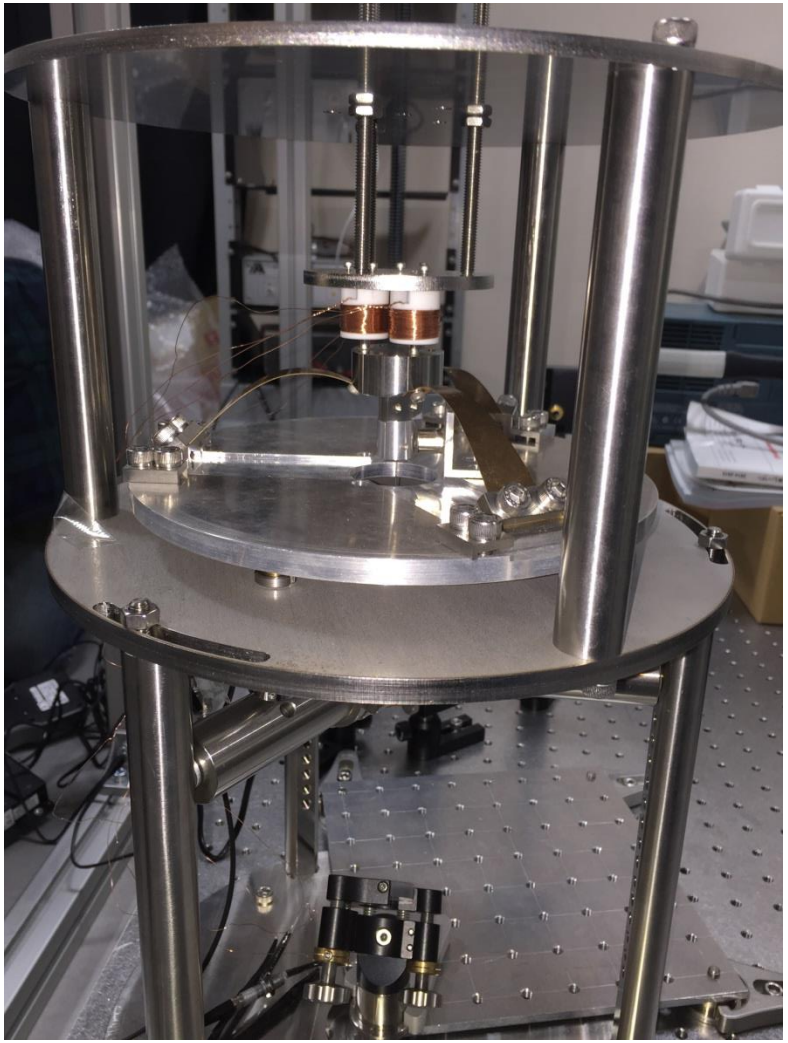
The known crackling noise includes earthquake, Barkhausen noise, etc.

Crackling noise in the VIS of KAGRA

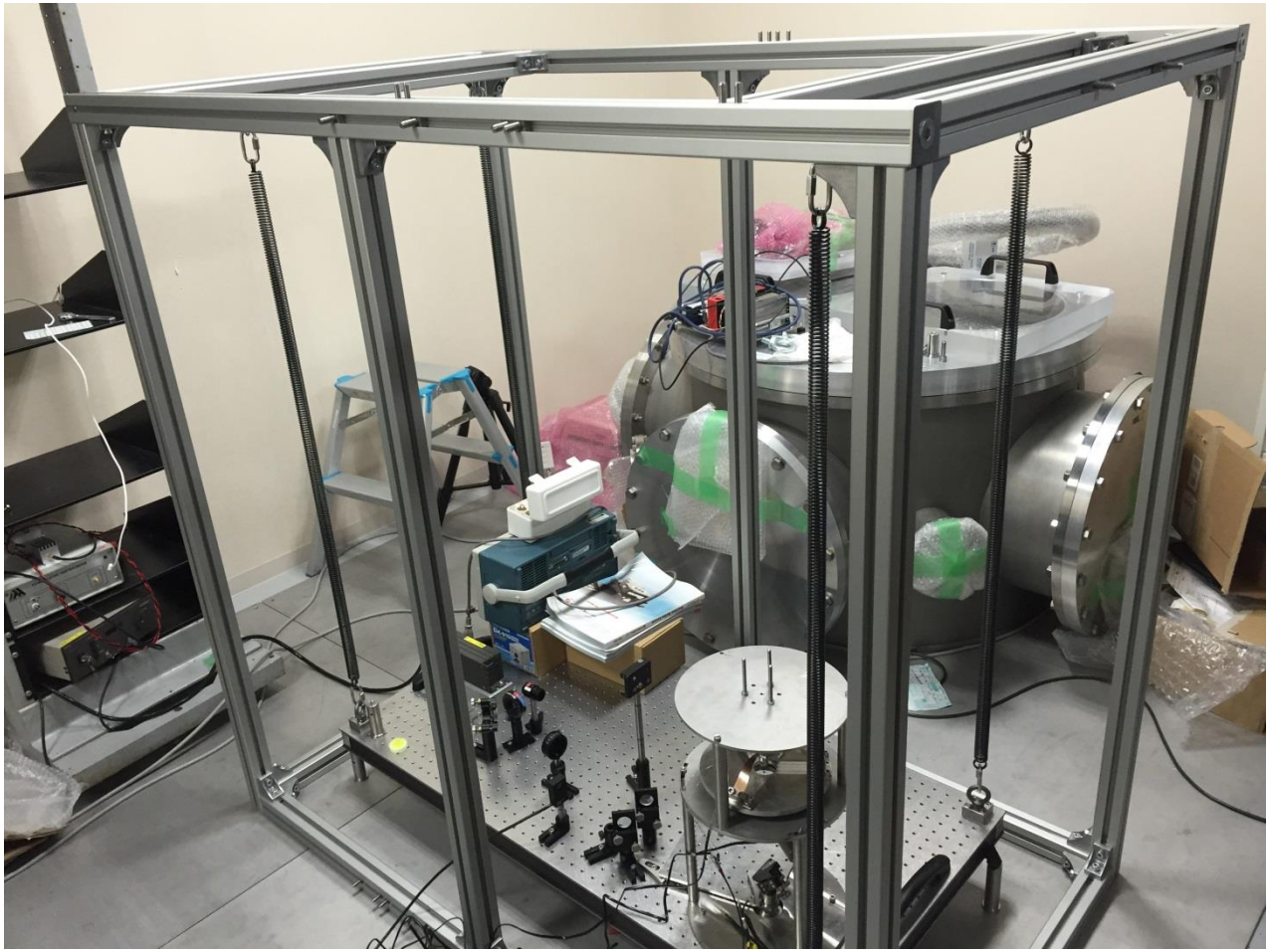
- It has been observed low-frequency (on a time scale of seconds) stochastic deviations from elasticity of GAS filters*, which is called creep noise.
- Crackling noise induces a wide-frequency-band random events in GAS filter, which might pollute the detection frequency band of KAGRA.
- Especially, the floor has a tilt of 1/300 in KAGRA, so that about 0.3% vertical motion of the mirror will couple into KAGRA's readout.

* DeSalvo et.al, 2011. The role of Self-Organized Criticality in elasticity of metallic springs: Observations of a new dissipation regime. *The European Physical Journal Plus*, *126*(8), pp.1-39.)

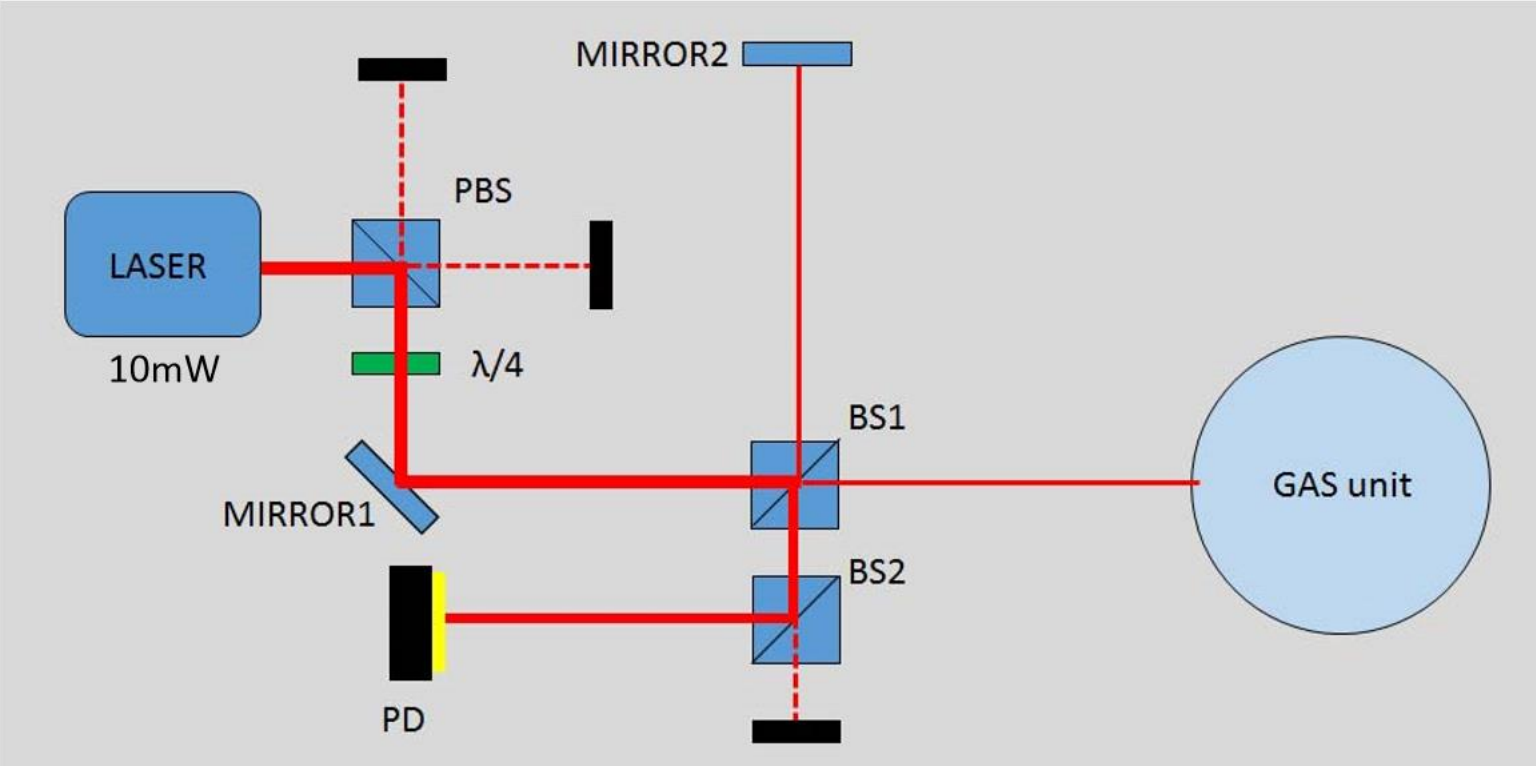
GAS unit change the photo



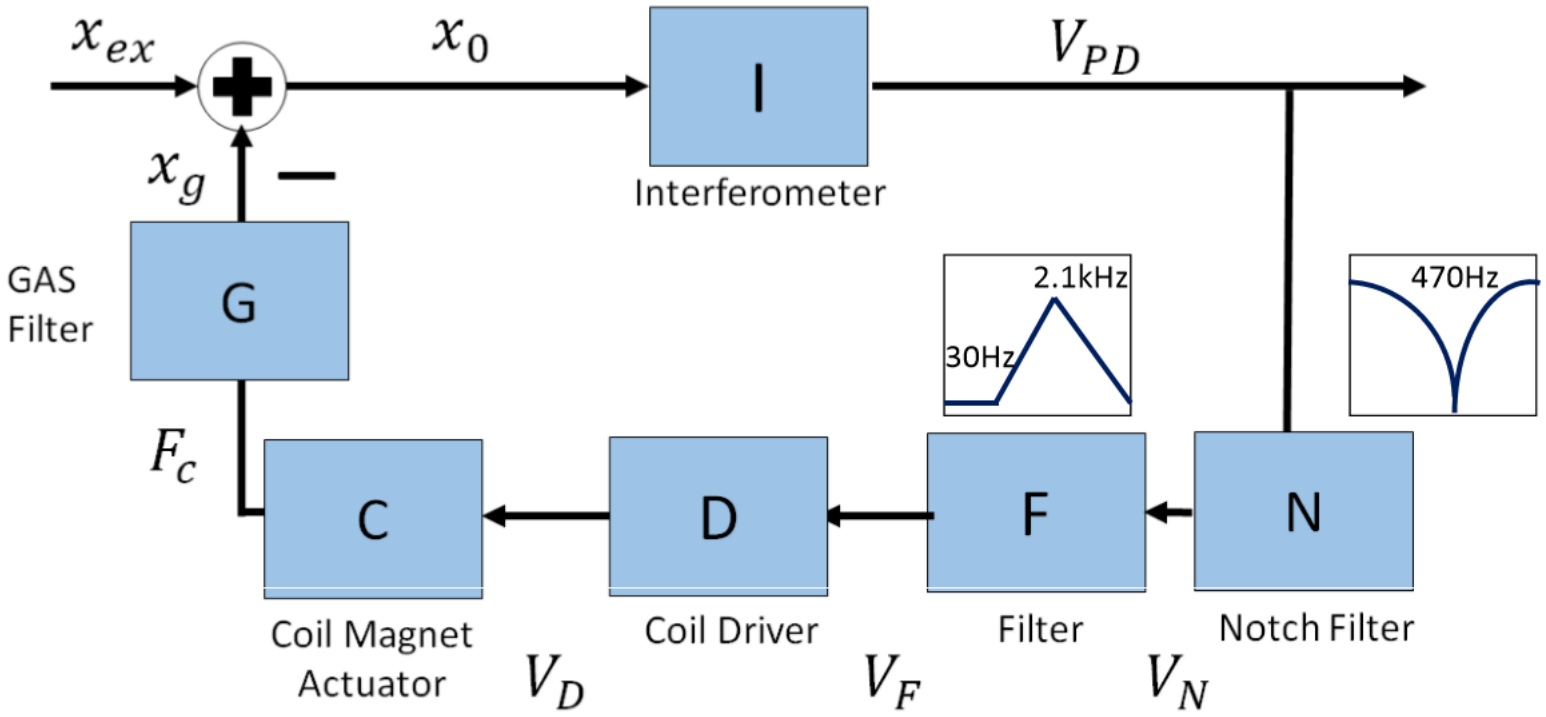
Vibration isolation system



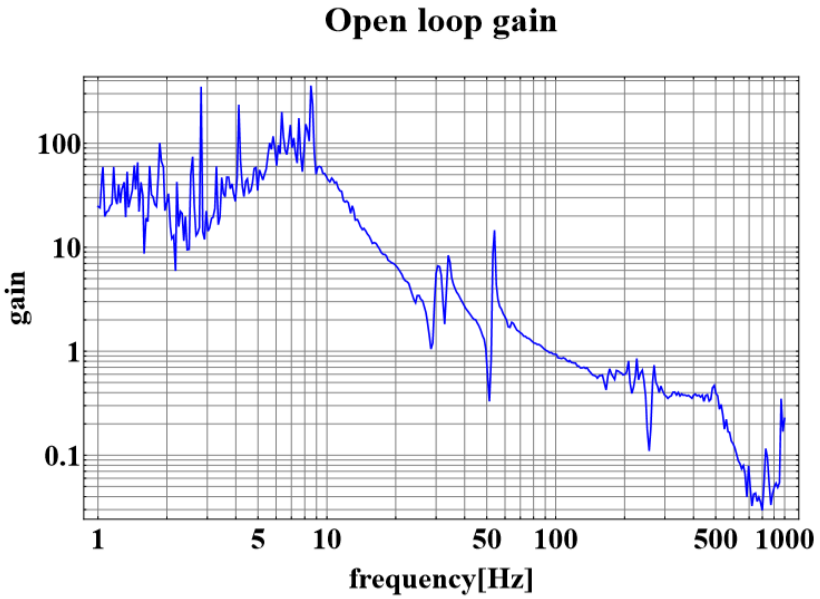
Optics simplify mid-fringe lock

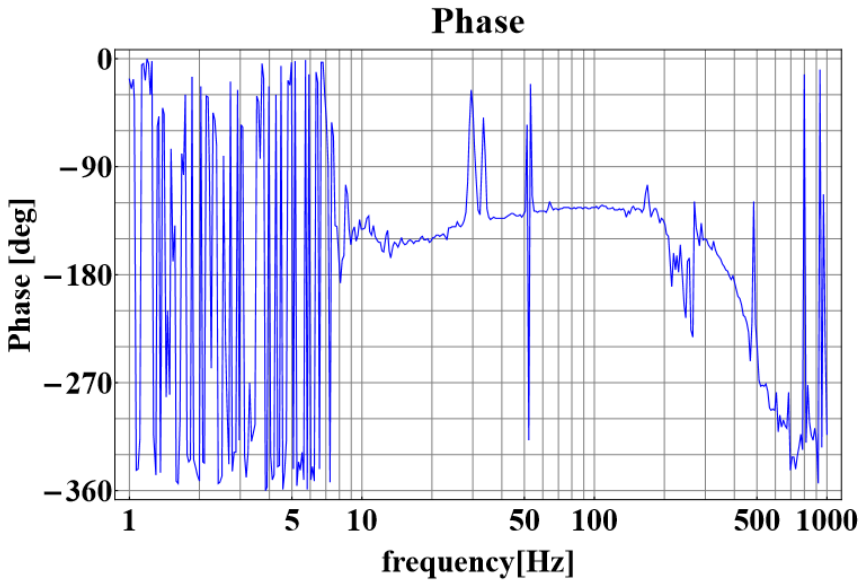


Feedback control

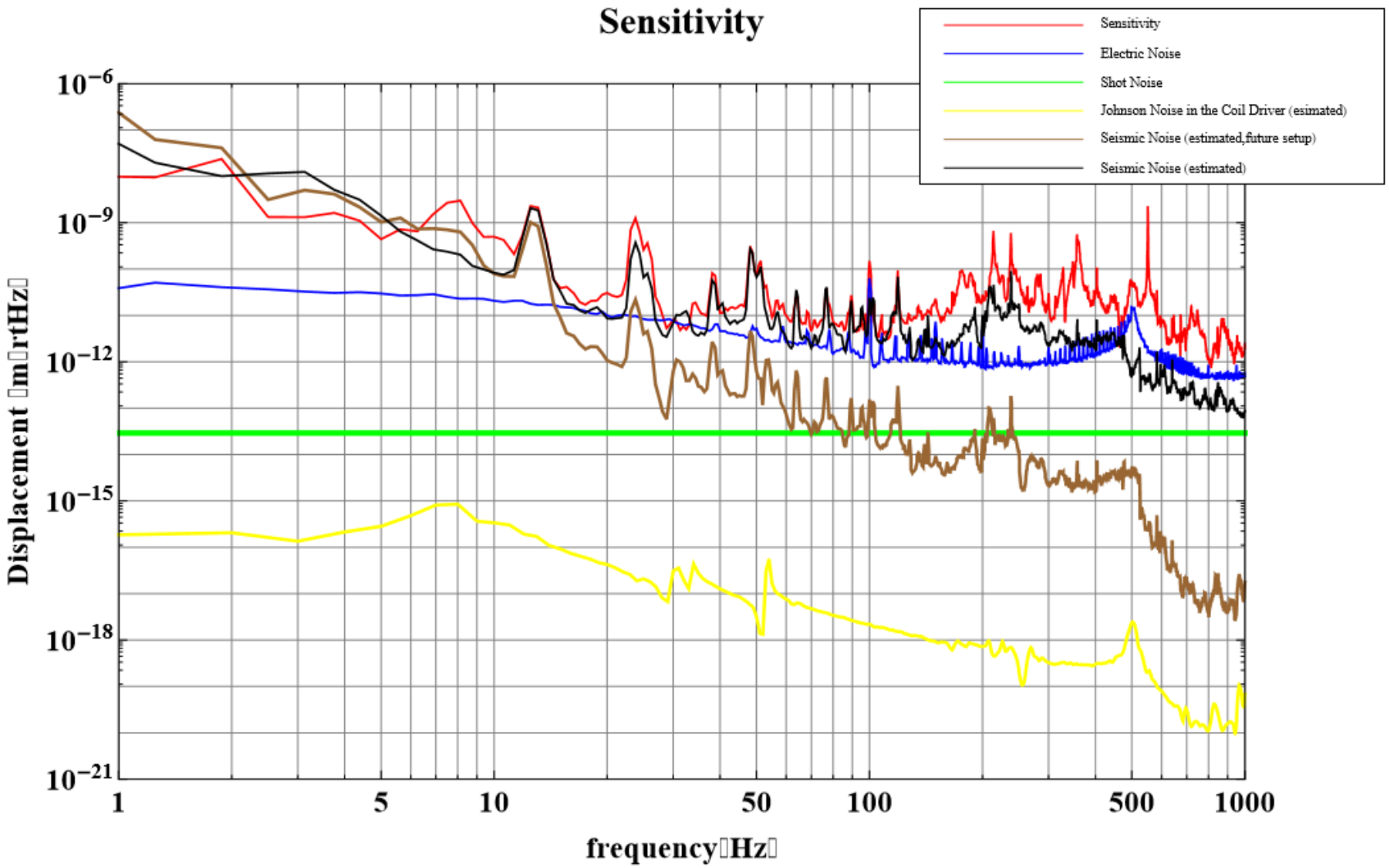


Open loop TF measurement

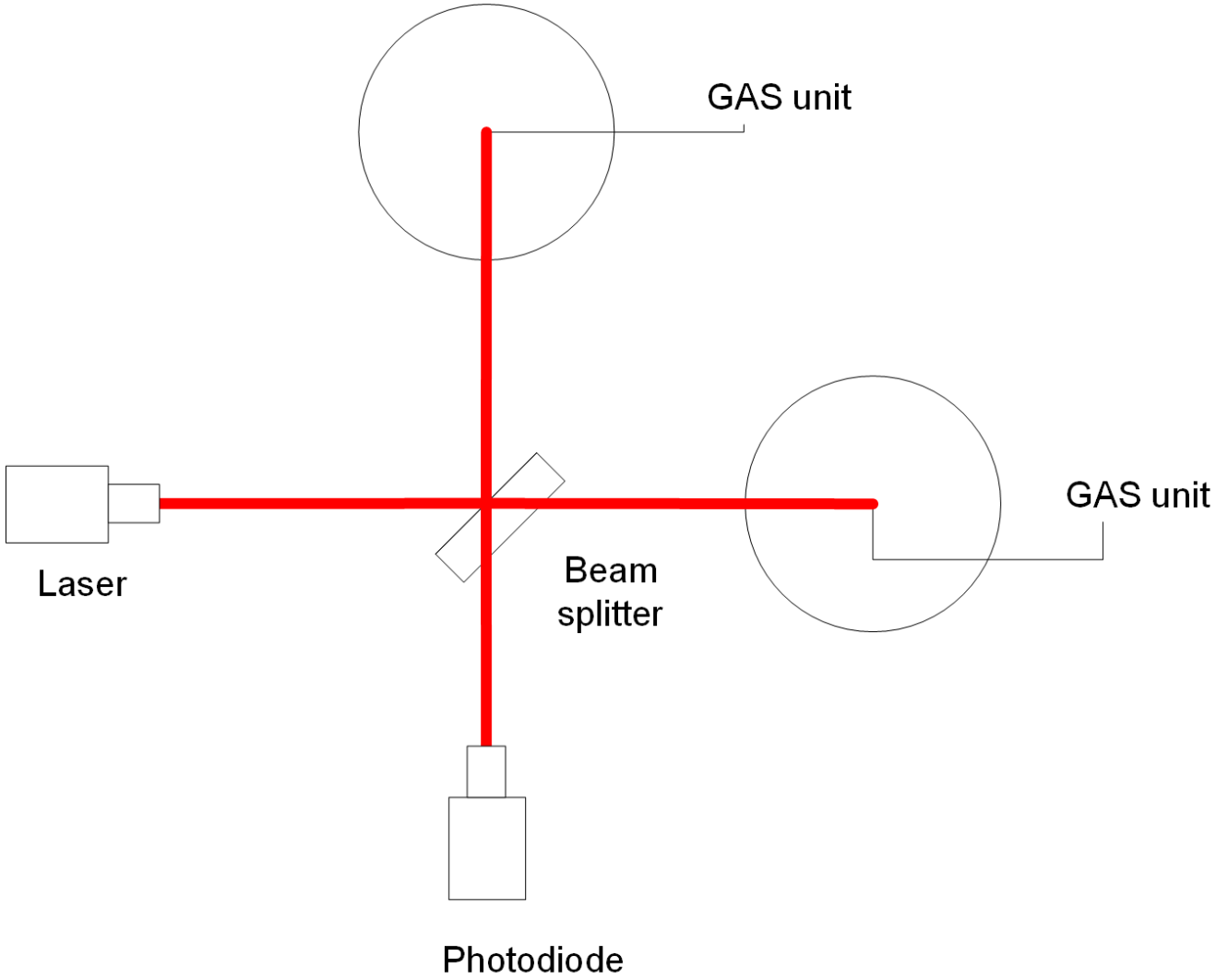


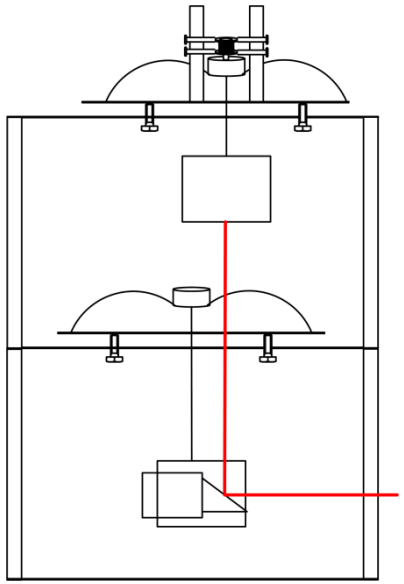


Noise spectrum



The configuration of crackling noise experiment





GAS unit

The measurement strategy