

Noise Budget of Optical Lever with Position Sensitive Detector (PSD)

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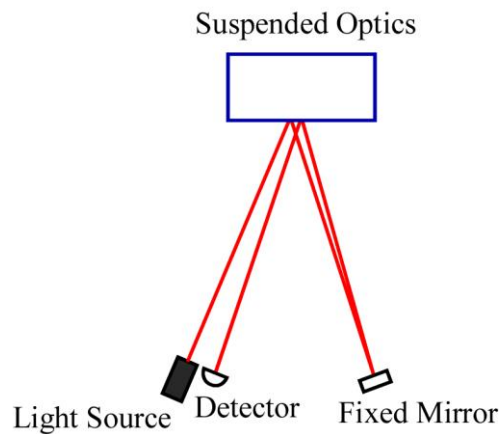


Fig.1: Configuration of an optical lever

Assumption

Light source: SLD (Super Luminescent Diode)

Output power: 1.0 mW

Relative intensity noise: 3×10^{-5} /rtHz @1 Hz

Detector: Two-Dimensional PSD (Position Sensitive Detector)

Photosensitivity: 0.6 A/W

Linear Range: +/- 4 mm

Readout: Transimpedance amplifier

Transimpedance resistance: 100 k Ω

Operational amplifier voltage noise: 2 nV/rtHz (knee freq: 2 Hz)

Operational amplifier current noise: 0.3 pA/rtHz (knee freq: 100 Hz)

RIN rejection ratio by normalization: 1%

Optical configuration: double bounce

Roundtrip length: 4 m

Intensity reflectivity of the suspended optics: 0.5

Noise Budget

DC Sum current from PSD: 150 μA , DC Sum output voltage: 15 V

Expected sensitivity to mirror angle: 33 $\mu\text{rad/V}$

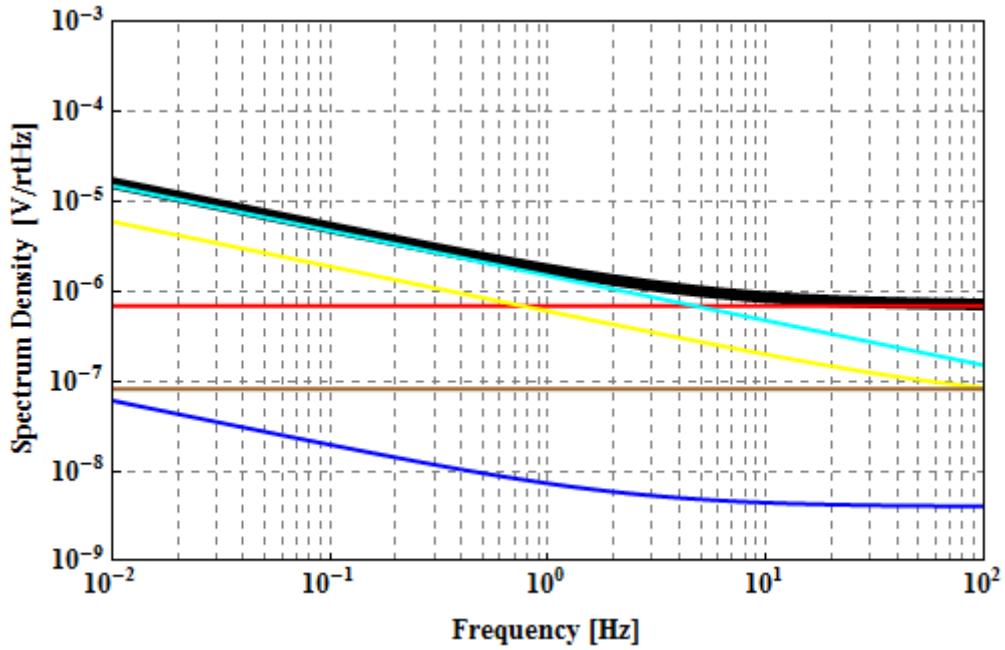


Fig. 2: Noise spectrum in output voltage.

Blue: OP-amp voltage noise, *Yellow:* OP-amp current noise, *Brown:* Johnson noise of transimpedance resistor
Cyan: Relative intensity noise of light source, *Red:* Shot noise limit, *Black:* Sum of them

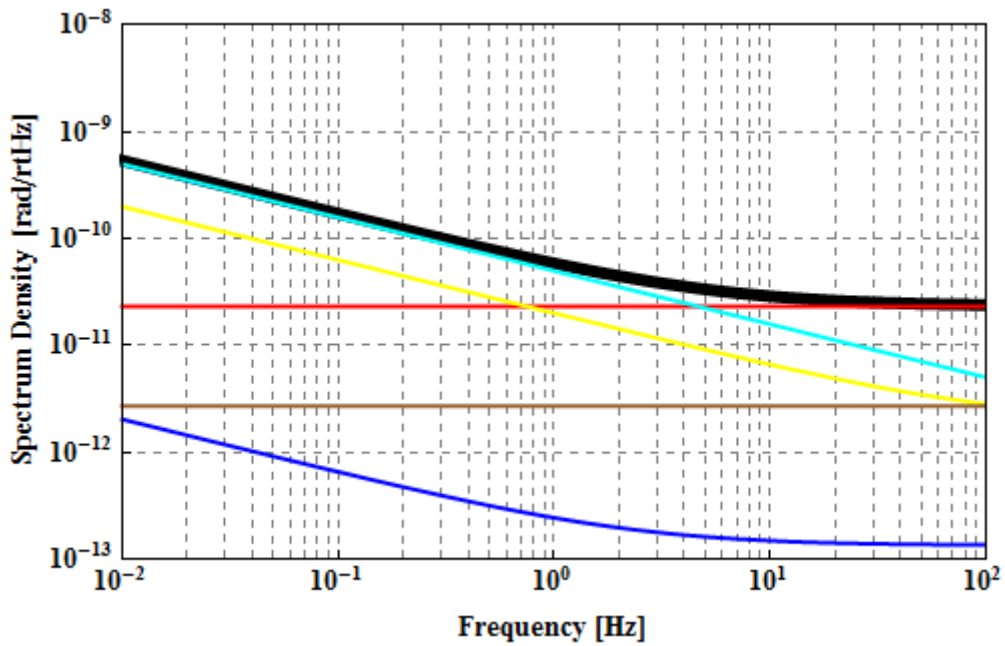


Fig. 3: Noise spectrum in optics angle. 3×10^{-11} rad/rtHz @10 Hz