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**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 x 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 kΩ

 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 μrad/V



Fig. 2: Noise spectrum in output voltage.

*Blue*: OP-amp voltage noise, *Yellow*: OP-amp current noise, *Brown*: Johnson noise of transimpednace resistor

*Cyan*: Relative intensity noise of light source, *Red*: Shot noise limit, *Black*: Sum of them



Fig. 3: Noise spectrum in optics angle. 3x10-11 rad/rtHz @10 Hz