

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
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OMC DCPD characterization for aLIGO transition		
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1 Introduction

The eLIGO OMC DCPD preamps ([D060572-v1](#)) and photodiodes (EG&G/Perkin-Elmer C30665, 3-mm InGaAs) will be reused on the Advanced LIGO OMCs. This document describes the characterization of the preamps and diodes at the time of their removal from the eLIGO assemblies so that this information is available during aLIGO.

2 Analysis

2.1 Livingston – L1

During the H1 squeezing experiment, the eLIGO-L1 OMC was shipped to Hanford due to its lower loss, and the eLIGO-H1 OMC was sent to Livingston. Therefore, the photodiodes and preamps (S/N 006 and 008) from the eLIGO-H1 OMC will be on the *aLIGO*-L1 OMC.

2.1.1 DCPD dark noise

The DCPD dark noise was measured using a spare eLIGO whitening amplifier. The voltage signal was picked off at the output of the in-vacuum preamp, and the external whitening amplifier was only used as a power supply and to provide the transimpedance switching function. The photodiodes and preamps were still installed in the eLIGO assembly.

Figure 1 shows the photocurrent-referred noise level of the DCPD and preamp chains in both the 100- and 400- Ω configurations, compared with a LISO simulation for each circuit. The shot-noise level for a 35-mA photocurrent is plotted for reference. Also plotted is the measurement noise level in each case.

As an independent verification, the shot noise intercept was verified using a halogen light source in Fig. 2. The output noise levels in a dark state are compared with the LISO prediction, then with the incoherent sum of the electronics noise and shot noise for the measured DC photocurrent.

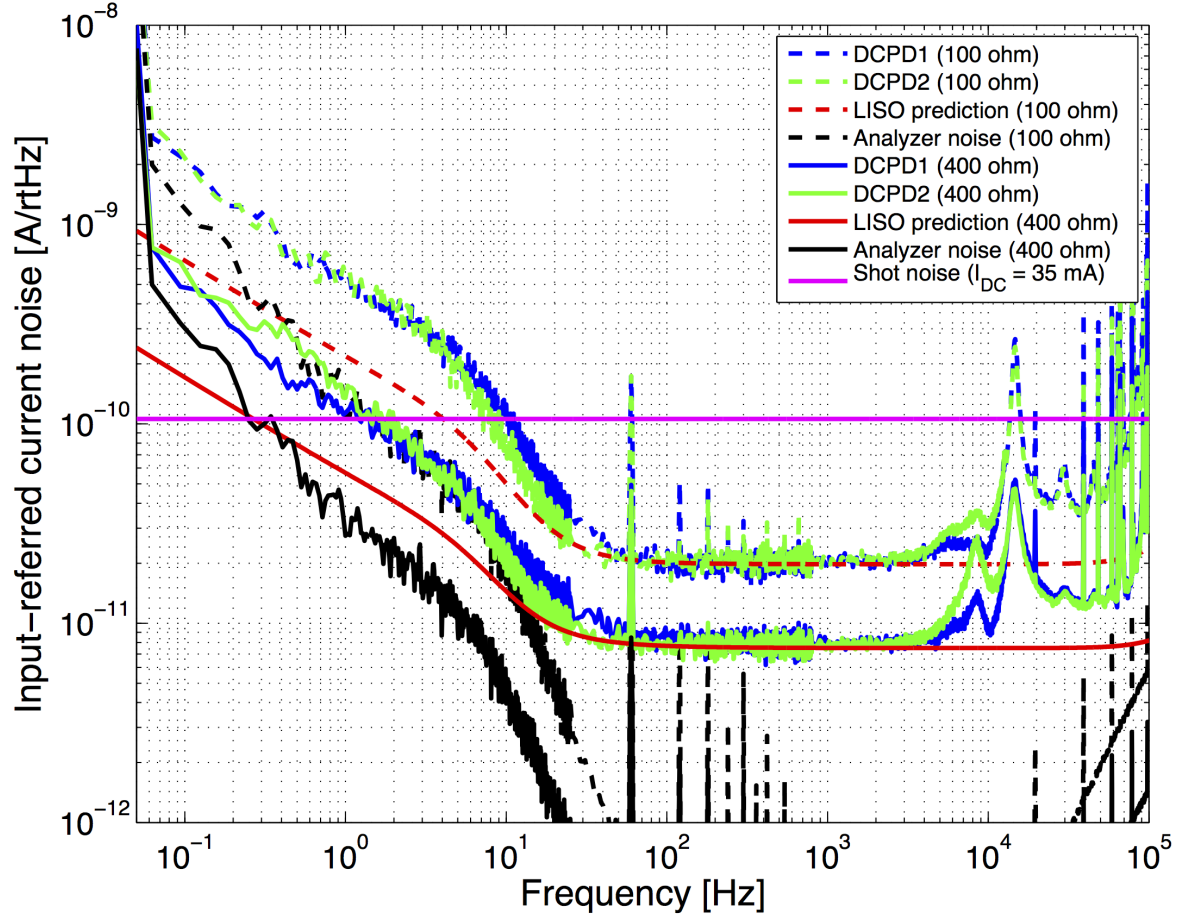


Figure 1: L1 DCPD photodiode and preamp chain noise for $Z = 100 \Omega$ and $Z = 400 \Omega$.

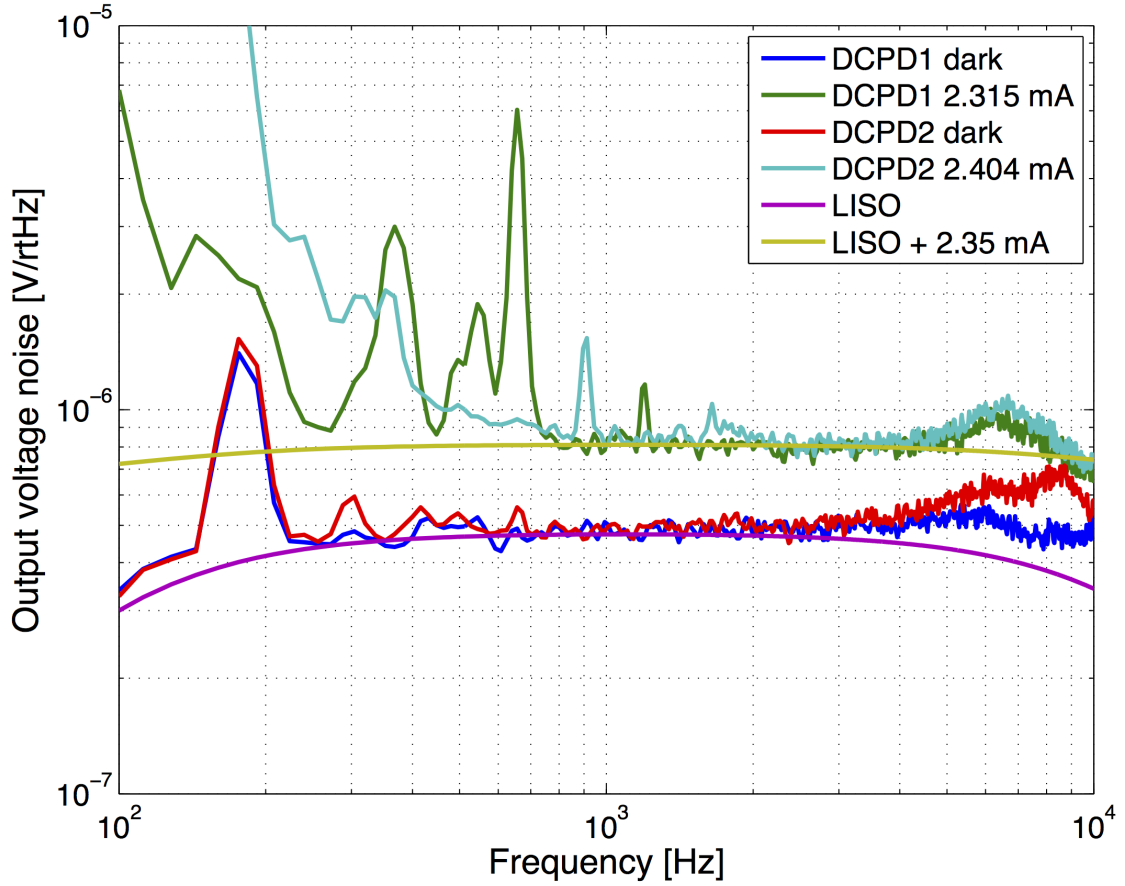


Figure 2: Demonstration of the shot noise intercept for the L1 DCPDs.

2.1.2 DCPD preamp voltage transfer function

After removal of the photodiodes, the preamp voltage transfer functions were measured by injecting an excitation at the photodiode socket between the anode and ground pins. This means the excitation is applied across the transimpedance resistor, but this is negligible given the low source impedance of the spectrum analyzer.

The transfer function measurement is shown in Fig. 3. Each preamp plotted alongside the LISO prediction, and the variation from the model is shown magnified against the right axis.

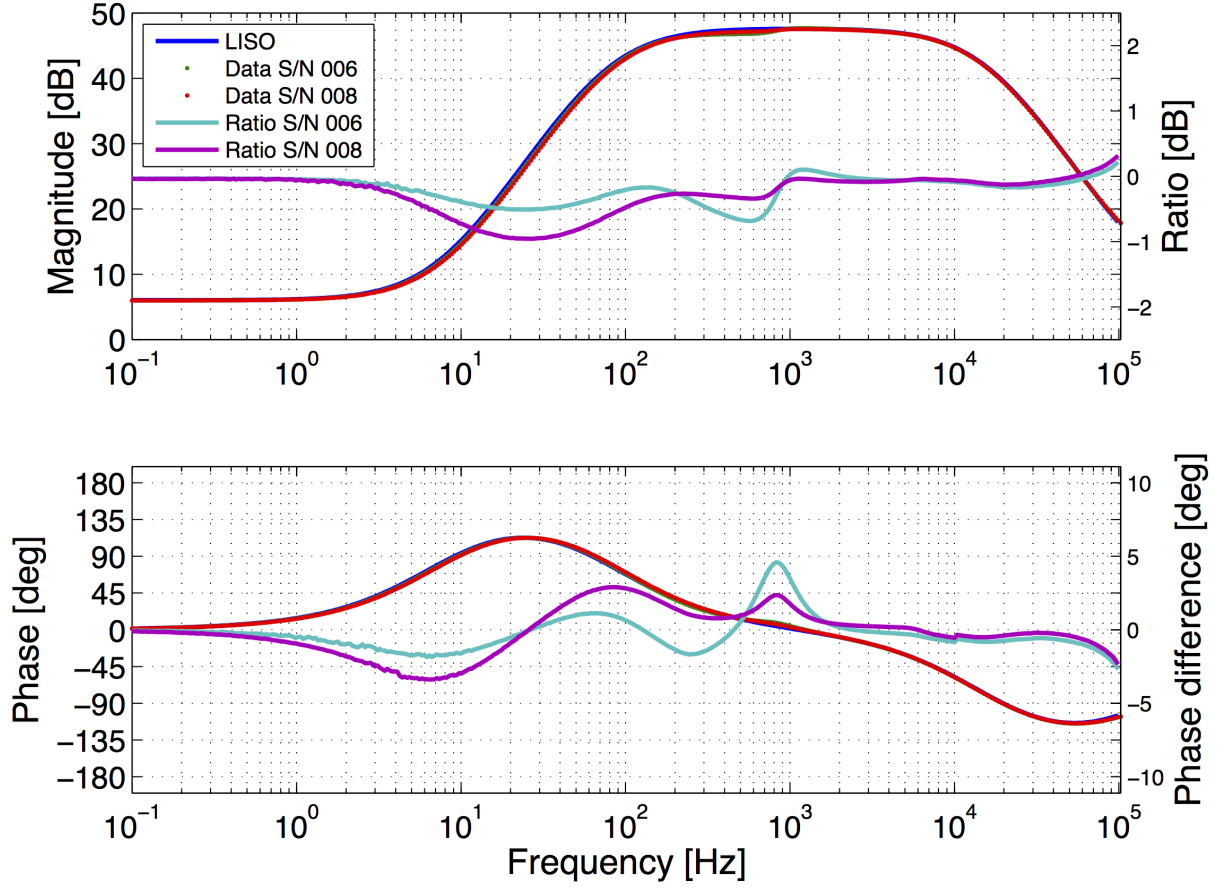


Figure 3: L1 DCPD preamp voltage transfer functions, compared with the LISO prediction for the ideal circuit.

2.2 Hanford - H1

This section will be completed once the corresponding analysis is done on the H1 DCPDs.

2.3 India - I1

This section will be completed once the corresponding analysis is done on the I1 DCPDs. Note that these will not have previously been integrated in an eLIGO OMC.