

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY  
- LIGO -  
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Technical Note	LIGO-T1100564-1	2011/11/04
<b>E.G.&amp;G. Photodiode angular response</b>		
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## 1 Introduction

The Advanced LIGO Output Mode Cleaner (OMC) uses E.G. & G. 3 mm diameter photodiodes to read out the dark port. Note that E.G.&G. was bought by Perkin Elmer Optoelectronics, and then spun off into Excelitas. The LIGO OMC will use the C30655 3 mm diode. The tests described here use the C30642 2 mm diode from the same product series. The Quantum Efficiency (QE) depends on the incident angle and the polarization. In this note, we present measurements of both.

## 2 Setup

The setup is shown in Figure 1. The photodiode is reverse biased with two AAA batteries

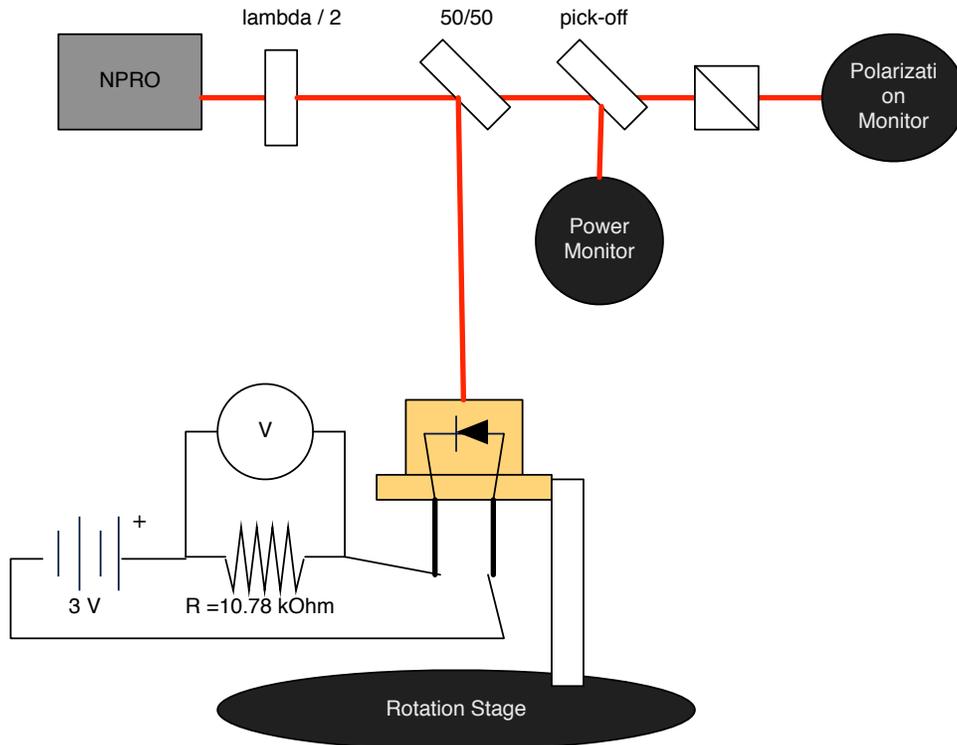


Figure 1: The measurement configuration.

through a 10.78 k $\Omega$  resistor. The photodiode is mounted at the center of a rotation stage. For each data point, the stage was rotated through 10 degree steps, followed by a realignment of the incident laser beam. The voltage was measured using a Fluke meter, and optical powers were measured with an Ophir with and without the filter. The no-filter power measurements were generally 15% lower than the with-filter measurements, but are the numbers we use here because of their higher precision.

Two diodes were used in this measurement. Diode 1 was measured with the glass attached. The diode was damaged during the procedure to remove the window. Diode 2 was measured

with the glass removed. There may be some error in the absolute calibration of the QE and for the relative QE between diodes. No particular effort was made to use a well calibrated photodetector. There is evidence of different calibrations for the power meter with and without the filter, as well as for spatial dependence of the signal.

### 3 Results

The results for the two diodes are shown in Figure 2.

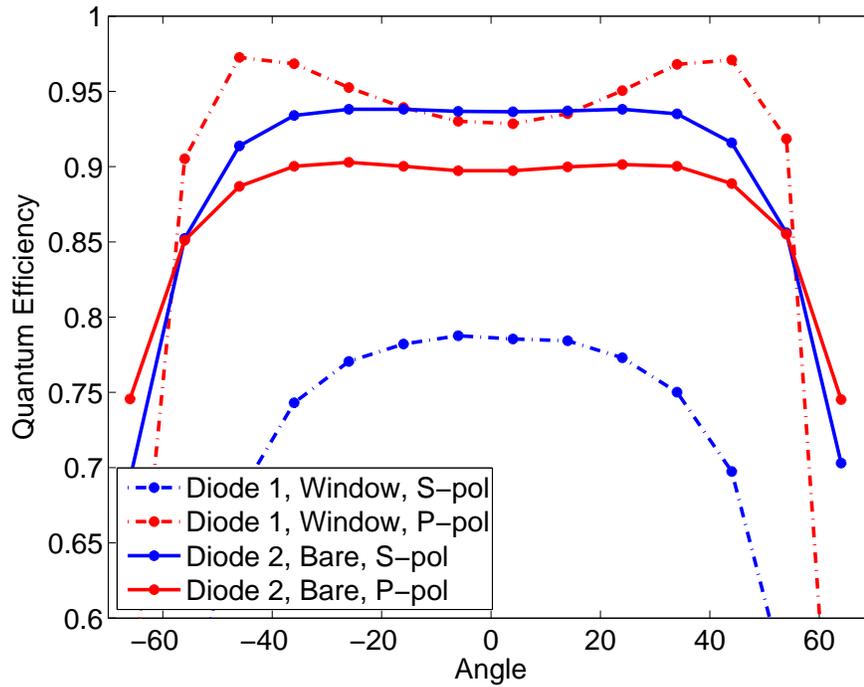


Figure 2: The results for QE as a function of angle. The dashed lines are for Diode 1, with a window. The solid lines are for Diode 2 sans window. The red is for P-polarization, the blue is for S. The error on the absolute QE is  $\pm 10\%$ .

The variation in the peak QE is within the errors of the power measurement, estimated to be  $\pm 10\%$ . The sharp drop in efficiency starting at  $\pm 50$  deg likely arises from the laser beam overfilling the diode. The window has a high variability in the QE, as apparent for Diode 1, with a peak at 50 deg, right before the cutoff. Without the window, the P-polarization variation is 0.6% and the S-polarization variation is flat.

**The window-less E.G.&G. photodiodes show essentially no variation with angle.**