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"DESIGN AND CONSTRUCTION

OF

AN OPTICAL LEVER RECEIVER"

PROGRESS REPORT

BY

AABEG SINGH BHANDARI

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MENTOR: Dr. MICHAEL SMITH

My project is to analyze, build, and test a prototype optical lever receiver for LIGO. The purpose of this project is to verify the feasibility of developing an optical lever receiver that is sensitive only to angular deviation of the reflected beam. To achieve this goal, we will have to build a computer model of optical lever receiver by using the ABCD matrix formalism for Gaussian beam propagation. Dr. Michael Smith has modeled a more recent lens system using ZEMAX optical design program, and we will be building this lens system. Till now my effort has been to design a computer model for optical lever receiver using real thick lenses. Initially, I designed a computer model of the same optical lever receiver using thin lens approximation. High level mathematical software called math lab is used to calculate the ABCD matrix for beam propagation to design the prototype optical lever receiver.

The optical lever receiver consists of a two-stage afocal beam reducing telescope that magnifies angle of collimated input beam. A focal length of the output of the telescope converts the beam angle to a beam displacement, which is measured by a quad photo detector placed at the end of the optical receiver to measure the output beam angle. The purpose of such arrangement is to obtain an output beam that is only a function of input beam angle and not of the input beam height. The output beam angle is highly magnified and therefore the quad photo detector is able to measure a small variation in the input angle.

The beam at quad photo detector is controlled by varying the beam diameter of the input beam. The spot size at the quad photo detector will be measured with a beam scanning

apparatus. We have successfully designed a computer model of both the thin lens approximation and the actual thick lens version.

The motive of my project is to construct an optical lever. We will start building the optical lever based on its computer model. The optical lever receiver will then be tested by measuring the angle of an input optical beam from a lens. The input beam angle will be measured independently with an autocollimator.

Everything in this project has been very challenging to me. I have managed to learn how to use mat lab and ABCD matrix extensively and have successfully performed very complicated mathematical calculation using it. The computer models are entirely designed by using those programs extensively. I believe my next steps of building and testing the optical lever receiver to be extremely challenging as such task needs enormous work, dedication and patience. It has made me believe that there is lot to accomplish yet.