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Progress Report on

"Investigating the light scattering properties of LIGO materials"

Shasta Shakya
Mentor: Dr. Michael Smith
shakyas@hanover.edu
(573) 465-3045
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The LIGO project for undergraduates was an excellent opportunity to quench my thirst to learn more and expose myself to the challenges of advanced research. I had developed a special interest in optics when I did a research on "Spectroscopic properties of various solid, liquid and gaseous substances." This interest in optics was a valuable source of motivation for my present LIGO research, which is a study of the scattering properties of various LIGO materials.

My mentor, Dr. Michael Smith, is working on the control of light noise in the LIGO interferometers to achieve their required sensitivity. To control the stray light due to scattering from different surfaces, baffles and beam dumps made up of low scattering, absorptive materials are needed at various locations within the LIGO interferometers. The scattering property of a surface is described by the Bidirectional Reflectance Distribution Function (BRDF). In this project, I will design and build a BRDF measuring apparatus and measure the BRDF of different LIGO samples to choose one to be used as baffles and beam dumps in the LIGO interferometer.

During my first week, I read and learned about various new topics that I would be dealing with in my project. My mentor explained to me the method of ABCD matrix that I would be using. The method of paraxial optical rays and ray matrices (ABCD) applied to Gaussian beams is a very important tool in the study of beams and it was the basis for the set-up of my BRDF measuring apparatus. It was also interesting to read about other new topics as the working of Acuosto-optic modulator (AOM), BRDF etc. Learning the set-up of my apparatus enlightened me on the practical application of different theories I had learned in class. Besides, I learned how to use Matlab, which is an extensively used computer program in advanced research.

I spent the next weeks in designing and building my apparatus. It was interesting to observe how different theories and ideas could bond together well to design one scattering measuring apparatus. It was even more interesting to realize how one could fuse different ideas to get one result. It was challenging for me to learn and work in a totally new and advanced environment. Moreover, I was working in an advanced project like this one for the first time.

My set-up is not completely ready yet. I have all the components of the apparatus mounted on an optical base-plate. But, I still need to get the laser beam through the apparatus to check if my set-up works and make any necessary adjustments. I also need to get all other devices like AOM and Lock-in amplifier working. But, before that, I need to familiarize myself with how those devices work as I am using them for the first time. I will also read more about BRDF so I can understand the experimental procedure better. My upcoming work is not going to be less challenging as the real technical experiment is yet to start. This is a good opportunity to learn and I am glad I am already learning so many new things.