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Development of a light collection device for a Low Temperature Scanning Tunnelling Microscope

Edivar F. Carvalho*, Luiz F. Zagonel.

Abstract

The purpose of this project was to make computational simulations of some light phenomena, using Python language. In our case, the object of study was reflection of light in a mirror, and refraction of light on a lens. The purpose of these simulations is to find the dimensions of these devices which would better fit our experiment. The results helped us to obtain optimum performance of our optical device.

Key words:

Simulations, Geometrical Optics, Python

Introduction

The experiment of study is the emission of light by a sample inside a microscope (STM). Inside the microscope a tip will generate a local electric contact with the sample that is useful for imaging. At the same time, light can be emitted by some kinds of luminescent samples. We want to lead this light outside of the microscope to determine its spectrum. We do that using a mirror and a lens that focuses the light to an optical fiber. Image 1 illustrates the light collection device.

Image 1. Sketch of the experiment

Results and Discussion

The focus of the project was to find the best mirror that would fit inside the microscope, that is, the one that would send more light from the sample to the optic fiber. Image 2 gives an idea of how the mirror looks like.

Image 2. Sketch of the mirror.

A lot of graphics were made to have a better idea of how the simulations were going. For instance, image 3 shows the position at which the light beams hit the mirror.

Image 3. Example of graphic generated to visualize the simulations. The blue dots are the position at which the light beams hit the mirror.

We also worked on seeing how the refraction of light occurred on the lens. Image 4 shows a simulation made to test the code.

Image 4. Simulation made to see the refraction of light on a lens. We see the set of light beams coming from the left being focalized by the convergent lens.

Conclusions

The code made for the Project proved to be working, and with the simulations made we were able to choose the best parameters for the mirror (like length and width) to collect the best amount of light possible.

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