

# Refraction of Microscopic Lasers to Find Abnormalities in Cancer Cells

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## Background

**Light:** A type of energy released which stimulates sight and makes things visible

- Reflection: A change in direction of light so that bounces off an object and returns back.
- Refraction: A change in the direction of light so it
  - Refractive Index: dimensionless number that describes how light propagates through a certain medium.

**Laser:** a device that emits light at a certain wavelength and frequency.

- Green Lasers have a wavelength of 543 nm
- The diameter and magnification of a laser will stay the same through any distance in a constant medium.

**Medium:** a substance or material in which light waves are allowed to pass

- Grating: An optical device that diffracts a laser into multiple different lasers in different angles.
  - Transmission grating: A type of grating that splits a laser after passing through the grating.
  - Refractive grating: A type of grating that reflects and splits a laser upon hitting the grating.

**Matlab:** An application used largely by scientists and engineers to provide data.

## Focus

**Focus of my study:** To use and manipulate microscopic lasers with the information that was found to observe differences in lasers between animal normal cells and animal cancer cells.

## Characteristics of Light

**Introduction:** Several experiments were done testing the characteristics of light. We specifically tested the lights ability to be reflected, refracted, and diffracted. We were able to come up with a few important characteristics that are necessary.

**Refraction:** When light refracts it bends in a certain direction. The experiment conducted was a laser emitting through a plastic block at an angle. The laser bends because when light enters a medium with a higher refractive index and it is at an angle then the laser will bend towards the medium. It then bends back because the light exits the medium to a lower refractive index so the laser then continued at the same angle and speed before entering the medium.

Figure 1: Refractive Index chart

Medium	Index of Refraction
vacuum	1.0000
air	1.0003
ice	1.31
water	1.33
ethanol	1.37
glycerin	1.47

**Diffraction:** When light is diffracted the light splits into multiple separate lines. An experiment took place using a diffraction grating to understand diffraction at a small level. The experiment done was using a device called a diffraction grating. By shining a laser through the device, we were able to watch the laser split into 6 different spots with an equal amount of space between it. This allowed us to calculate, at the microscopic level, the spacing between the small slits in the grating called grooves.

**Reflection:** Light is reflected when it bounces off a certain medium and returns in a direction towards the light source. A similar experiment to the diffraction occurred where we tested the spacing between the microscopic grooves on a CD. We shined a laser at a CD and we were able to see the light bounce of the CD and split into approximately 9 spots against a wall. This occurred because the light would bounce off the grooves at different places and angles so each laser would be minutely shifted to the right or left.

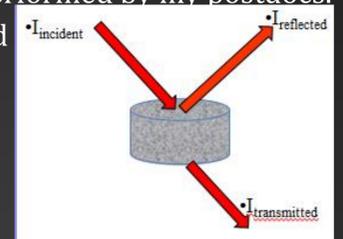
**Prism:** We did a simple experiment by shining a white light through a plastic prism. This experiment allowed us to visually see the prism refract a normal white light into several different colors. This occurs because white light contains all colors, each with a different wavelength. When it shines through the prism, it is refracted and the colors with the larger wavelength move more straight and stay on top while the colors with lower wavelength refract more and bend towards the bottom.

**Conclusion:** Using these characteristics found we are able to understand what occurs specifically when we are using lasers in cells.

## Refraction in Cells

**Introduction:** We use the certain characteristics of light that we learned through the experiments to understand and apply it to the human cancer cells. In this experiment we will hypothetically shine lasers in a microscopic level and see how much light is reflected and how much light is refracted between the normal cell and the cancer cell. The only thing that would change the intensity of light refracted and reflected would be if the refractive index of the cells are different. The cells are only few microns long and lasers have very small wavelength such as the green laser so we will be able to see any structural changes between the two cells. We were able to hypothesize that the cancer cell reflected more light than the normal cell because the cancer cells had a larger refractive index. The cancer cells would have a larger refractive index because while cancer is occurring in a cell, the cell reproduces many thicker organelles and cytoplasmic structures. This would make the cell more denser than the normal cell thus reflecting. The lab was performed by my postdocs.

Figure 2: Light, reflected and refracted in cell:



**Results:** In the experiment the lab tested both cells by shining the laser in a microscopic environment. It came out with these results.

Figure 3: Normal cell:

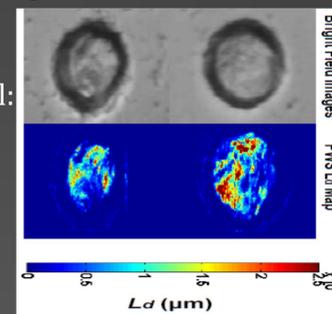
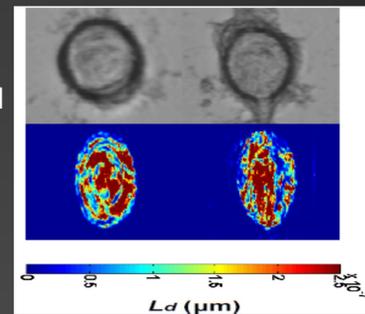


Figure 4: Cancer cell



These result support my hypothesis because in the pictures, produced by a Partial Wave Spectroscopic Microscopy and Confocal Microscopy, we are able to know how much light is reflected and refracted.

**Conclusion:** With this lab we know that cancer cells have a larger refractive index and that they reflect more light than they refract. This information can be useful in detecting early stages of cancer.

## Conclusion and Future Work

Our results show that by using a laser and manipulating it we can find the differences of a normal cells and cancer cell just by understanding that it is denser and has a larger refractive index. Today, there are thousands of uses of lasers that continue to grow. One important use of the laser are in cells. With a laser, we can identify microscopic structures in cells and look for problems occurring in the cells. For example, we could use a laser in cancer cells to scan for specific incongruities with normal cells. Future studies will be conducted with lasers and cancer cells to find more solutions to early detection and identification of cancer.

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I would like to dedicate this poster to my loving and supportive family.

## References

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