Mirror Reflections

Skylar Li, 2019

Introduction

Mirrors are an interest to me because a perfect mirror was only created by MIT a few years ago. A simple mirror may reflect 99% of light, but with every reflection, a certain amount of photons is absorbed by the mirror, making the reflection weaker and weaker.

The word laser originated from the acronym LASER, which stood for light amplification by stimulated emission of radiation. The energy that a laser emits, in the form of coherent light (a beam of photons that have the same frequency) travels at the speed of light; which is about 300,000 km per second.

Problem Statement

For my research question I asked: many reflections can a laser have in a room of mirrors? After solving for the number of reflections, I wanted to further ask how long it would take for the laser to diminish until it is invisible to the human eye.

Results

First, we assume that the laser is pointed in a rectangular room, with mirrors on every side that reflect 99.99% of light. Now we know with each reflection, 0.01% of light is absorbed by the mirror. We will also assume that light can't be seen by the naked eye if less than 1% is present. Using conversion,99.99%=0.9999 and 1%=0.01.

Let "N" be the total number of reflections made by the laser.

$$0.9999^{N} = 0.01$$

In order to isolate"N", I applied natural log to both sides of the equation.

$$N ln(0.9999) = ln(0.01)$$

Using simple algebra, I was able to find that N=46049.39. Since the laser cannot reflect 39 hundredths of itself, I rounded up. It would take 46050 reflections for a laser to become invisible to humans.

The second question I asked myself was how long would it take for the laser to disappear?

The variable “s” is the number of seconds it takes for the laser to disappear. I let the variable “ l ” be the distance between the parallel mirrors (in meters).

Since we know that light travels at 300,000 km per second, we know that the laser travels at 300,000,000 meters per second.

$$l / 300000000 = 1 \; second$$

The formula to find the number of seconds for the laser to disappear is :

$$s = 46050(l/300000000)$$

If the distance between the mirrors is 10 meters, then the time it takes for the laser to disappear is
d

$$s = 46050(10/300000000)$$
$$s = 0.000135$$

Conclusion

It takes 46050 reflections for a laser to disappear. In a square room with a length of 10 meters, the laser would disappear in 0.000135 seconds.

From this project, I was able to solve my problem. I think this problem was too straight forward. If I were to continue with this topic, I would probably look for patterns in which the laser goes when it is pointed at a specific angle and perhaps focus on more realistic mirrors and lasers. I think it would be interesting to explore patterns that a laser would make in different shapes as well.