CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
J1517

Project Title
Diffractive Bending of Laser Beams Around Objects

Abstract

Objectives/Goals
My science project studies the phenomenon of light bending around objects. When traveling close to an object, the direction of a light beam slightly bends towards that object. Light bending was first predicted by Einstein, and later proved by astronomical observations. Previous research resulted in three independent theories: one based on Einstein relativity, one on classical Newtonian particle interaction, and one based on electromagnetic wave diffraction. My objective is to expand the existing theories coverage by developing a new theory that describes the light bending dependence on the geometrical shape of the object.

Methods/Materials
The method consists in measuring the deviation of a laser beam spot on a screen when a test object is brought very close to the beam. I have built an experimental fixture consisting of a laser pointer mounted on a solid stand and having an adjustable sliding table for the test objects. Since the deviation is very small and hard to be seen with the eye, I used a microscope to amplify this deviation.

Materials: Laser pointer; Sliding mechanism from a telescope; Intel #Play# Microscope; Mechanical clamps; Screws, Nuts and Nails; Light sensor and Voltage Meter; Pieces of wood; Cylindrical rubber objects; Laptop computer; Software: Microsoft Excel, Microsoft Word, and Intel-Play image capture program.

Results
The results showed that the light bending angle depends on the test object radius, in the way that it increases as the radius decreases. Based on the measurement results, I have created a mathematical model that can be used to calculate the bending angle for a given radius. This model consists of three equations, first a second order polynomial type, second a power function type, and third a linear type.

Conclusions/Discussion
My study has proved that the diffractive bending of light beams around objects depends on the partial curvature radius of the object#s surface closest to the beam. The experimental fixture I have built was able to be used to measure the bending angle of a light beam generated by a laser pointer, and using this fixture I have measured the bending angles for different radius test objects. The results showed that the bending angle increases with the decreasing of the test object radius. From the measured data I have built a mathematical model that describe the variation of the bending angle function of the object#s radius.

Summary Statement
My project studies how laser beams bend when traveling near an object and how the bending angle depends on the object#s geometry.

Help Received