Optics and Pool: Play the Game

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Abstract. *The objective of this work is, with the use of a pool table, to apply and demonstrate the laws of reflection to students of the early ranks of basic school.*

The idea of associating the use of a pool table to the teaching of geometric optics is based on the need to make the teaching process more appealing on behalf of the students; being pool a popular and appealing game, it would be possible to teach physics concepts in an apparently informal context. This assembly is also simplified due to the fact that only day-to-day materials are used, reducing it's final cost (for that effect we only need to perform a few reversible changes to the pool table).

Associated to the poll table (in an early stage) is a flat mirror system, that is placed along the table borders, and laser markers which allow us to visualize the incisive and reflected beams' path, making possible the prediction of the ball's path by applying the laws of reflection.

In a subsequent stage, the used mirrors will be spherical concave and convex, associated to it's equivalent and adapted pool table, being the calculations preformed similar to those of preformed with the flat mirror system.

With the implementation of this system, it is meant for students to take conclusions about the laws of reflection by comparison to the ball and luminous beam paths.

Keywords. Non-formal learning, Science Education, School, Hands-on experiments, Optics, Mechanics.

1. Introduction

In this communication we will present an experimental work to be carried out by students, from even the early ages of basic school, in a non-formal environment. Using a pool table (a game well know to many students) students will perform a series of experiments learning and demonstrating the laws of light reflection.

The idea of associating the use of a pool table to the teaching of geometric optics is based on the need to make the teaching process more appealing on behalf of the students. Being pool a popular and appealing game it would be possible to teach physics concepts in an apparently informal or non-formal context. This assembly is also simplified due to the fact that only day-to-day materials are used, reducing it's final cost as we only need to perform a few reversible changes to a pool table.

2. How to bring together pool and optics

To a regular (or especially designed) poll table is attached a flat mirror system, that is placed along the table borders. Laser pointers aligned over the table will allow us to visualize the incidence and reflected beams' path, as it is shown in figures 1 and 2.

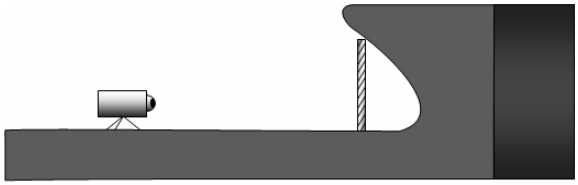
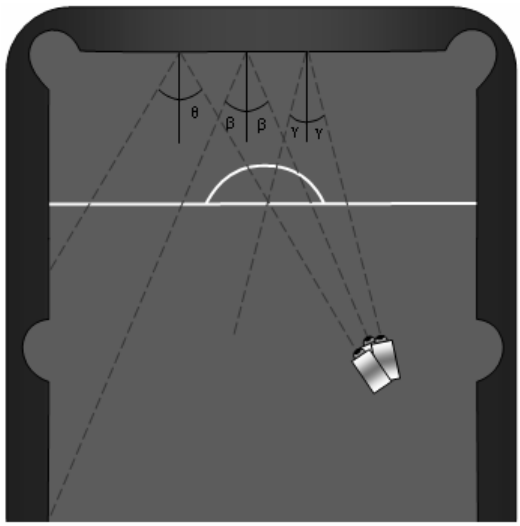


Figure 1: Adaptation of a mirror to the pool table walls

This way, it is possible to predict the ball's path by applying the laws of reflection, as it is shown in figure 3.

In a subsequent stage, the used mirrors will be made spherical concave and convex, and adapted to the pool table, being the experiments and calculations preformed in a similar to those preformed with the flat mirror system, as shown in figure 2.



Figures 2: Scheme of the application

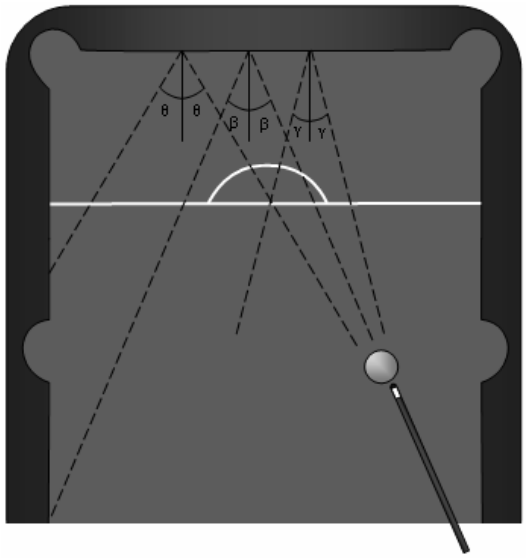


Figure 3: Prediction of the ball's path

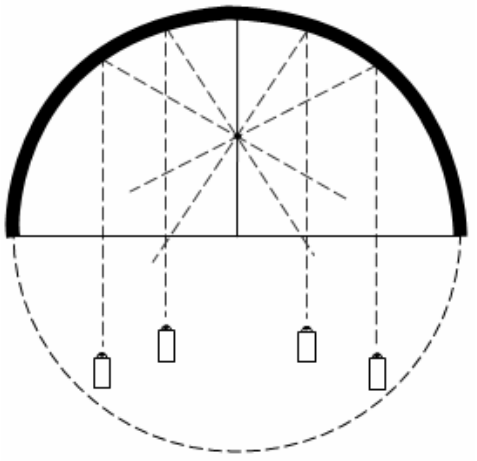


Figure 4: Adaptation of spherical concave mirror to the pool table

As it is possible to see, in a pool table with this shape, all the balls moving through a trajectory parallel to the straight sides of the pool will always enter the hole made on the table, if it is positioned in the focus of the analogue mirror (figure 5.).

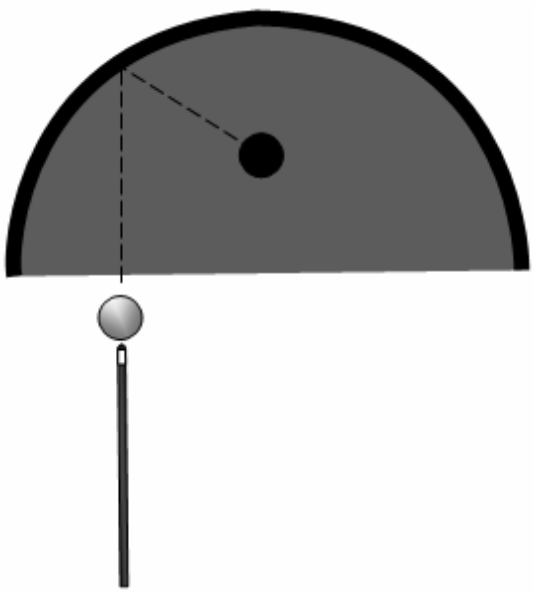


Figure 5: Prediction of the ball's path in a spherical concave table border

At the time of the curve mirror experimentation we can also explore geometry related concepts like, for instance, the determination of focal lengths.

3. How to achieve the activity' objectives

With the implementation of this system it is meant for students to take conclusions about the laws of reflection by comparing the ball and luminous beam paths.

Other of our goals is to raise the interest of the students to a subject like optics, using a well know and always fashionable game, played from youngsters to older people, in every contexts of the society.

Using this popular game, with the proper adaptations, it is also possible to use this equipment in the study of many other concepts, like:

- the reflection laws (as it was shown above);
- the optical fibers – as it happens in the optical fibre, the ball will move in the pool table, bouncing along the borders, as the light beam reflect along the fibre.

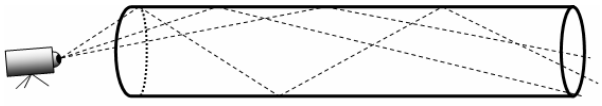


Figure 6: Scheme of light propagation in a optic fiber.

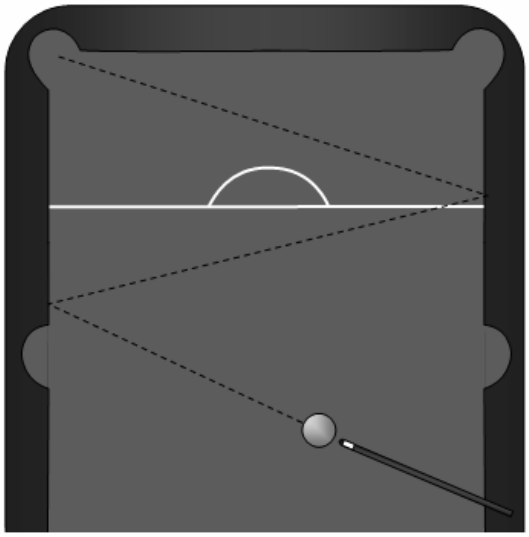


Figure 7: Adaptation of the pool table to optical fibres study

- mechanical energy conservation -using a spring to push the ball it is possible to relate the ball velocity with the force applied to the spring resulting in different total trajectories of the ball (number or re-bounces that will be intuitively related to the energy lost during the bouncing and re-bouncing process).

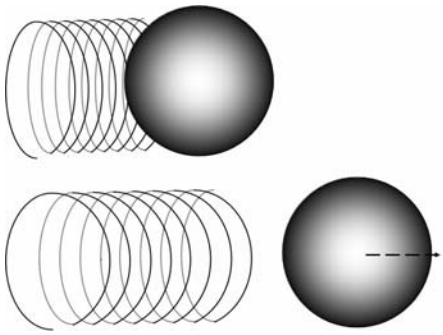


Figure 8: The use of springs allows the adaptation of the pool table to the study of energy conservation

- linear momentum conservation. This is surely one of the first ideas we may have when thinking about a pool table. However the previous observation of the light reflection process will help the full understand of this process - using several ball's students will study and understand linear momentum conservation in collisions.

One of the advantages of this equipment is that it is possible, with small adjustments and a bit of imagination, to create new combinations that may allow the exploration and study of many different concepts.

In a more developed stage of the experimentation of this system we can create more challenges such as making the pool ball reach a certain position, after a given number of hits (an equivalent to the same number of light reflections).

The objective can be the conception, by the students, of systems (including adaptations of the pool table) or procedures to study some defined phenomena with the establishment of the correct strategy: the elaboration of the strategy for the study of a subject implicates a good knowledge of it.

7. Conclusion

Learning in a non-formal or informal context often is easier and more effective, specially if the activities involved relates to former knowledge or experience from the students. Furthermore it is essential that the fun side of it is complemented by serious analysis that should always lead to the establishment of clear conclusions.

8. Acknowledgement

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8. References

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