International Journal of Multidisciplinary Research and Growth Evaluation.

Study on Whether the Curved Shape of the Rainbow Originates from the Curvature of Water Droplet or Simply Represents Solar Disc Edge Refraction

Angel Pérez Sánchez
Comillas University (ICADE), España

* Corresponding Author: **Angel Pérez Sánchez**

Article Info

ISSN (online): 2582-7138
Volume: 06
Issue: 04
July - August 2025
Received: 09-06-2025
Accepted: 10-07-2025
Published: 02-08-2025
Page No: 1231-1234

Abstract
The most widely accepted explanation among scientists is that rainbow is formed by the refraction and reflection of sunlight within each individual water droplet. According to this view, the combined effect of all the refracted and reflected rays from countless droplets creates a single rainbow visible on the horizon. However, this explanation appears to raise a contradiction: if each droplet produces such an effect, the result should be thousands of rainbows (one per droplet), rather than a single unified arc.
The standard explanation addresses this by proposing that the geometry of the reflection is such that only those reflected rays on a specific cone—with the observer's eyes at the vertex—contribute light to the visible rainbow. This cone would define the circular shape of the rainbow.
Nevertheless, an alternative interpretation could be that the circular rainbow shape arises from the refraction of Solar disc as it interacts with ambient moisture. This hypothesis also poses challenges, such as the fact that we do not see the entire solar disc as iridescent in the sky—only its colored edge appears.
Both explanations deserve careful and detailed analysis, which this study aims to explore.

DOI: https://doi.org/10.54660/.IJMRGE.2025.6.4.1231-1234

Keywords: Rainbow formation, Water droplet optics, Rainbow geometry, Geometrical optics,

1. Introduction

The aim of this study is to analyze the shortcomings of the currently predominant theory on rainbow formation—based on the refraction and reflection of light within water droplets—and to propose a simpler alternative: that the rainbow reflects the diffracted arc of the solar disc.
Alternatively, one might consider that the arc shape of the rainbow results not from the spherical curvature of the droplets, but from the curvature of the solar disc itself. This hypothesis suggests that the iridescent arc is a consequence of how Sun edge light diffract during its passage through moisture in the atmosphere.
Both interpretations raise fundamental questions about the origin of the rainbow's geometry. This paper explores the optical reasoning behind each approach and aims to clarify which mechanisms most accurately account for the phenomenon.

2. Traditional Theory; Rainbow curved shape depends on Water Droplet Curvature

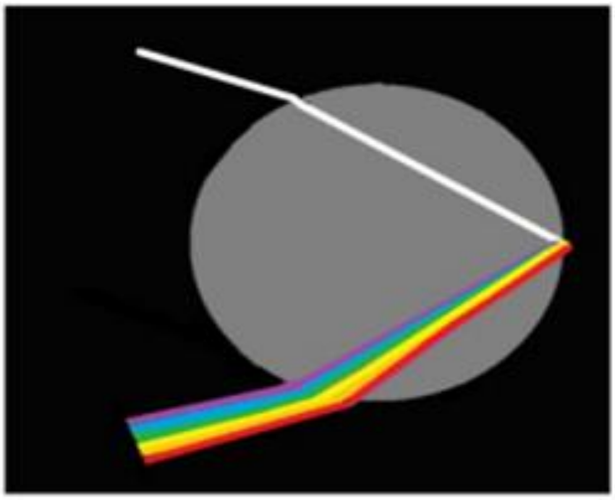

Fig 1: Light reflection in water droplet.

Rainbows are among the most admired and widely studied atmospheric optical phenomena. Traditionally, it has been explained as the result of the interaction between sunlight and countless water droplets suspended in the atmosphere after a rain shower. The classical model, established through the works of Descartes and Newton, proposes that the rainbow emerges from the combined effects of internal reflection and refraction, of light inside each droplet.

In this model, sunlight enters a spherical droplet, reflects at the water interface and refracts internally once upon exiting. The angle at which light emerges from the droplet, produces a concentrated arc of colored light. When this effect is multiplied across millions of droplets aligned at a specific angle relative to the observer, the result is a single, circular arc: the primary rainbow.

2.1. Traditional Theory Problems

1. If each droplet produces a rainbow through individual optical processes, why do we observe only one coherent arc instead of thousands of overlapping rainbows?
2. To resolve this, it is commonly argued that the geometry of the reflected rays alignment along a specific conical surface, with the observer's eye at the apex. This geometric alignment would then account for the singular circular appearance of the rainbow. But why light is reflected along a cone is not well understood and it seems that too many droplets' reflections must coincide for this to occur.
3. For rainbows reflected by thousands of drops to converge into a single rainbow, a curtain of water drops aligned on a smooth, uniform surface would be needed, whereas rain and clouds do not have uniformly aligned water drops.
4. Rain and clouds don't keep static droplets instead keep moving ones, The rainbow should look like many multi-coloured dots falling, but rainbow keep static shape instead.
5. It seems that for the system to work, each drop must be placed in the necessary place to converge its light refraction into a single rainbow, when the drops have an uneven distribution.

3. Rainbow curved shape by solar disc edge refraction

This idea would solve the aforementioned problem of thousands of rainbows formation. The sun refracts its light as it passes through clouds or rain in the atmosphere above the observer, and this refracted light is reflected on the horizon in the rainbow. The clouds or moisture would act as the Newton's prism used to decompose the light, and the rainbow would be reflected in the air in front of the observer, this air act as a movie screen or mirror.

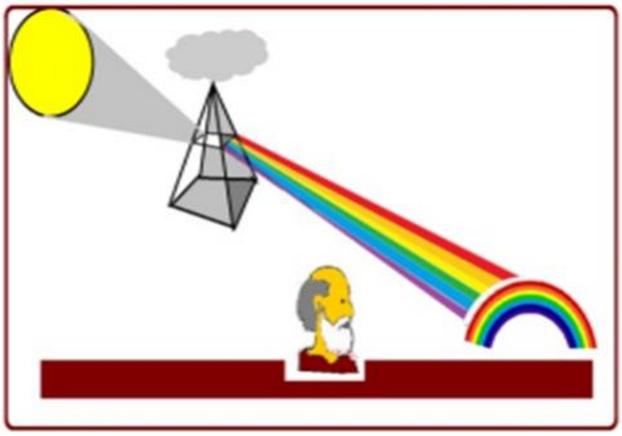

Fig 2: Solar circle refraction to form the rainbow.

Let's analyse the following photo:

Light entering through a section of the door skylight is reflected by a mirror held by a person; toward the inside of the same door, this light, while being reflected, is refracted by the mirror glass. With this experiment, we have replaced the circular solar focus with an irregularly shaped focus, and we see that the rainbow formed reproduces the shape of the irregular focus of door skylight edge. Traditional theory states that the shape of a rainbow is due to the shape of the material reflecting the light.

In this experiment, the shape of the rainbow is determined by the light-emitting source that generates the rainbow.

Fig 3: Light reflection on mirror.

On next figure light beam shape affects the form of the rainbow. A parallelepiped-shaped beam of a flashlight projected on a screen. Rainbow forms along the edges of the parallelepiped, as a result of refraction of also parallelepiped shaped light through the flashlight's glass.

Fig 4: Flashlight with a parallelepiped-shaped focus is reflected.

3.1. Problems of solar disc edge refraction

The However, considering the origin of the rainbow as product of solar circle refraction as it crosses the rain raises some questions:

Obtain a complete iridescent circle as a result, not just an arc. To solve this problem, we will turn to another classic: Isaac Newton and his color disc; Newton spun his disk in such a way that the different colors overlap on our retina, resulting in a view of the color white. White is the sum of the other colors. This is what happens in the refracted light from inside the sun, where overlapping rainbows form, resulting in white light. The rainbow remains as a remnant at the outline of the Sun, as overlapping rainbows do not occur at the outline.

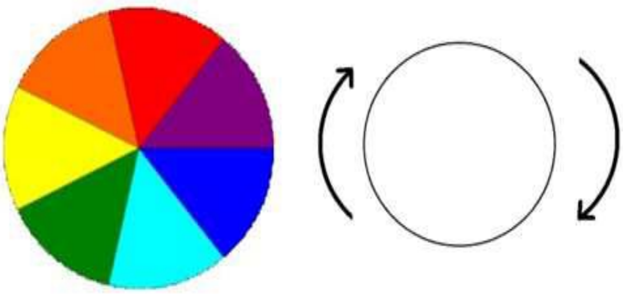

Fig 5: Newtons color disc

Rainbow inside should keep white color, just as Newton's Color Circle. However, on rainbow inside photos, while not white, maintain a whitish and lighter tone compared to the outside.

Fig 6: Rainbow inside in a whitish tone

Why rainbow on the horizon seems much larger than directly observed sun?

Refraction involves a change in the direction of light. In this case, the light from the edge of the sun is deflected toward the outside of the solar circle, enlarging the arc.

4. Problems that traditional theory cannot solve but "Solar Disk Diffraction" Theory can:

Only those reflected rays on a specific cone—with the observer's eyes at the vertex—contribute light to the visible rainbow. This cone should place observer at rainbow center.

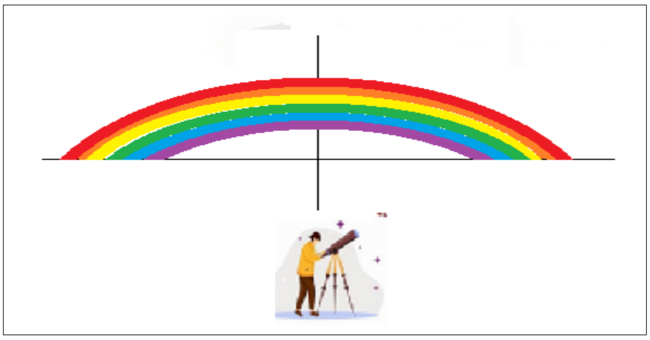

Fig 7: Observer at rainbow center.

in so many photos observer isn't at rainbow center, look at this rainbow observed from the airplane window.

Fig 8: Rainbow from the airplane window.

So, rainbow is reflected in the layer of air that acts like a movie screen.

5. How would "Refraction of the Solar Disk" theory explain secondary rainbow?

A double refraction could provide an answer

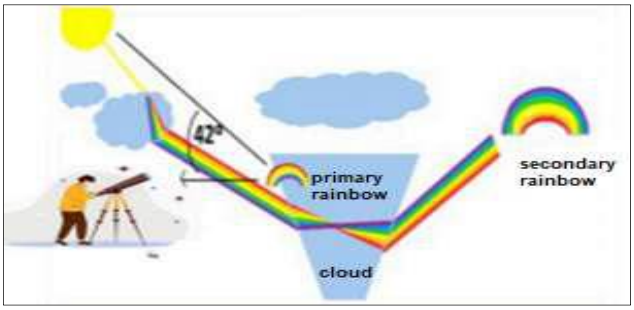

Fig 9: Secondary Rainbow.

6. Experiment with water drops.

In this photo, water droplets are produced by a vaporizer, and a parallelepiped-shaped flashlight is used as a spotlight. The light, after passing through the water vapor in the vaporizer, is projected onto the wall, reflecting the parallelepiped shape of the flashlight's spotlight.

The important thing is to see the reflection of the light produced by the vaporizer's droplets, which, as we can see, also maintains the same parallelepiped shape as the spotlight.

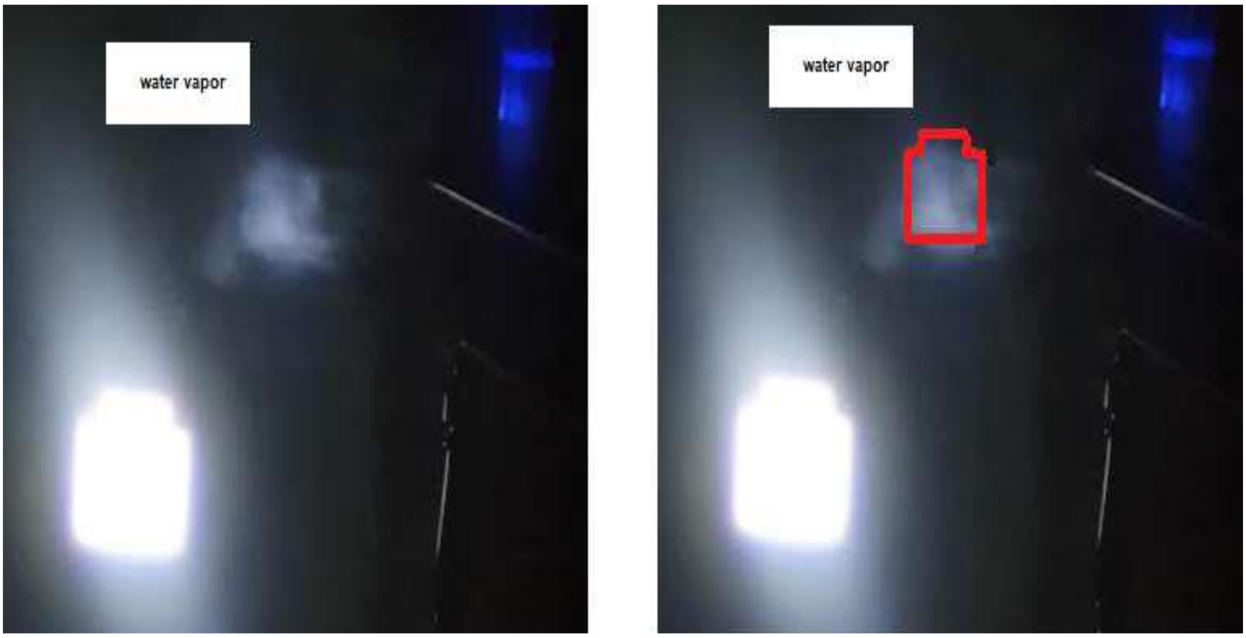

Fig.10. Experiment with water drops.

7. Conclusions

The traditional system of rainbow formation pioneered by Newton and Descartes, based on the refraction and reflection of light in water droplets, is a complicated and difficult system, especially because of the need for the refraction and reflection in each water droplet to combine to form a global rainbow. It's simpler to consider solar circle is diffracted by the humidity of the atmosphere, and the product of this diffraction of the solar sphere is reflected on the horizon to see the rainbow.

As Occam's Razor says, of two possible solutions, the correct one is the simplest.

8. References

1. Adeniyi KA, T O. Developing nanoindentation and non-contact optical metrology techniques for precise material characterization in manufacturing. Int J Multidiscip Res Growth Eval. 2022;3:720-34.
2. Descartes R. Discours de la méthode pour bien conduire sa raison et chercher la vérité dans les sciences. Paris: [publisher unknown]; 1637.
3. Dini Mufidati S. The development of RBL-STEM learning materials to improve students' conjecture thinking skills in solving the antimagic rainbow coloring problem in greenhouse using artificial neural networks. Int J Multidiscip Res Growth Eval. 2023;4(3):894-901.
4. JugandoconBlutu. Experimento # 24 "Tu propio Arcoiris Compacto" [Internet]. YouTube; 2011 [cited 2025 Aug 16]. Available from: [URL not provided].
5. Newton I. Discours de la méthode pour bien conduire sa raison et chercher la vérité dans les sciences. London: Sam. Smith and Benj. Walford; 1704.
6. Perez Sanchez A. Consideration of starlight waves redshift as produced by friction of these waves on its way through space. World Acad Sci Eng Technol. 2024;18(10):1030-4.
7. Perez Sanchez A. Magnetic lines of force & diamagnetism. World Acad Sci Eng Technol. 2023;17(8):876-80.
8. Perez Sanchez A. Consideration of magnetic lines of force as magnets produced by percussion waves. World Acad Sci Eng Technol. 2024;18(9):950-4.
9. Perez Sanchez A. Earth’s outer core metal liquid flow generates magnetic field without using geodynamo. Glob J Res Eng A Mech Mech Eng. 2025;25(1):110.
10. Perez Sanchez A. Twisters and traveling Higgs bosons, unify general relativity and quantum mechanics, and explain dark matter. Glob J Res Eng A Mech Mech Eng. 2025;25(1):11-20.
11. Perez Sanchez A. Discovery a periodic table new rule by studying the noble gases atomic numbers sequence. Int J Multidiscip Res Growth Eval. 2025;6(3):1030-4. doi:10.54660/.IJMRGE.2025.6.3.1030-1034.
12. Perez Sanchez A. Electrical attraction law by electron flow unifies attraction and repulsion into a single attraction force and solves strong nuclear force mystery. Int J Multidiscip Res Growth Eval. 2025;6(4):630-3. doi:10.54660/.IJMRGE.2025.6.4.630-633.
13. Ravi Sankar TP. Cost-effective strategies for transitioning legacy coaxial to fiber optic broadband networks: a multi-faceted approach. Int J Multidiscip Res Growth Eval. 2025;6:1805-180.