This mexican student solves yet another ancient optics problem

"If Newton were alive today, I think he'd like to read my PhD thesis," says **Rafael González**, a PhD student at Tec de Monterrey.

González and **his mentor**, **Julio César Gutiérrez** (the Tec's third most published researcher over the past decade) have just **published the answer to a problem that seemed impossible to solve.**

They published the **formula that demonstrates it is possible to solve the optical fault known as chromatic aberration with a single lens** in Applied Optics, the ***Journal of The Optical Society of America*****.**

Chromatic aberration, or spherochromatism, means that **the colors in light disperse** when passing **through a lens** and **cannot be focused on the same point.**

Isaac Newton himself had attempted to solve it, something Rafael is already familiar with, as the year before last he **discovered the solution to another optical problem** attempted by Newton: **spherical aberration.**


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GOODBYE CHROMATIC ABERRATION

Surrounded by a sea of lenses (like the ones on your camera), Rafael González and Dr. Gutiérrez **talked to CONECTA** about their **discovery.**

*"**Newton** assumed in his book **Opticks** (his second most famous work), that **you couldn't make a single-lens system to correct chromatic aberration,"*** explains Rafael.

*"Scientists such as **Newton** attempted it, but so did **Huygens**, **Descartes**, **Abbe**. It was a **problem attempted by many physicists**,"* adds Gutiérrez.

"Scientists such as Newton attempted it (...) It was a problem attempted by many physicists."

What they **have now achieved** is a **mathematical formula** with an **approximate** but **valid solution** that can **correct it with a single lens.**

"It's a model that gives you the optimum surface area of a lens for minimizing chromatic aberration," summarizes Gutiérrez.

Their solution was given in the article **Analytic design of a spherochromatic singlet.**

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OPTICS, IMAGE SCIENCE, AND VISION

Analytic design of a spherochromatic singlet

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We derive the analytic formula of the output surface of a spherochromatic lens. The analytic solution ensures that all the rays for a wide range of wavelengths fall inside the Airy disk. So, its amount of spherical aberration is small enough to consider the lens as diffracted limited. We test the singlet lens using ray-tracing methods and find satisfactory results, including spot diagram analysis for three different Abbe wavelengths.

https://doi.org/10.1364/JOSAA.37.000149

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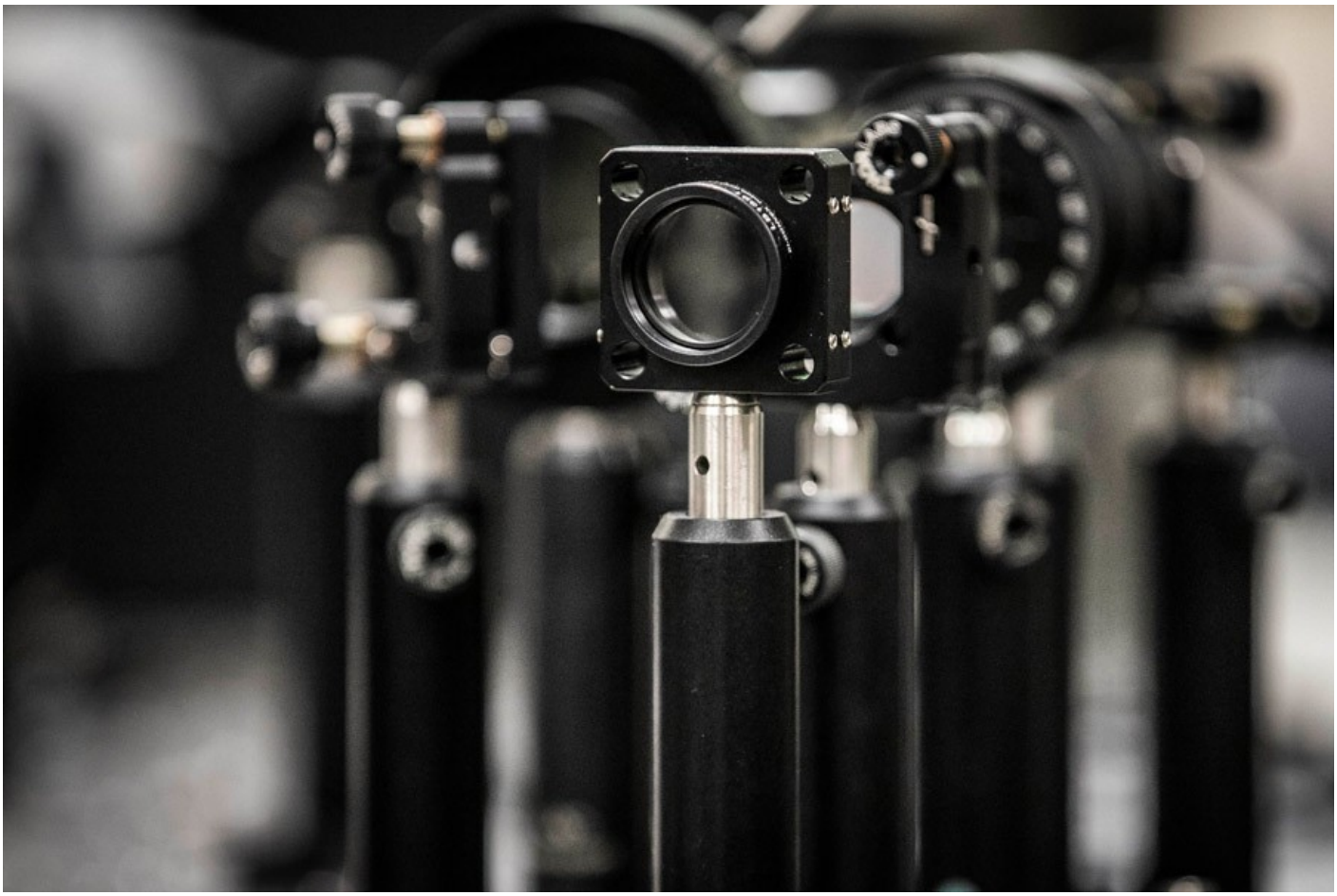

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TWO ZERO TO RAFAEL

For Rafael González, this is the **second time in two years** that he's found a **solution** to an **optical problem** that was **unsolved for centuries.**

In 2018, he published the **exact solution to spherical aberration** in the same **Journal of The Optical Society of America**.

In fact, **that work was what opened the door to the new** solution to chromatic aberration.

*"It was **straight after having found the previous solution,** although we had to work hard on it,"* he says.

ALSO READ: **THE SOLUTION HE DISCOVERED TO SPHERICAL ABERRATION**

Spherical aberration causes a **loss of resolution when viewing through spherical lenses**. **Newton and others had also attempted a solution.**

The article **was downloaded thousands of times and earned the Editor's Pick. On that occasion, González and his colleague** Alejandro Chaparro had toiled away on solving the **centuries-old problem.**

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HIS WORK AND ITS IMPACT

For **Dr. Gutiérrez, Director of the Optics Center at the Tec's Monterrey campus** and reviewer of González's PhD thesis, what **his student has done is remarkable:**

"It means a lot. ***The work shows how many hours Rafa has put into it,"*** he says with praise.

"*As Mexicans, it's great to see things being done well* *to that end.* ***There's a lot of talent in Mexico*** *and a great deal of potential,"* he adds.

The specialist explains that González's work on these solutions could have an **effect on how optical problems are addressed now:**

"The impact *has to do with* ***reformulating how you attack optical design problems****, which is to say at the level of how* ***optical design theory is studied.****"*

"The impact has to do with reformulating how you attack optical design problems."

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THE "HOLY GRAIL" AND THE SEARCH FOR A PERFECT FORMULA

Rafael wants to continue solving problems, inspired by the great minds of science.

He's currently working with the **University of Oxford** and the **Mixteca University** on a **microscope** lens that can be used in **cellphones.**

Not only that, he's also working on **two books,** together with Gutiérrez and Chaparro. One is for the **Institute of Physics** in the United Kingdom and the other is for the **International Society for Optics** in the US.

He says his **goal** is to focus on **aplanatic lens theory (for resolving optical aberrations)** together with what he's already solved.

"Two very important problems within the theory have now been solved *and I'm convinced that I only need time and resources to carry on,"* he says.

"Let's say that ***the Holy Grail would be discovering a general equation for an optical system*** *that was free of the* ***5 Seidel Aberrations (or classical monochromatic aberrations),"*** says the physicist.

"The Holy Grail would be discovering a general equation for an optical system that was free of the 5 Seidel Aberrations."

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https://tec.mx/en/news/national/research/eureka-mexican-solves-centuries-old-physics-problem