The absorption of an individual electrons captured on video

June 17 2021, by Carina Eliasson

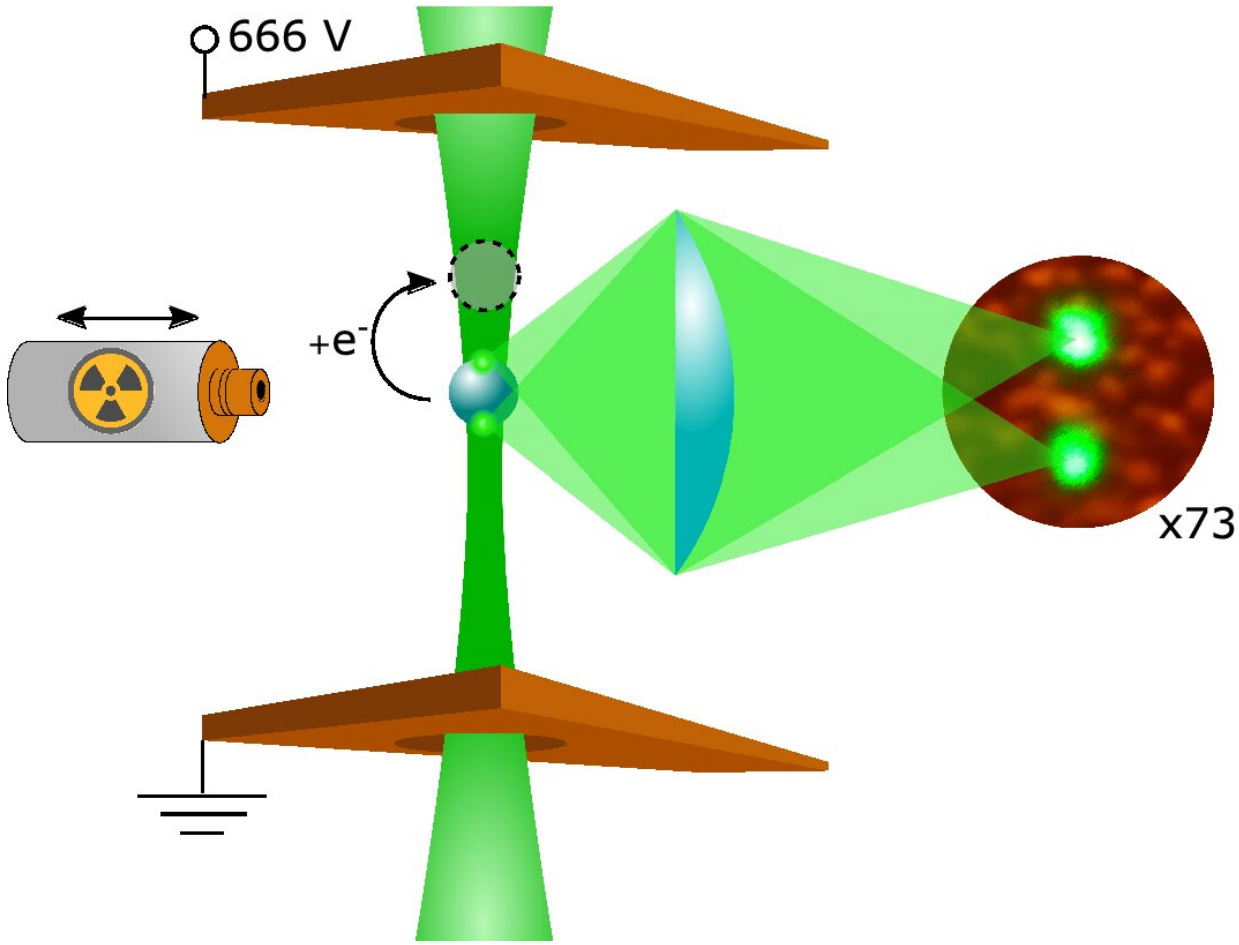

Figure 1 From: Visualizing the electron's quantization with a ruler

Researchers at the University of Gothenburg have observed the

absorption of a single electron by a levitated droplet with such a magnification that it is visible with the naked eye and can even be measured with a normal millimeter scaled ruler.

Matter in the universe is composed of elementary particles like electrons, protons, and neutrons. They are everywhere, but they are so small that they are not visible. In the last century, physicists have proven the existence of these particles through different experiments, but in most cases, the observation of the particles have been indirect.

Electrons are one of these fundamental particles. In 1909, Robert Millikan proved that the charge of the electron is quantized. In other words, there exists a minimum, indivisible amount of charge. By letting hundreds of charged droplets fall into an electric field and then performing a statistical analysis of their motion, he demonstrated that the electron's charge is quantized.

An experiment with a single levitated drop

"Now, we have created a modern version of this classical experiment by levitating a single droplet in the air using a laser," says Javier Marmolejo, Ph.D. at the Department of physics at the University of Gothenburg.

In this experiment, the quantization of the electric charge is directly visible for the first time without advanced equipment or a complex statistical analysis.

"We trapped a drop using a laser inside a strong electric field and added individual electrons by exposing it to alpha radiation. The drop performed quantized jumps every time it absorbed one or a few electrons. By magnifying the image of the droplet using a single lens, we were able to see the effect of a single electron absorption and to measure the jumps with a ruler. The bright spot moved about one millimeter for

every absorbed electron."

The drop had a diameter of 29 micrometers, which roughly corresponds to the thickness of a human hair. Despite this, it contains around 3.7 $x10^{15}$ negatively charged electrons.

"The feat is incredible when one considers that the effect of adding a single electron to a droplet that already has 3,700,000,000,000,000 is visible with the naked eye."

Now that it is possible to see the effect of a single electron, a new opportunity emerges to better communicate science regarding elementary particles to the general public, the researchers comment.

More information: Javier Tello Marmolejo et al, Visualizing the electron's quantization with a ruler, *Scientific Reports* (2021). DOI: 10.1038/s41598-021-89714-2

Provided by University of Gothenburg

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