A "fundamental" number may be shifty, astronomers say

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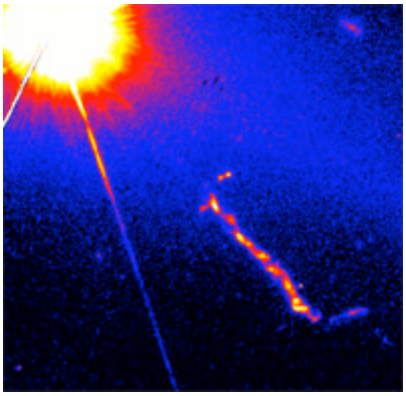
A number traditionally believed to be the same universe-wide, and which characterizes the strength of electricity and magnetism, actually varies from place to place, according to a new study.

Astronomers involved in the research predict it will generate controversy because it could force a rethinking of the foundations of physics. It might among other things imply that the universe is infinitely large, they add.



A quasar designated 3C273 as observed by the Hubble Space Telescope. (Credit: NASA/STScI)

The scientists are slated to present the findings on Sept. 8 at the Joint European and National Astronomy Meeting in Lisbon, Portugal, and have submitted a paper to the journal *Physical Review Letters*.

The research team, led by John Webb of the University of New South Wales, Australia, studied quasars, very distant galaxies witnessing violent processes at their cores due to giant black holes that lie there.

This furious activity generates bright light that travels through the cosmos. Part of this light is absorbed by various atoms in clouds in space. The absorption leaves distinctive signatures on the light's colors, offering astronomers a further opportunity to study natural processes billions of light-years away. A light-year is the distance light travels in a year.

Webb and colleagues used these processes to estimate a number known as the fine-structure constant, which characterizes the strength of the so-called electromagnetic force. This force determines the strength of electric and magnetic fields, which are so closely intertwined that they are treated as a single force. Light, indeed, is simply an oscillation of interwoven electric and magnetic fields.

Webb said his results imply that the fine-structure constant might have different values depending on which direction we are looking in the sky, thus being not so "constant" after all.

"The precision of astrophysical measurements of the fine structure constant, or alpha, dramatically increased about a decade ago," Webb said, when he and a colleague introduced a new method for measuring the figure. "Since then evidence started mounting, suggesting this crucial physical quantity might not be the same everywhere."

Variation by place in the "constant" appears to be much more than variation by time, if there is any, added the researchers.

They claim that the implications of these results are so resounding that they will probably cause controversy in the scientific community.

Using two major observatories, the Keck Telescope in Hawaii and the European Southern Observatory's Very Large Telescope in Chile, Webb and his team observed the light from quasars, the most luminous objects in the known universe. Although quasars are incredibly far away, we can detect them due to the sheer quantity of light that they emit. The light is thought to come from material that heats up as it plunges into the central, "supermassive" black holes.

Because the light that reaches us from these objects actually left them billions of years ago, the images we receive offer a record of the way they would have looked back then.

"The interaction of the light from the quasars with the gas clouds provides an impressive opportunity to investigate the physical conditions when the Universe was just a fraction of its current age," said PhD student Julian King, also of the university, who played a major role in the research. It's "exciting that we have the technology to be able to measure the laws of physics in the early Universe so precisely," he added.

The new results can be explained if our Universe is exceptionally or even infinitely large, the researchers said. This would allow fundamental quantities and "constants" to have different values in different areas. In such a scenario, we would exist in just a tiny patch of the cosmos, with correspondingly small changes in the physical constants.

This view, the scientists said, raises questions as to why a whole range of these "constants" happen to be just right—in our area—for developing life, along with physics and chemistry as we know them.