The Universe is Only Pretending, Physicist Says

Like a Hologram, the Universe Merely Appears to Have Three Spatial Dimensions, Scientists Infer

by **Alexandra L. Woodruff**
Contributing Writer

In quantum physics, nothing is as it seems. As physicists continue to study the universe they continually run into new questions that shake how humans understand the universe's intricate mechanics.

UC Berkeley physics professor, Raphael Bousso, is trying to break down the mysteries of the universe with a concept called the holographic principle. Physicists stumbled on the idea while studying black holes. It is a concept, which ultimately questions whether the third dimension exists.

"There's a real conflict between the way that we're thinking about the world right now, which is a very local way where everything happens independently in different regions of space and the way that we're going to have to think about it," said Bousso in an interview.

Bousso presented the ideas at a seminar last weekend called "Latest Theories About the Universe and Its Governing Laws: Theoretical Physics Made Easy for the Public" at the Lawrence Hall of Science to an audience of about 100.

The holographic principle uses the optical concept of holograms to try to visually explain the complex idea. Holograms are most often used on credit cards and are images that look three dimensional, but they exist on a two dimensional surface.

RAPHAEL BOUSSO

"You have to keep in mind that we're just using that name as a sort of metaphor for something that we're specifying quite precisely when we're talking about how much information there is relative to certain areas," he said.

A computer chip is a good way to visualize the principle. The chip has information stored on it in the form of data, but this isn't the information Bousso is talking about. Information in the holographic principle means the entire collection of matter the chip is made of.

"One way of quantifying the complexity of matter is to ask how many different states can it be in? How many things can you wiggle in? How many different ways?" Bousso said.

It would seem logical that if you doubled the size of the chip, then you could store twice as much information on the chip.

"What we've found is that it appears that gravity conspires against that when you really try to store a lot of information in a special region, then once you double that region you can't store twice as much anymore," Bousso said.

In other words, if you have a bunch of grapes in the fridge and have all the information including water content, temperature and anything else, you should be able to create an exact replica of the grapes.

Physicists have found the information content doesn't hinge on volume, but rather on surface area. An information increase can only happen on a two-dimensional surface and information density cannot increase by volume, a three-dimensional measurement.

"The total amount of information that you can store in the world grows only like the surface area of the region that you're considering," he said.

The discovery ultimately says the concept shows the third dimension could be an illusion because complex calculations can't prove it exists. The recognition is a step of progress, but Bousso doesn't know where it will ultimately lead.

"It may be a major step, it may just be one piece in a very big puzzle, but I think it's definitely progress towards that goal," he said.

Although there is practical way to use these principles right now, Bousso said he and fellow physicists are driven to understand nature at the most fundamental level.

Albert Einstein didn't have any practical applications for his theory of relativity when he first discovered it, but now the concept is woven into today's technology with things like global positioning systems, he said.

"It happens to be true that sooner or later these types of progress have not just had practical applications, but they really underlie almost everything that we can do technologically today," Bousso said.

Ultimately, the physicist wants to find the origins and the implications of the holographic principle.

He said the principle has given insight into physics concepts that scientists have understood for years.

"It gives us a preview of some of the unifications and the explanatory power that the quantum gravity we're seeking is going to have," Bousso said.

Contact Alexandra L. Woodruff at science@dailycal.org.