Findings by dark energy researchers back Einstein's conception of gravity

By **Will Dunham**

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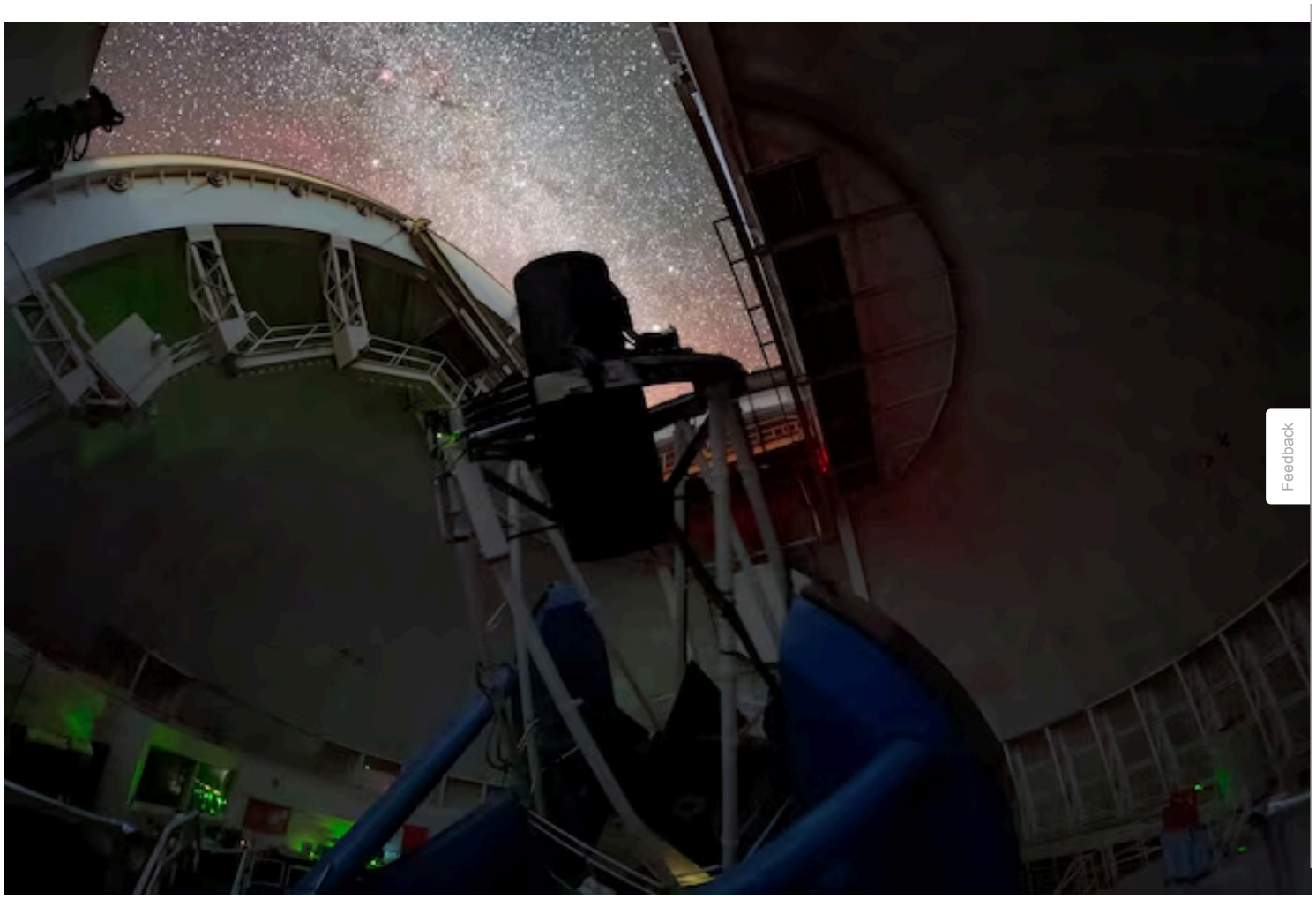

The Dark Energy Spectroscopic Instrument at Kitt Peak National Observatory in Arizona is operated imaging the night sky in 2022, in Kitt Peak, Arizona, U.S. Kitt Peak National...
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WASHINGTON, Nov 19 (Reuters) - Scientists working in an international collaboration have tracked how the structure of the cosmos has grown over the past 11 billion years, providing the most precise test to date of how gravity behaves at very large scales. And what they found is that it acts as physicist Albert Einstein predicted it would in his groundbreaking 1915 theory of general relativity.

The findings announced on Tuesday are part of a years-long study of the history of the cosmos focusing upon dark energy, an invisible and enigmatic force that is accelerating the ongoing expansion of the universe. The researchers used a year of observations by the Dark Energy Spectroscopic Instrument (DESI) at Kitt Peak National Observatory in Arizona, which can capture light from 5,000 galaxies simultaneously.

Gravity is one of the universe's fundamental forces. Einstein's theory linked space, time and gravity. It holds that concentrations of mass and energy curve the structure of space-time, influencing the motion of whatever passes nearby.

"Einstein's theory of general relativity describes the motion of massive objects in a gravitational field that they create. It is one of the most successful physical theories that we have. The discovery of the accelerating universe, however, led to suggestions that maybe general relativity needs to be modified," said University of Michigan cosmologist Dragan Huterer, co-leader of the working group that interpreted the DESI cosmological data.

But the new DESI findings revealed gravity behaving as Einstein foresaw that it would.

The Big Bang event 13.8 billion years ago initiated the universe, and it has been expanding ever since. Scientists in 1998 disclosed that this expansion was actually accelerating, with dark energy as the hypothesized reason.

The new DESI findings focused on the growth of what is called the cosmic structure, dating back to when the universe was about 20% its current age. This refers to the large-scale organization of matter, with galaxies, galaxy clusters and even larger galaxy superclusters not distributed haphazardly in the universe but rather forming a cosmic web - interwoven networks of filaments and walls - with immense voids existing in between.

This structure results from the gravitational pull of matter throughout the cosmos.

The new analysis was based on DESI observations of almost 6 million galaxies and their luminous cores, dating back 11 billion years.

The DESI scientists in April unveiled the largest three-dimensional map of the cosmos and announced findings that suggested that dark energy may not be an unchangeable force but rather one that is dynamic, evolving over time. Those findings focused on a specific feature of how galaxies cluster. The new analysis widened the scope.

"Our DESI data shows that it is in agreement with Einstein's theory of gravity but still favors a dynamical dark energy - and finding these simultaneously is new," said astrophysicist Mustapha Ishak-Boushaki of the University of Texas at Dallas, co-leader of the working group.

"Dark energy seems to be dynamical and weakening. That changes the future of the evolution of the universe, which does not need to be accelerating forever in its expansion," Ishak-Boushaki added. "The strong hint that dark energy is dynamical is the most important finding since the discovery of cosmic acceleration in 1998."

The universe's contents include ordinary matter - stars, planets, gas, dust and all the familiar stuff on Earth, including people and popcorn - as well as dark matter, which is invisible material that may make up about 27% of the cosmos, and dark energy, which may account for 68% of the cosmos.

"Dark energy is responsible for the accelerated expansion of the universe. The physical nature of dark energy is at present unknown," Huterer said.

The new findings appear to corroborate the current standard model of cosmology that includes the theory of general relativity.

"Verifying whether the standard model is indeed the correct model is at the forefront of cosmology research," Huterer said.

The DESI collaboration involves more than 900 researchers from more than 70 institutions worldwide, managed by the U.S. Department of Energy's Lawrence Berkeley National Laboratory. The new research was published on the arXiv online repository ahead of peer review.

Reporting by Will Dunham, Editing by Rosalba O'Brien

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