Researchers examine Einstein's theories on the universe

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Einstein's self-proclaimed "biggest blunder" -- his postulation of a cosmological constant (a force that opposes gravity and keeps the universe from collapsing) -- may not be such a blunder after all, according to the research of an international team of scientists that includes two Texas A&M University researchers.

The team is working on a project called ESSENCE that studies supernovae (exploding stars) to figure out if dark energy – the accelerating force of the universe – is consistent with Einstein's cosmological constant.

Texas A&M researchers Nicholas Suntzeff and Kevin Krisciunas are part of the project, which began in October of 2002 and is scheduled to end next month after achieving its goal of discovering and studying 200 supernovae. The team uses a 4-meter diameter telescope in Chile during the observing season of October to December to find the supernovae.

In 1917, Einstein was working on his Theory of General Relativity and was trying to come up with an equation that describes a static universe – one that stands still and does not collapse under the force of gravity in a big crunch. In order to keep the universe static in his theory, Einstein introduced a cosmological constant – a force that opposes the force of gravity.

Then, 12 years later, Edwin Hubble discovered that the universe is not static – it is actually expanding. So Einstein scrapped his idea of a cosmological constant and dismissed it as his biggest blunder.

In 1998, however, two teams of scientists, one of which Texas A&M researcher Suntzeff co-founded, discovered that the universe is not only expanding, but its expansion is actually accelerating – going faster and faster.

"So there had to be some other force that had overcome the force of gravity and is driving the universe into an exponential acceleration," Suntzeff said. This opposing force is what scientists now call dark energy, and it is believed to constitute roughly 74 percent of the universe. The other constituents of the universe are dark matter, which composes about 22 percent of the universe, and ordinary matter, which is about 4 percent.

"Eighty years later, it turns out that Einstein may have been right [about a cosmological constant]," Krisciunas said. "So he was smarter than he gave himself credit for."

The type of supernovae that the ESSENCE team studies all give off the same amount of energy and have essentially the same peak brightness. Researchers can compare the observed brightness of a supernova that they see in the sky to its known actual brightness to figure out how far away the supernova is.

Researchers also look at what is called the redshift of the supernova, which tells them how fast the universe is expanding. When scientists compare the distance of the supernova to its redshift, they can measure the acceleration of the expansion of the universe. This acceleration is caused by the force scientists call dark energy.

The ESSENCE team can then use the value of the acceleration to figure out the density of dark energy, which they then use to calculate what is called the w-parameter. For Einstein's cosmological constant to be correct, the w-parameter must equal -1, and so far, the results of the ESSENCE project seem to confirm that it is indeed very close to -1.

"The magic value is -1 exactly," Krisciunas said. "If the number turns out to be precisely -1, then this dark energy is a relatively simple thing – it is Einstein's cosmological constant." The team won't have the final results until later next year, but right now, the measurement is coming in at -1 plus or minus 10 percent error, Suntzeff said, so the initial data seems to point to Einstein being correct.

"We can never test [dark energy] in the laboratory, so astronomers have to measure it [through observational data], and one of the ways we're measuring it is with supernovae in the ESSENCE project," Suntzeff said. "Dark energy is completely unexplained by conventional physics. Perhaps this is a manifestation of the 5th dimension from string theory. Or maybe it is a new vacuum energy density that is changing slowly in time. We have no idea, and that is what excites both physicists and astronomers."

Source: Texas A&M University

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