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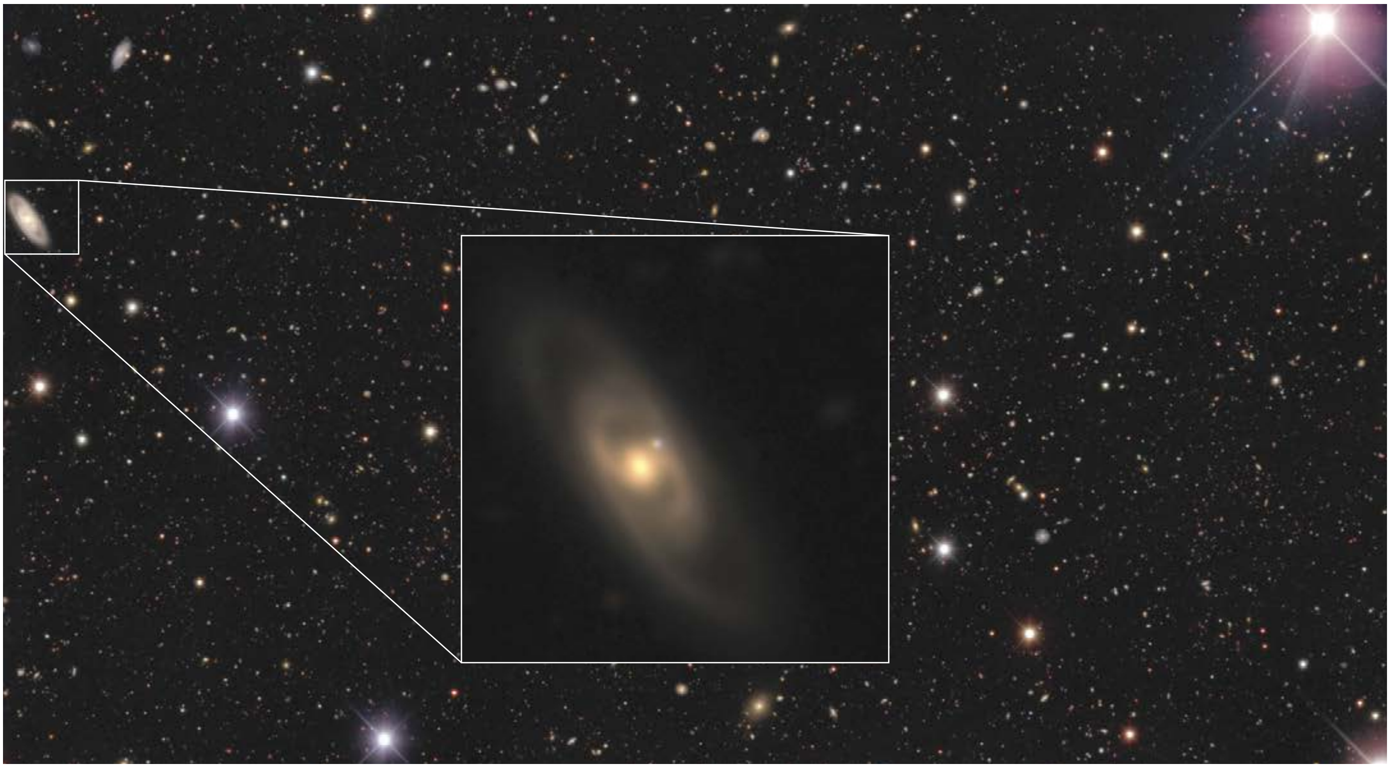

DES COLLABORATION / NOIRLAB / NSF / AURA / M. ZAMANI

▲ The inset shows a Type Ia supernova (dot of light to upper right of galaxy's bulge) detected during the course of the Dark Energy Survey. This supernova is nearby; its light took only 0.6 billion years to travel to Earth.

COSMOLOGY

New Supernova Catalog Used to Measure Strength of Dark Energy

AT THE TURN OF the century, astronomers discovered that the universe's expansion has been speeding up since the Big Bang. Now, in a study posted on the arXiv preprint server, a team of astronomers suggest that dark energy, the force behind this phenomenon, might be weaker than we first thought.

Dark energy is an unidentified quantity that exerts a repulsive pressure. Evidence for its existence first came from the study of a few dozen Type Ia supernovae, exploding white dwarf stars (*S&T:* Feb. 2024, p. 26). These supernovae can be calibrated as *standard candles*, meaning they explode with a known luminosity. Astronomers can then use them to measure the expansion rate of the universe.

Until now, supernova studies have led astronomers to think dark energy exerts the same force everywhere, everywhen. In this simple scenario, the repulsive pressure is inherent to empty space itself and is labeled the *cosmological constant*. But a study of thousands of Type Ia supernovae in the Dark Energy Survey (DES) suggests that dark energy might not be constant after all.

During a five-year survey, astronomers used the Dark Energy Camera, mounted on the Víctor M. Blanco 4-meter Telescope at Cerro Tololo Inter-American Observatory in Chile, to discover 1,635 Type Ia supernovae. The light from these supernovae has come from a huge range of distances, traveling between 1 billion and 8 billion years before arriving at Earth. Using the supernovae as standard candles, the team calculated the universe's expansion rate and established new constraints on dark energy.

To describe dark energy, physicists use the *equation of state*, labeled w, which is defined as the ratio of pressure to density. The value of w determines the nature of dark energy. In the simplest scenario, dark energy is the cosmological constant and $w = -1$. However, the DES supernovae point to a value between −0.66 and −0.95; this less negative number might indicate that the repulsive force weakens with time.

The result doesn't completely rule out a cosmological constant, though: Random fluctuations in the data could reproduce the findings about 5% of the time. (In technical terms, dark energy is still consistent with the cosmological constant to within two sigma.)

"It's tantalizing," says study lead Tamara Davis (University of Queensland, Australia). "Maybe the universe isn't quite as simple as we had thought."

Mickael Rigault (French National Centre for Scientific Research), who was not a part of the collaboration, was impressed with the group's techniques. However, he's less sure what this means for dark energy: "It's an interesting fluctuation," he notes. "I think we can still consider dark energy to be a cosmological constant. But we shall see."

■ ARWEN RIMMER