IF DARK ENERGY is truly a cosmological phenomenon that has its roots in the fabric of the universe and physics as we understand them, then as Kirshner points out, it should show up in Earth-based laboratories. To date, particle physicists have been unable to test dark energy experimentally here on Earth.

The reasons why are reminiscent of an earlier era when astronomers wrangled with another problem in physics: the speed of light. They were able to determine that indeed the speed of light was finite from observations within the Solar System. However, they were unable to determine its speed until French physicist Armand Fizeau made ground-based measurements in 1849.

Christian Beck, a mathematical physicist at Queen Mary College, University of London, and colleagues, have proposed a way that dark energy be measured in the laboratory. The idea is that dark energy might be produced by very low frequency electromagnetic vacuum fluctuations. These might be detectable using current laboratory superconductors. Three such European experiments are already in the works with first results expected in 2008.

Space agency NASA and the U.S. Department of Energy are taking a more conventional route by funding a joint dark energy mission. They have selected three proposals to compete for funding for a US$600 million dark energy space mission, which would launch around 2013. All would offer more supernovae measurements at higher precision in determining their distance than the current ground-based accuracies of eight or nine per cent.

Destiny, the Dark Energy Space Telescope, would detect and observe more than 3,000 supernovae over its two-year primary mission. SNAP, the Supernova/Acceleration Probe, is an ambitious proposal involving a spectrograph and both visible and infrared cameras. And ADEPT, the Advanced Dark Energy Physics Telescope, would conduct a large galaxy redshift survey, as well as map the three-dimensional positions of 100 million galaxies.

And for those who look at cosmology and physics as an abstraction – an esoteric science whose significance is hard to reconcile with a world labouring under pressing problems – we should remember that we appear to live in a privileged epoch in the history of the universe.

At this particular juncture of space-time in our small part of the universe, we're in a remarkable position to determine the expansion history of the cosmos. That's because we can observe it. In the future, we may not be so lucky, since dark energy is inherently accelerating the universe at an exponential rate.

In a decelerating universe, nothing would disappear; the longer we wait the more we would see. An accelerating universe creates the opposite effect. In 100 billion years, dark energy's accelerating effect will render the CMB completely undetectable, and with it will go the basis for determining modern cosmology. By then, we may look upon a virtually empty void rather than a star- and galaxy-filled sky.

"In about two trillion years, the redshift will be so great that every galaxy outside our local group of galaxies will have completely disappeared from view," says Lawrence Krauss, a cosmologist at Case Western Reserve University in Ohio.

"Future intelligent observers may derive a completely incorrect view of the universe. We appear to live in a special time. But by the same token, that suggests it's possible to rigorously infer wrong things about the universe because of things one can't observe."

Meanwhile, Brian Schmidt is in two minds about the chances of settling the dark energy issue before he retires from research. "By retirement," says Schmidt, "I'd hope to be in a position that we know what dark energy is and we're working on something else. But I expect to still be scratching my head, wondering what dark energy is and working on something else anyway."

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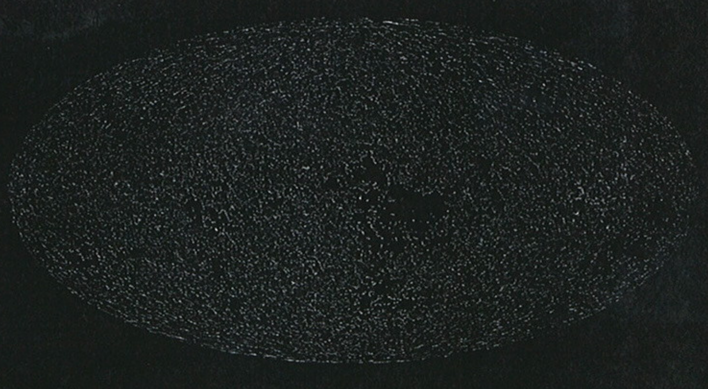

Cold echo: This image comes from the Wilkinson Microwave Anisotropy Probe (WMAP), a NASA satellite sent to survey the CMB. The colours represent the relative 'warm' and 'cool' areas. The WMAP mission helped to establish that a majority of the universe is made of dark energy.

Map of the universe: This startling image shows a detailed map of more than 1.5 million galaxies as well as around 500 million stars in our own galaxy. The colours represent the redshift of galaxies, with blue being the closest to us, and red the most distant.