



Dark Universe shows dark matter as a web in space, lit up by yellow clusters of galaxies.

ASTRONOMY

The great unseen

Eric Hand views a planetarium show on dark matter and dark energy that is both dislocating and transfixing.

A twinkling, time-lapse whorl that puts you at the centre of the Universe, and a comforting narrative to take you from Earth to outer space in stages — from the known to the unknown. Such is the old-school planetarium experience. But *Dark Universe*, the first new show for four years at the American Museum of Natural History's Hayden Planetarium in New York City, dares to turn the whole thing on its head.

The 23-minute show dislocates the viewer by starting from a disembodied vantage point in the black of outer space. Smudges of light streak by. "Way out here, 10 million light years from planet Earth, every point of light is a galaxy containing billions of stars,"

intones narrator Neil deGrasse Tyson, the planetarium's director. Zooming in at warp speed, the viewer stumbles on the Milky Way, the Sun and Earth, crashing through the planet's atmosphere to land at the 2.5-metre telescope on Mount Wilson near Los Angeles, California, where Edwin Hubble inferred the expansion of the Universe in the 1920s. The reversed ride is audacious and surprising. But it is the two main focuses of the show — dark matter and dark energy — that really throw you.

These are humbling, even alienating, concepts. Dark matter, the unknown stuff that

knits the Universe together, outnumbers the atoms that make up stars, planets and people by a ratio of nearly six to one. Midway through the show, in what he calls its Halloween scene, director Carter Emmart represents dark matter as a spooky black web against a dark-grey background.

Dark energy is even more terrifying. This repulsive force was discovered in the late 1990s, when far-off supernovae were found to be a little more distant than expected. Emmart has fun showing how the supernovae, the known luminosity of which is used to measure distance, explode with strobe-like regularity. Dark energy is accelerating the expansion of the Universe, and threatens one day to hurl other galaxies beyond the view of the Milky Way.

I would have liked *Dark Universe* to fast-forward to this depressing but inevitable conclusion, but it does not. The Hayden's shows do not shy away from facts — a previous one depicted the Sun, bloated in old age, encroaching on a scorched Earth — but this particular consequence of dark energy may have been a fact too far. "We don't want to scare our audience," says Emmart. Instead, with streaky vector lines, he tries to explain a difficult, subtle concept: how dark energy's accelerating effect is less apparent on the most distant, oldest galaxies. At the time these galaxies emitted the light that is now reaching Earth, dark energy's repulsion was outmatched by the force of gravity, which was stronger in the dense early Universe.

The rendering of such concepts relies on the digital projectors lining the rim of the planetarium's dome; it would have been impossible with the old-fashioned bulbous star projectors that rose from the centre of the room. Unfettered, Emmart takes full advantage of the third dimension. In a spectacular simulation, we follow the Galileo Probe into the intense pressures of Jupiter's atmosphere. There, in the planet's 'cold-storage locker', astronomers learned about the abundances of primordial hydrogen isotopes that helped to constrain temperatures just after the Big Bang.

Staff at the planetarium hint that its next show, in two or three years, could deal with an altogether cosier subject: the thousands of extrasolar planets discovered in the past two decades, and the astrobiological possibilities therein. More aliens, less alienation. In the meantime, lean back in the Hayden's steeply raked seats and let your cosmic insignificance sink in. The dark Universe, not the blue Earth, is at the centre of it all — and it is man-made telescopes that tell us so. ■

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