



## The rise, the fall and the rebound of cyclic cosmology

The idea that the universe will one day crunch back together and go through another big bang is, appropriately, coming back, finds **Leah Crane**

THE universe is dead; long live the universe. Not right this moment, not yet. But one day, everything we know will be gone.

Some say our ever-expanding universe will do a cosmic U-turn. Everything will crunch together into the tiniest possible space and then explode out again in a riot of rebirth – that’s the idea we call cyclic cosmology, or the big bounce. It was popular in the mid-20th century, fell from favour and now may be making a comeback thanks to new data from the largest 3D map of the universe ever created, made by the Dark Energy Spectroscopic Instrument (DESI).

As is occasionally the case with grand cosmological hypotheses, proponents of cyclic cosmology mostly preferred it for its elegance. Catherine Heymans, the Astronomer Royal for Scotland, expressed it nicely during a recent *New Scientist* subscriber event I hosted, where she said, “It really gels with me that the universe sort of is created in a big bang,

**DESI, on the Mayall Telescope, was used to make the largest-ever 3D map of the universe**

it expands, it slows down, gravity pulls it back in on itself, there’s a big crunch, there’s another big bang and it expands... This just makes me very happy.”

For a long time, cyclic cosmology lost popularity, driven partly by the work of Adam Riess and his colleagues, who discovered dark energy and showed that the universe is expanding at an accelerating rate. If the space between stars is growing faster and faster, it feels unlikely that it will eventually shrink back down to nothing again. “At the moment, the evidence is pointing towards a very cold and sad and empty death for our universe,” said Heymans.

The second law of thermodynamics is another sticking point: it says disorder, or entropy, in a closed system (such as the universe, as far as we know) can never decrease. With an expanding universe, we would just see a continual slow increase in entropy. But if the universe starts contracting again, entropy would correspondingly start to decrease.

One way around the entropy problem was popularised in the 2010s by legendary theoretical

physicist Roger Penrose. His model, called conformal cyclic cosmology, would look exactly like an ever-expanding universe... right until the very end. As the universe expands and everything gets further from everything else, matter will decay into its composite parts, and everything will just be leftover photons floating in the abyss. Penrose proposed that the extreme emptiness and uniformity of space-time at the end of one cycle is the same as the structure we’d expect at the beginning of a new one. Thanks to this functionally identical structure, a new, expanding universe can be kicked off from the frigid remains of the previous one.

This idea is niche and difficult to test. So, we’re stuck without much of a way to apply these ideas to the real universe we live in.

Enter DESI. Its enormous map of the universe has shown that dark energy seems to be weakening. That is, the outward acceleration of the universe seems to be slowing. This radical shift in our understanding could kick off an era of new theories about how our cosmos will spend its final days.

Among those new theories, cyclic cosmologies seem to be rising once again. “What could be causing dark energy to change could mean that in another 10 billion years’ time, dark energy weakens so much that it does reverse and it does pull everything back in on itself,” said Heymans.

“Without understanding the nature of the dark energy that’s driving the present acceleration, it’s very difficult to extrapolate it into the future,” said Riess, at the same event. “I would say all bets are off.” Smart money may still be on a cold and empty end of the universe, but, for the first time in a century, it might be worth placing a long-shot wager on the big bounce. ■



Leah Crane is a senior reporter at *New Scientist*, covering topics ranging from private space flight and cosmology to quantum mechanics. She writes *New Scientist*’s monthly space newsletter, *Launchpad*. Sign up at [newscientist.com/launchpad](https://www.newscientist.com/launchpad)

### Leah’s week

**What I’m reading**  
*Travel guides on Reykjavik, Iceland, where I’m going soon to accompany a New Scientist Discovery Tour.*

**What I’m watching**  
*Paradise on Hulu, starring the sterling Sterling K. Brown.*

**What I’m working on**  
*Sculpting and painting 50 tiny clay Cheerios for a very stupid art piece titled “Macroplastics”.*



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