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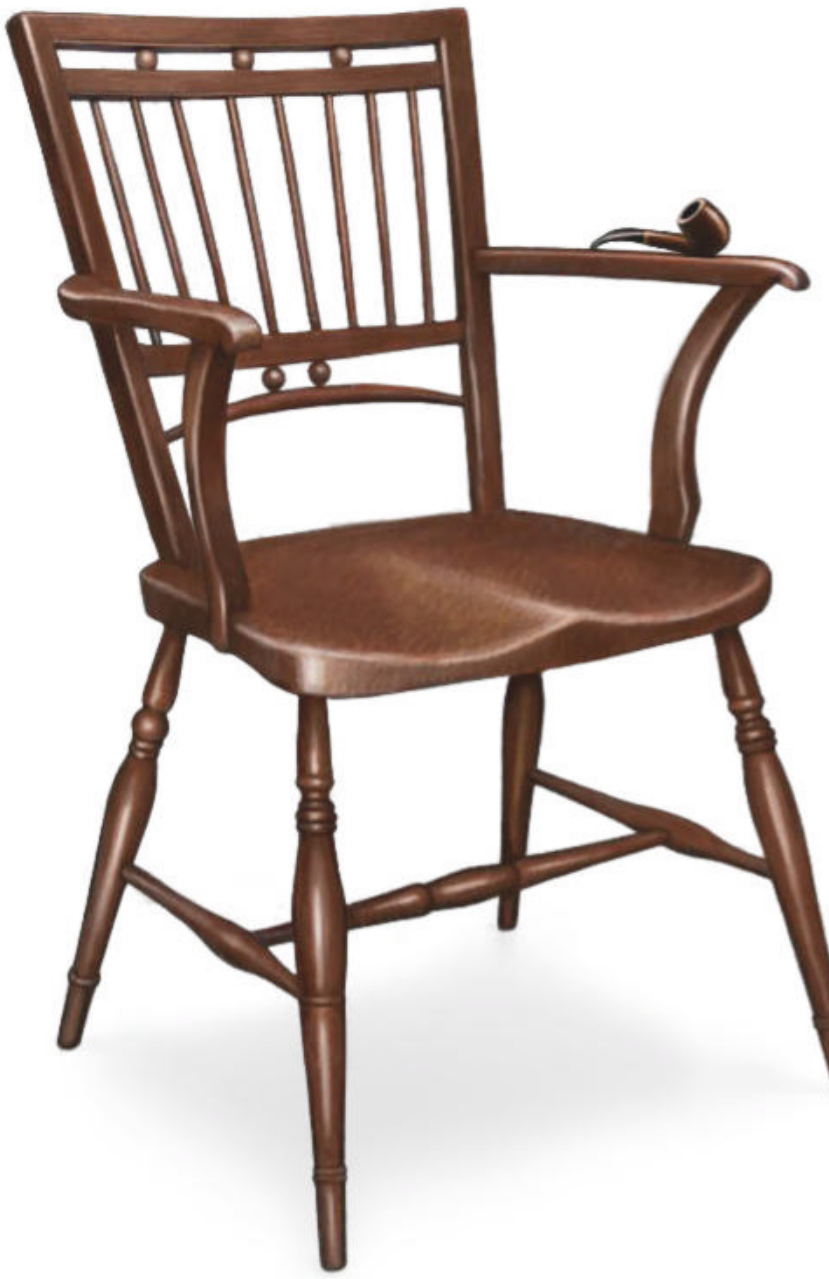

WHY THIS CHAIR DOES NOT EXIST

A new view of quantum reality

By Carlo Rovelli

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Cosmology

The universe may be unbalanced

The symmetry that supports our understanding of the cosmos might not be real

Leah Crane

A FUNDAMENTAL tenet of the modern model of cosmology is coming into question. A survey of more than 1 million galaxies across the cosmos has shown that the distribution of matter may not be the same in every direction, which could upend much of what we understand about the universe.

The cosmological principle posits that, viewed on large enough scales, the distribution of matter should be smooth and regular in every direction. This assumption is used in many cosmological calculations, most notably in the standard model of cosmology, called lambda-CDM.

Nathan Secrest at the US Naval Observatory in Washington DC and his colleagues set out to test the principle using more than 1.3 million quasars, which are supermassive black holes surrounded by bright matter that are found at the centres of some galaxies.

They expected to see a slight unbalance, or lack of symmetry, due to the movement of our solar system and galaxy through space. "In our direction of motion, we should see more objects, and in the opposite direction, we should see fewer objects," says Secrest.

This cosmic Doppler effect has been measured in the past using the cosmic microwave background, a sea of radiation left over from the big bang. But the unbalance in quasar distribution was more than twice as big as expected (*The Astrophysical Journal Letters*, doi.org/fx9g).

An illustration of the expansion of the universe, just after the big bang

NASA'S GODDARD SPACE FLIGHT CENTER/CI LAB/SCIENCE PHOTO LIBRARY

The disagreement between the quasar distribution and the cosmic microwave background may point to a fundamental error in the standard cosmological model. If it remains, it could change what we think we know about the big bang and the moments following it, which affected the shape and expansion of the universe.

"According to lambda-CDM, the universe is really lumpy on the scales we live on, galaxies and clusters of galaxies, and then it becomes smoother as you get bigger," says Michael Turner at the University of Chicago. "Assuming this analysis is correct, it doesn't get as smooth as quickly as you expect – all this means is the simplest model of lambda-CDM is not right."

Several physical mechanisms could resolve the discrepancy. The most elementary explanation is that we are moving much faster through the universe than we thought. But there are more complex possibilities as well, such as unexpected curvatures in space-time or strange properties of dark energy.

"Lambda-CDM is not the whole story and we're getting closer to the point where we can get beyond it to something deeper," says Secrest. "We are starting to see the intrinsic structure of the universe better than ever before."

Figuring out what that structure is and how it differs from our current understanding will require many more observations of the large-scale distribution of matter, using not only quasars but many other types of cosmological objects as well. ▮

Botany

Fairy lantern has a 'mouth' and saps energy from fungi

IN A Malaysian rainforest, botanists have discovered a new species of fairy lantern – a strange and enigmatic type of parasitic plant.

Fairy lanterns (*Thismia*) emerge briefly from underground as tiny, intricate flowers. Lacking the chlorophyll that helps plants photosynthesise to generate energy, they instead steal nutrients from fungi. Many species have disappeared from human eyes shortly after being discovered, sometimes never being seen again and other times reappearing decades later.

In 2017, Mat Yunoh Siti-Munirah, a botanist at the Forest Research Institute Malaysia in Kepong, saw images of flowers shared on social media by a guide at Malaysia's Royal Belum State Park. Suspecting the photos depicted an undescribed *Thismia* species, Siti-Munirah and her colleagues visited the park two years later to search for the fairy lanterns.

Beneath a tree, the team found several of the fairy lanterns, which turned out to be a new *Thismia* species that has been named *Thismia belumensis*.

Fairy lanterns typically have radially symmetrical flowers, often with odd, antenna-like projections. But in *T. belumensis*, a ring of tissue in the flower's centre expands upwards into a "hood" that opens sideways, looking a little like a snake's open mouth (*PhytoKeys*, doi.org/fx82).

"The new species of fairy lantern may already be critically endangered because of its small range"

"The species has a floral shape very rare in *Thismia*, known only in a single other species," says Maxim Nuraliev at Lomonosov Moscow State University in Russia.

In this previously known species, the structure is made of two distinct lip-like sections, differing from the new species' hood, says Siti-Munirah.

She and her colleagues already consider the fairy lantern critically endangered. They found fewer than 10 plants, and the species' small range in the park makes it vulnerable. ▮

Jake Buehler