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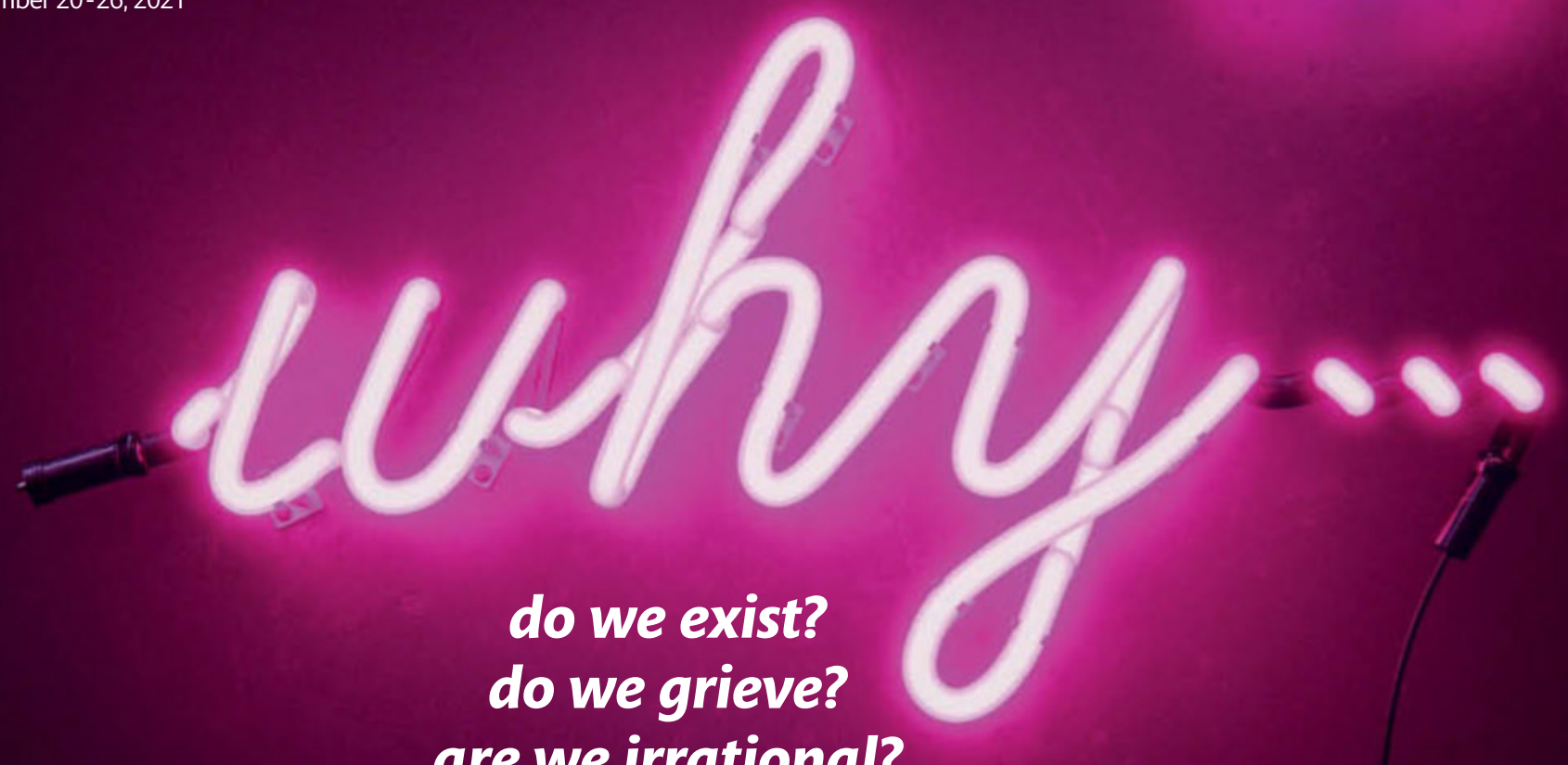
65TH ANNIVERSARY SPECIAL



do we exist?
do we grieve?
are we irrational?
is there a cosmic speed limit?
does evolution happen?
are we conscious?
does time only move forward?
is there something rather than nothing?
is the universe intelligible?
haven't we heard from aliens?
is quantum theory so strange?
are we good and evil?
is the universe just right?

13 of the most profound questions about the cosmos (and us)

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Space

Enigmatic Planet Nine may have been seen by a space telescope in 1980s

Jonathan O'Callaghan

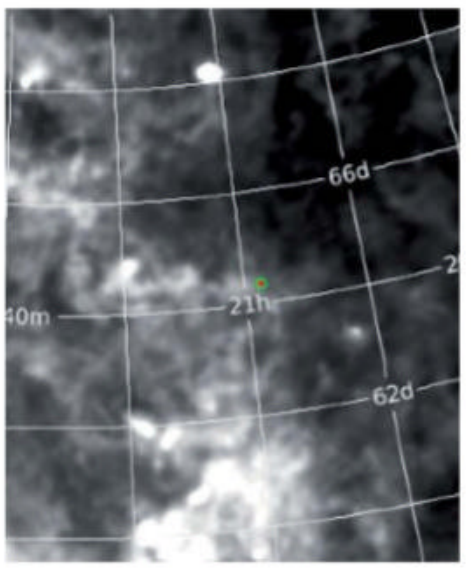
EVIDENCE has been found for a massive planet in the outer solar system, which may be the elusive Planet Nine long sought by astronomers.

Planet Nine is a hypothesised world orbiting far beyond Neptune, in our solar system's outer reaches. The gravitational clustering of some objects in this region suggests the presence of such a world, a super-Earth at least five times as massive as our planet. However, no concrete evidence for it has yet been found.

Michael Rowan-Robinson at Imperial College London examined data from a now-defunct space telescope called the Infrared Astronomical Satellite (IRAS) to look for Planet Nine.

Launched in 1983 and operating for nine months, the telescope surveyed the sky in infrared, discovering objects such as asteroids and comets.

Going back through the telescope's data, Rowan-Robinson looked for evidence of a previously overlooked object orbiting at the proposed distance of Planet Nine,



SCHLEGEL, FINKBEINER AND DAVIS (1998)

Map centred on the Planet Nine candidate (red and green dot)

and one candidate stood out.

IRAS detected evidence for an object three to five times the mass of Earth, orbiting about 225 times further from the sun than Earth does, roughly in Planet Nine's expected location (arxiv.org/abs/2111.03831). "It's very tantalising," says Rowan-Robinson.

The limitations of the telescope, however, mean there is quite a bit of uncertainty about whether it is really a planet or not. In particular, the candidate is close to our galactic plane – that is, the thick disc of our galaxy that is full

3–5

times the mass of Earth – the estimated size of the possible Planet Nine candidate

of dust and stars, and some of these might appear deceptively planet-like in a small data set.

"But in the data, it does behave quite like a moving object," says Rowan-Robinson, which would suggest it was a planet rather than a distant star.

Mike Brown at the California Institute of Technology, one of the scientists who proposed the existence of Planet Nine in 2016, says that while the finding was interesting, he couldn't be sure the candidate wasn't a false positive.

"This paper was great and I'm really glad he did this analysis," says Brown. But the uncertainties in the data resulting from the proximity to the galactic plane meant it was "hard to pull out signals from all this dust".

Even if the candidate did turn out to be a planet, it doesn't quite fit the expected parameters of Planet Nine. "It's a little too small, it's a little too close and it's quite a bit too inclined to the plane of the solar system," says Brown. "It can't cause those gravitational perturbations that we're seeing. It's not doing what we think is happening."

Nonetheless, Samantha Lawler at the University of Regina in Canada says it is worth having a look at the expected location of this candidate planet, to see if it is really there. "It's a specific prediction for a spot on the sky where there could be something very interesting," she says. "Someone should go observe that spot for sure."

Rowan-Robinson says it is unlikely this candidate world and Planet Nine could both exist. "If this object is real and it is not [Planet Nine], then it is a really remarkable coincidence," he says. ▮

Evolution

Birds in the Amazon are now smaller due to climate change

TROPICAL birds deep in Brazil's Amazon rainforest are shrinking and developing longer wings as they adapt to climate change – but why is something of a mystery.

Researchers studied data for 77 tropical bird species over the past 40 years and found that all of them had lost body mass. Some species have been losing nearly 2 per cent of their weight per decade.

Birds and mammals of the same species are generally larger at higher latitudes. The leading explanation is that their smaller surface-area-to-volume ratio allows them to better conserve heat. The inverse would help smaller species in hot climates to cool and could explain why birds are getting smaller as the climate warms, says Vitek Jirinec at the Integral Ecology Research Center in California, who led the analysis.

In line with this, the mean temperature of the birds' habitat today is 1°C warmer in the wet season and 1.65°C warmer in the dry season compared with 1966. Weather patterns are also more

BLICKWINKEL/ALAMY

A golden-crowned spadebill (*Platyrinchus coronatus*)

extreme, with 13 per cent more rain falling in the wet season and 15 per cent less in the dry season, and the birds lost mass more sharply after extremely dry or wet seasons.

This could suggest that body mass loss is partly a short-term response to changes in their environment rather than entirely down to evolution. For instance, a lack of rainfall could cause a decline in the number of insects that the birds feed on, say the researchers.

But none of this can explain the team's other main finding. Wingspan has become significantly larger in one-third of the bird species over the past 40 years (*Science Advances*, doi.org/gnfxjr).

"Mass is a generally good index of body condition in birds," says Jirinec. "If they are simply not getting enough to eat, you would expect them to lose weight. But why would they have more energy to grow their wings?" ▮

Luke Taylor