He and his colleagues found that, during the fires, vast black plumes of smoke, rich in nutrients, were swept thousands of kilometres away over the ocean. Within days, these aerosols had infused the waters with much-needed iron, nourishing phytoplankton, which sucked up carbon equivalent to as much as 95% of the emissions from the fires.

The ocean achieves "an amazing sleight of hand — like a magician", says Bowman.

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NEW DARK ENERGY COULD SOLVE UNIVERSE EXPANSION MYSTERY

Traces of primordial form of the substance hint at why the cosmos is expanding faster than expected.

By Davide Castelvecchi

Cosmologists have found signs that a second type of dark energy — the ubiquitous but enigmatic substance that is pushing the Universe's expansion to accelerate — might have existed in the first 300,000 years after the Big Bang.

Two separate studies — both posted on the arXiv preprint server[1,2] — have detected a tentative first trace of this 'early dark energy' in data collected between 2013 and 2016 by the Atacama Cosmology Telescope (ACT) in Chile. If the findings are confirmed, they could help to solve a long-standing conundrum surrounding data about the early Universe, which seem to be incompatible with the rate of cosmic expansion measured today. But the data are preliminary and don't show definitively whether this form of dark energy really existed.

"There are a number of reasons to be careful to take this as a discovery of new physics," says Silvia Galli, a cosmologist at the Paris Institute of Astrophysics.

The authors of both preprints — one posted by the ACT team, and the other by an independent group — say that further observations from the ACT and another observatory, the South Pole Telescope in Antarctica, could provide a more stringent test. "If the early Universe really did feature early dark energy, then we should see a strong signal," says Colin Hill, a co-author of the ACT team's paper[1] who is a cosmologist at Columbia University in New York City.

Mapping the CMB

Both the ACT and the South Pole Telescope are designed to map the cosmic microwave background (CMB), primordial radiation sometimes described as the afterglow of the Big Bang. The CMB is one of the pillars of cosmologists' understanding of the Universe. By mapping subtle variations in the CMB across the sky, researchers have found compelling evidence for the 'standard model of cosmology'. This model describes the evolution of a Universe containing three primary ingredients: dark energy; dark matter, which is the primary cause of the formation of galaxies; and ordinary matter, which accounts for less than 5% of the Universe's total mass and energy.

Current state-of-the-art CMB maps were provided by the European Space Agency's Planck mission, which was active between 2009 and 2013. Calculations based on Planck data predict — assuming that the standard model of cosmology is correct — exactly how fast the Universe should be expanding now. But for the past decade or so, increasingly accurate measurements of that expansion, based on observations of supernova explosions and other techniques, have found it to be 5–10% faster[3].

Theorists have suggested a plethora of modifications to the standard model that could explain this difference. Two years ago, cosmologist Marc Kamionkowski at Johns Hopkins University in Baltimore, Maryland, and his collaborators suggested an extra ingredient for the standard model[4]. Their 'early dark energy' would be a sort of fluid that permeated the Universe before withering away within a few hundred thousand years of the Big Bang.

Early dark energy would not have been strong enough to cause an accelerated expansion, as 'ordinary' dark energy is currently doing. But it would have caused the plasma that emerged from the Big Bang to cool down faster than it would have otherwise. This would affect how CMB data should be interpreted — especially when it comes to measurements of the age of the Universe and its rate of expansion that are based on how far sound waves were able to travel in the plasma before it cooled into gas.

The two latest studies find that the ACT's map of the CMB's polarization fits better with a model that includes early dark energy than with the standard one. Interpreting the CMB on the basis of the early dark energy model and ACT data would mean that the Universe is now 12.4 billion years old, about 11% younger than the 13.8 billion years calculated using the standard model. Correspondingly, the current expansion would be about 5% faster than the standard model predicts — closer to what astronomers calculate today.

Hill says that he was previously sceptical about early dark energy, and that his team's

GIULIO ERCOLANI/ALAMY

The Atacama Cosmology Telescope in Chile.

findings surprised him. Vivian Poulin, an astrophysicist at the University of Montpellier in France and a co-author of the second study[2], says it was reassuring that his team's analysis agreed with the ACT team's own.

But Galli warns that the ACT data seem to be inconsistent with calculations by the Planck team, which she was part of. And although the ACT's polarization data might favour early dark energy, it is unclear whether another major set of data — its map of CMB temperatures — shows such a preference. It will be crucial to cross-check the results using the South Pole Telescope, she adds.

Wendy Freedman, an astronomer at the University of Chicago in Illinois, says that the ACT-based results are interesting, if preliminary. "It is important to pursue different models" and compare them with the standard one, she says.

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SWEDISH MISCONDUCT AGENCY SWAMPED WITH CASES IN FIRST YEAR

The newly formed government body investigated 46 cases in 2020 — 3 times more than expected.

By Holly Else

Scientists have inundated Sweden's new national research-misconduct investigation agency with cases, and there is no sign of a let-up in referrals.

Researchers brought 46 cases to the organization — called the National Board for Assessment of Research Misconduct (NPOF) and based in Uppsala — in its first year, according to a report detailing its activities in 2020. This caseload was three times higher than officials were expecting.

In most countries, universities and research institutions deal with misconduct allegations in-house, which can lead to some cases not being handled fairly or transparently. Sweden followed Denmark — the first country in the world to set up such an agency, in 2017 — in a bid to shake up research-fraud probes.

Research-misconduct specialists had warned that the nascent agency could be overwhelmed. They say that the high number of cases could be down to researchers feeling more comfortable about reporting suspicions to an independent agency than to their own institutions, as they did under the previous system.

Rebuilding trust

So far, investigations into 25 of the 46 cases have concluded, with 11 judged to be outside the agency's remit, 10 researchers acquitted and 4 researchers found guilty of misconduct. Last month, the researcher at the centre of the agency's first guilty verdict won her court appeal against the decision.

Sweden created the agency after trust in its science was shaken by the case of star surgeon Paolo Macchiarini, formerly at the prestigious Karolinska Institute in Stockholm. Macchiarini was eventually found guilty of misconduct relating to trials of an experimental trachea-transplant method, after being cleared by three in-house investigations that were later deemed to be flawed by an independent investigation commissioned by the institute.

Following the scandal, an inquiry led by Margaretha Fahlgren, a literature researcher at Uppsala University, suggested that Sweden establish a government body to handle allegations of serious research fraud — defined as fabrication, falsification or plagiarism — at publicly funded institutions. In 2019, parliament passed a law to define research misconduct and establish the NPOF. The agency began operating in January 2020.

> **"It's past time for the entire research ecosystem to attend to healthy lab cultures."**

In its first-year report, the NPOF said that 30 of the 46 cases it had investigated concerned medicine, health and natural sciences — although it received referrals from all research areas except agricultural science and veterinary medicine. The 46 cases included 56 incidents of alleged misconduct, with 10 relating to fabrication, 18 to forgery, 18 to plagiarism and 10 to other matters.

The organization handed down its first guilty verdict in September 2020, against biomedical scientist Karin Dahlman-Wright, former vice-president of the Karolinska Institute. She took up the post in the wake of the Macchiarini scandal, but stepped down in 2019 when misconduct allegations against her surfaced.

The NPOF found that Dahlman-Wright had committed research misconduct, with four of seven research papers investigated containing manipulated images. Dahlman-Wright denied the allegations, and appealed her case at the Administrative Court in Uppsala, which upheld her claim in August. Although the articles "contain images that do not correspond to the results that the images are said to show", the court said in a statement, it ruled that Dahlman-Wright had not been grossly negligent — an essential component of Sweden's definition of research misconduct.

The NPOF is preparing to appeal against this decision, and did not respond to *Nature*'s requests for a comment about the case. Dahlman-Wright also declined to comment.

Dahlman-Wright's appeal was one of two against guilty verdicts by the NPOF. A verdict is still awaited on the other appeal, in a case that involves 13 materials and nanotechnology researchers at Linköping University, who, the NPOF ruled, fabricated X-ray diffractograms in four research papers. The two other researchers found guilty of misconduct have not appealed, and any sanctions will be implemented by their institutions in accordance with the law, an NPOF representative told *Nature*.

Extra staff

Fahlgren, who sits on the NPOF board, says that many of the cases referred to the agency were the result of personal disputes, particularly between PhD students and their supervisors.

"This is an issue with the work environment — not misconduct — and we hope to communicate with universities about how to deal with this," says Fahlgren.

For 2021, the NPOF expects to receive a similar number of referrals as in 2020, and it has taken on another staff member to help to address the caseload.

C. K. Gunsalus, a research-integrity specialist at the University of Illinois at Urbana–Champaign, says that the referral figures in Sweden are consistent with what has been seen in the United States for many years. Awareness of responsible research standards and the idea that people are more comfortable taking concerns to an independent body, rather than their own institutions, could be behind the unexpectedly high number of referrals, she says.

"It's past time for the entire research ecosystem to attend to healthy lab cultures at the front end and to provide meaningful, safe and trusted ways to surface issues within institutions — as well as checks and balances for those systems," Gunsalus adds.