New Scientist

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that NIST are the ones in the room making the decisions, but if you don't believe us, there's no way you could verify that without being inside NIST," says Moody.

However, Bernstein alleges that NIST hasn't been open about the level of input by the NSA, "stonewalling" him when he has asked for information. As a result, he has made freedom of information requests and taken NIST to court, forcing it to reveal details of the NSA's involvement.

Documents released to Bernstein indicate that a group described as the "Post Quantum Cryptography Team, National Institute of Standards and Technology" included many NSA members and that NIST had met with someone from the UK's Government Communications Headquarters (GCHQ), the UK equivalent of the NSA.

Alan Woodward at the University of Surrey, UK, says there are reasons to be wary of encryption algorithms. For example, the GEA-1 code used in mobile phone networks during the 1990s and 2000s was found to have a flaw that made it millions of times less computationally intensive than it should have been to crack – although a culprit who put it there has never been identified.

But Woodward says that the current PQC candidates have been heavily scrutinised by academics and industry and haven't yet been found lacking, while other algorithms that featured in earlier stages of the competition have been demonstrated to be flawed and were eliminated.

"Intelligence agencies have a history of weakening encryption, but there's been such a lot of security analysis done on these candidates that I would be surprised if Kyber were somehow booby-trapped," he says. ▮

Space

Largest known solar storm struck Earth 14,300 years ago

Alex Wilkins

THE most powerful solar storm ever may have hit Earth 14,300 years ago, according to records preserved in Alpine tree trunks. It is unclear how much damage a similar storm might cause today, but electricity grids could theoretically be knocked offline for months and all satellites destroyed.

In 2012, Fusa Miyake at Nagoya University in Japan discovered evidence in tree trunks of very powerful solar flares – charged particles expelled from the sun that, along with magnetised plasma and gamma rays, make up solar storms. These flares, which date back many centuries, may have caused a spike in the level of a radioactive form of carbon in trees.

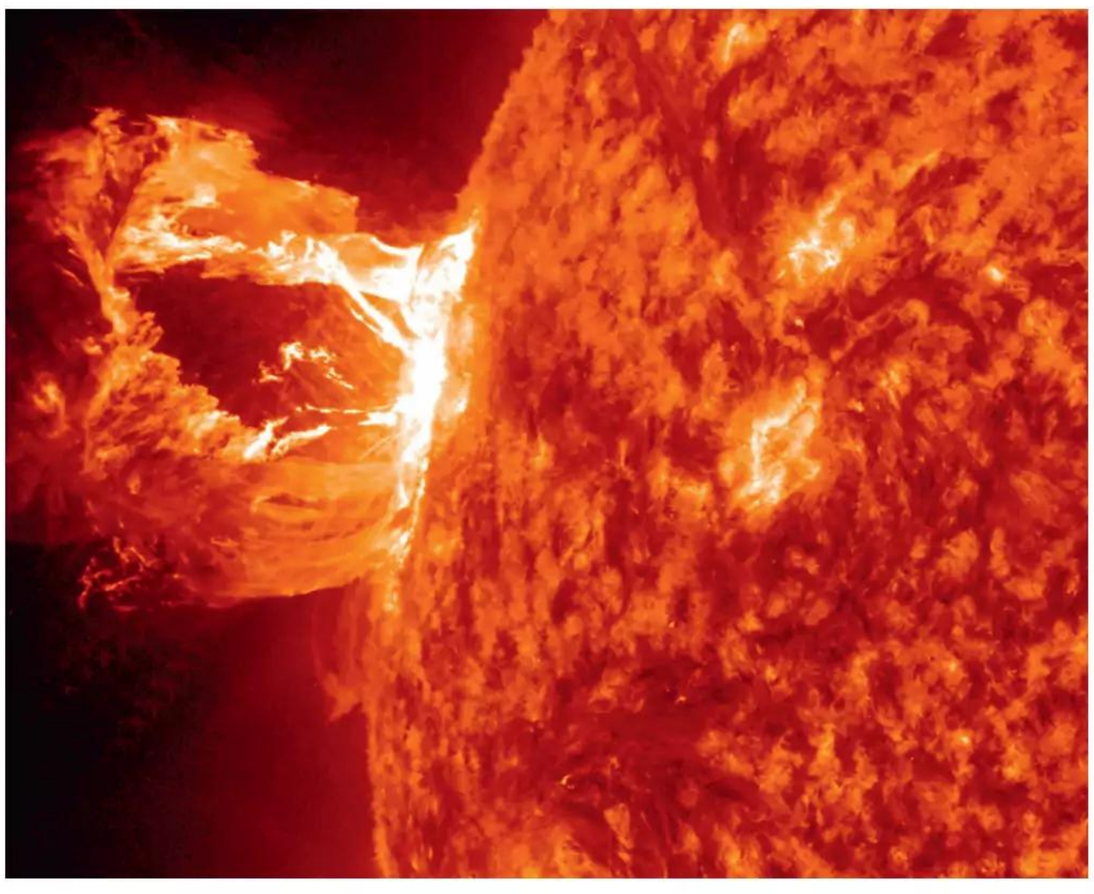
Since then, at least nine probable ancient solar storms, called Miyake events, have been discovered in this way.

Now, Tim Heaton at the University of Leeds, UK, and his colleagues have found evidence of a solar storm almost twice as large as the next largest Miyake event, in pine tree trunks in the southern French alps.

"We don't totally know what would happen if a similar storm happened today," says Heaton. "Some people think they would be absolutely catastrophic, cause huge, month-long blackouts to half the globe and destroy the solar panels on our satellites and put them permanently out of action." Other predictions suggest much less disruption, but there is a lot of uncertainty, says Heaton.

He and his team looked at 140 tree trunks buried in a bank of the Durance river in Provence. As the bank eroded, the trunks were exposed and the team could look for raised levels of carbon-14, a kind of carbon that has two more neutrons than normal and is produced by energetic particles hitting Earth's atmosphere.

By comparing the tree rings and constructing a timeline of when each tree lived, the researchers dated a huge spike in carbon-14 to 14,300 years ago.



NASA/SODATA/ALAMY

Large flares bursting out of the sun can cause solar storms

They also matched this spike to elevated levels of beryllium from Greenland ice cores, which is produced in a similar way to carbon-14 (*Philosophical Transactions of the Royal Society A*, doi.org/kxzh).

It is difficult to compare such a storm with anything in recorded history, says Heaton. The largest solar storm we have experienced, the Carrington event of 1859, sparked fires and induced currents in telegraph wires, but this one was so small compared with Miyake events that it wouldn't even register a blip in the radiocarbon record.

"Some people think these storms would be catastrophic, causing month-long blackouts"

While the 10 Miyake events known about over the past 15,000 years seem relatively infrequent, we don't know whether they occur with any sort of pattern. It is also unclear why the sun produces them. "They're not part of what people thought was the sun's potential behaviour," says Heaton. "We don't even really know whether they are a totally special behaviour of the sun or just the extreme ends of the more moderate solar storms that we see all the time."

"This is maybe the biggest [solar storm] we've seen in the past, but I think we've just scratched the surface," says Raimund Muscheler at Lund University in Sweden. The carbon-14 spike doesn't tell us about the gamma rays or plasma emitted during solar storms, though, he says, because carbon-14 is only produced from the sun's high-energy particles, such as protons. ▮