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Mystery of how lightning forms solved: Cosmic rays interacting with hail cause phenomenon, study claims

- Dutch researchers say they have an answer for how lightning begins
- Cosmic rays from supernovae are thought to strike ice particles in clouds
- This causes a short-circuit and produces the large flashes of lightning
- Scientists still aren't sure where exactly the discharges occur, though

By JONATHAN O'CALLAGHAN FOR MAILONLINE

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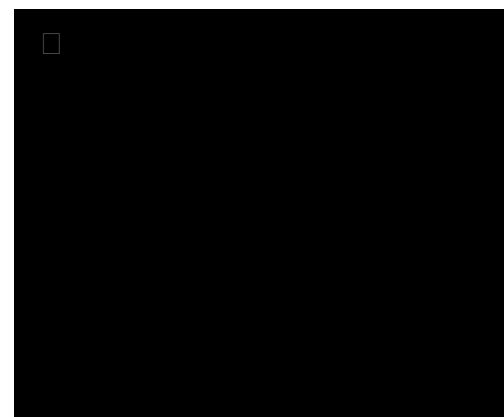
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The mystery of how lightning begins in clouds may have been solved, scientists have claimed.

Research has shown that the interaction of hail and cosmic rays from elsewhere in the universe could be causing the huge bolts.

The model also suggests that lightning is less likely to form at high altitudes.

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Dutch researchers say they have an answer for how lightning begins (stock image shown). Cosmic rays from supernovae are thought to strike ice particles in clouds. This causes a short-circuit and produces the large flashes of lightning. Scientists still aren't sure where exactly the discharges occur, though

How lightning begins has long been a mystery in lightning research.

The process that takes place is fairly clear: electric fields in thunderclouds are short-circuited, creating the huge flashes of light and energy, but how does this start?

Now, researchers at the National Research Institute for Mathematics and Computer Science (CWI) in Amsterdam, the University of Groningen and the University of Brussels say they have the answer.

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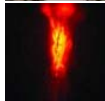
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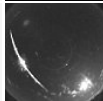
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They say it begins with large ice particles, or hydrometeors, forming in clouds.

These are caused by hailstones moving up and down in the turbulent air inside thunderclouds

When these ice particles grow in an elongated shape, about 2.4 inches (6cm) long, it focuses electric fields inside the cloud towards their tips.

This creates what is known as a 'conductive tube'.

Normally, there are too few free electrons in the surrounding air for anything to short-circuit these tubes and create lightning.

However, high-energy cosmic rays from supernovae, black holes and so on can generate large showers of free electrons.

If an electric field was created that was 10ft (three metres) high and 2.2 square feet (0.2 square metres) in size, just one air shower of particles formed from a single cosmic ray could create lightning by short-circuiting the tubes.

WHAT ARE COSMIC RAYS?

A long-standing puzzle in astrophysics is the source of ultra-high-energy particles from space that hit Earth.

Called cosmic rays, they're up to a billion times more energetic than particles at Cern's Large Hadron Collider.

They strike the atmosphere and cause an enormous shower of other particles, mostly muons, electrons and photons, over a wide area.

Though they were discovered decades ago, cosmic rays at these high energies are very rare, making it difficult to pinpoint where in the universe they originated.

It's thought that some come from supernovae, but it's likely there are other sources of cosmic rays in the universe as well.



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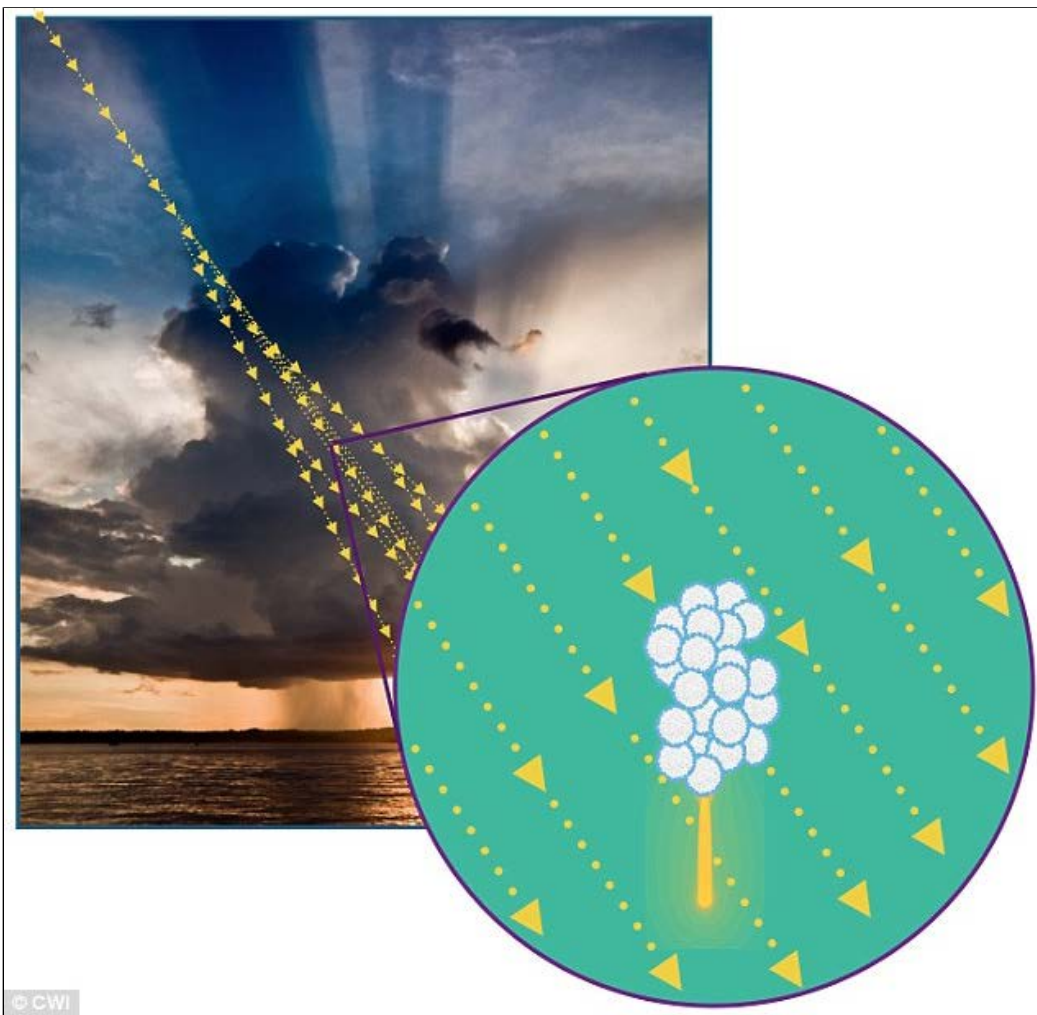
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When ice particles in thunderclouds grow in an elongated shape (illustrated), about 2.4 inches (6cm) long, it focuses electric fields inside the cloud towards their tips. High-energy cosmic rays can then cause a short-circuit in a resultant 'conductive tube' by creating a shower of particles

The model suggests that lightning at higher altitudes, above 7.5 miles (12km), is less likely to occur as the hydrometeors cannot reach the required length to make a big enough electric field.

'We now have all puzzle pieces in hand to understand the origin of lightning,' said Dr Ute Ebert, head of the Multiscale Dynamics research group at CWI and a professor at Eindhoven University of Technology.

'The start of lightning is highly complex because there are many processes unfolding at very different scales in space, time and energy.'

PhD student Casper Rutjes, who was involved in the research, said: 'These energetic particles really come from the far universe, such as protons from supernovae.'

'If the particle avalanche enters the high electric field of the hail point, one streamer discharge begins to grow and lightning starts.'

He added: 'So if you look at a thunderstorm, then you know that it is coming from a cosmic particle from outer space!'

Saved by the deckhand



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Cosmic rays strike the atmosphere and cause an enormous shower of other particles, mostly muons, electrons and photons, over a wide area. It's thought that some come from supernovae (illustration shown), but it's likely there are other sources of cosmic rays in the universe as well

The researchers noted that there were still plenty of questions remaining, such as where exactly the discharge occurs.

'Our institute is using data from large radio telescopes, like the Dutch Low Frequency Array LOFAR, to study lightning and increase our understanding of this phenomenon,' said Dr Olaf Scholten from the University of Groningen.

The **study** was published in the journal Physical Review Letters.

Read more:

[Physical Review Letters: Prediction of Lightning Inception by Large Ice Particles and Extensive Air Showers](#)

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