Could ferocious lightning storms on other planets beam radio signals to Earth?

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Ferocious lightning storms millions of times more powerful than those on Earth could be responsible for unexplained radio signals from planets orbiting other stars.

That is the finding of researchers from the University of St Andrews

School of Physics and Astronomy in a piece of work published today (25 April 2016).

In 2009 French astronomers observed what was thought to be a weak radio signal coming from the exoplanet HAT-P-11b, a "mini-Neptune" about five times bigger in size than the Earth and 26 times more massive. The following year the French team made an attempt to locate the signal again, but was unsuccessful leaving the phenomenon unexplained.

The St Andrews team set out to solve the mystery. Gabriella Hodosán, the Life, Electricity, Atmosphere, Planets (LEAP) Project PhD student leading the study said: "We assumed that this signal was real and was coming from the planet. Then we asked the question: could such a radio signal be produced by lightning in the planet's atmosphere, and if yes, how many lightning flashes would be needed for it?"

Assuming that the underlying physics of lighting is the same for all Solar System planets, like Earth and Saturn, as well as on HAT-P-11b, the researchers found that 53 lightning flashes of Saturnian lightning-strength in a km2 per hour would explain the observed radio signal on HAT-P-11b.

Dr Paul Rimmer, LEAP researcher and co-author of the paper, said: "Imagine the biggest lightning storm you've ever been caught in. Now imagine that this storm is happening everywhere over the surface of the planet. A storm like that would produce a radio signal approaching 1% the strength of the signal that was observed in 2009 on the exoplanet HAT-P-11b."

Miss Hodosán continued: "Such enormous thunderstorms are not unreasonable.

"Studies conducted by our group have also shown that exoplanets orbiting really close to their host star have very dynamic atmospheres, meaning that they change continuously, producing clouds of different sizes, even whole cloud systems, all over the planet's surface.

"HAT-P-11b, being so close to the star, is likely to have such a dynamic, cloudy atmosphere, which would allow the formations of huge thunderclouds, focusing the lightning activity to a certain regime of the planetary surface, such as the face of the planet, which was observed in 2009."

The team hoped that this intensity of lightning could be observed with optical telescopes but were thwarted by the powerful light emissions from the star around which HAT-P-11b orbits.

The process of lightning discharges involves plasma processes at very high temperatures and the release of a large amount of energy. This results in chemical reactions in the atmosphere that otherwise would not occur. These reactions produce molecules that can be used as lighting tracers.

The team considered whether such enormous thunderstorm clouds produce these tracer molecules, which then could be observed by Earth-telescopes, and suggested hydrogen cyanide (HCN) to be such a potential fingerprint of lightning. This molecule could be observable in the infrared spectral band, even years after the huge storm on HAT-P-11b would have occurred.

Miss Hodosán said: "In the future, combined radio and infrared observations may lead to the first detection of lightning on an extrasolar planet.

"The importance of the study is not just this prediction, but it shows an original scenario for the explanation of radio emission observable on extrasolar planets."

Dr Christiane Helling, the LEAP Project principal investigator, said: "With all necessary caution, linking extraterrestrial lightning and radio emissions will open a new window to prove the presence of atmospheres and of clouds on extrasolar planets, both being essential for the existence of life as we know it."

More information: Lightning as a possible source of the radio emission on HAT-P-11b. *MNRAS*, mnras.oxfordjournals.org/conte … jkey=4QdkEO09yQk8Mzg

Provided by University of St Andrews

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