New discovery at Jupiter could help protect Earth-orbit satellites

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Radio waves accelerate electrons within Jupiter's magnetic field in the same way as they do on Earth, according to new research published in *Nature Physics* this week. The discovery overturns a theory that has held sway for more than a generation and has important implications for protecting Earth-orbiting satellites.

Using data collected at Jupiter by the Galileo spacecraft, Dr Richard Horne of British Antarctic Survey (BAS) and colleagues from the University of California, Los Angeles, and the University of Iowa found that a special type of very low frequency radio wave is strong enough to accelerate electrons up to very high energies inside Jupiter's magnetic field.

According to lead author, Dr Richard Horne,

"We've shown before that very low frequency radio waves can accelerate electrons in the Earth's magnetic field, but we have now shown that exactly the same theory works on Jupiter, where the magnetic field is 20,000 times stronger than the Earth's and the composition of the atmosphere is very different. This is the ultimate test of our theory."

"On Jupiter, the waves are powered by energy from volcanoes on the moon Io, combined with the planet's rapid rotation – once every 10 hours. Volcanic gasses are ionized and flung out away from the planet by centrifugal force. This material is replaced by an inward flow of particles that excite the waves that in turn accelerate the electrons."

Understanding how electrons are accelerated will help scientists make better predictions of when satellites are at risk of damage by high-energy charged particles. These particles encircle the Earth in the Van Allen radiation belts and can damage satellites by causing malfunctions and degrading electronic components. However, the number of particles in the radiation belts can change dramatically within a few minutes, which is why more accurate forecasting is needed.

The discovery also has other scientific implications for Jupiter – it overturns a theory that has held sway for more than 30 years. According to Dr Horne,

"For more than 30 years it was thought that the electrons are accelerated as a result of transport towards Jupiter, but now we show that gyro-resonant wave acceleration is a very important step that acts in concert. Once the electrons are accelerated, they are transported closer to the planet and emit intense synchrotron radiation out into interplanetary space. Our theory provides the missing step to explain this high intensity radiation from Jupiter, which was first detected on Earth more than 50 years ago."

Source: British Antarctic Survey