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Press release **Immediate release**

HKU and UCLA Scientists Uncover the Mechanism powering "Space Battery" above Auroral Regions

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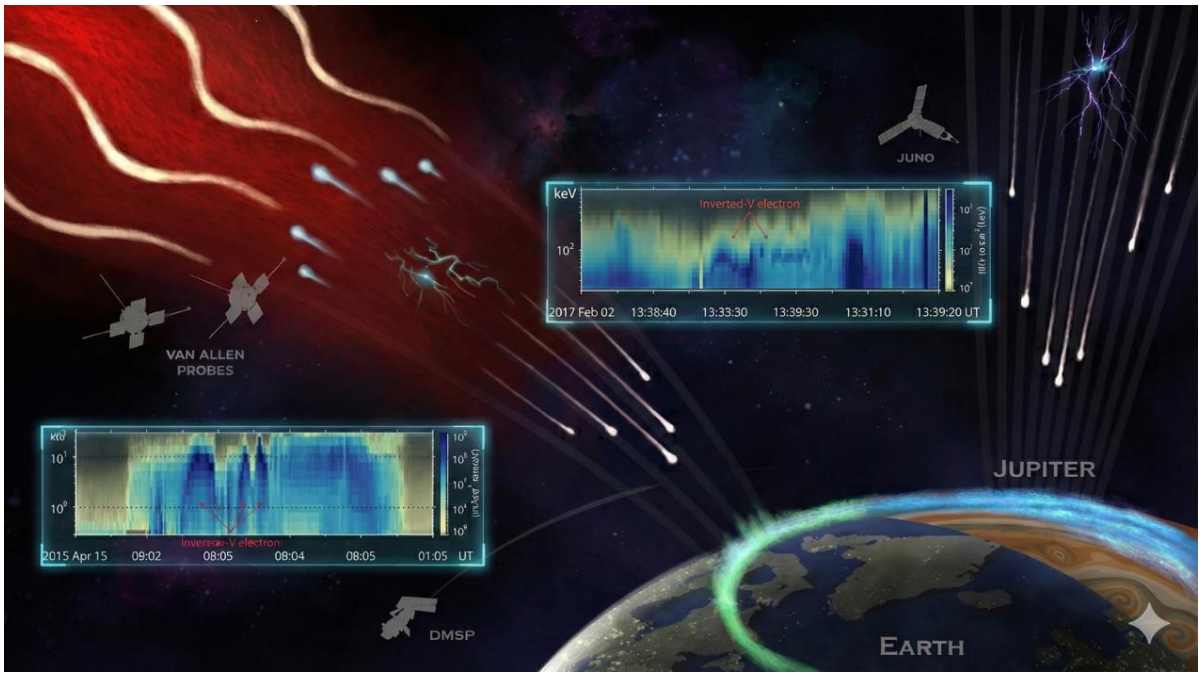

Comparative schematic of auroral acceleration processes on Earth and Jupiter. The electron spectrum for the Earth was from DMSP F19 spacecraft, and the one for Jupiter was from Juno spacecraft. Both spectra exhibit a similar inverted V-shaped structure, indicating the presence of stable electric potential drops above the auroral regions. This similarity points to a common auroral acceleration mechanism across planets and illustrates how insights from planetary aurorae help interpret high-resolution observations near Earth. Image credit: S. Tian and Z. Yao

The dazzling lights of the aurora are created when high-energy particles from space collide with Earth's atmosphere. While scientists have long understood this process, one big mystery remained: What powers the electric fields that accelerate these particles in the first place?

A new study co-led by the Department of Earth and Planetary Sciences at The University of Hong Kong (HKU) and the Department of Atmospheric and Oceanic Sciences at the University of California, Los Angeles (UCLA) now provided an answer. Published in *Nature Communications*, the research reveals that Alfvén waves — plasma waves travelling along Earth's magnetic field lines — act like an invisible power source, fueling the stunning auroral displays we see in the sky

By analysing how charged particles move and gain energy in different regions of space, the researchers demonstrated that these waves act as a natural accelerator, supplying energy that drives charged particles down into the atmosphere and produces the glowing auroral lights.

To confirm their findings, the team analysed data collected by multiple satellites orbiting Earth, including NASA's Van Allen Probes and the THEMIS mission. The data provided solid evidence that Alfvén waves continuously transfer energy to the auroral acceleration region, maintaining the electric fields that would otherwise dissipate.

"This discovery not only provides a definitive answer to the physics of Earth's aurora, but also offers a universal model applicable to other planets in our solar system and beyond," said Professor Zhonghua YAO of the Department of Earth and Planetary Sciences at HKU. Professor Yao leads a dedicated team in space and planetary science at HKU, which has established a reputation for high-impact research on planetary auroras.

With deep expertise in the magnetospheric dynamics of planets like Jupiter and Saturn, the HKU team brought a critical planetary perspective to the study. "Our team at HKU has long focused on the auroral processes of giant planets. By applying this knowledge to the high-resolution data available near Earth, we have bridged the gap between Earth science and planetary exploration." Professor Yao added.

The research represents a model of interdisciplinary collaboration. The UCLA team, led by Dr Sheng TIAN, contributed extensive expertise in Earth's auroral physics, while the HKU team provided the broader context of planetary space physics.

The full research paper can be read at: https://www.nature.com/articles/s41467-025-65819-4

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