How Auroras on Jupiter Provide an Interdisciplinary Lens to Investigate Heliophysics Science

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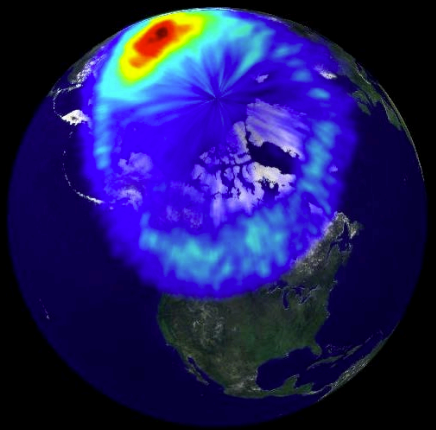
New images taken by the Hubble Space Telescope reveal captivating ultraviolet and x-ray auroras on Jupiter, which span an area larger than the size of our entire planet. Internal and external plasma sources enter into both Earth's and Jupiter's upper atmospheres and interact with each planet's magnetic fields to produce auroras. How these auroras are created varies greatly based on each planet's atmospheric composition, internal magnetic field strength and the collision chemistry between incoming plasma particles and the particles in each planet's atmosphere. Studying the two systems and applying what we know from one system to another can help us understand more about the strength of each auroral source. Investigating scientific mysteries through an interdisciplinary lens helps us see science from a whole systems approach, which in turn gives us important information about our own Earth-based systems.

On both Earth and Jupiter, auroras are created when high-speed plasma particles (electrons and ions), found in plasma streaming along the planet's magnetic fields, collide with atoms and molecules in each planet's atmosphere. The area influenced by each planet's magnetic field, or magnetosphere, acts as an invisible shield that protects it from the solar wind, the continuous stream of charged particles flowing out from the sun. The solar wind interacts with the magnetosphere by populating it with charged particles and energizing it, accelerating the co-mingled magnetospheric and solar wind particles to such an extent that they precipitate down into a planet's atmosphere. These particles are funneled down by way of the magnetic North and South Poles, which is why auroras are predominately visible in these areas. What we observe as auroras occur after the plasma particles collide with atmospheric particles, and energized photons in the form of light are released as they return to their normal states. Aurora are created by the interaction between the solar wind and the magnetosphere, as well as by magnetospheric processes. Jupiter's moons also contribute to the formation of its auroras, especially its volcanic moon, Io.

Although auroras occur on both our home planet and Jupiter, Jupiter's auroras are hundreds of times more powerful than ours and as such are not visible to the naked eye as they lie in the UV and x-ray portions of the light spectrum. The brilliant auroral displays in Jupiter's atmosphere observed by NASA satellites are a result of incoming oxygen and sulfur ions, moving at nearly the speed of light. Scientists from JAXA wanted to know why these ions moved so fast. They used data collected from NASA's Chandra X-Ray Observatory and concluded that the solar wind contributed to the fast acceleration of these ions, causing them to appear in the x-ray spectrum. On Earth we are able to monitor the solar wind and magnetosphere to study what causes auroras thanks to missions within the Heliophysics System Observatory, such as the ACE, Magnetospheric Multi-Scale (MMS), Van Allen Probes, THEMIS missions. Our understanding from the Heliophysics Systems Observatory helps support the Planetary Science Division's Juno Mission, which successfully entered Jovian orbit on Independence Day of this year, to better compare and contrast the magnetospheric and atmospheric interactions on both planets.



As different as our two planetary bodies are, observing the brilliant and beautiful auroras on Jupiter is a reminder of something we enjoy and admire here on Earth. Something we can learn from and something that connects us back home.

Top left image credit: NASA Hubble Space Telescope. Above image credit: NASA Heliophysics Polar mission (2000) .