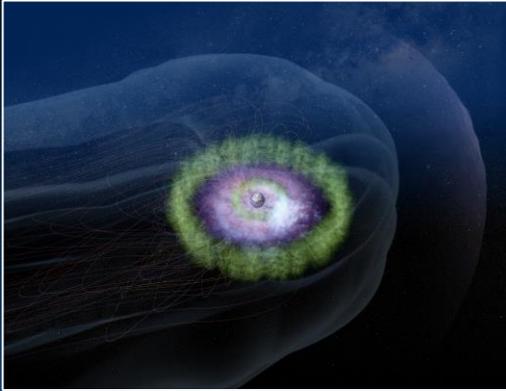


# Finding the Origin of Energetic Particles in Near-Earth Space with the NASA Heliophysics Magnetospheric Multiscale Mission



Although extremely powerful, the Sun does not produce many energetic charged particles. However, lower energy particles originating from the Sun (and Earth) can be energized through multiple processes by the Earth's magnetic field. As such, energetic particles are primarily found within the region of space dominated by the Earth's magnetic field, known as the "magnetosphere." Despite this fact, energetic particles are still commonly found outside of the magnetosphere. This raises questions as to where these particles come from and how they get there.

New research using data from NASA's Magnetospheric Multiscale Mission, or MMS, has found an answer to this puzzle.

*An artist's depiction of **Earth's magnetosphere** is shown in the image above. The green circle indicates Earth's outer radiation belt, which is one area of the magnetosphere that houses energetic particles.. Credit: NASA.*

A group led by Ian Cohen of John Hopkins University Applied Physics Laboratory in Laurel, Maryland, studied 238 events observed by MMS to put together a statistical analysis of how particles are being energized. They looked specifically at a region of the magnetopause — the edge of the region around Earth under the influence of the planet's magnetic field — which was on the dayside of Earth, one area of focus during MMS's prime mission.

Their results, accepted for publication in the *Journal of Geophysics Research* found that energetic electrons observed just outside of the magnetopause originated within the region dominated by Earth's magnetic field. **The electrons were then accelerated during magnetic reconnection** — an event where entangled magnetic field lines from Earth and the Sun become reconfigured. As the field lines reorient themselves, they create portals for the energetic particles to escape across the magnetopause, and can boost the particles' energies in the process.



***Earth's magnetopause/magnetosheath region** is the boundary region between the magnetosphere, which is an extension of Earth's magnetic field, and the interplanetary magnetic field. This region is indicated in purple in the image above. Credit: NASA.*

**The results from this study** were possible due to **MMS's unique orbit** in Phase 1a that carried it through areas of possible reconnection in the day side magnetopause. Now in Phase 2 of its mission, MMS has swung into a larger orbit, which will take it through reconnection regions on the night side of Earth. This orbit will allow scientists to compile a more complete a global picture of energetic particle phenomena surrounding Earth.

