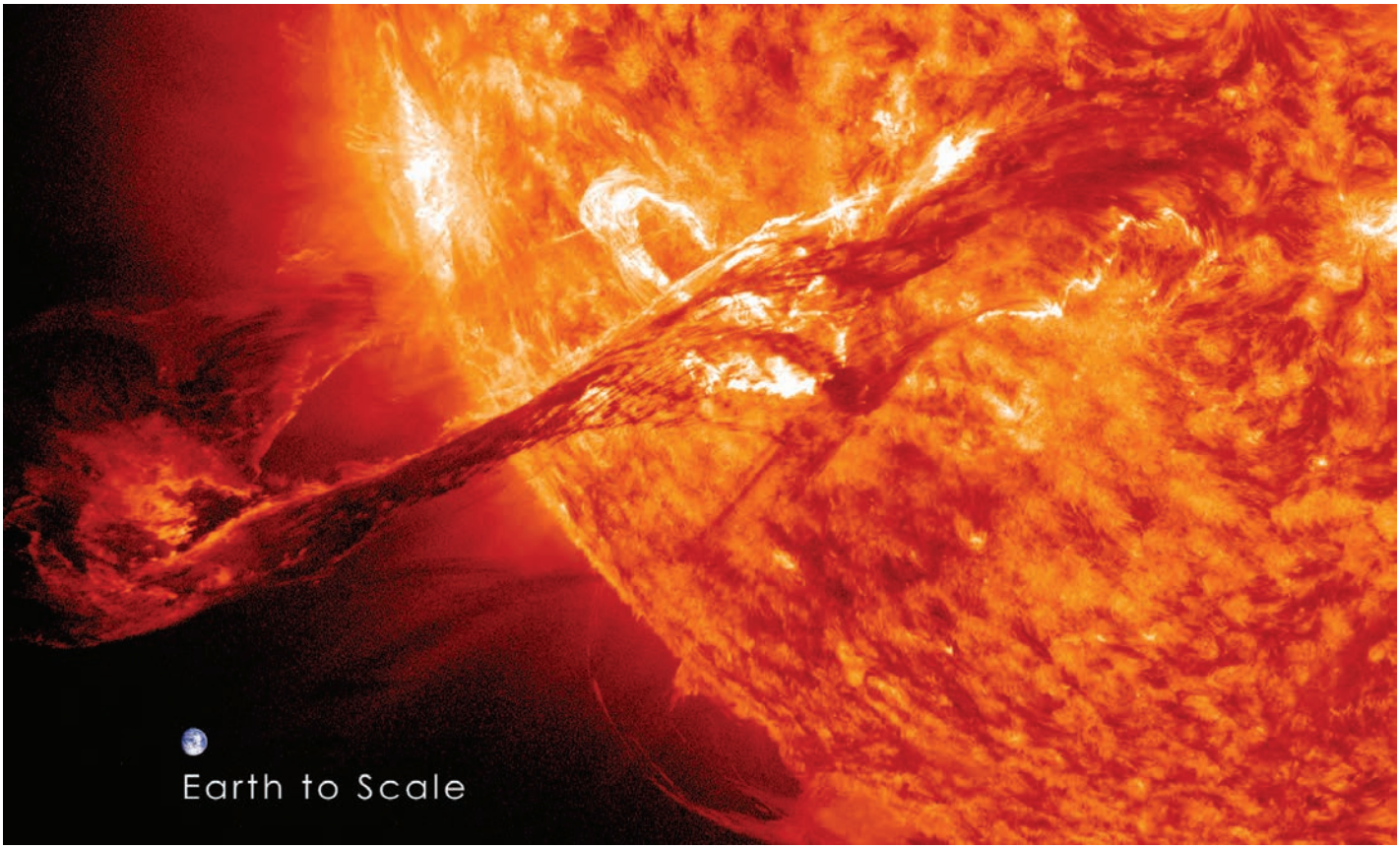
VOL. 105 | NO. 11
NOV–DEC 2024

Eos

SCIENCE NEWS BY AGU

AGU
ADVANCING EARTH AND SPACE SCIENCES

Coronal Mass Ejection Gives Earth's Magnetosphere Rare "Wings"



A coronal mass ejection (CME) in April 2023 caused Earth to grow Alfvén wings. The CME shown in this image, with Earth illustrated to scale, took place in 2021. Credit: NASA/GSFC/SDO

Like a supersonic jet being blasted with high-speed winds, Earth is constantly being bombarded by a stream of charged particles from the Sun known as solar wind.

Just like wind around a jet or water around a boat, these solar wind streams curve around Earth's magnetic field, or magnetosphere. On the sunward side of the magnetosphere, they form a front called a bow shock, and on the nightside, they stretch into a windsock shape with a long tail.

Dramatic changes to solar wind alter the structure and dynamics of the magnetosphere. An example of such changes provides a glimpse into the behavior of other bodies in space, such as Jupiter's moons and extrasolar planets.

Chen et al. report unprecedented observations of a rare phenomenon created during a coronal mass ejection (CME). CMEs typically travel faster than the Alfvén speed, at which vibrating magnetic field lines move through magnetized plasma, which can vary with the plasma environment. A CME in 2023 disrupted the normal configuration of Earth's magnetosphere for about 2 hours. The researchers analyzed observations from NASA's Magnetospheric Multiscale (MMS) Mission to learn what occurred.

On 24 April 2023, the MMS spacecraft observed that though the streaming speed of the solar wind was fast, the Alfvén speed during the strong CME was even faster. This anomaly caused Earth's bow shock to temporarily disappear, allowing the plasma and magnetic field from the Sun to interact directly with the magnetosphere. Earth's wind sock tail was replaced by structures called Alfvén wings that connected Earth's magnetosphere to the recently erupted region of the Sun. This connection acted as a highway transporting plasma between the magnetosphere and the Sun.

This unique CME event offered new insights into how Alfvén wings form and evolve, the authors write. A similar process could occur around other magnetically active bodies in our solar system and universe, and the researchers' observations suggest that the formation of aurorae on Jupiter's moon Ganymede may also be attributable to Alfvén wings. The authors suggest that future work could look for similar Alfvén wing aurorae occurring on Earth. (*Geophysical Research Letters*, https://doi.org/10.1029/2024GL108894, 2024) **—Nathaniel Scharping,** *Science Writer*