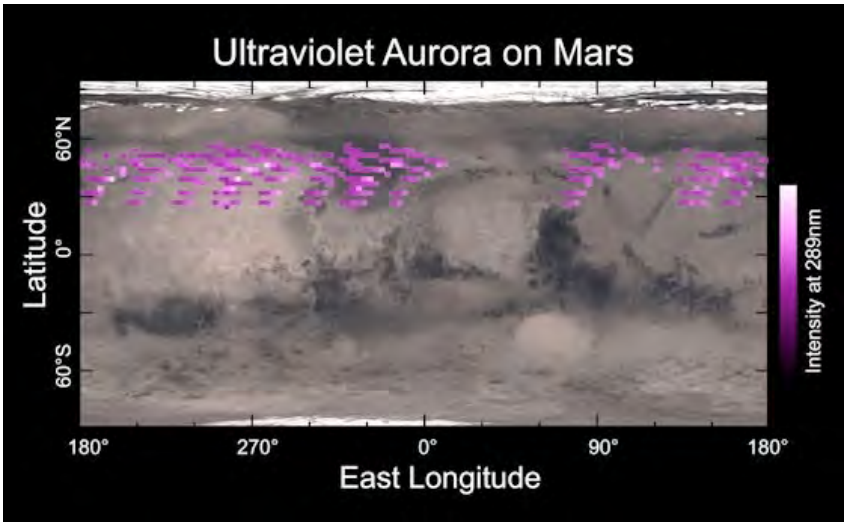
AURORAS ON MARS

One day, when humans go to Mars, they might find that, occasionally, the Red Planet has green skies.

In late Dec. 2014, NASA's MAVEN spacecraft detected evidence of widespread auroras in Mars's northern hemisphere. The "Christmas Lights," as researchers called them, circled the globe and descended so close to the Martian equator that, if the lights had occurred on Earth, they would have been over places like Florida and Texas. Auroras on Mars appear to be more wide ranging than imagined.



A map of MAVEN's Imaging Ultraviolet Spectrograph (IUVS) auroral detections over a 5-day period in December 2014, overlaid on Mars' surface. The map shows that the aurora was widespread in the northern hemisphere, not tied to any geographic location.

This isn't the first time a spacecraft has detected auroras on Mars. Ten years ago, the European Space Agency's Mars Express found an ultraviolet glow coming from "magnetic umbrellas" in the southern hemisphere. Unlike Earth, Mars does not have a global magnetic field that envelops the entire planet. Instead, Mars has umbrella-shaped magnetic fields that sprout out of the ground like mushrooms, here and there, but mainly in the southern hemisphere. These umbrellas are remnants of an ancient global field that decayed billions of years ago.

Auroras occur, both on Earth and Mars, when energetic particles from space rain down on the upper atmosphere. On Earth, these particles are guided toward the poles by our planet's global magnetic field. That's why auroras are seen most often around the Arctic and Antarctic. On Mars, there is no organized planetary magnetic field to guide the particles north and south—so they can go anywhere, and the particles seem to precipitate into the atmosphere anywhere they want, Magnetic fields in the solar wind drape across Mars, even into the atmosphere, and the charged particles just follow those field lines down into the atmosphere.

According to the MAVEN data, solar particles that caused the "Christmas lights" penetrated deeply into the Martian atmosphere---sparking auroras less than 100 km from the surface. That's lower than auroras on Earth, which range from 100 km to 500 km high. Although the Martian atmosphere is primarily CO_2, it does contain some free oxygen – and that is key to the colour of the auroras. Excited oxygen atoms in the Martian atmosphere would likely produce green light.

MAVEN arrived at Mars in Sept. 2014 on a mission to investigate a planetary mystery: Billions of years ago, Mars was blanketed by layer of air massive enough to warm the planet and allow liquid water to flow on its surface. Life could have thrived in such an environment. **Today, however, only a tiny fraction of that ancient air remains, leaving Mars a desiccated wasteland. Where did the Martian atmosphere go?** A favourite theory is solar wind erosion. Because Mars no longer has a global magnetic field to protect it, solar wind might strip away material from the upper layers of the atmosphere. Watching the auroras could help MAVEN mission scientists learn more about this process.

MAVEN happened to be at Mars when comet Siding Spring passed the Planet within 130,000km in October last year. Its remote-sensing Imaging Ultraviolet Spectrograph observed intense ultraviolet emission from magnesium and iron ions high in the atmosphere in the aftermath of the meteor shower. The emission dominated Mars' ultraviolet spectrum for several hours after the encounter and then dissipated over the next two days. **Sampling the comet dust it found eight different types of metal ions, including sodium, magnesium and iron.** These are the first direct measurements of the composition of dust from an Oort Cloud comet. The Oort Cloud, well beyond the outer-most planets that surround our sun, is a spherical region of icy objects believed to be material left over from the formation of the solar system. AK from NASA Notes