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Low-Altitude Magnetic Topology with MAVEN SWEA and MAG

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The Solar Wind Electron Analyzer (SWEA) and Magnetometer (MAG) onboard the MAVEN spacecraft measure electron pitch angle and energy distributions at 2-second resolution (∼8 km along the orbit track) to determine the topology of magnetic fields from both external and crustal sources. Electrons from different regions of the Mars environment can be distinguished by their energy distributions. Thus, pitch angle resolved energy spectra can be used to determine the plasma source regions sampled by a field line at large distances from the spacecraft. From 12/1/2014 to 2/15/2015, when periapsis was at high northern latitudes, SWEA observed ionospheric photoelectrons at low altitudes (140-200 km) and high solar zenith angles (120-145 degrees) on ∼35% of the orbits. Since this electron population is unambiguously produced in the dayside ionosphere, these observations demonstrate that the deep Martian nightside is at times magnetically connected to the sunlit hemisphere. The BATS-R-US Mars multi-fluid MHD model suggests the presence of closed crustal magnetic field lines over the northern hemisphere that straddle the terminator and extend to high SZA. Simulations with the SuperThermal Electron Transport (STET) model show that photoelectron transport along such field lines can take place without significant attenuation. Precipitation of photoelectrons onto the night-side atmosphere should cause ionization and possibly auroral emissions in localized regions. On one orbit, the O_2+ energy flux measured by STATIC correlates well with precipitating photoelectron fluxes.