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Auroral ionization patches on the nightside of Mars

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The MARSIS (Mars Advanced Radar for Subsurface and Ionospheric Sounding) instrument on board the Mars Express spacecraft regularly observes localized areas of enhanced ionization on the Martian nightside(SZA $>$105º). These enhancements appear near regions having residual crustal magnetic field. The isolated patches of ionization typically have electron densities of 5x10^4 e/cm^3 with the peak observed density being 1.8x10^{5}e/cm^3. In the vicinity of the density features ASPERA ELS observes heated electrons. Using a model of the Martian magnetic field we are able to map enhanced electron fluxes measured at the spacecraft by the ASPERA instrument to specific ionized areas detected remotely by radar sounding. These areas are located at cusps of the magnetic field at altitudes of $\sim$127 km. In the strongest magnetic field region MARSIS is able to detect the depleted density cavity caused by plasma being excluded from regions of closed field lines, both by directly measuring the local density during ionospheric sounding, and by measuring the column total electron content during subsurface sounding.