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# Solar control of ionospheric absorption of low frequency radar reflections from the surface of Mars

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Using the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) instrument aboard the Mars Express spacecraft over a period of ninety days, we identify five discrete time intervals when the radar signal reflected from the surface of the planet is strongly absorbed by the ionosphere. By using data from the Gamma-Ray Spectrometer (GRS) on the Mars Odyssey spacecraft, the Electron Reflectometer on the Mars Global Surveyor spacecraft, and x-ray measurements from the GOES-12 spacecraft, we show a clear correlation between the loss of the surface reflection signal and increases in solar proton fluxes in the energy range of a few tens of MeV and x-ray fluxes at wavelengths of 1 to 8 Å. The periods of absorption coincide best with periods of enhanced fluxes of solar protons, although for certain short-lived periods the signal loss appears to be best explained by increases in x-ray flux. We conclude that ionization caused by solar energetic particles and x-rays has a significant effect on radio wave absorption in the Martian ionosphere.