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Ion cyclotron waves around Mars: observations and simulations

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Ion cyclotron waves are generated during the interaction between the solar wind and the Martian exosphere. When the atmospheric neutrals are ionized in the solar wind, the fresh ions are accelerated by the electric field and gyrate around the magnetic field in the solar wind, in a process called ion pick-up. In the meanwhile, ion cyclotron waves grow from the free energy of the largely anisotropic distribution of these fresh ions, with left-handed polarization and a wave frequency near the ion's gyrofrequency. Observations of the ion cyclotron waves enable us to study the atmospheric loss due to solar wind pick-up process. At Mars, the exospheric hydrogen is picked up by the solar wind and produces proton cyclotron waves. The Mars Global Surveyor detected proton cyclotron waves which extend from the magnetosheath of Mars to over 12 Mars radii with amplitudes that vary slowly with distance. A hybrid simulation is applied to study the wave generation and evolution due to solar wind pick-up to try to understand the relation between the wave energy and pickup rate. By comparing the wave observations and the hybrid simulation results, we hope better understand the hydrogen exosphere configuration and the loss of water from Mars.