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# Observational, theoretical and simulation studies on EMIC waves generated by fast shocks in the magnetosphere and solar wind

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Electromagnetic ion cyclotron (EMIC) waves are often observed in the magnetosphere and solar wind. We present a series of simulation study on the generation of hydrogen, helium and oxygen EMIC waves associated with fast magnetosonic shocks in the magnetosphere and in the solar wind. In the magnetosphere, these shocks can be associated with either dynamic pressure enhancement or shocks in the solar wind and can lead to the formation of a “bunch” distribution of O+ ions in the perpendicular velocity phase space. The O+ bunch distribution can excite strong He+ EMIC waves and weak O+ and H+ waves. The dominant He+ EMIC waves are strong in quasi-perpendicular propagation and show the presence of harmonics in the frequency spectrum of Fourier analysis.

On the other hand, in the solar wind, the generation of EMIC waves is widely discussed. Strong fast magnetosonic shocks are often observed in the solar wind. In the shock downstream region, the hydrogen and helium ions are strongly heated to achieve high ion beta and high temperature anisotropy, leading to efficient generation of EMIC waves and mirror mode waves in the downstream region. These wave modes are often identified in satellite observations. The EMIC waves in the simulation are found to grow both in the parallel and quasi-perpendicular direction. We also find coalescence of mirror waves as they drift with the plasma to further downstream region.

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