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Recent progress in the wave-particle interaction in the inner magnetosphere and associated M-I coupling

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The wave-particle interaction is an important candidate for the energy coupling between the inner magnetosphere and ionosphere. In this report, we show our recent progress in wave-particle interaction in the inner magnetosphere and the influence of associated precipitating energetic ions/electrons on the sub-auroral ionosphere with conjugate observations of satellites and ground-based instruments. We have shown the in situ evidence of the modification of the parallel propagation of EMIC waves by heated He+ ions. With observations of Cluster satellites, we have revealed the different mechanisms of energetic ions scattered into the loss cone in the plasma sheet and the plasmaspheric plumes. We have also displayed the excitation of oblique O^+ band EMIC waves in the inner magnetosphere driven by hot H^+ with ring velocity distributions. With observations of Van Allen Probe, we have shown fine structured multiple-harmonic electromagnetic emissions at frequencies around the equatorial oxygen cyclotron harmonics outside the core plasmasphere off the magnetic equator during a magnetic storm. In addition, we also display the modulation of fast magnetosonic waves by the background plasma density. Finally, we report an interesting case that background plasma density modulated the lower cutoff frequency of chorus emissions from above 0.1 f_{ce} (typical ordinary chorus) into 0.02 f_{ce} (extremely low-frequency chorus).