
ABSTRACTS (MASTER THESIS)

Relativistic acceleration of protons by EMIC waves in Jovian magnetosphere

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We perform test particle simulations of interactions between protons and a coherent electromagnetic ion cyclotron (EMIC) wave around Jupiter. Simulation results indicate that non-relativistic protons are trapped and accelerated by the EMIC wave. We also simulate the motion of relativistic protons interacting with the EMIC wave. The results show that the relativistic protons are accelerated by the EMIC wave with very high efficiency compared with the case of non-relativistic protons. We find two characteristics from the simulation results. First, the gyro-phases of the protons with low equatorial pitch angles are bunched together and almost all of the protons are trapped. We reveal that the cause of phase bunching is the Lorentz force generated by the wave magnetic field and protons. Our simulations show that the effect of phase bunching becomes stronger when the amplitude of the EMIC wave is larger or the pitch angles of protons are low. Second, the direction of the trapped relativistic protons reverses, causing a long-time acceleration process. In the process, since the Lorentz factor increases, the resonance condition changes. Therefore, parallel motion of resonant protons changes from opposite direction to the same direction of wave propagation, resulting in longer trapping. We confirm that this process is the same as the Relativistic Turning Acceleration (RTA) process of electrons interacting with whistler mode waves. We find that the further the turning point is from the equator, the more efficient the RTA process is. Moreover, the acceleration efficiency of the RTA process increases when the amplitude of the EMIC wave is large.