

# Dynamics of energetic protons interacting with electromagnetic ion cyclotron waves

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We perform simulations of non-relativistic protons interacting with EMIC waves in the Earth's magnetic field. We find that the non-relativistic protons are trapped and accelerated by waves. We also perform simulations of the motion of relativistic protons in the Jovian magnetic field. We find highly efficient acceleration of the protons by the EMIC waves. The efficiency is greater than that at the Earth. In this acceleration process, the direction of proton velocity along the magnetic field is reversed. We observe that this acceleration process is quite similar to the acceleration process of relativistic electrons by whistler-mode chorus waves, called Relativistic Turning Acceleration (RTA). We modify the nonlinear trapping theory for the relativistic proton case. We confirm that our results satisfy the theoretical conditions for RTA.