

## Nonlinear Trapping Conditions of relativistic electrons interacting with whistler-mode chorus emissions at oblique angles

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We have derived explicit formulae of inhomogeneity factors controlling the nonlinear trapping conditions for Landau and cyclotron resonances to analyze nonlinear wave trapping and associated acceleration of energetic electrons by an obliquely propagating chorus element generated at the magnetic equator. In evaluating the frequency sweep rate of the chorus element as observed at fixed positions, we assumed the quasi-parallel propagation. We find efficient acceleration of relativistic electrons by nonlinear trapping at Landau resonance with obliquely propagating whistler-mode chorus emissions. The acceleration is due to the perpendicular component of the wave electric field rather than the parallel electric field. We performed test particle simulations to confirm that nonlinear wave trapping by both Landau and cyclotron resonances can take place for a wide range of energies, resulting in efficient acceleration of relativistic electrons.

### Reference:

Omura, Y., Hsieh, Y.-K., Foster, J. C., Erickson, P. J., Kletzing, C. A., & Baker, D. N. (2019). Cyclotron acceleration of relativistic electrons through Landau resonance with obliquely propagating whistler-mode chorus emissions. *Journal of Geophysical Research: Space Physics*, 124, 2795&#8211;2810. <https://doi.org/10.1029/2018JA026374>