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Simulation study on alpha-driven localized cyclotron modes in nonuniform magnetic field[1] KUAN-REN CHEN, TSUNG-HUA TSAI, National Cheng Kung University, Tainan, Taiwan, LIU CHEN, University of California, Irvine, CA. — Resonance is a fundamental issue in science and requires precise synchronization. As an ion version of cyclotron maser, relativistic ion cyclotron instability is driven by fusion produced MeV ions whose Lorentz factor is very close to unity. Cyclotron maser requires a small positive frequency mismatch between the wave and the harmonic cyclotron motion of fast particles. Thus, it is generally believed that it can not survive the nonuniformity of magnetic field such as in realistic devices. However, our simulations have shown that localized cyclotron waves are excited when the magnetic field is with a sinusoidal nonuniformity much larger than the frequency mismatch required. This indicates that resonance is a consequence of the need to drive instability for dissipating free energy and increasing the entropy. When a favorable wave eigen-frequency is collectively decided in a coherent means, a special wave form in real space is created for this purpose, even without boundary. Furthermore, the results also indicate that the wave eigen-frequency found can be lower than the local harmonic cyclotron frequency. The simulation results are compared with the analytical results from a perturbation theory.

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