相対論的アルフヴェン波の非線形発展に伴う粒子加速

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Particle acceleration in developing relativistic Alfven turbulence

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A new particle acceleration process in developing Alfvenic turbulence in a relativistic pair plasma is investigated by utilizing one-dimensional full particle simulation. The developing turbulence is formed in the course of parametric instabilities of a large amplitude circularly polarized Alfven wave which is universally present in space and astrophysical environments. When amplitude of a parent wave becomes large as same as the ambient magnetic field, rapid spectral (inverse) cascade occurs through successive decay instabilities. During the successive instabilities, some particles are efficiently accelerated to relativistic energies through coherent wave-particle interactions leading to a power-law-like energy distribution function. It is observed in the simulation that high-energy particles having large relativistic masses are preferentially accelerated as the turbulence spectrum evolves in time. The mechanism of the acceleration is simultaneous relativistic resonance between a particle and two different waves.