Geophysical Research Abstracts, Vol. 7, 08245, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08245

Acceleration of charged particles by gyro-resonant surfing at quasi-parallel shocks

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We discuss an acceleration mechanism of charged particles by magnetohydrodynamic (MHD) structures, such as quasi-parallel shocks and short-large amplitude magnetic structures (SLAMS). In the presence of electromagnetic waves and an electrostatic electric field, particles are accelerated efficiently in the perpendicular direction to the background magnetic field owing to the combination of two effects, the trapping of particles by the wave and the dragging by the electrostatic field to keep the resonance condition. This allows particles to propagate downstream even when they initially have smaller kinetic energy than the potential. We show fundamental properties of this mechanism that is referred to as gyro-resonant surfing.