§24. Particle Acceleration in Magnetic Field Reconnection

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To examine an effective acceleration of particles to very high energy, we propose a kinetic model of non-steady magnetic field reconnection [1]. The model of the two colliding plasmas is shown in Fig.1.

Since each plasma has an anti-parallel component of magnetic field B_z, the magnetic-null region or the magnetic neutral sheet is created by adding two fields of plasmas.

Particles located near the magnetic neutral sheet are effectively accelerated in the x direction as shown in Fig.2. Gains of such particles increase linearly as time elapses, however they become saturate sooner or later on the way of acceleration. While, another particles exit from the neutral sheet and drift along the magnetic field with gyrating motions.

A handy type of optimal energy gain is approximately given by

$$G_{\mathrm{opt}} = 1200 B_0(\mathrm{G})\lambda(\mathrm{cm})\ \mathrm{eV}$$

where B_0 is the magnitude of magnetic field and λ is the half width of the neutral sheet.

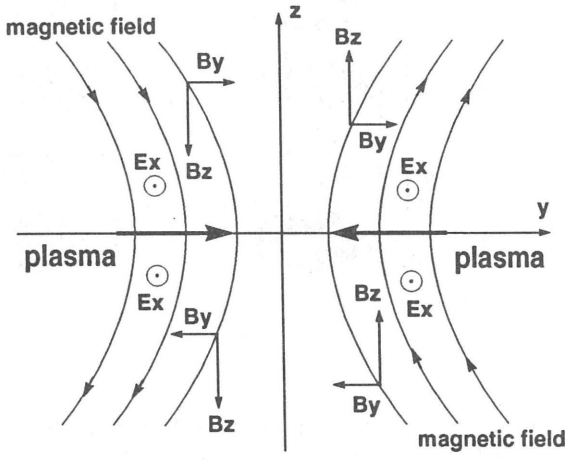

Fig.1 A kinetic model of the magnetic field reconnection.

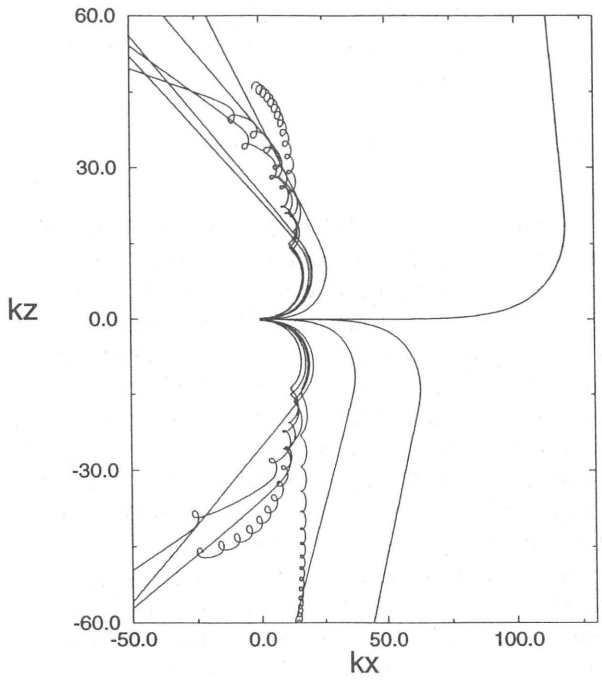

Fig.2 Particle trajectories on the xz plane.

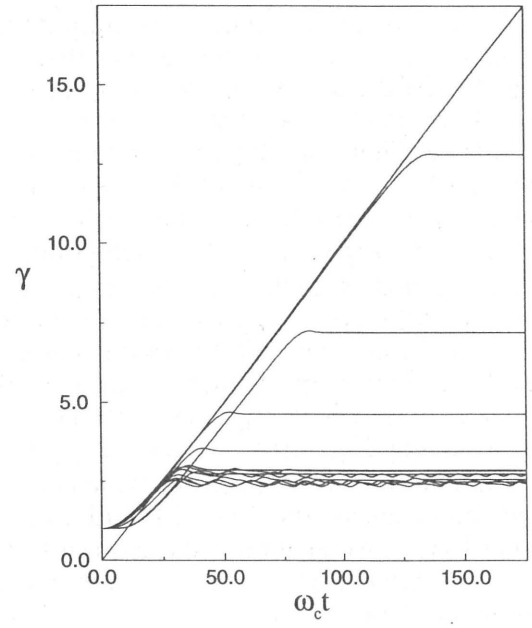

Fig.3 Time evolution of gains of particles.

References

[1] S.Takeuchi: Porc. of Kofu Symposium *New Look at the Sun with Emphasis on Advanced Observations of Coronal Dynamics and Flares, ed. S.Enome and T.Hirayama*, NRO Report No. 360 (1994) pp.251-254.