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Three-dimensional asymmetric magnetic reconnection

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A kinetic model of asymmetric magnetic reconnection in three-dimensional space is analyzed theoretically and with numerical calculations. Consider the case where the two magnetized plasmas are colliding each other; for example suppose that the plasma shock is propagating through the uniform background plasma.

In order to provide a clear understanding of the magnetic reconnection presented here, we show a simple representation of the model with the cartoon in Fig.1. *PlasmaA* is the stationary plasma whose magnetic field is given by B_1. *PlasmaB* is propagating with the velocity v_s in the positive y direction. The electric field of this plasma is given by $E_2=(v_s/c)B_2$ (c being the velocity of light). The magnitude of the field is smaller than that of the field B_1, i.e., $B_1 < B_2$. The crossing angle is defined as the angle between the fields B_1 and B_2. This angle plays an important role in generating the magnetic neutral sheet. If the crossing angle is greater than a right angle, then the magnetic neutral sheet is created in front of the shock. The resonant particle interacting with the shock is trapped by the neutral sheet. Accordingly such the particle is accelerated by the electric field E_2 in the neighborhood of the neutral sheet. If the angle is nearly equal to a right angle, the direction of the acceleration is almost the same as the direction of the magnetic field B_1. The reason is that the direction of the electric field is almost the same as the direction of the field B_1. This is the way of the field-aligned acceleration presented by the author [1]. If the crossing angle is smaller than a right angle, then the magnetic neutral sheet is not created. Therefore the effective energy gain of the particle cannot be expected.

[1] S. Takeuchi, Phys. Plasmas 19, 070703 (2012).

Keywords: asymmetric magnetic reconnection, particle acceleration, plasma shock wave

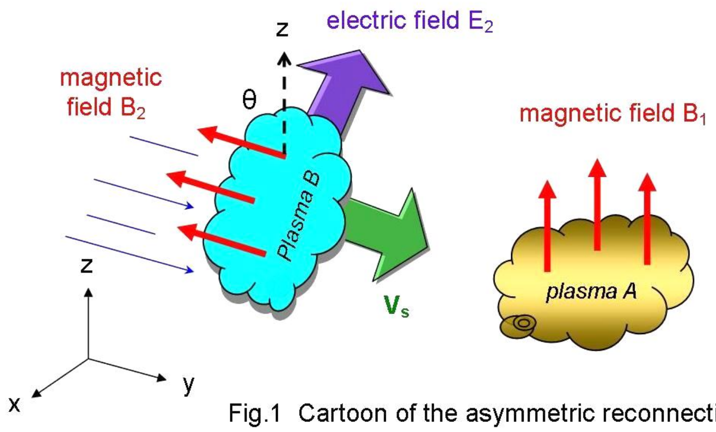

Fig.1 Cartoon of the asymmetric reconnection