A new model of magnetic reconnection: Self-similar evolving model

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I present a new model for time dependent fast magnetic reconnection in free space, which is characterized by self-similar evolution.

Many cases of reconnection in astrophysical phenomena are characterized by huge dynamic range of expansion of the size ($¥sim 10^7$ for typical solar flares). Although such reconnection is intrinsically time dependent, the specialized model underlying the situation has not been established yet. Such reconnections can be treated as an evolutionary process in free space which is free from any external influence, because the resultant scale is much larger than the initial scale. In spite of this fact, most of the previous numerical works focused on the evolution strongly affected by artificial boundary conditions like on the simulation boundary. Our new model clarifies a realistic evolution of actual astrophysical reconnection.

This new model of reconnection is first demonstrated by MHD numerical simulation in a very wide spatial dynamic range (Nitta et al. '01). The result clearly shows that self-similar evolution is stable for any ideal MHD mode. We can also check the coincidence with true self-similar solution obtained from an analytic procedure (so-called Grad-Shafranov approach; Nitta et al. '02). The resultant reconnection rate is spontaneously determined by the reconnection system itself, and is explained by a simple shock-tube model for reconnection outflow (Nitta '04).

In this talk, I will show the outline of this self-similar reconnection model and discuss the possibility of observational inspection of this model.