Structural Change of out-of-plane Magnetic Field by the Number of Small Islands to Merge into Large Island through Coalescence

Tuyosi, INfoo HAYAKAWA[1]
[1] Dept. Earth and Planetary Sci., Tokyo Inst. Tech.

Magnetic reconnection in the magnetotail is known as a significant key process of conversion of magnetic energy into kinetic energy of plasmas, and plays an important role at the substorm onset. Tearing instability is thought to be one candidate of plasma instabilities to trigger directly the magnetic reconnection. While a lot of observational studies have shown the evidence of well-developed large-scale magnetic island in the magnetotail, these evidences are both temporally and spatially limited scales. Thus, it is hard to see the large-scale island formation in the real space from the *in-situ* observations. Recent advances of computer techniques make it possible to carry out large scale numerical simulations, in which multiple merging of magnetic islands is allowed. Results of recent simulation have suggested that a large-scale magnetic island is formed through the coalescence of small-scale islands in nonlinear stage of tearing instability. In this presentation, we have investigated effects of initial number of small magnetic islands, m, on structures of a finally-matured large magnetic island. In order to do this, m is set to be $m = 2$, 4, and 8. A small initial guide field has been introduced to mimic the real magnetotail situation. If m=2, quadrupole magnetic field comes out when two islands are merging into final bigger island. The structure is similar to Hall magnetic field but opposite in direction, therefore this type of coalescence would be called ”””’reversed Hall”””” type. In contrast, when m=4 and 8, the structure is quite different from that of ”””’reversed Hall”””” type. When well-matured two magnetic islands are coming closer to each other, flux of out-of-plane magnetic field is compressed to converge at the O-point, which is located almost the center of the final bigger magnetic island. Then strong out-of-plane magnetic field appears at the O-point. The present study has found two different scale lengths during multiple-coalescence stage. One is the shorter scale, in which coalescence occurs in the early stage. The other one is the longer scale, which governs the final bigger magnetic island. These two scales may have influences on each other. The results of the present study will be helpful in understanding observation results because the initial number of small islands to merge into one large island is predictable. This prediction will also useful for the determination of required time/spatial resolution of future observational instruments.