

232<sup>th</sup> Regular Open Seminar (2018 Jun 13)

## Title : Magnetic reconnection in space: Shocking structures in magnetohydrodynamic simulations

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**Related RISH mission :** Mission 3 (Sustainable Space Environments for Humankind)  
Mission 5 (Quality of the Future Humanosphere)

### Abstract :

Phenomena like solar flares and magnetic substorms are direct/possible consequences of magnetic reconnection in space. These "magnetic reconnection" events abruptly release the stored energy, as they change the topology of the magnetic field lines. Since the reconnection process is highly nonlinear and complex, computer simulations have become a very important tool to explore the inner workings of magnetic reconnection.

In this talk, we will overview our recent investigations on magnetic reconnection by means of magnetohydrodynamic (MHD) simulations. First, we will introduce theoretical background on MHD, numerical schemes, and techniques for parallel computing. Then, we will present two science topics. First, we study the structure of a "plasmoid," a magnetic island generated by a plasma jet from the reconnection site. Thanks to a high-accuracy code, we resolve various structures in and around the plasmoid, as summarized in the 2018 edition of the "plasmoid diagram" (Figure 1). They are the outcome of high-speed fluid dynamics or compressible fluid dynamics, similarly as in aerospace engineering and in astrophysical jet physics. Then, we will demonstrate our recent results on plasmoid-dominated turbulent reconnection, which contains many plasmoids in a system. We have also made our simulation code "OpenMHD" publicly available. I hope that everyone enjoys MHD simulation on his/her computer.

Reference: S. Zenitani, *Magnetohydrodynamic (MHD) simulations of magnetic reconnection with a high-resolution shock-capturing code*, Sustainable humanosphere (生存圏研究), **13**, 27 (2017)

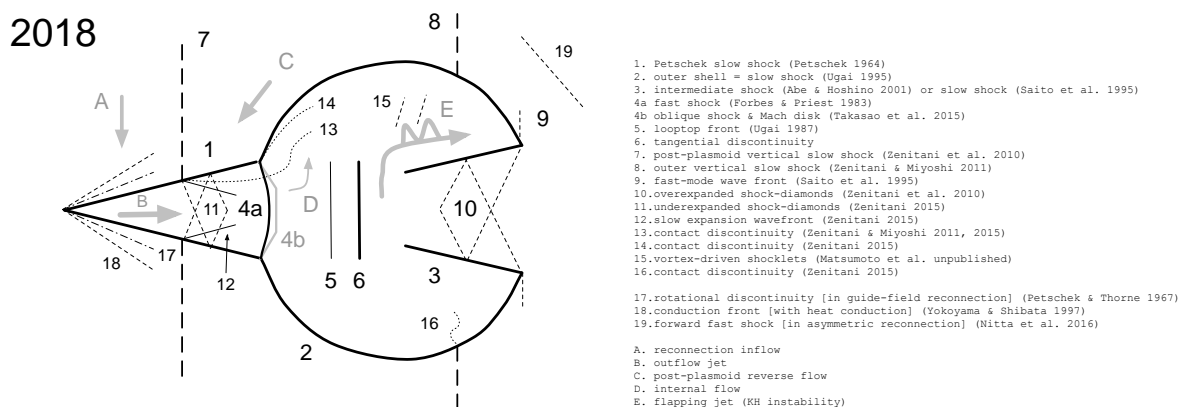


Fig. 1 A schematic diagram of the structure of a plasmoid