2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Evolution of Solar Magnetic Fields – From Emergence to Eruption

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Solar eruptions are one of the most dynamic phenomena observed in the solar corona, which rapidly eject coronal plasmas confined by twisted magnetic fields toward the interplanetary space. These eruptions are considered to occur at the final evolutionary stage of solar magnetic fields that emerge from the solar interior, forming the so-called flux ropes that contain coronal plasmas observed as solar prominences/filaments, and finally erupting toward the interplanetary space. Solar eruptions are sometimes accompanied by explosive events known as solar flares.

In this talk, I demonstrate a series of dynamic processes leading to a solar eruption, by showing the results from magnetohydrodynamic (MHD) simulations performed by our group. Magnetic Rayleigh-Taylor instability enables the subsurface magnetic flux to emerge into the solar corona where a flux rope is formed [1,2], while the quasi-static evolution of a flux rope before it erupts is described by a dynamic equation where the magnetic pressure gradient force, magnetic tension force, and gravitational force come into play [3]. We also theoretically explain observational features of a prominence/filament in a flux rope [4]. Then we discuss a key mechanism causing the dynamic state transition from the quasi-static state to the eruptive state of a flux rope [5-7]. Finally, we show a recent MHD simulation reproducing the dynamic state transition in an observed active region [8].

[1] Magara, T. 2001, Astrophysical Journal, 549, 608

[2] Magara, T. & Longcope, D. W. 2003, Astrophysical Journal, 586, 630

[3] Magara, T. 2004, Astrophysical Journal, 605, 480

[4] Magara, T. 2007, Publications of the Astronomical Society of Japan, 59, L51

[5] Magara, T. 2013, Publications of the Astronomical Society of Japan, 65, L5

[6] An, J. M. & Magara, T. 2013, Astrophysical Journal, 773, 21

[7] Magara, T. 2015, Publications of the Astronomical Society of Japan, 67, L6

[8] Lee Hwanhee & Magara Tetsuya 2018, Astrophysical Journal, in press