Realistic MHD Modeling of delta-sunspots: How to Generate Most Violent Active Regions of the Sun

*Shin Toriumi[1], Hideyuki Hotta[2]

1. Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 2. Graduate School of Science, Chiba University

Observations revealed that the delta-shaped sunspots, in which opposite polarities are closely neighboring that they share a common penumbra, produce the strongest solar flares in history. In this study, for the first time, we succeed in simulating the entire process where a subsurface magnetic flux tube is elevated by the turbulent background convection and spontaneously forms delta-shaped sunspots in the photosphere, by utilizing the novel radiative MHD code R2D2, which simultaneously solves the thermal convection from the deepest convection zone to the surface layer of the Sun. We find that within the delta-spots, strongly sheared polarity inversion lines, spot rotations, and flux rope structures are built, all of which are consistent with the observations of flare-prolific active regions. In the presentation, we discuss the key roles of turbulent convection in producing the delta-spots, the most eruptive category of active regions.

Keywords: Solar flares, Coronal mass ejections, MHD simulation, Magnetic flux emergence, Sunspots

