

Large-scale MHD simulation of solar convection zone and dynamo

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Abstract

In the talk, I review recent development of the solar dynamo study.

The sun has the sunspots, i.e., cool and strong magnetic region, on the surface. The number of the sunspot varies with 11-year cycle period. This is one of the most important unresolved problems in the astrophysics. Since the sunspot has strong magnetic field, the sunspot cycle is thought as a magnetic activity cycle. We need to understand the magnetic field generation, i.e. dynamo, to understand this mystery. The solar convection zone is filled with ionized plasma and this plasma move turbulently, since the solar convection zone is thermal convectively unstable due to the energy flux from the radiation zone. We need to understand this turbulence and its interaction with the magnetic field. This issue involves a lot of processes 1. Excitation of the thermal convection. 2. Anisotropic angular momentum transport. 3. Generation of the large-scale flow patterns. 4. Global stretching and transport of large-scale magnetic field. 5. Anisotropic magnetic field generation with turbulent electromotive force. 6. Small-scale magnetic field generation without any anisotropy. We need to understand all these processes. In the talk, these processes are reviewed and I introduce recent development of the understanding of these ideas.

In the final part of the talk, I introduce our 5-year plan to advance the solar dynamo study.