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Mean Field Dynamo Theory and Solar Cyclicity: The Helicity Challenge

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Prof. Kirill Kuzanyan is a Leading Researcher at the Institute of Terrestrial Magnetism, Ionosphere and Radio-wave Propagation of Russian Academy of Sciences in Moscow, Russia. He got his Ph.D. in 1995, and in 2004 he became a Habilitated Doctor. Since 1998, already 20 years, he has established close research collaboration with solar physicists at NAOC, China, visiting almost every year. He has also several collaborations with research groups in the UK, Germany, Italy, Sweden and Japan. His research interests are in the field of Mean-Field turbulent dynamo theory, magneto-hydrodynamics and physics of turbulence, solar magnetic activity and cyclicity, and studies of magnetic helicity.

Abstract

In 1955, Parker suggested a dynamo mechanism in the solar interior based on the combined action of differential rotation and cyclonic convective vortices as a viable way to generate magnetic fields capable of driving the activity cycle. We are able to quantify the differential rotation from the motion of large-scale magnetic fields at the solar surface and from helioseismology in the solar convection zone. Recent observations of helical structures in the magnetic fields of solar active regions at the photospheric level have enabled us time-latitudinal distribution of the magnetic field helicity (mirror asymmetry of magnetic fields), which plays a key role in the mechanism of magnetic field generation operating in the solar interior. Our results bring up a newtype of characteristic of hydromagnetic dynamos and pose a challenge to the theory of stellar and planetary magnetic fields. The origin of helicity comes from background turbulent dynamo action as well as large-scale tilt of bipolar magnetic flux tubes, the building material for sunspots. We carry out quantitative computations of these two helicity inputs, and give observational interpretation of the results.
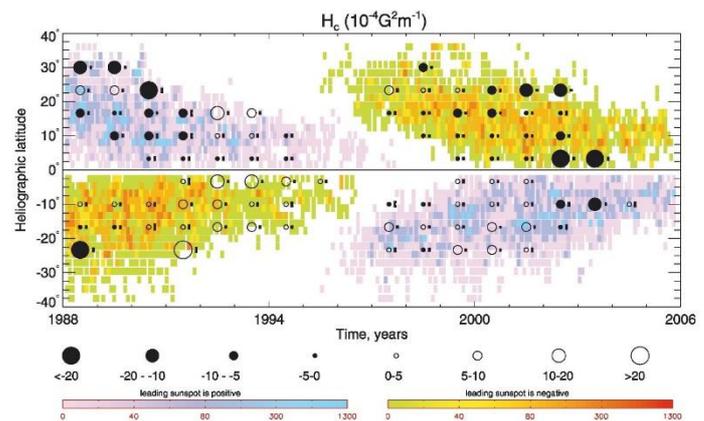
All are welcome ！Tea and coffee will be served at 2:15 PM.