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Simulation study on the hemispheric asymmetry of the solar dynamo cycle based on the flux transport dynamo model

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It is well known that the polarity of the solar magnetic fields on the poles periodically reverse at about 11 years. And it is also known that the reversal at one pole is followed by that on the other pole. The time difference of magnetic field reversal between the poles was first noted by Babcock (1959) from the very first observation of polar field. Svalgaard and Kamide (2013) recently indicated that there is a relation between the time difference of polarity reversal and the hemispheric asymmetry of the sunspot activity. However, the mechanisms for the hemispheric asymmetry are still open to be revealed.

In this paper, we study the asymmetric feature of solar dynamo based on the flux transport dynamo model (Chatterjee et al. 2004). We carried out the mean field dynamo simulations using the updated SURYA code which was originally developed by Choudhuri and his collaborators (2004). We analyzed the phase relation between the symmetric and asymmetric components, which correspond respectively to the quadrupole and dipole-like components, using the field decomposition technique proposed by Nishikawa and Kusano (2008). As a result, we found that the two components are mixed even if the dipole-like component is predominant and that the mixing of the two components causes the time lag of polar field reversals between the different hemispheres.

We will discuss also about the causal relationship between the time lag of polar field reversals and the asymmetric activity of sunspot focusing on the influence of nonlinear feedback processes driven by the magnetic buoyancy.

Keywords: solar dynamo, simulation