The Peculiar Minimum and Implications to Solar Dynamo

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The present unusually long minimum raises the question whether we could be entering another grand minimum. To answer this question, we need to understand what causes irregularities of the sunspot cycle and what might have produced the previous grand minima. I shall summarize the basic physics of the flux transport dynamo model and argue that the fluctuations in the Babcock-Leighton process for generating the poloidal magnetic field is the main source of irregularity in the solar dynamo. In a dynamo model with reasonably high turbulent diffusivity, the poloidal field at the end of a cycle is found to be correlated with the strength of the next cycle (Jiang, Chatterjee & Choudhuri 2007, MNRAS 381, 1527). Our recent effort in modeling the Maunder minimum (Choudhuri and Karak 2009, RAA 9, 953) suggests that the poloidal field produced at the end of the cycle immediately preceding the Maunder minimum was probably not higher than 0.4 of the average poloidal field at the end of a cycle. Although the poloidal field at the end of the cycle 23 was low, our dynamo model predicts that it is not low enough to push the dynamo into another grand minimum. According to our dynamo model, we are on the threshold of a weak next cycle and not another grand minimum. The possible slowing down of the meridional circulation also could have prolonged the duration of the minimum.