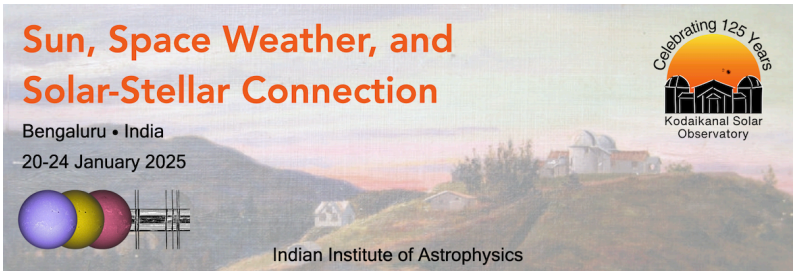

Contribution ID: **36** Type: **Contributed talk**

Dynamo Modelling for Cycle Variability and Occurrence of Grand Minima in Sun-like Stars at Different Rotation Rates

Thursday, January 23, 2025 2:10 PM (15 minutes)

Like the solar cycle, stellar activity cycles are also irregular. Observations reveal that rapidly rotating (young) Sun-like stars exhibit a high level of activity with no Maunder-like grand minima and rarely display smooth regular activity cycles. On the other hand, slowly rotating old stars like the Sun have low activity levels and smooth cycles with occasional grand minima. We, for the first time, model these observational trends using flux transport dynamo models. We build kinematic dynamo models of one solar mass star with different rotation rates. Differential rotation and meridional circulation are specified by computing them using equivalent mean-field hydrodynamic models of these stars. We include stochastic fluctuations in the Babcock-Leighton source of the poloidal field to capture the inherent fluctuations in the stellar convection. Based on extensive simulations, we find that rapidly rotating stars produce highly irregular cycles with strong magnetic fields and rarely produce Maunder-like grand minima, whereas the slowly-rotating stars (with a rotation period of 10 days and longer) produce smooth cycles of weaker strength, long-term modulation in the amplitude, and occasional extended grand minima. The average duration and the frequency of grand minima increase with decreasing rotation rate. These results can be understood as the tendency of less supercritical dynamo in slower rotating stars to be more prone to produce extended grand minima. We further conclude that even in rapidly rotating stars for which the star spots appear at high latitudes, the Babcock-Leighton dynamo operates.

Contribution Type

Theme

Solar - Stellar Connections

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