Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Nonlinear Model of Turbulent Dynamo and Assimilation of Sunspot Data IRINA KITIASHVILI, ALEXANDER KOSOVICHEV, NICK WEST, Center for Turbulence Research, Stanford University, THOMAS BEWLEY, JOE CESSNA, CHRISTOPHER COLBURN, Flow Control and Coordinated Robotics Labs, UC San Diego — We investigate a non-linear dynamical model to describe the cyclic behavior of magnetic fields on the Sun. The model is derived by applying a low-mode approximation to the mean-field turbulent dynamo theory and taking into account variations of magnetic helicity. We show that the model reproduces the observed behavior of the Sun's global magnetic field: the periodic polarity reversals, migration towards the equator, and the relationship between the growth rate and the strength of the 11-year sunspot cycles. In addition, the model has chaotic regimes, which may be important for understanding the long-term behavior of the solar cycles. Since the properties of the solar dynamo, such as turbulent diffusion and helicity, are unknown, we apply data assimilation methods for obtaining the best estimate of the true state of the system and also for predicting the next cycle. In particular, we used the Ensemble Kalman Filter and recent modifications, to assimilate the sunspot data available for 1755-2008 into the model. We compare the assimilation results and discuss the predictions of the next sunspot cycle.

Alexander Kosovichev
Stanford University

Date submitted: 04 Aug 2008 Electronic form version 1.4