



Extrapolating Solar Dynamo Models Throughout the Heliosphere



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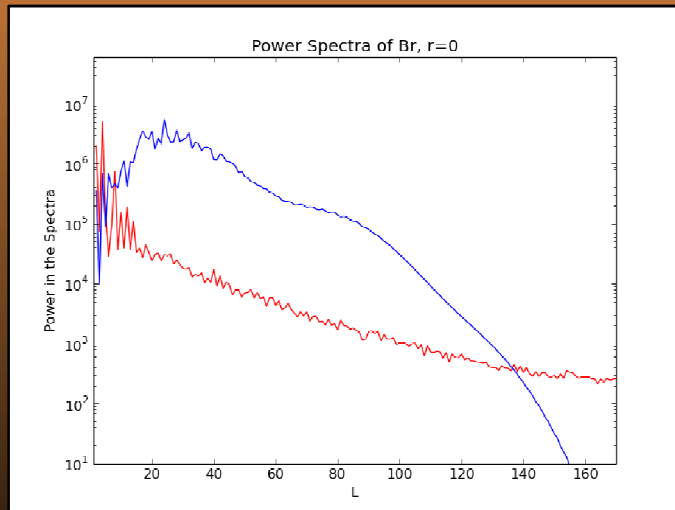
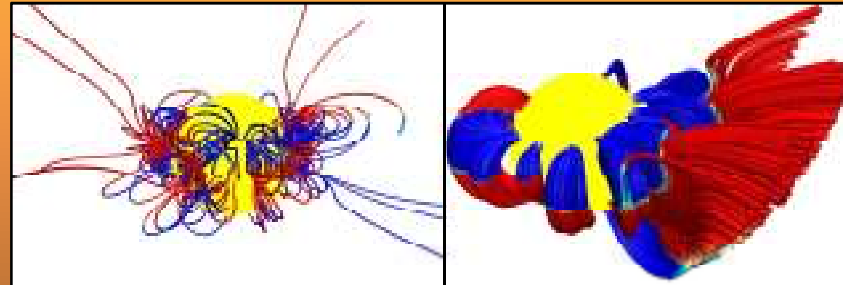
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Summary

The Babcock-Leighton and Convective models of the solar dynamo can be visualized with supercomputer models from ASH code. Currently the models only represent the dynamo's behavior at the edge of the convective zone. In order to visualize the dynamo's behavior throughout the heliosphere, PFSS extrapolations have been implemented on both BASH data and CASH data via a Python routine, and the resulting models are compared here.

Methods

- A Python Routine was constructed to undertake the PFSS extrapolation.
- The routine uses Spherical Harmonic Transforms and Associated Legendre polynomials to maximize accuracy.
- The extrapolated data is formatted for use with NCAR's Vapor visualization tool. Vapor visualizes the data, and then takes images that can make time-evolving movies.



Data

- Above, left: An equatorial slice of a BASH model extrapolated out to 4 solar radii, where many magnetic loops representing active regions and sunspots can be seen.
- Above, right: A CASH model extrapolated out to 4 solar radii, where the model already begins to exhibit dipole-like behavior, and has very little complex structure.
- Left: the power spectra of the two models plotted out at the solar surface. BASH is in blue, CASH is in red. This quantitatively shows the level of complexity in the models—BASH has an increase in power at around 80 L, signifying its heightened complexity, while CASH has a spectrum that is much broader, with a significant amount of power in the lower degrees.

Results

- The implementation of sunspots in BASH data contributes very noticeably to the magnetic field even at further distances from the sun.
- Areas indicative of active regions remain out of CASH's capabilities.

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