Project Details

ROSES ID: NNH15ZDA001N
Selection Year: 2015
Program Element: Focused Science Topic

Topic: The Solar-Stellar Connection

Project Title:
Stellar Insights into Solar Magnetism: Exploring Fundamental Dynamo Physics Across the Lower Main Sequence

PI Name: Benjamin Brown
PI Email: bpbrown@colorado.edu
Affiliation: University Of Colorado, Boulder
Project Member(s):
- Rast, Mark Peter; Co-I; University Of Colorado, Boulder
- Oishi, Jeffrey S; Co-I; State University of New York, Farmingdale
- Wimert, Carol; Co-I
- Dickinson, Gwen; Co-I
- Toomre, Juri ; Co-I; University Of Colorado, Boulder
- Brun, Allan Sacha ; Co-I; University Of Colorado, Boulder
- Miesch, Mark ; Co-I; University Corporation For Atmospheric Research (UCAR)

Summary:
Magnetism is a ubiquitous feature of stars like our Sun. Stars on the lower main sequence generate their magnetic fields by dynamo action in their sub-photospheric convection zones. When stars like the Sun are young, they rotate much more rapidly and are much more magnetically active. High coronal X-ray emission in young stars, cyclic magnetism, and frequent large stellar flares must profoundly affect these potential abodes of exosolar life. Likewise, solar magnetic activity and space weather affect life here on Earth. In this proposed research, we will probe the fundamental physics of dynamo action across the lower main-sequence of sun-like stars. The proposed work involves numerical and theoretical studies of global-scale stellar dynamo action, seeking to understand the fundamental physics that drive stellar dynamos in solar-like stars. This effort includes global-scale 3-D MHD simulations on supercomputers, mean field models, and significant work to understand the underlying fundamental physical processes occurring in stellar dynamos.

Our proposed work fits naturally into Focus Team Effort 2: The Solar-Stellar Connection of Living With a Star science. This work addresses the Heliophysics Science Question ``What causes the Sun to vary?''. Our work will provide theoretical underpinnings for the current missions STEREO and IRIS, and especially for the HMI and AIA instruments on the SDO mission. All are concerned with evolving solar magnetism, as are our proposed theoretical efforts. Our work on stellar dynamos and magnetism will aid in interpretations of results from Kepler and TESS, where stellar spots and white light flares are major observational features. By studying stellar dynamo properties across the lower main sequence, we can learn what is specific to the Sun and what is common to all solar-like stars. Our work will position the Sun and its dynamo in a broader context.

Publication References:

Summary: no summary

Reference: Alvarado-Gómez, J. D.; Hussain, G. A. J.; Cohen, O.; Drake, J. J.; Garraffo, C.; Grunhut, J.; Gombosi, T. I.; (2016), Simulating the environment around planet-hosting stars. I. Coronal structure, Astronomy & Astrophysics, Volume 588, id.A28, 15 pp, doi: 10.1051/0004-6361/201527832

Summary: no summary

Reference: Alvarado-Gómez, Julián David; Hussain, G.; Grunhut, J.; Cohen, O.; Garrafo, C.; Drake, J. J.; Gombosi, T. I.; (2016), Simulating The Environment Around Planet-Hosting Stars, The 19th Cambridge Workshop on Cool Stars, Stellar

Systems, and the Sun (CS19), Uppsala, Sweden, 06-10 June 2016, id.14, doi: 10.5281/zenodo.154585

Summary: no summary

Reference: Alvarado-Gómez, J. D.; Hussain, G. A. J.; Cohen, O.; Drake, J. J.; Garraffo, C.; Grunhut, J.; Gombosi, T. I.; (2016), Simulating the environment around planet-hosting stars. II. Stellar winds and inner astrospheres, Astronomy & Astrophysics, Volume 594, id.A95, 19 pp, doi: 10.1051/0004-6361/201628988