Dynamic Origins of Solar and Stellar Magnetism

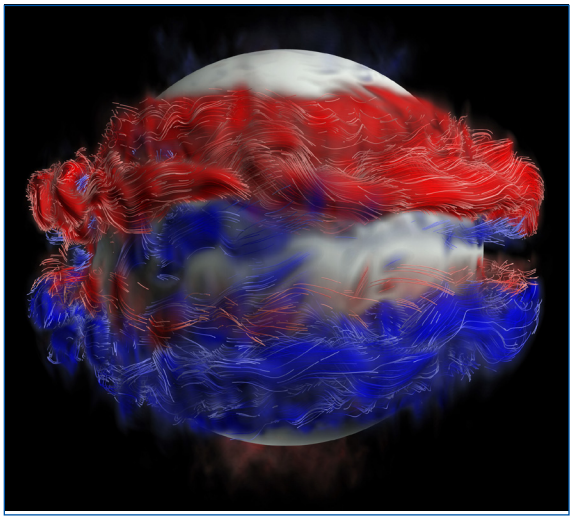
Science Mission Directorate

As the root of solar variability, solar magnetism influences Earth's climate system, regulates space weather, and shapes the geospace environment. Understanding the origins of solar magnetism is a prerequisite to understanding how the Sun interacts with the Earth and the other planets of the solar system, which comprises the core mission of NASA's Heliophysics Division.

NASA missions such as the Solar Dynamics Observatory reveal magnetic activity in the Sun with dramatic clarity. This vibrant magnetism originates below the Sun's surface, in the highly turbulent convection zone where the kinetic energy of plasma motion is converted into magnetic energy in a phenomenon known as a hydromagnetic dynamo.

We are using NASA supercomputing and mass storage resources to model solar and stellar dynamos. Simulations of these dynamos are computationally demanding, requiring high spatial resolution and long time-integrations in order to capture the complex, multi-scale, nonlinear interactions that can give rise to cyclic magnetic activity on time scales that are orders of magnitude longer than those of the convection. NASA's supercomputing resources enable these high-resolution models and accommodate the hundreds of terabytes of data that they generate. The Agency's networking and visualization resources are also essential to properly analyzing this data and maximizing its scientific impact.

Mark S. Miesch, High Altitude Observatory, National Center for Atmospheric Research
miesch@ucar.edu



Wreathes of magnetism in a star rotating five times faster than the Sun. Color indicates magnetic polarity, which reverses sign every few years. Observations of young stars confirm that turbulent convection and rapid rotation breed vigorous magnetic activity. *Benjamin Brown, University of Wisconsin; Timothy Sandstrom, NASA/Ames*