# GLOBAL SIMULATIONS OF THE SOLAR CONVECTION ZONE USING PERTURBED MHD EQUATIONS

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Solar convection pervades the outer 30 percent of the Sun's radius, also known as the solar convection zone (SCZ). It lies at the origin of all solar magnetic activity including the solar cycle, sunspot formation, flares and coronal mass ejections. Convection is driven by radiative heating at the bottom of the SCZ and by a thin surface boundary layer where radiative cooling occurs. To avoid the computational burden of having to resolve the radiative transfer taking place in the surface layer, most global simulations of solar convection model the transport of energy near the top boundary by a flux proportional to the entropy gradient using a large thermal diffusivity. Alternatively, global convection can be driven internally by damping the entropy perturbations with respect to a prescribed weakly unstable ambient state. The ambient state represents the Sun's interior stratification in a state of global thermal equilibrium and is chosen such that it is consistent with helioseismically-calibrated solar structural models.

In this talk we describe how the perturbation form of the equations governing solar magnetohydrodynamic (MHD) convection is obtained from a set of unperturbed MHD equations cast in the anelastic approximation. We present solutions from global MHD simulations of the SCZ in which a large-scale solar-like magnetic field develops and undergoes anti-symmetric polarity reversals about the equator on a decadal time scale [1-2]. Moreover, a detailed analysis of the entropy equation is presented that gives insights into the mechanism responsible for the magnetic modulation of the convective energy transport inside the simulation.

## REFERENCES

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