Gravity waves nonlinear excitation and propagation in solar-like stars

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Abstract

Using the ASH code we have made a 3-D model of the full Sun (from r=0 to 0.97 Rsol) coupling nonlinearly its convective envelope to its deep radiative interior. Solar-like differential rotation is developing due to the joint action of the Coriolis force on the turbulent convective motions and the feedback (via thermal wind balance) of a self-established tachocline at the base of the convective envelope. The model further self-consistently excite gravity waves and modes due to the continuous pummeling action of cold convective plumes on the top of the radiative interior. When compared with the Aarhus oscillation code we find a very good agreement between the ridges present in the power spectra and the frequency computed from the 1-D background structure of the 3-D model.This model allows us to study for the first time excitation and propagation of gravity waves in 3-D in a star and to study their visibility through a differentially rotating convective envelope. We also assess their lifetime, rotational splitting and radiative damping and found departure from the linear asymptotic theory.

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