"ACOUSTIC WAVES GENERATED BY IMPULSIVE DISTURBANCES IN A GRAVITATIONALLY STRATIFIED MEDIUM"

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There are two well-known oscillations detected from the sun: the five-minute oscillation period attributed to global pressure modes (or "p-modes") in the solar interior, and the lesser-known three-minute oscillations in the chromosphere. Like the interior p-modes, the chromospheric oscillations are thought to be standing oscillations, waves that are trapped between two nodes from which they reflect. In this case, the photosphere and the transition region (TR) between the chromosphere and corona would be such reflecting nodes. However, signatures of these oscillations have been detected in the low corona, indicating that they are able to propagate through the TR. In this study, the authors investigate an alternative explanation to the idea that the cutoff frequency at the temperature minimum can explain the three-minutes oscillations, since it doesn't explain why frequencies just above the cutoff are largly evanescent. They suggest that the medium through which the waves are travelling manifests its response to some type of excitation in the form of the waves that are then observed. This excitation would have to be a continuous supply of energy and have the result that $k \ll \omega_0/C_s$ (where k is the wavenumber, ω_0 is the cutoff oscillation frequency, and C_s is the sound speed), which gives frequencies around the cutoff.

An initially static theoretical model of a solar atmosphere was modeled using the assumptions of stable gravitational stratification and an isothermal environment. Dimensionless parameters for wave velocity, mass density, pressure, and the displacement due to perturbation of the medium were evolved in time after a perturbation was introduced. Important relations such as the wave equation and dispersion relation, along with reasonable boundary and initial conditions, a solution was derived for the wave speed.

The outcome of this simulation was a result of the two limiting parameters in the model: the initial wave velocity, u_0, and the velocity correlation length, L. The three-minute periods were found to be freely propagating (i.e. no driving force present after the initial excitation) dispersive waves whose frequency rapidly dropped due to energy loss. The damping of high-frequency waves first, follwed by lower frequency waves later explained the drop in power beyond the cutoff frequency that was initially unexplained. The source of energy powering these oscillations in the first place was attributed to either the continuous photospheric motions caused by convective turbulence in the solar interior, or velocity impulses from impulsive disturbances in the upper photosphere.