

On Magneto--Seismology

The subsurface properties, e.g, density and differential rotation, of the Sun have been inferred in great detail by analyzing the waves on its surface. This method of helioseismic inversion has revolutionized solar physics. Can they be extended to infer deeply buried magnetic fields ? After a review of the present status of this question, I will present our recent results on how deeply buried magnetic fields can change the surface dispersion relations in a stratified medium. In particular, for waves in an isothermal, stratified medium with a magnetic field that points along a direction perpendicular to that of gravity and varies exponentially in the direction of gravity we find exact analytical solutions for two different cases: (a) waves propagating along the direction of the magnetic field and (b) waves propagating along the direction of the gravity. In each case, we find solutions in terms of either the hypergeometric functions or their confluent cousins. The eigenfrequencies decrease with increasing degree of the spatial inhomogeneity of the magnetic field and the nodes of the eigenfunctions leak toward regions of lower Alfvén wave speed. In polytropic gas we are so far unable to obtain any exact solution in terms of known functions. We calculate the effects of the magnetic field using numerical and perturbative methods.