Mathematical modelling of effect of flows in magnetic flux tubes

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Magnetohydrodynamic (MHD) waves are thought to play a crucial role in the energy budget of the solar atmosphere. It is well thought that these waves contribute to the heating of the solar chromosphere and corona. As a result, understanding the physics and behaviour of these waves within the context of a realistic solar atmospheric environment is of great importance. The solar atmosphere is dynamic and contains structures which may support the propagation of these waves. Many, if not all, of these structures will have plasma flow present, however the exact velocity profile of these flows are as yet unobservable.

We derive a new governing equation describing the generalised case for a spatially arbitrary flow in a 2-dimensional magnetic slab. This equation reduces to the familiar known forms if the flow is constant or removed entirely. This second order differential equation with varying coefficients has no known analytic solution, as such the dispersion diagram cannot be derived analytically and a numerical method must be used instead.

We therefore also introduce the idea for a new method of retrieving the dispersion diagram describing the types of waves which can exist in the system. This method is based on the shooting method and requires that the total pressure perturbation and total horizontal velocity (displacement) is matched at the boundaries of the slab.

This theoretical study of waves propagating in a spatially dependant flow in a magnetic slab will be verified via 2-3D numerical modelling to visualise the effect of the flow.

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