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Wave Conversion and Heating in a Two-fluid partially ionized atmosphere

The solar chromosphere is a highly dynamic layer governed by magnetic forces. Models and observations alike have difficulties in their analysis and interpretation. For instance, what mechanism is responsible for heating the chromosphere needs yet to be determined. Chromospheric plasma contains a significant amount of neutral particles. For phenomena operating at timescales significantly larger than collision times between neutrals and charges, both components move as a whole. Friction between the particles, however, may be able to efficiently raise the temperature of the plasma if the time scales approach those of collisions. Here, we investigate wave dissipation via charge-neutral collisions as a heating mechanism in a two-fluid model for charges and neutrals. We focus on propagation of magneto-acoustic waves in two distinct 2D setups containing an acoustic-to-magnetic (or viceversa) conversion area. In the first scenario, we use a vertically stratified but horizontally uniform atmosphere, with a homogeneous magnetic field set to establish an Alfvén-acoustic equipartition region halfway within the domain. In the second case, we consider the same thermodynamic background but a potential magnetic field, allowing for the presence of a magnetic null point. Moreover, we perform comparative analysis for two distinct atmospheres: a Holmul model that represents a cool atmosphere in radiative equilibrium, and a hot chromosphere represented by a Val3c model. Our simulations demonstrate that magnetic waves are more damped and cause greater dissipation and heating than acoustic waves, in line with the theoretical work of Cally & Gómez-Míguez 2023.

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