Introduction

For more than a decade it has been known that sunspots absorb and shift the phase of $f$- and $g$-modes incident upon them (e.g., Brown, 1990). Understanding the mechanisms causing such of these effects is vital to the local helioseismology of sunspots (and magnetic flux concentrations in general). Recent modelling efforts by Crouch & Cally (2003, 2005), Cally, Crouch, & Braun (2003), and Crouch et al. (2006) have demonstrated that both effects can be explained by simple sunspot models provided the magnetic field inclination is taken into account. If the betatron-like layer typically lies in the near-surface layers below the sunspot photosphere, MHD mode conversion can occur. Mode conversion provides a promising absorption mechanism because the slow magnetoacoustic-gravity waves and Alfvén waves can guide energy along the magnetic field away from the acoustic cavity into the interior or, less preferentially, up into the overly-spherical sunspot models. This allows asymptotic solutions for the wave equations to be found in the interior and on the surface of the model, and to ensure total pressure balance, i.e.,

$$\rho_0 u_0 = \rho u_0.$$ 

The modified pressure is then used to connect the adiabatic coefficient $\gamma$, with a simple Saha equation solver that includes the ionization of hydrogen and helium only.