Understanding radial velocity pulsations observed in oscillating magnetic stars

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New high-resolution spectroscopic observations of rapidly oscillating Ap (roAp) stars reveal an interesting and complex behavior of pulsations in the atmosphere of these stars, such as the indication of a co-existence of standing and running waves in their atmospheric layers. This spectroscopic data holds unique information about the structure and dynamics of the peculiar atmospheres of these stars. Here we present the results of a model developed for the atmosphere of roAp stars with the purpose of understanding the general trends seen in the atmospheric pulsation data acquired with high-resolution spectroscopy. In our analysis we consider a model of mass $M = 1,79M_{sun}$ and effective temperature of $T_{eff} = 8363$ K. At each latitude, we model the outer region of the atmosphere by an isothermal plane parallel layer, which is matched to the stellar model at a temperature of T=6822 K. In addition, we assume that this region is magnetically dominated and, consequently, that the magnetoacoustic wave has decoupled into its acoustic and magnetic components. Starting from the equations for the displacement parallel and perpendicular to the direction of the magnetic field and using the analytical solutions for the velocity components appropriate to this model, we determine the expression for the velocity component parallel to the line of sight averaged over the visible stellar disk, for a general position of the observer. Fitting the latter to a function of the form Acos(σt+phase), with σ the oscillation frequency and t the time, we derive the amplitude A and the phase for our model as function of height in the atmosphere. The results are compared to the general trends of the phase and amplitude derived from the spectroscopic data. Such comparison allows as to link the observed behavior to the physical and geometric quantities that are involved in the problem.