Propagation of Radial Pulsation Modes in the Outer Atmosphere of Arcturus: First Results

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Abstract

I present first results of a study about propagating radial pulsation modes in the outer atmosphere of Arcturus (K1.5 III). Mechanical energy input is explicitly taken into account by treating shock wave dissipation. I investigate the influence of different wave frequencies on the mass loss behavior of the star. I show that significant time–averaged mass loss can only be produced when periods larger than 5 x 10^5 s ($\sim$ 1 week) are employed. The initial atmosphere I use extends from 1.2 R_* up to 11.8 R_*. All wave models are adiabatic. I found that the mass loss rates and the final flow speeds obtained are extremely sensitive to the wave periods. In a certain regime the effect of increasing the period by a factor of 4 is to increase the corresponding mass loss rate by four orders of magnitude. I note that the mass loss rate and final flow speed of the wind for a 5.6 x 10^5 s period wave are somewhat close to the observed values. A more complete discussion regarding mass loss generation in Arcturus has been presented by Cuntz (1990). Recent observations of low–amplitude radial velocity variations in the photosphere of Arcturus provide evidence that the theoretically predicted mass loss frequencies might exist. Belmonte et al. (1990) presented evidence for a $\sim$8.3 d period with an amplitude of $\sim$50 m s^{-1}, which they attributed to the fundamental radial pulsation mode. Further studies are in progress (Larson et al. 1992). I note that if the 8.3 d period is real than it would be sufficiently large to support continuous mass loss. Judge & Stencel (1991) argued that the mechanical energy in the observed disturbances could be $\sim$15 times greater than the energy required to drive the wind. For other stars than Arcturus the required minimum mass loss periods can be estimated as $P_{ML} \sim R_*$.

References:

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