Shock propagation through cepheid envelopes

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A cepheid is a supergiant variable star which is positioned in the instability band of the HR diagram. Spectroscopic and interferometric observations [1] show that long-period cepheids exhibit asymmetries in the P Cygni-type profiles around the H$_\alpha$ line [2]: an absorption component with an emission component redshifted or blueshifted depending on the pulsation phase. Astronomers assume that these asymmetries are caused by the presence of strong shocks [3] propagating in the envelope due to the pulsation of the photosphere [4].

The HADES code [5] is a numerical tool which is developed since several years to perform numerical simulations of radiative hydrodynamics models for the study of hypersonic flows in stellar physics (jets of young stars, accretion shocks, supernova remnants, etc.). The interest of our work is to use HADES to carry out simulations of shock in the envelope of cepheids according to the scenarios proposed by astronomers. In order to compare our numerical results with observations, an observable around the H$_\alpha$ line is reconstructed from hydrodynamic quantities resulting from numerical simulations (density, velocity and temperature of the fluid).

References

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