Radiation Hydrodynamics in Stellar Atmospheres

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The radiation received from stars provides the diagnostic tool to infer temperatures, densities, hydrodynamic motions, and chemical compositions in their atmospheres. For most stars it appears to be an adequate first approximation to assume that there are no large-scale hydrodynamic motions. However, in the most luminous stars the intense radiation field deposits sufficient photon momentum in the outermost layers to drive them off in a supersonic hydrodynamic flow. Likewise, in exploding stars such as novae and supernovae, the dominant form of energy and momentum content and transfer may reside not in the material flow, but in the radiation field. Further, pulsating stars are driven by an internal "radiation engine" in which the variation of the opacity of the material with temperature and density acts as a thermodynamic valve. In all these objects, and adequate analysis of the physics of the atmosphere requires application of the discipline of Radiation Hydrodynamics, where one considers the dynamics of a two-component (at least!) radiating fluid. This talk will illustrate some aspects of the radiation-material interaction that produce large-scale motions in stellar atmospheres and envelopes, and make some connections between stellar and laboratory radiation-driven phenomena.