



Problems in Astrophysical Fluid Dynamics

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The variety of fluid processes observed throughout the universe staggers the imagination, yet the subject has not attracted nearly as much serious interest from professional fluid dynamicists, as have geophysical fluid problems. Yet, in the sixties and seventies of the previous century, several symposia were held that brought astrophysicists and fluid dynamicists together under various titles such as Cosmical Gas Dynamics; we might even follow Lighthill's lead in another subject and speak of Astrofluidynamics. Those old symposia were well attended and quite stimulating. To give an idea of the kinds of problems that arise in astrophysics I outline here a (subjective!) selection of fluid dynamical problems faced by astrophysicists. I begin with thermal instability, a characteristic process discussed in astrophysics and this flows naturally into the larger domain of radiative fluid dynamics wherein radiation affects the dynamics both thermally and dynamically and also plays a significant role in the observations. Astrophysicists must also face the problems associated with long mean free paths in plasmas and in their gravitational analogues – gases whose constituent particles are stars or even galaxies. As time permits, I shall also speak of fluid dynamics in accretion disks and rotational processes in the sun. This selection only scratches the surface of the subject and it is meant to be introductory. My subject is really astrophysically motivated fluid dynamics and the approach to be used in this discourse is largely analytic. However, I would stress that, on the hard core astrophysical side, progress is being made largely in the development of simulations. This is true throughout the subject, and is especially evident in a wide range of compressible flows such are encountered in stellar convection, the dynamics of interstellar gas clouds and in the formation of large-scale structure in the early universe.

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