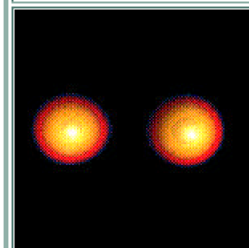
Movies
Produced by LSU's Astrophysics Theory Group

Department of Physics & Astronomy
Louisiana State University

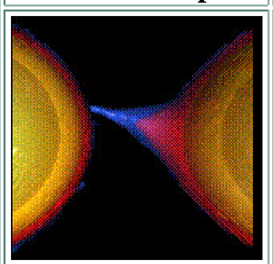
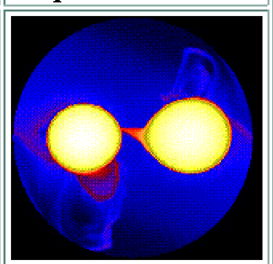
The Dynamics of Mass-Transferring Binary Star Systems

(Preliminary Results)
[1998 - 1999]

Stable System

Quicktime (1,648K)

In a separate summary report we have described a published study of the stability of close, equal-mass binary star systems that exhibit different degrees of gas compressibility. Here we briefly describe a related ongoing investigation into the stability of close binary systems in which the stars have unequal masses. This is a much more difficult problem in several respects. First, it is more difficult to construct initial equilibrium models of unequal-mass binary star systems; second, there is more demand on the computational tools when simulating the dynamical evolution of such systems; and third, the variety of systems that can be studied (*i.e.*, the size of the initial parameter space) is much much larger. Most importantly, perhaps, is the realization that when the masses of the two stars are unequal, one star is likely to fill its Roche lobe before the other and thereby instigate a mass-transfer event. This, of course, also makes the study of such systems more interesting in an astrophysical context.

The animation sequence labeled here as "Stable System" demonstrates how well we are able to follow the orbital motion of an unequal-mass (mass ratio = 0.81) system in which the less massive component very nearly fills its Roche lobe. In this movie the system is being viewed "face-on," and from the inertial frame of reference. We have followed the dynamical evolution of the system through more than four full orbits, fully resolving the structure of both polytropic stars.

3D Closeup	**Equatorial Slice**
	
Quicktime (1,083K)	Quicktime (1,093K)

The two animation sequences shown here to the left depict the very early stages of evolution in our first test run of an $n = 3/2$ polytropic system that was expected to be unstable toward mild mass transfer. The illustrated system has a mass ratio $q = 0.88$, and at the beginning of the simulation the less massive component (shown on the right) is just marginally filling its Roche lobe. In both movies the system is viewed face-on and from a frame of reference that is rotating with the orbital frequency of the system. The "Equatorial Slice" movie displays density contours in the equatorial plane, highlighting the flow of even the very lowest density material; the "3D Closeup" movie provides a magnified 3D rendering of isodensity surfaces in the accretion stream.

Producers	***Visualization Directors***	***Scientific Director***
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