

Early Shaping of Asymmetric Planetary Nebulae

Noam Soker

Department of Astronomy, University of Virginia
P.O. Box 3818 University Station, Charlottesville, VA 22903

We suggest that the shape of a young asymmetric planetary nebulae may be influenced by a close binary star located at its center. This binary is a relic of the common envelope phase, presumably through which the asymmetric planetary nebula evolved. We assume that for a short period of time, shortly after the cessation of the slow wind and long before the fast wind becomes effective, the binary ejects a small amount of mass, mainly in the equatorial plane. In this work we do not discuss the exact mechanism for the ejection of this pulse of mass. In the case in which the cooling is very efficient, (i.e., high-Mach-number isothermal flow), we can solve the problem analytically by using a few simplifying assumptions. In this case the high density region is shaped like a ring. We use two-dimensional hydrodynamics for the more general case. We find that at late times the high density region has a "horseshoe" shape, as viewed in the symmetry plane. There is an instability in the maximum density region. Finally we compare our results with the shape of the planetary nebula M2-9.