A hydrodynamical model of the circumstellar bubble created by two massive stars

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Numerical models of the wind-blown bubble of massive stars usually account only for the wind of a single star. However, since massive stars are usually formed in clusters, it would be more realistic to follow the evolution of a bubble created by several stars. We make a 2D model of the circumstellar bubble created by two massive stars: a 40 solar mass star and a 25 solar mass star and follow its evolution. The stars have a separation of approx. 16 pc and surrounded by a cold medium with a density of 20 particles per cubic cm. We use the MPI-AMRVAC hydrodynamics code to solve the conservation equations of hydrodynamics on a 2D cylindrical grid using time-dependent models for the parameters of the wind of the two stars. At the end of the stellar evolution (4.5 and 7.0 million years for the 40 and 25 solar mass stars respectively) we simulate the supernova explosion of each star. Initially, each star creates its own bubble. However, as the bubbles expand they merge, creating a combined, a-spherical bubble. The combined bubble evolves over time, influenced by the stellar winds and supernova explosions. The evolution of a wind-blown bubble, created by two stars deviates from that of the bubbles around single stars. In particular, once one of the stars has exploded, the bubble is too large to maintain for the wind of the remaining star and the outer shell starts to fall apart. The lack of thermal pressure inside the bubble also changes the behavior of circumstellar features close to the remaining star. The supernovae are contained inside the bubble, which reflects part of the energy back into the circumstellar medium.

Reference: Accepted for publication in Astronomy & Astrophysics
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1204.2078

Comments: additional data to be published online

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