3-D simulations of shells around massive stars

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As massive stars evolve, their winds change. This causes a series of hydrodynamical interactions in the surrounding medium. Whenever a fast wind follows a slow wind phase, the fast wind sweeps up the slow wind in a shell, which can be observed as a circumstellar nebula. One of the most striking examples of such an interaction is when a massive star changes from a red supergiant into a Wolf-Rayet star. Nebulae resulting from such a transition have been observed around many Wolf-Rayet stars and show detailed, complicated structures owing to local instabilities in the swept-up shells. Shells also form in the case of massive binary stars, where the winds of two stars collide with one another. Along the collision front gas piles up, forming a shell that rotates along with the orbital motion of the binary stars. In this case the shell follows the surface along which the ram pressure of the two colliding winds is in balance. Using the MPI-AMRVAC hydrodynamics code we have made multi-dimensional simulations of these interactions in order to model the formation and evolution of these circumstellar nebulae and explore whether full 3D simulations are necessary to obtain accurate models of such nebulae.

Reference: SociÃ©tÃ© Royale des Sciences de LiÃ¨ge, Bulletin, vol. 80, p. 266-278 (Proceedings of the 39th LiÃ¨ge Astrophysical Colloquium, held in LiÃ¨ge 12
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