Abstract: Massive stars (> 8M☉) lose mass throughout their lifetime, via winds and eruptions, before ending their lives in a cataclysmic supernova (SN) explosion. The interaction of this material with the surrounding medium creates vast wind-blown cavities surrounded by a dense shell, referred to as wind-blown bubbles. As the star evolves through various stages, the mass-loss parameters will change, affecting the structure of the bubble. When the star finally explodes, the resulting SN shock wave will expand within the bubble, and the dynamics and kinematics of the shock wave will depend on the bubble parameters. Similarly, the relativistic blast waves associated with gamma-ray bursts are expected to expand within wind bubbles surrounding Wolf-Rayet (W-R) stars. Thus, it is important to understand the structure of the bubble, as it influences the evolution and emission from supernovae and gamma-ray bursts.

Using an ionization-gasdynamics code, AVATAR, we compute the structure and evolution of the wind-blown bubbles around massive stars. We study the time evolution, dynamics, hydrodynamics and kinematics, the formation of instabilities, growth of small scale structure, and the onset of turbulence. Using the ISIS package, we compute the X-ray spectrum from the simulations as would be observed by the Chandra satellite, and compare to observational data.

(Dwarkadas & Rosenberg, HEDP, 2013, 9, 226)

Conclusions: We have developed a code that successfully manages to reproduce both the hydrodynamics and ionization structure of wind-blown nebulae around massive stars, and used it to reproduce the nebula around a 40 M☉ star. We have then computed the X-ray spectra from this bubble. Our simulations show that the X-ray emission in the MS phase is generally too weak to be detected by current X-ray satellites. It is higher in the W-R stage, but still difficult to detect. This is in agreement with observations, which have only detected 2 W-R nebulae, and no MS nebulae around massive stars (Chu et al. 2003 ApJ, 599, 1189; Chu, Guerrero & Grundl 2004).

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