Shape and evolution of wind-blown bubbles of massive stars: on the effect of the interstellar magnetic field

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The winds of massive stars create large (>10 pc) bubbles around their progenitors. As these bubbles expand they encounter the interstellar coherent magnetic field which, depending on its strength, can influence the shape of the bubble. We wish to investigate if, and how much, the interstellar magnetic field can contribute to the shape of an expanding circumstellar bubble around a massive star. We use the MPI-AMRVAC code to make magneto-hydrodynamical simulations of bubbles, using a single star model, combined with several different field strengths: B=5, 10, and 20 muG for the interstellar magnetic field. This covers the typical field strengths of the interstellar magnetic fields found in the galactic disk and bulge. Furthermore, we present two simulations that include both a 5 muG interstellar magnetic field and a 10,000 K interstellar medium and two different ISM densities to demonstrate how the magnetic field can combine with other external factors to influnece the morphology of the circumstellar bubbles. Our results show that low magnetic fields, as found in the galactic disk, inhibit the growth of the circumstellar bubbles in the direction perpendicular to the field. As a result, the bubbles become ovoid, rather than spherical. Strong interstellar fields, such as observed for the galactic bulge, can completely stop the expansion of the bubble in the direction perpendicular to the field, leading to the formation of a tube-like bubble. When combined with a warm, high-density ISM the bubble is greatly reduced in size, causing a dramatic change in the evolution of temporary features inside the bubble. The magnetic field of the interstellar medium can affect the shape of circumstellar bubbles. This effect may have consequences for the shape and evolution of circumstellar nebulae and supernova remnants, which are formed within the main wind-blown bubble.

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