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EVOLUTION OF A SUPERBUBBLE BLASTWAVE IN A MAGNETIZED MEDIUM.

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We investigate the effects of interstellar magnetic fields on the evolution and structure of interstellar "superbubbles", using both analytic and numerical MHD calculations. These cavities of hot gas, surrounded by shells of cold dense material preceded by a shock wave result from the combined action of stellar winds and supernova explosions in OB associations.

If the medium in which a superbubble goes off is homogeneous and unmagnetized, the blast wave expands isotropically. As the interstellar gas flows through the shock, it cools significantly and gets strongly compressed such that thermal pressure remains approximately equal to ram pressure. Hence, the swept up material is confined to a very thin shell.

However, if the ambient medium is permeated by a uniform magnetic field $\cancel{B_0 \sim 3\mu G}$ (typical value for the ISM), the configuration loses its spherical symmetry, and, due to magnetic pressure, the shell of swept up material does not remain thin. We find the following qualitative differences:

1. Except in the immediate vicinity of the magnetic poles, the shell is supported by magnetic pressure. ~~Its thickness, which is now~~ determined by flux conservation, increases continuously from the poles to the equator.
2. The refraction of field lines at the shock and the thermal pressure gradient along the shell both contribute to accelerating the gas toward the equator. The resulting mass flux considerably decreases the column density at the magnetic poles.
3. Away from the poles, magnetic tension in the shell causes the field lines (particularly the inner boundary) to elongate in the direction of $\cancel{B_0}$. ~~In contrast, the~~ shock wave radius increases with increasing θ , as would be the case if the wave were linear. At late times, however, the shock surface tends to flatten near the equator.
4. The reduced inertia of a parcel in the polar neighborhood makes it easier to decelerate, and accounts for the dimple which appears at the poles in numerical simulations. This dimple also results from the necessity to call on intermediate shocks in order to insure a smooth transition between a purely thermal shock at the poles and a magnetic shock in the rest of the shell.
5. The shock wave propagates faster than in the absence of magnetic field, except near the poles where the reduced mass of the shell allows it to be more efficiently decelerated. The shell inner boundary travels slower in a magnetized medium, regardless of the value of θ.

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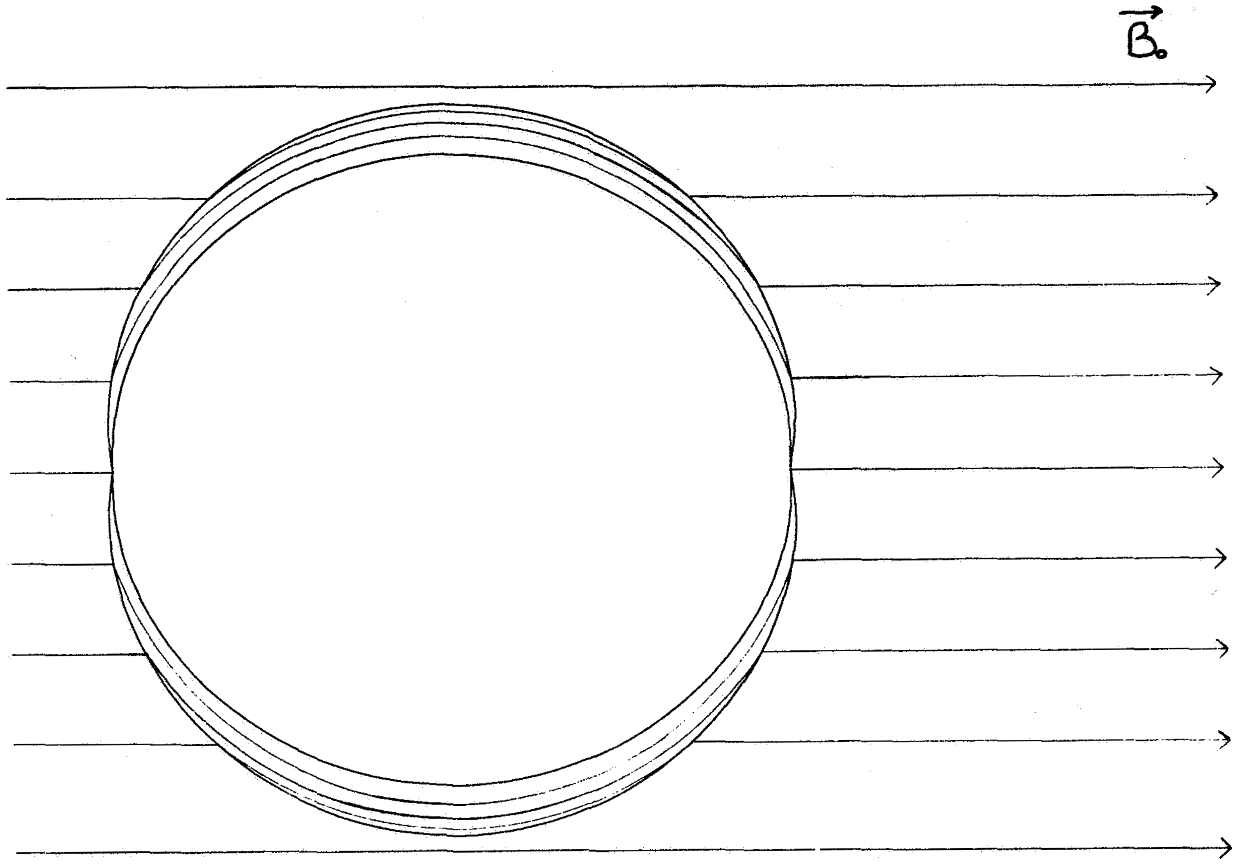

Shape of a superbubble in a medium with $n_0 = 0.324\ cm^{-3}$, $T_0 = 8000K$, $B_0 = 3\mu G$, at $t\ =\ 3 \times 10^6\ yr$.