GS64-01-97:

EXPANDING SUPERSHELL IN THE MILKY WAY

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The expansion of shocked interstellar medium around an OB association is an example of the astrophysical blastwave (Ostriker and McKee, 1988). The thin, cold, shell-like structure expanding supersonically accumulates the ambient medium. We assume that the shell has the zero thickness at radius of the shockwave r_S and that it expands at velocity v_S. The shell is divided into elements described with equations of motion: $\frac{d}{dt}(Mv_S) = dS[(P - P_o) + n_o v_o(v_S - v_o)] - Mg(R,z)$, where M and dS are the mass and the surface of it, P, P_o are the inside and outside pressures, n_o, v_o are density and velocity of the ambient medium and $g(R,z)$ is the gravitational acceleration in the Galaxy. R, z are the galactocentric cylindrical coordinates. The mass of an element increases as long as the expansion velocity component normal to the shell, $v_\perp$, exceeds the velocity of sound in the ambient medium $\dot{M} = v_\perp n_o dS$. The 3D model using the above infinitesimally thin shell approximation was developed by Palouš (1990, 1992) and Silich (1992).

In this contribution, the 3-D numerical simulations are compared with the HI feature GS064-01-97 discovered by Heiles (1979). This structure has also been observed as a part of the Leiden–Dwingeloo 21 cm survey of the Milky Way (Hartmann, Burton, 1994). Possible energies of expansion and the distances of the structure from the galactic center are proposed. The z-distribution of the ambient medium is $n(z) = n_C e^{(-\frac{(z-z_{warp})^2}{\sigma_C^2})} + n_E e^{-(\frac{|z-z_{warp}|}{z_E})}$, where n_C, n_E are the volume densities and σ_C, z_E are scale heights of the gaussian and exponential components. Their values are

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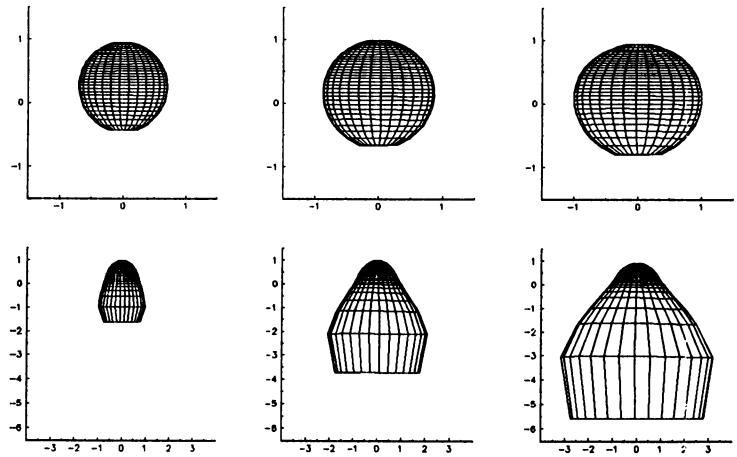

Figure 1. The supershell in the exponential (upper panel) or gaussian (lower panel) atmosphere after 10, 20 and 30 Myr of expansion.

derived from the total HI surface density $\Sigma_{\rm HI}$ and the scale height $z_{1/2}$ taken from Wouterloot et al. (1990). For the galactic HI warp we adopt $z_{warp} = 0.102\ (R - 8.075)\ cos(\phi - 85^o)$ according to Burton (1976).

Resulting initial energy is $\sim 10^{54}$ erg. With smaller or bigger values the supershell has column densities differing from observation. In the radial velocity channel maps, the angular diameter of the structure is best reproduced for the galactocentric distance 16 ± 1 kpc. In Fig. 1 we show the shape of the structure expanding in gaussian or exponential z-distribution of the ambient medium. For gaussian z-distribution the bubble blows-out to the galactic halo, which is not compatible with observation.

We conclude that the energy $\sim 10^{54}$ erg released at the galactocentric distance $\sim$ 16 kpc into the exponential HI atmosphere can produce the structure similar to GS064-01-97.

References

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