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FIRST HIGH-RESOLUTION SIMULATIONS OF THE LOCAL BUBBLE

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We present the first detailed numerical simulations, down to scales of 1.25 pc, of the evolution of a multi-supernova origin for the Local Bubble (LB).

This study follows the work by Berghöfer & Breitschwerdt (2002), who suggested that the LB was created by successive explosions of the stars from the moving subgroup B1 of the Pleiades, between ~ 15 Myrs ago and the present. A major difference from previous studies is that we follow the evolution of the LB in a *realistic* ambient background medium. The explosion of the stars was set to occur after 200 Myr of evolution of the large-scale simulations of the disk-halo interaction (de Avillez 2000). Their masses and main-sequence lifetimes are taken from the initial mass function (IMF) derived in Berghöfer & Breitschwerdt (2002). The stars explode at an average rate of 1 per 6.5×10^5 yr.

Modeling: A total of 20 stars with masses varying between 10 and 20 $M_\odot$ explode at $x = 220$, $y = 400$ pc (see Figure 1), thus generating the Local Cavity into which the LB will expand. The Galactic supernova (SN) rate has been used for the set-up of *other SNe* in the remainder of the disk. These runs (over 25 Myrs) made use of the 3-D parallel (multi-block structured), adaptive mesh refinement scheme developed by de Avillez & Mac Low (2003) with the finest level resolution being 1.25 pc in these runs. The grid has $0 \leq x,\ y \leq 1$ kpc, $|z| \leq 10$ kpc and periodic boundary conditions along the vertical direction, and free conditions at $z_{\rm min}$ and $z_{\rm max}$.

Results: The locally enhanced SN rate produces a coherent LB structure within a highly disturbed background medium (due to ongoing star formation). Successive explosions heat and pressurize the LB, which at first looks smooth, but develops internal structure at $t > 8$ Myr. After 13.5 Myr, 20 SNe have occurred inside the LB, filling a volume roughly corresponding to the present day LB (Figure 2). The LB is still bounded by a shell, which starts to fragment due to Rayleigh-Taylor instabilities after the last explosion. Clouds and cloudlets of various sizes are formed when dense shells of bubbles collide, as has been predicted by Breitschwerdt, Freyberg, & Egger (2000). The volume filling factor of the hot gas is moderately low ($\sim 20\%$) even without a magnetic field.

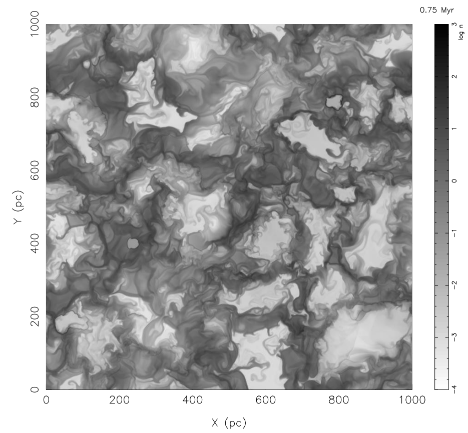

Fig. 1. The first star, having a mass of 20 $M_\odot$, explodes at $x = 220$, $y = 400$ pc, defining the origin of the LB.

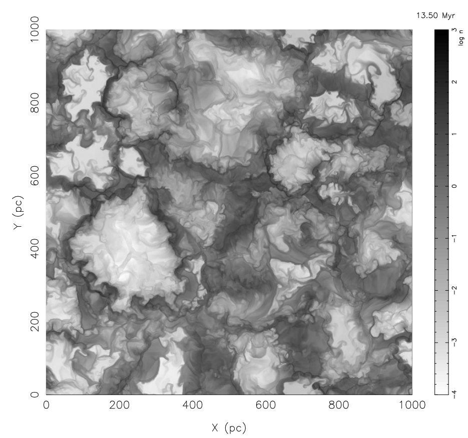

Fig. 2. The local bubble at time 13.50 Myr after the 20th supernova, which originated from a 10 $M_\odot$ star, occurred.

This is the highest resolution model of the LB so far, showing structures down to 1.25 pc, emphasizing the need to probe even smaller scales in order to understand its evolution, and to interpret detailed observational data, especially in the EUV and soft X-rays.

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