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How to Interpret the Bubble-Dominated ISM in the LMC?

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Abstract. 3D computer simulations are used to discuss shapes, expansion velocties, masses and fragmentation of expanding shells in the LMC.

1. Model of the LMC

A three component model of the mass distribution in the LMC composed of the interstellar medium, stars and dark matter is proposed by Efremov et al. (1999). We assume that the large-scale shape of the gravitational potential is formed by stars and dark matter. The model reproduces the rotation curve of the LMC as it is given by Kim et al. (1998), the total mass within 8 kpc from the LMC center is $8 \times 10^9 M_\odot$, 60 % is in stars and 40 % is in the dark matter. The interstellar medium is distributed in a disk, which is partially supported by the centrifugal force and partially balanced with the pressure gradients. Such distribution has been used by Tomisaka & Ikeuchi (1988) and others for models of large-scale bipolar flows from nuclear starbursts in dwarf galaxies. For the gas turbulent velocity 8 km s^{-1} we get $2.2 \times 10^8 M_\odot$ for the total gas mass within 4 kpc, and about 375 pc for the thickness of the gas layer between $1 < r < 4$ kpc.

2. Shapes, Velocities and Masses of Expanding Shells in the LMC

The expansion of gas layers due to energy inputs from OB associations is described using a 3D computer code, which has been developed by Palouš (1990) and Ehlerová et al. (1997). The results of simulations with the average or increased densities are given in Table 1 and Fig. 1. Conditions for instability and fragmentation of expanding and decelerating shells have been discussed by Ehlerová et al. (1997). The fragmentation integral I_f is shown as a function of time in Fig. 1 (right panel). For values $I_f \sim 1$ the fragments are well developed, so that star forming clouds may form.

3. How to Trigger Star Formation?

Computer simulations of expanding shells in the LMC give sizes, expansion velocities and masses in agreement to the observed values. However, our analysis shows that, with the average gas density of the LMC, they are rather stable. Assuming that the gas density has been increased to higher values, probably

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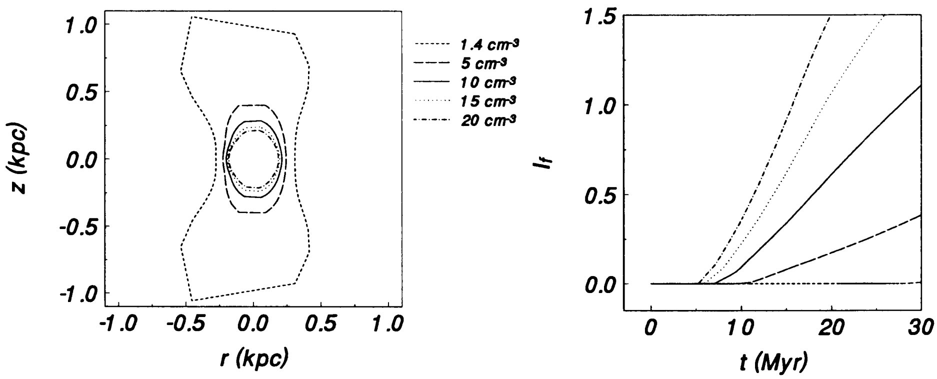

Figure 1. Shells after 15 Myr of expansion: $r_{sh} - z_{sh}$ cuts (left panel), and the value of the fragmentation integral I_f as a function of time (right panel). The values of the ambient density n_0 are indicated.

due to the compression by another nearby supershell, the expanding shell may become instable, fragment, and form the next generation stars.

	5 Myr				10 Myr				15 Myr			
n_0	r_{sh}	z_{sh}	v_{exp}	m_{sh}	r_{sh}	z_{sh}	v_{exp}	m_{sh}	r_{sh}	z_{sh}	v_{exp}	m_{sh}
1.4	157	190	23.3	0.7	225	410	40.7	1.9	278	1062	113.4	2.7
5	122	135	15.5	1.2	176	236	15.6	3.5	225	397	27.3	5.0
10	106	114	12.6	1.6	154	188	11.6	4.4	201	279	14.8	5.9
15	97	104	11.2	1.9	143	165	10.1	4.5	189	234	11.4	5.8
20	91	97	10.3	2.0	136	151	9.21	4.4	182	208	9.6	5.4

Table 1. Five models at three expansion times: 5, 10 and 15 Myr. The expansion starts with the total energy input $E_0 = 5 \times 10^{52}$ erg in the medium of the volume density n_0. The resulting typical radius r_{sh}, the z extent of the shell z_{sh}, both in pc, the typical expansion velocity v_{exp} in km s^{-1} and the total mass in the shell m_{sh} in $10^6 M_\odot$ are given.

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