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# The Physics of $10^6$ K Gas in LMC Supergiant Shells

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**Abstract.** We present first results of our study of the interplay between the $10^6$ K, $10^4$ K, $10^2$ K gas phases in the supergiant shell LMC 4.

## 1. Introduction

Supergiant shells are the largest interstellar structures in galaxies. The Magellanic Clouds harbour more than ten supergiant shells like LMC 1, LMC 4, and SMC 1 (Meaburn 1980), which appear as complete shells of H$\alpha$ filaments with some normal HII regions distributed along the rim. LMC 4 is the largest of the supergiant shells, with a diameter larger than 1.4 kpc. LMC 4 also contains Shapley Constellation III, a very large OB association (e.g., Braunsfurth & Feitzinger 1983). The most promising formation mechanism of H$\alpha$ supergiant shells calls for the combined effect of fast winds of massive stars and SNe to create the expanding bubble (e.g. Mac Low et al. 1989). We have shown earlier, that the cavity of LMC 4 contains $10^6$ K hot gas (Bomans et al. 1993) and that $10^5$ K gas exists on boundary layers between hot and cold gas (Bomans et al. 1996). Supergiant shells are therefore exquisite laboratories for studying the interplay of the cold, warm, and hot gas phases of the interstellar medium.

## 2. Data

The presented H$\alpha$ image is a mosaic of five fields taken with the Curtis Schmidt at CTIO. Exposure time of each field is 30 minutes. The IRAS $100\mu$ image is produced by the SKYVIEW facility using the IRAS Sky survey (Wheelock et al. 1991). The X-ray image is mosaicked from our ROSAT PSPC raster pointings of LMC 4 and all available archived PSPC pointings in the LMC 4 region (about 200). We excluded the regions around point sources to minimize the contamination of diffuse emission, and transformed the remaining photons into a common reference frame. The mosaicking software produces spectra of defined regions by collecting the corresponding photons from all observations and correcting them individually for vignetting.

## 3. Large Scale Structure

The Hα image shows the known 1.4 kpc ring of LMC 4. This very deep image reveals the complexity of the filaments, making it sometimes difficult to define the exact boundary of LMC 4. On large scales Hα filaments are located just inside the peaks of the neutral gas ridge. We overlaid the X-ray medium band image with contours of the IRAS $100\mu$ emission. A ring of enhanced X-ray emission follows the outline of the neutral gas hole, with the X-ray surface brightness decreasing toward the center. The center is still above the surface brightness of the extragalactic background, as measured outside the LMC. This structure may imply that we simply see the edge-brightening of a shell of gas with a very low density (and therefore low surface brightness) in the central region. This is exactly what theory predicts for a superbubble (Weaver et al. 1978). The higher X-ray surface brightness along the rim is partly caused by the mass evaporation across the conduction zone between the dense cold shell and the hot interior.

## 4. Temperature Structure of the Hot Gas

The medium to soft band ratio map shows a harder emission in the high surface brightness regions near the shell walls. This is consistent with recent supernovae from Shapley Constellation III hitting the shell walls and producing hotter and relatively dense plasma. Such a scenario was suggested for the superbubble N51D by Chu & Mac Low (1990). The spot of lowest X-ray surface brightness coincides with the minimum of neutral gas column density. Here, the HI 21cm line also shows high velocity components receding relative to the rest velocity of the LMC (Domgoergen et al. 1995). The low X-ray surface brightness supports that in this region LMC 4 has started to break out into the halo of the LMC.

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## References

Bomans, D.J., Dennerl, K, & Kürster, M. 1993, A&A, 283, L21

Bomans, D.J., de Boer, K.S., Koornneef, J., & Grebel, E.K. 1996, A&A, 313, 101

Braunsfurth, E., & Feitzinger, J.V. 1983, A&A, 123, 113

Chu, Y.-H., & Mac Low, M.-M. 1990, ApJ, 365, 510

Domgoergen, H., Bomans, D.J., & de Boer, K.S. 1995, A&A, 296, 523

Mac Low, M.-M., McCray, R., & Norman, M.L. 1989, ApJ, 337, 141

Meaburn, J. 1980, MNRAS, 192, 365

Weaver, R., McCray, R., Castor, J., Shapiro P., & Moore R. 1978, ApJ, 218, 377

Wheelock et al. 1991, IRAS Sky Survey Atlas Explanatory Supplement

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