KINEMATICS OF THE HII REGION N11 IN THE LMC

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INTRODUCTION

Four mechanisms have been proposed to explain the structures and large scale mass motions of HII regions: the Champagne model, the 'classical' picture of an expanding Strömgren sphere, interaction of stellar winds and supernova blast waves with the surrounding medium. Especially the last three models have been used to explain the LMC shell structures. Braunsfurth et al. (1983) showed that it is not possible to distinguish the driving mechanisms for individual regions from their global appearance (dimension). Detailed studies of individual shells however, have been limited to the largest and brightest (30 Dor) or the more symmetric ones (e.g. N70, rings around WR stars).

The N11 complex (DEM 34, MC 18) is the most massive LMC HII region, has the largest excitation parameter, highest Hα and FUV flux besides 30 Dor (Braunsfurth et al., 1983, Israel, 1980). Meaburn (1978) described the shell like structure around the OB association LH 9, while Henize (1956) catalogued several bright HII condensations, which dominate this complex. Only the brightest of these (B) has been studied in detail to identify the excitation sources (Heydari-Malayari et al., 1983).

OBSERVATIONS

A Fabry-Perot etalon (interference order=1482, free spectral range =4.4 Å= 200 km/s) has been used with a focal reducer at the 1m telescope of the European Southern Observatory to study the radial velocities of the Hα line. 440 velocity points have been measured on 6 plates using a modified Abbe comparator. From these, mean values have been derived over a grid of 1'=16 pc side length, centered on the bright WC5 star HD 32228 (R64, FD6, Br9...). The internal error is about 3 km/s for well exposed ring segments, while it can be considerably higher for weak ring segments. The 1□' mean values were used to derive a velocity field which was checked with the individual velocity points to position contour lines more exactly. This was however possible only for the brighter regions, where the number and accuracy of individual data points is large enough.

S. van den Bergh and K. S. de Boer (eds.), Structure and Evolution of the Magellanic Clouds, 391–392.

https://doi.org/10.1017/S0074180900040547 Published online by Cambridge University Press

To study the exciting sources of the nebulae, CMDs were derived from published photographic magnitudes and colours (Woolley, 1963, Lucke, 1972). After applying a correction of 0.2mag to Woolley's V and B-V data, the values of both authors agree very well for LH 9. The stars of the associations LH 10 and LH 13 which are embedded in the nebulae N11 B and C respectively, are too red to fit the main sequence. If this is not due to observational difficulties (nebular background, multiple stars), reddening of about E(B-V)=0.5mag and absorption of A_V=3•E(B-V)=1.5mag must be assumed to fit these stars to the main sequence. With the distance modulus of 18.6 mag and E(B-V)=0.1mag for LH 9 a $(B-V)_0-M_V$ diagram can be constructed. Some of the bluest and brightest stars are either compact HII regions or multiple stars or have smaller reddening values. The high absorption would allow to identify most of the exciting sources of the nebulae. Fitting isochrones to the data yields an age of about 4.5 for LH 9 and about 3.5 million years for the clusters embedded in the nebulae. This age sequence is supported by the ages derived for the HII regions (Dottori et al., 1981), though their ages are older.

DISCUSSION

The velocity fields of N11B and C vary from about 285km/s at the southwest edge to about 295(B) and 290(C) km/s at the NW edge. These two condensations are at the SW border of a large (0.5x1kpc) HI cloud with a radial velocity of 293km/s. A geometric model could explain the two HII condensations as cavities (blisters) at the edge of the HI cloud with flows of ionized gas into the direction of the observer.

The region around the association LH 9 appears even on long exposure plates devoid of Hα emission, while the surrounding nebulae show an ellipsoidal ring structure of 70x100pc inner diameter. Dominant object of this association is something like a compact cluster around the WC5 star HD 32228. The galactic counterparts of these stars have high mass loss rates with wind powers of about $1.5 \cdot 10^{38}$erg/s. Interaction of this wind with the neutral cloud (density 2.5 cm^{-3}) would form a bubble of the observed dimensions after about 700 000 years. Due to the faint hydrogen emission around the association, radial velocities are difficult to measure. On one interferogram however, split lines are marginally visible, indicating an expansion velocity of about 40 ± 20 km/s, which could also be explained by a wind-driven bubble.

Sequential star formation appears attractive to explain the age difference and the spatial arrangement of the N11 complex: first LH 9 has been formed and the stellar wind and ionization-shock front expanding into the HI cloud might have triggered star formation in N11B and C.

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