

THE EXTRAGALACTIC HII REGION N11 AND ITS SURROUNDING FIELD

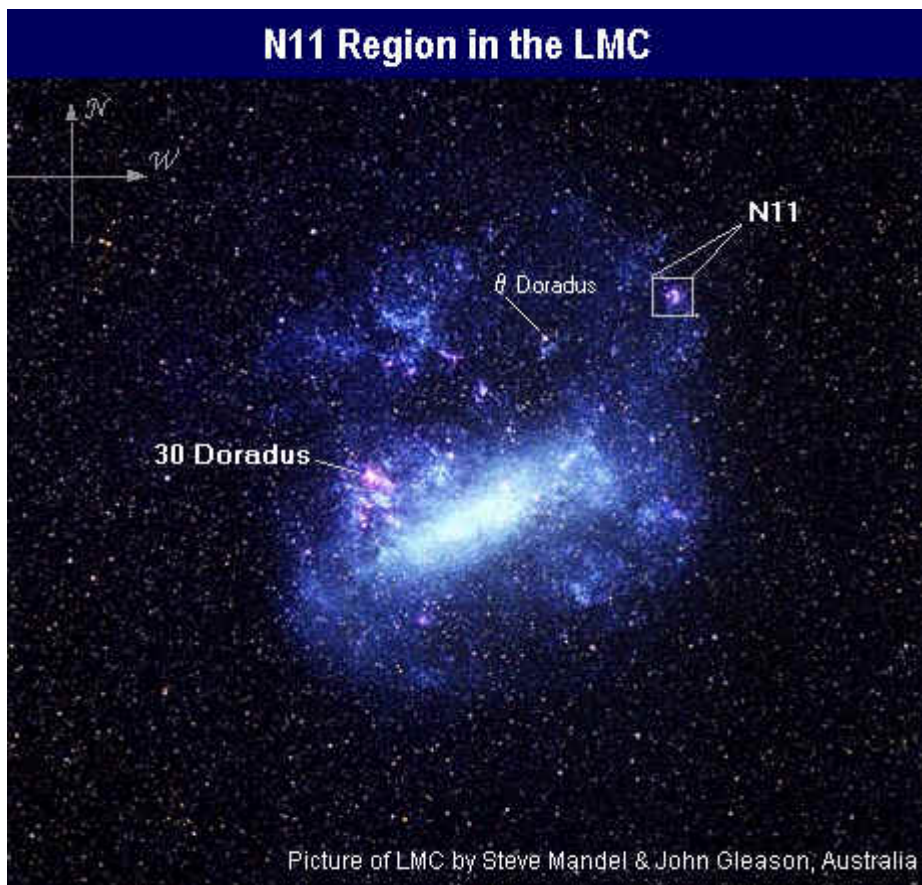
by Leo Cavagnaro

The Observation of the Second Largest HII Region in the Large Magellanic Cloud

The northwest corner of the Large Magellanic Cloud (LMC) is home of many different kind of deep sky objects, including bright nebulae, open and globular clusters and supernova remnants. Several of these objects are visible within the range of average size amateur telescopes.

But more than this, the northwest region hosts the second largest HII region of our satellite galaxy, the N11 complex.

I began the observation of this interesting formation from an observing site at Uspallata Valley (2,000 meters above sea level) at 01:25am on February 14, 2010, when the LMC was at 40 degrees altitude. This is a circumpolar object at this latitude and it reaches about 53 degrees when it transits. At the lowest altitude (inferior transit) it is visible at 13 degrees above the southern horizon. Taking this into account, the best season to observe this galaxy is during the southern summer months (December, January, February & March) when it is high in the sky.



The N11 Complex and Its OB Associations

N11, whose parts are known with the more familiar numbers in the NGC catalogue, lies about 4.75 degrees to the northwest of the 30 Doradus complex (Tarantula Nebula) and can be, according to Y. Nazé *et. al.* in their paper “**XMM-Newton Observations of the Giant HII Region N11 in the LMC**”, a more evolved version of this latter nebulae. Observing our nearby satellite galaxy through common and average size binoculars, i.e., 10x50s, N11 is one of the most prominent features that is clearly visible among others, like the 30 Doradus Complex, the conspicuous off-center bar-type structure (see picture above) and the stellar arcs in the northeast part of the galaxy, where Shapley’s Constellation III (one of the most enigmatic structures in the Local Universe: a coherent semi-circular arc spanning several hundred parsecs, composed of

thousands of bright young stars and tens of star clusters) in the LMC4 region lies (nebulae complex to the north of 30 Doradus and to the east of q Doradus). I have indicated all of these features on the picture above taken by Australian astrophotographers. If you come to the southern hemisphere to observe the sky have in mind that N11 is one of the extragalactic bright nebulae.

The 4.8 magnitude star q Doradus, which is clearly visible to the naked eye from a dark sky site, can be a good starting point to find N11 (see picture in first page). This HII region lies about 1.8 degree west-northwest of this star. A first view at low magnification (42x) shows a prominent nebulae com-

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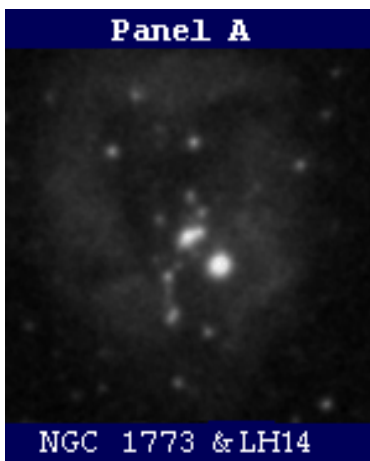
plex about 15 arcminutes wide in a $PA^1=234$ degrees. It is clearly visible even with direct vision and without a filter and contains some patches with different angular sizes and shapes. As mentioned in the paper above it harbors some associations² of massive stars: LH9, LH10, LH13 and LH14 (Lucke & Hodge 1970) and even a SNR, N11L, which is included in another observing project I am carrying out with a bigger mirror (16 inches).

The pattern of three stars indicated with a red circle in Figure 1 on the next page helped me find one of the hazy patches in the complex, NGC 1773, the smaller of the three most conspicuous component of the complex. It is situated half way between the stars HD 32427 (visual magnitude 9.2) and GSC-8889-0432 (visual magnitude 10.7) indicated with letter **A** and **B** respectively in Figure 1 which you can also use to find it. At this power, NGC 1773 shows a star-like bright center surrounded by a faint and small round nebulosity (see Figure 2). The bright core looks off-center with the nebula. Higher magnification is necessary in order to get a more detailed view of its structure.

An open cluster, NGC 1776, with a magnitude of 13 and about 1 arc minute in size (according with the [Wolfgang Steinicke's Revised NGC and IC Catalog](#)) lies close to the star **B** but I could not see it at this magnification.

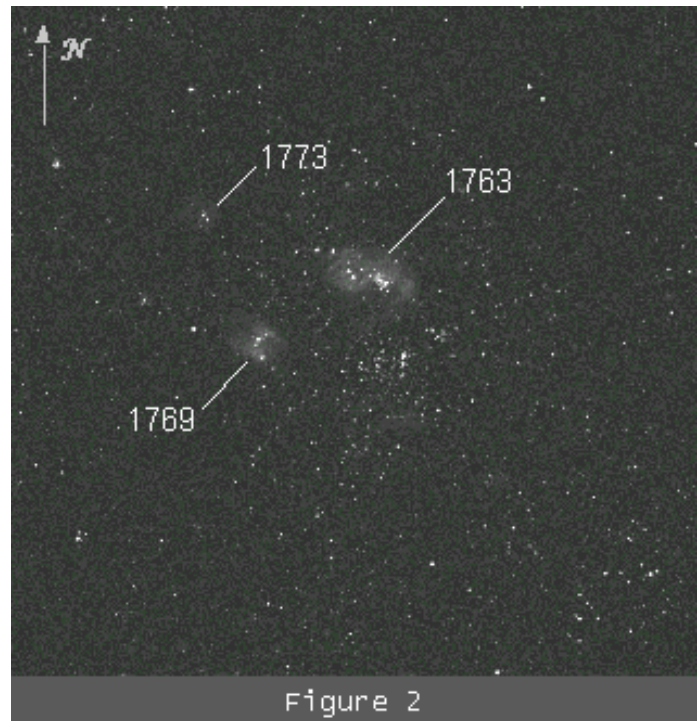
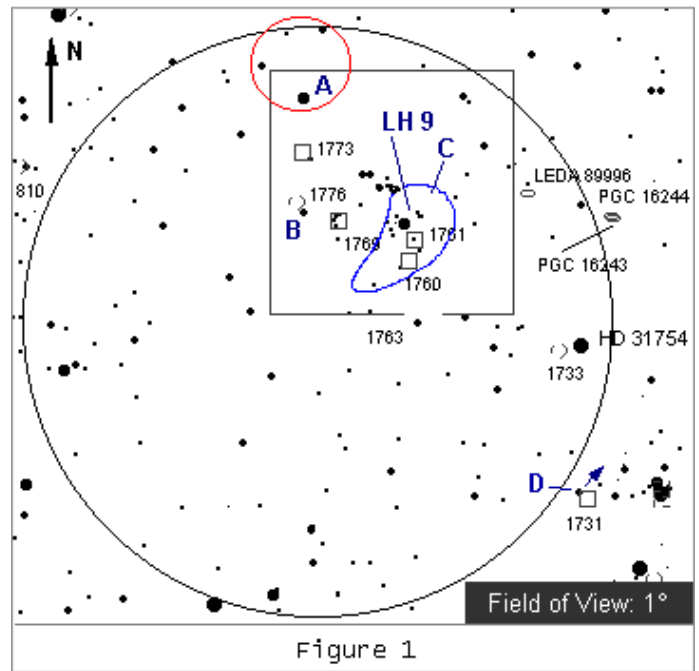
One of the two brightest patches of the complex, NGC 1769 (indicated in Figure 2), looks round with a symmetric nebulosity surrounding a bright stellar-like core. If you observe this nebula carefully for several minutes using averted vision its shape is better viewed.

The other brightest nebula, NGC 1763, is indicated in Figure 2. It is a structure with a brightness similar to that of NGC 1769, and elongated approximately east-west. A more detailed observation at the same magnification (42x) made possible the detection of a stream of faint stars within this nebulae structure, the bigger one.



The zone labeled **C** (Figure 1) that is outlined with a blue line is visible as several faint stars very close to each other embedded in a faint nebulosity. The brightest part is coincidentally in the area where nebulae NGC 1760 and NGC 1761 are situated in the eyepiece field (in the southwest part of the complex).

After the observation and identification of the whole



complex, I decided to use the UHC nebula filter to observe each patch again at the same magnification.

NGC 1769 and NGC 1763 appeared smooth in brightness through this filter and more contrasted with the background sky. On the other hand, NGC 1773 looked sharper and the nebulosity in the region labeled **C** more obvious, with a detached small spot in the south edge, surely NGC 1760.

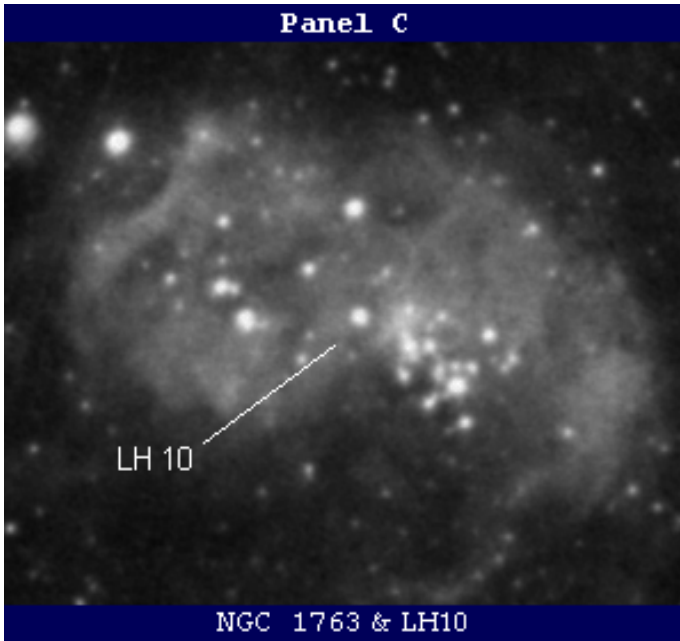
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Using an eyepiece that gives a little higher magnification (78x) two stars appear in NGC 1773 (also N11D) surrounded by a faint nebulosity (see **Panel A**). Embedded in the nebulosity lies LH 14, the least studied of the four OB associations.

NGC 1769, at this magnification, shows the star-like core and the surrounding circular nebulosity with more detail. Mentioned above, there are some OB associations in the N11 complex. LH 13 lies in this bright component also known as N11C. LH 13 contains two compact stellar clusters, Sk-66°41 and HNT. The ages of the two clusters suggest there is no association between them (Heydari-Malayeri *et. al.* 2000). I think the stellar core I saw through my 8-inch telescope is actually Sk-66°41 according to its position in NGC 1769 (see **Panel B**).

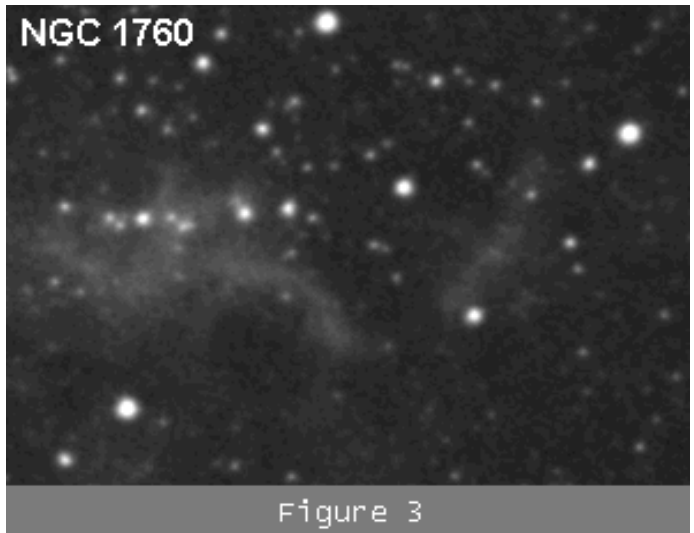
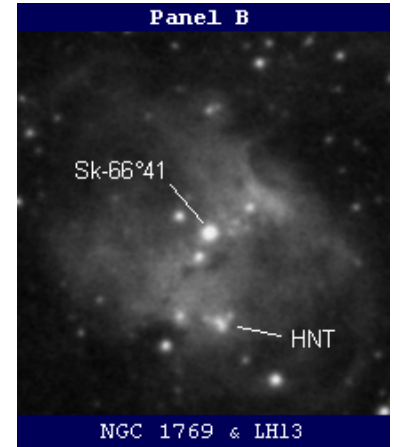
At 78x the stream of stars in the elongated patch NGC 1763 (also N11B) is clearly visible on its south edge (**Panel C**). These stars belong to the OB Association LH 10 which is the youngest cluster of the N11 complex, containing several O3



stars and, according to Nazé *et. al.* 2001, is still embedded in its natal cloud but its most massive components have already begun to blow bubbles around them.

Finally, the region indicated with **C** in Figure 1 looks very interesting at this higher magnification with several stars easier to observe in a hazy background. This group of stars I saw is the LH 9 association (indicated in Figure 1), whose action on its surroundings has triggered a burst of star formation in the periphery leading to the birth of the three other OB associations (Rosado *et. al.* 1996).

At 106x using a UHC nebula filter a very faint and smooth nebulosity with an irregular shape is visible in the zone where NGC 1760 lies (see eyepiece field in page 7). The view I had of NGC 1760 was not as detailed as shown in the DSS image below (Figure 3).



The Surrounding Field of N11

Other objects are situated close to the N11 complex. If we move about 25 arc minutes to the southwest we find the brightest star in the 1 degree field, HD 31754, a 6.4 magnitude reddish star. Very close to it lies the faint (magnitude 13.3) open cluster NGC 1733. I tried to observe it but it was not visible at 42x.

Three galaxies are situated to the west of the N11 complex, the pair of PGC galaxies (16243 & 16244) were not visible at low magnification (42x) and the same occurred with the galaxy LEDA 89996, also not visible at higher magnification (106x).

To the south of these galaxies lies NGC 1731 (see eyepiece

field in page 2). According to [Wolfgang Steinicke's Revised NGC and IC Catalog](#) and software Skymap Pro 6, this is a cluster with nebulosity. Through my 8-inch telescope it looks like a faint luminosity engulfing the 10.7 magnitude star TYC 8889-619-1 indicated with letter **D** in Figure 1. The nebula extends toward the direction indicated by the blue arrow there.

Our nearby galaxy is home of several interesting nebulae complex and group of stars, it is rich in objects to explore through telescopes, thus discovering the wonderful structure and content of this companion, with the Small Magellanic Cloud, of our Milky Way.

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1_ PA= Position Angle

2_ OB Association:

The concept of a stellar association was originally introduced in 1949 by V. A. Ambartsumian, who later separated them into OB and T associations (Ambartsumian 1968). Morgan, Sharpless, & Osterbrock (1952) considered as a stellar association any loose group of stars within an area where bright OB stars exist and with evidence of a common origin.

A recent definition of a stellar association (Kontizas et al. 1999) refers to it as a single, unbound concentration of early-type luminous stars, embedded in a very young star forming region.
