

H II Region Statistics in Barred and Non-Barred Galaxies

M. Rozas and J. E. Beckman

*Instituto de Astrofísica de Canarias, E-38200 La Laguna, Tenerife,
 Canarias, Spain*

J. H. Knapen

*Université de Montréal, Dép. de Physique, C.P. 6128, Succ. Centre
 Ville, Montréal, Québec, H3C 3J7 Canada.*

Abstract. We present new high quality $H\alpha$ continuum-subtracted images of the grand design galaxies NGC 157, NGC 3631, NGC 6764, and NGC 6951, two of them barred and two non-barred, and describe the statistical properties of the HII regions. We have determined the positions, angular sizes and fluxes of individual HII regions, and construct luminosity functions and diameter and density distributions. We find no significant differences between arm and interarm HII region properties, or between the barred and non-barred galaxies. This paper summarizes work described in more detail by Rozas et al. (1995a,b)

1. Observations

The observations were made during of night of 8-9 September 1990 (NGC 157, NGC 6764, NGC 6951) and 20 May 1992 (NGC 3631) with the William Herschel Telescope equipped with the TAURUS camera in imaging mode and an EEV CCD with pixels of projected size $0''.279 \times 0''.279$. The seeing measured at the images was $0''.8$ and $1''.3$ (NGC 3631). We obtained two 1200s exposures for each object: one through a 15\AA wide $H\alpha$ filter redshifted to match the recession velocity of the galaxy, and one through a non-redshifted $H\alpha$ filter to subtract the neighboring continuum emission.

2. HII region selection procedure

In our selection procedure, we started out by defining detection criteria for HII regions. We found that a lower limit of nine contiguous pixels, each with an intensity of more than three times the rms noise of the local background, was an adequately conservative limit for defining an HII region, and distinguishing it from cosmic ray hits or noise peaks.

In many cases, the emission between two HII regions does not reach the background value: the HII regions are connected. We used (following e.g. Rand 1992) the criterion that if an $H\alpha$ emitting complex shows multiple peaks, it is divided, catalogued and measured as separate HII regions. For each HII region

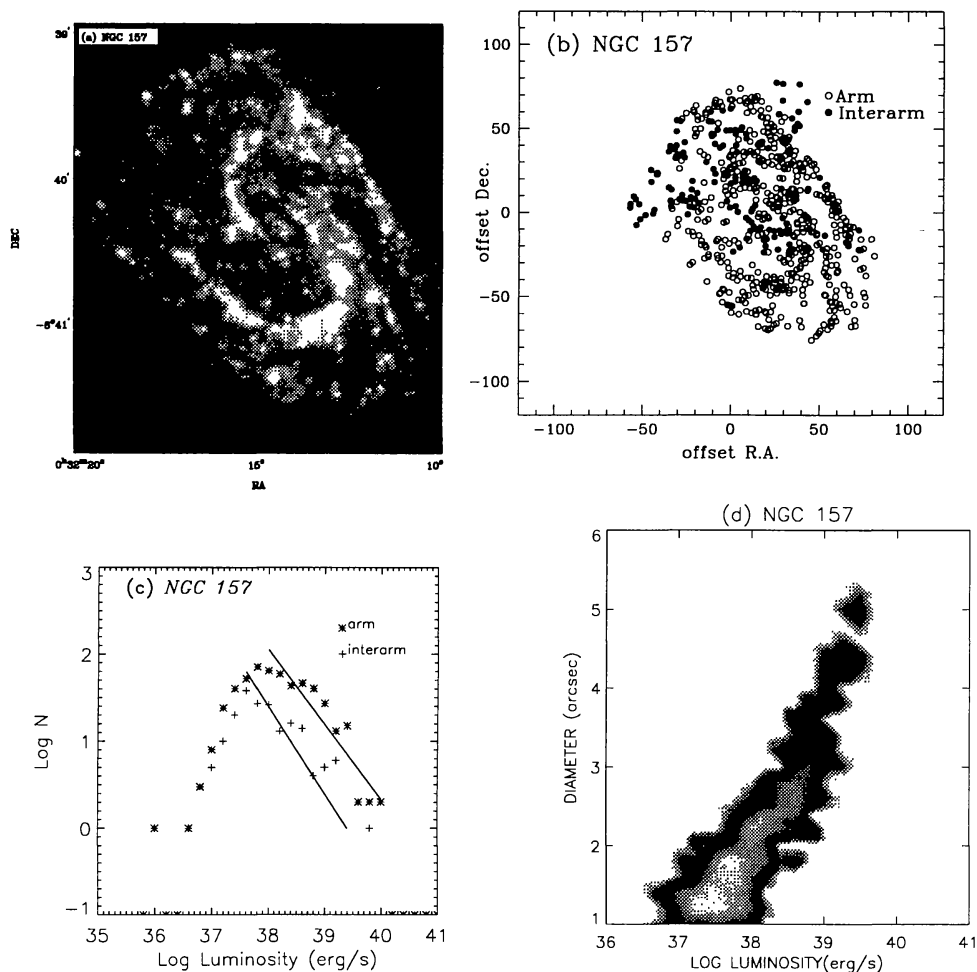


Figure 1. (a, upper left), grey scale representation of $H\alpha$ continuum-subtracted image of NGC 157. (b, upper right), deprojected map of NGC 157, composed of schematic representations of the positions of the measured H II regions. (c, lower left), arm and interarm H II region luminosity functions of NGC 157. (d, lower right), projection on the D-log L plane of the number of H II regions, represented as grey-scale, as a function of their diameter (arcsec) and of their luminosity (erg s^{-1}) for NGC 157.

thus identified, we measured the (x, y) positions in the image relative to the position of the galactic nucleus. We also determined its radius and flux. The flux was integrated in a circular aperture around the center of the HII region and a local residual sky background was subtracted, if appropriate.

For all the regions catalogued, we determined the R.A. and Dec. offsets in arcsec and deprojected distances from the center.

We also determined the effective diameter of each region and its luminosity. For absolute flux calibration we used observations of a standard star of the Filippenko & Greenstein (1984) list.

Finally we gave each region a type assignment: according to whether it is in an arm or an interarm region.

In Figure 1 we show the $H\alpha$ image and a map of the catalogued HII regions for NGC 157, as well as the arm and interarm luminosity functions (LFs) and the diameter-luminosity-number relation for this galaxy.

3. Results and conclusions

- From deep $H\alpha$ images of NGC 157, NGC 3631, NGC 6764, and NGC 6951 we have catalogued a total of 708, 1322, 348, and 674 H II regions respectively, and assigned them to the arms or the interarm disk.
- The total LFs have slopes which agree well with values obtained for other late-type spirals (Kennicutt et al. 1989; Knapen et al. 1993), and the slopes are the same for barred and non-barred galaxies.
- The LFs for the different subsamples of H II regions in the arms and interarm zones have similar slopes, and they are the same for barred and non-barred galaxies within the uncertainties of the fits.
- The projection onto the D-log L plane of the number of H II regions as a function of diameter and luminosity shows a slight curvature towards the highest values (see Figure 1d), possibly marking the limitation on the size of the neutral gas clouds which give birth to the stellar associations.
- We have compared the results for these four galaxies with results for other spiral galaxies in the literature and find that the properties of HII regions in the arm and interarm zones differ in some galaxies but are equal in others. This may be due to the presence of sufficiently strong arms to lift the higher end of the LF in some galaxies such as M51.

References

- Filippenko, A. V. & Greenstein, J. L. 1984, PASP, 96, 530
 Kennicutt, R. C., Edgar, B. K., & Hodge, P. W. 1989, ApJ, 337, 761
 Knapen, J. H., Arnth Jensen, N., Cepa, J., & Beckman, J. E. 1993, AJ, 106, 56
 Rand, R. J. 1992, AJ, 103, 815
 Rozas, M., Beckman, J. E., & Knapen, J. H. 1995a, A&A, in press
 Rozas, M., Knapen, J. H., & Beckman, J. E. 1995b, in preparation