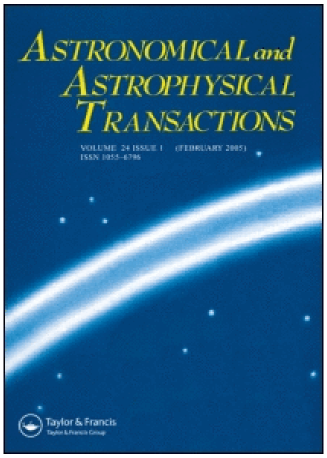


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# STAR FORMING REGIONS IN DISKS OF GALAXIES

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An analysis of the parameters of 71 star forming regions in nine late type spiral galaxies is presented. It is based on multicolor surface photometry data. The ages of the star forming regions are estimated using the evolutionary synthesis method. In most galaxies, the star forming regions are usually located in the resonance rings. The star forming regions belonging to a given galaxy have approximately the same age. The investigation of the distribution of star forming regions by the distance between neighbouring star forming regions shows that a special distance scale exists for ring galaxies.

KEY WORDS Galaxies: spiral, galaxies: late types, star formation, star forming regions

## 1 INTRODUCTION

In the last two decades the problem of star forming regions in galaxies has become very popular. Investigations of star forming regions, their sizes, ages and location in galaxies are conducted both theoretically and observationally. Elmegreen (1994) showed the existence of good conditions for starbursts in the inner Lindblad resonance rings of late types galaxies. Starbursts are proposed to result from gravitational instabilities that fragment the ring into several bound clouds. We present an analysis of multicolor photometry data of 71 star forming regions in 9 late type spiral galaxies.

## 2 OBSERVATIONS AND DATA REDUCTION

Data for the galaxies were obtained with the 1-m telescope at the Special Astrophysical Observatory (SAO) of Russian Academy of Sciences using a K585 CCD camera and with the 1-m and 1.5-m telescope at Mount Maydanak Observatory (MMO) of Ulugh Beg Astronomical Institute of the Uzbek Academy of Sciences

**Table 1.** Description of the observations

| *NGC* | *Filters* | *Observatory* | *Telescope* | *Device* |
|---|---|---|---|---|
| 3184 | *VRI* | SAO | 1-m | CCD |
| 3726 | *BVRI* | SAO | 1-m | CCD |
| 4136 | *BVRI* | SAO | 1-m | CCD |
| 5351 | *BVRI* | SAO | 1-m | CCD |
| 5605 | *BVRI* | MMO | 1.5-m | CCD |
| 5665 | *BVRI* | MMO | 1.5-m | CCD |
| 6217 | *UBVRI* | MMO | 1-m and 1.5-m | EIC and CCD |
| 7292 | *UVR* | MMO | 1.5-m | EIC |
| 7678 | *UBVR* | MMO | 1.5-m | EIC |

using a TI-800 CCD camera and an electronic image converter (EIC). A description of the observations is presented in Table 1.

The CCD camera, EIC and corresponding filters are described in more detail by Esipov *et al.* (1991), Artamonov *et al.* (1999) and Bizyaev *et al.* (2001). The data reduction described in more detail by Artamonov *et al.* (1999). We used the ESO-MIDAS system for the data reduction. The ages of the star forming regions were estimated by their colors using the PEGASE code (Fioc and Rocca-Volmerange, 1997).

Nine late type spiral galaxies were observed. The parameters of the galaxies are presented in Table 2. The data are taken from Internet base LEDA. $D_{25}$ is the corrected isophotal diameter in kpc; $i$ is the inclination in degrees; $P.A.$ is the positional angle in degrees; $M_B^0$ is the absolute blue magnitude, corrected for Galactic absorption; $R$ is the distance to the galaxy in Mpc; $\beta$ is the minimal diameter of observed star forming regions in pc (linear scale of resolution); $N$ is the number of investigated star forming regions in a given galaxy. In addition, we used the data of Larson (1999) for 13 star forming regions in NGC 3184 in our analysis.

**Table 2.** The parameters of the galaxies

| *NGC* | *Type* | $D_{25}$ | $i$ | *P.A.* | $M_B^0$ | *R, Mpc* | *β, kpc* | *N* |
|---|---|---|---|---|---|---|---|---|
| 3184 | SBc | 19.39 | 24.2 | 135 | −19.81 | 9.75 | 95 | 13 |
| 3726 | SB(r)c | 22.19 | 49.2 | 10 | −20.37 | 13.90 | 150 | 12 |
| 4136 | SB(r)c | 9.10 | 22.4 | 135 | −18.41 | 9.72 | 90 | 11 |
| 5351 | SB(r)c | 42.19 | 59.2 | 100 | −21.19 | 50.81 | 500 | 8 |
| 5605 | SBc | 20.74 | 33.9 | 38 | −20.71 | 44.64 | 170 | 5 |
| 5665 | SBc | 19.01 | 53.4 | 145 | −20.46 | 30.62 | 115 | 6 |
| 6217 | SB(r)c | 21.60 | 39.0 | 165 | −20.31 | 21.92 | 80 | 11 |
| 7292 | IBm | 10.97 | 43.9 | 5 | −18.61 | 15.54 | 180 | 1 |
| 7678 | SBc | 33.89 | 48.5 | 5 | −21.58 | 48.24 | 200 | 4 |

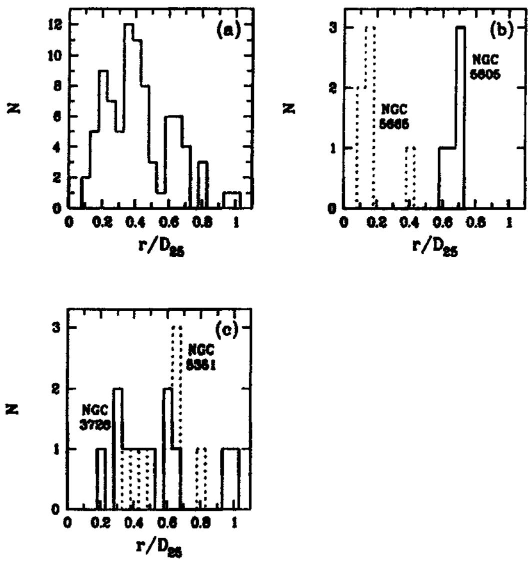


**Figure 1** Distribution of the star forming regions by deprojected distance to the galactic center for all investigated galaxies (*a*), and for the individual galaxies (*b*, *c*).

## 3 ANALYSIS

### *3.1 Distances of Star Forming Regions to the Galactic Center*

The distribution of star forming regions by distance from the center of a galaxy is presented in Figure 1. The distance is normalized to the optical diameter of the galaxies. Several clear maxima are observed on the histogram (Figure 1*a*). This shows that star forming regions are created at particular distances from the galactic center. In some galaxies all star forming regions occur at the same distance from the center. Examples are shown in Figure 1*b*. Probably, these distances are the radii of inner Lindblad resonance and other resonances for these galaxies. However, there are galaxies (include ring galaxies), where the star forming regions are found at different distances from the center of the galaxy (Figure 1*c*).

### *3.2 Distances between Neighbouring Regions of Star Formation*

We examined the reciprocal distances between neighbouring star forming regions in the galaxies. Results for two ring and two non-ring galaxies are shown in Figure 2. Both ring galaxies have the same distances between neighbouring regions of star formation (Figures 2*b*, 2*d*).

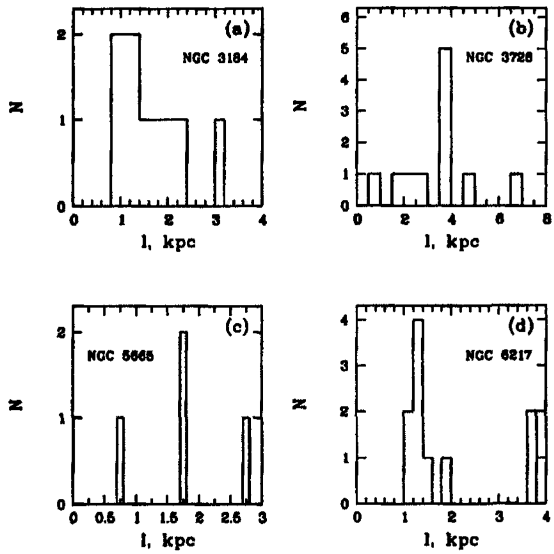


**Figure 2** Distribution of the star forming regions by distance between neighbouring star forming regions for NGC 3184 (*a*), NGC 3726 (*b*), NGC 5665 (*c*), and NGC 6217 (*d*).

## 4 CONCLUSIONS

Most star forming regions in the galaxies are located in the inner Lindblad resonance ring and in other resonance rings. In some ring galaxies the distances between neighbouring star forming regions are approximately same. This corresponds to the modern theory of star formation in galaxies (Elmegreen, 1994).

An analysis of ages and sizes of the star forming regions is presented in a separate JENAM-2000 publication (Gusev, 2001).

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