

# 15. HII REGIONS IN NGC 628, NGC 4254 AND NGC 5194

K. CHUVAEV and I. PRONIK

*Crimean Astrophysical Observatory, Nauchny, Crimea, U.S.S.R.*

Multicolour observations of galaxies are being carried out at the prime focus of the 2.6 m Schajn telescope using an image converter and 6–9 colour filters. The effective wavelengths are approximately 3600, 3730, 4400, 4680, 5090, 5280, 6090, 6600 and 7400 Å. The filters for 3730, 5090 and 6600 Å are centred on emission lines. For absolute calibration extrafocal star images are used.

The observations of the Sc galaxies NGC 628, NGC 4254 and NGC 5194 were carried out in 1965–69. Two of the galaxies are single, but NGC 5194 is double.

The energy distributions for the central region and for dozens of bright patches in each galaxy have been determined. The mean colour characteristics of the central regions and bright patches are given in Table I. Here  $n$  is the total number of bright patches measured, while  $n_1$  of them are HII regions;  $J_\lambda$  are the corresponding brightnesses in the wavelength  $\lambda$ .

TABLE I  
Ratios of brightnesses in three colours

NGC	$n$	$n_1$	Central region		Bright patches	
			$J_{3600}$	$J_{4350}$	$J_{3600}$	$J_{4350}$
			$J_{4350}$	$J_{5550}$	$J_{4350}$	$J_{5550}$
628	60	42	0.4	0.54	0.8	1.7
4254	53	38	0.58	0.81	1.1	1.7
5194	85	58	0.46	0.70	1.2	1.4

The central regions (with diameters  $\sim 400$  pc) of NGC 4254 and NGC 5194 are bluer than that of NGC 628. Moreover there are huge HII regions in the centres of NGC 4254 and NGC 5194, with sizes of the order of the corresponding central discs. The brightnesses of the central HII regions near  $H\alpha$  are by 10–20% higher than the continuous spectrum. No emission has been found near  $H\alpha$  in the central disc of NGC 628. Compact groups of stars have been observed in the central discs too.

Most patches in spiral arms have more or less smooth spectral energy distribution (except in the  $H\alpha$  region) due to stellar radiation. As it is seen from Table I the star patches are bluer than the central regions of the galaxies. Moreover, the colour characteristics of the blue spectral region of the patches of NGC 4254 and NGC 5194 are like those of B 3 stars, and of the green like A-F stars. The spiral arm patches of NGC 628 are redder than those of NGC 4254 and NGC 5194. All bright star patches under consideration are not younger than A-F stars.

In most patches the spectral continuum breaks at the  $H\alpha$  region where a rise of radiation is observed (Figure 1). In some of  $HII$  regions one can suspect the presence of nebular lines too. The upper limit of masses of  $HII$  regions in spiral arms of all galaxies is equal to  $10^5 M_{\odot}$ , but perhaps it must be lowered by one order of magnitude, because the filamentary structure of gas nebulae has not been taken into account.

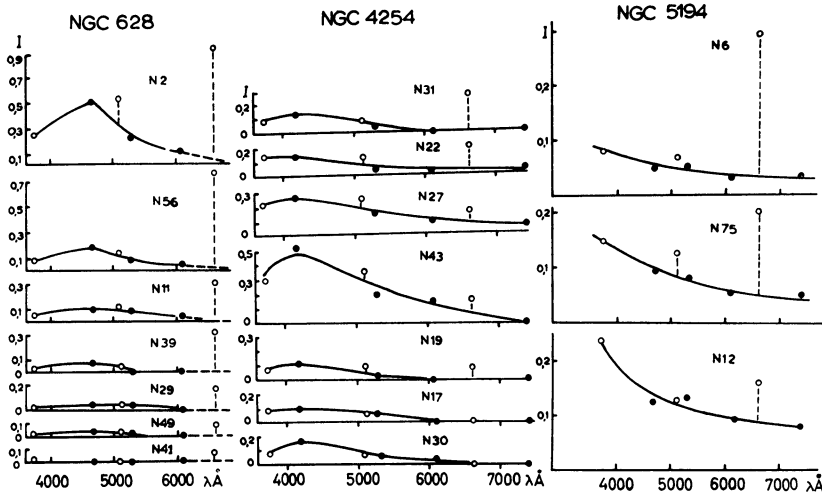


Fig. 1. Energy distribution in the spectra of some typical spiral arm patches, shown in Figures 2, 3, 4. Circles indicate the positions of possible emission lines.

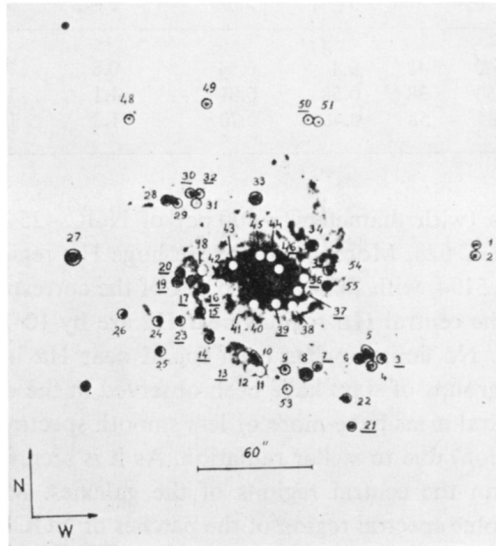


Fig. 2. Spiral arm patches considered in NGC 4254. Underlined numbers are for the patches without  $H\alpha$  emission.

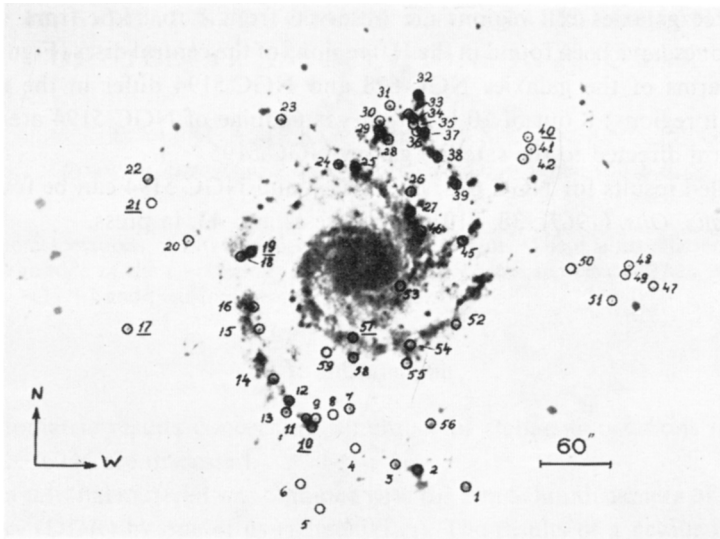


Fig. 3. The same as in Figure 2 for NGC 628.

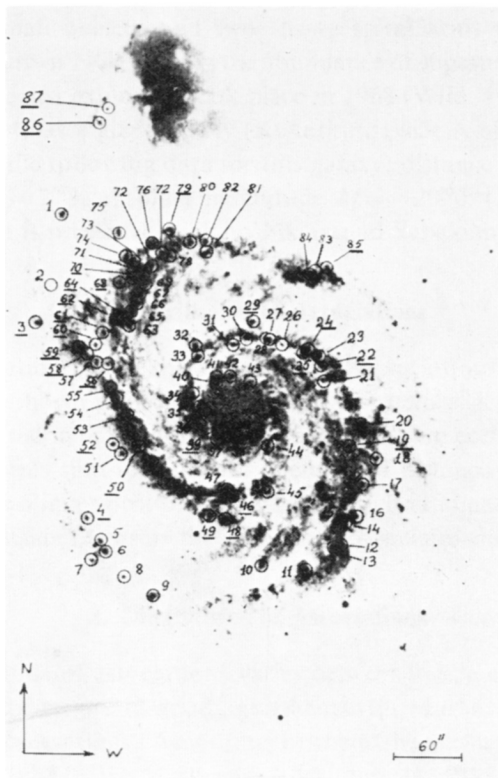


Fig. 4. The same as in Figure 2 for NGC 5194.

In all three galaxies HII regions are observed from 1 to 8 kpc from the centre, the nearest ones have been found in the HII regions of the central discs (Figures 2, 3, 4). The spiral arms of the galaxies NGC 628 and NGC 5194 differ in the number of brightest HII regions: 8 out of 10 brightest gas nebulae of NGC 5194 are located in the spiral arm directed to the satellite galaxy NGC 5195.

The detailed results for NGC 628, NGC 4254 and NGC 5194 can be found in *Izv. Krym. Astrofiz. Obs.* (1967), **38**, 219; **40**, in press; and **43**, in press.