

BVR_cI_c SURFACE PHOTOMETRY OF SEYFERT GALAXIES MRK 304 AND MRK 352

L. S. Slavcheva-Mihova
Institute of Astronomy, Sofia, Bulgaria

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Abstract

We present BVR_cI_c surface photometry of Seyfert galaxies Mrk 304 and Mrk 352. We extract radial profiles of surface brightness, which, within the errors, agree well with other measurements.

The Seyfert galaxies Mrk 304 and Mrk 352 were observed at the Rozhen National Astronomical Observatory of Bulgaria in the course of the imaging study of the sample of active galaxies defined by Petrov (1988). Observations were performed in September 10, 1997 with the 2-m Ritchey-Chrétien telescope equipped with 1024×1024 Photometrics CCD camera (CCD chip SITe SI003AB with pixel size of $24 \mu\text{m}$ that corresponds to 0.31 arcsec on the sky, conversion factor $1.21 \text{ e}^-/\text{ADU}$, readout noise $3.3 \text{ e}^-/\text{px}$) and standard Johnson-Cousins filters. The galaxies were observed through BVR_cI_c filters acquiring two or more frames per filter; the camera was used in 2×2 binned mode. Zero exposure frames were taken regularly during the observing run and the flat field frames were taken in morning and/or evening twilights.

The primary reduction of the data was performed using ESO-MIDAS package. It includes: mean overscan level subtraction, trimming, residual bias pattern subtraction using median zero exposure frame, flat-fielding using median flat fields, fringe correction (only for I_c frames) using median fringe frame and cosmic rays removal. Next, the frames were shifted to match the

highest signal-to-noise R_c frame. Finally, the frames in each filter were co-added. The FWHM of the final frames was in the range 3.0–5.0 arcsec. The total exposure time ranges from 90 s to 180 s.

In order to reduce the noise in the outskirts of the galaxies and to smooth them and the sky background we have used adaptive filter following Lorenz et al. (1993). We approximate sky background by a surface created from a 2-dimensional polynomial of 1st order using the least-squares method interactively, having masked out all the pixels 0.66σ above the trial sky level (the trial estimate of the sky level and its σ were computed using histogram analysis). The resulting fit was subtracted from the frame.

We then fit a set of ellipses to the galaxy image using ESO-MIDAS task FIT/ELL3 that applies Bender & Moellenhof (1987) method. Before fitting was performed the stars that overlies the galaxy image were cleaned out using bilinear interpolation; the stars not cleaned by this procedure were excluded from the ellipse fitting by specifying sectors containing the stars that were not included in the fit. The extracted profiles were transformed to instrumental magnitude per squared arcsecond and normalized to 1 s exposure.

Extinction and photometric transformation coefficients were derived with the help of NGC7790 standard field observation taken during the same night as the galaxies 2 or 3 times.

Coefficients were determined following Harris et al. (1980) and transformation equations were applied to the galaxy profiles. The resulting surface brightness profiles are plotted in Figure 1 (for Mrk 304) and in Figure 2 (for Mrk 352) against the equivalent radius r_{eq} ($= \sqrt{ab}$, where a and b are the major and minor axes of the ellipses, respectively). These profiles are in good agreement with the ones derived by Granato et al. (1993) showing the reliability of the reduction and analysing methods applied by us.

The dependency of the axial ratio (b/a) and of the position angle PA (North through East) on the equivalent radius is shown in Figure 2. The colour profiles are plotted in Figure 3.

Galaxy axis ratio and position angle were determined using 25 B mag/sqars
isophote: $b/a=...$, $PA=...$

References Petrov G. T., 1988, ApSS, 148, 305

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Harris W. E., 1980, PASP, 93, 507

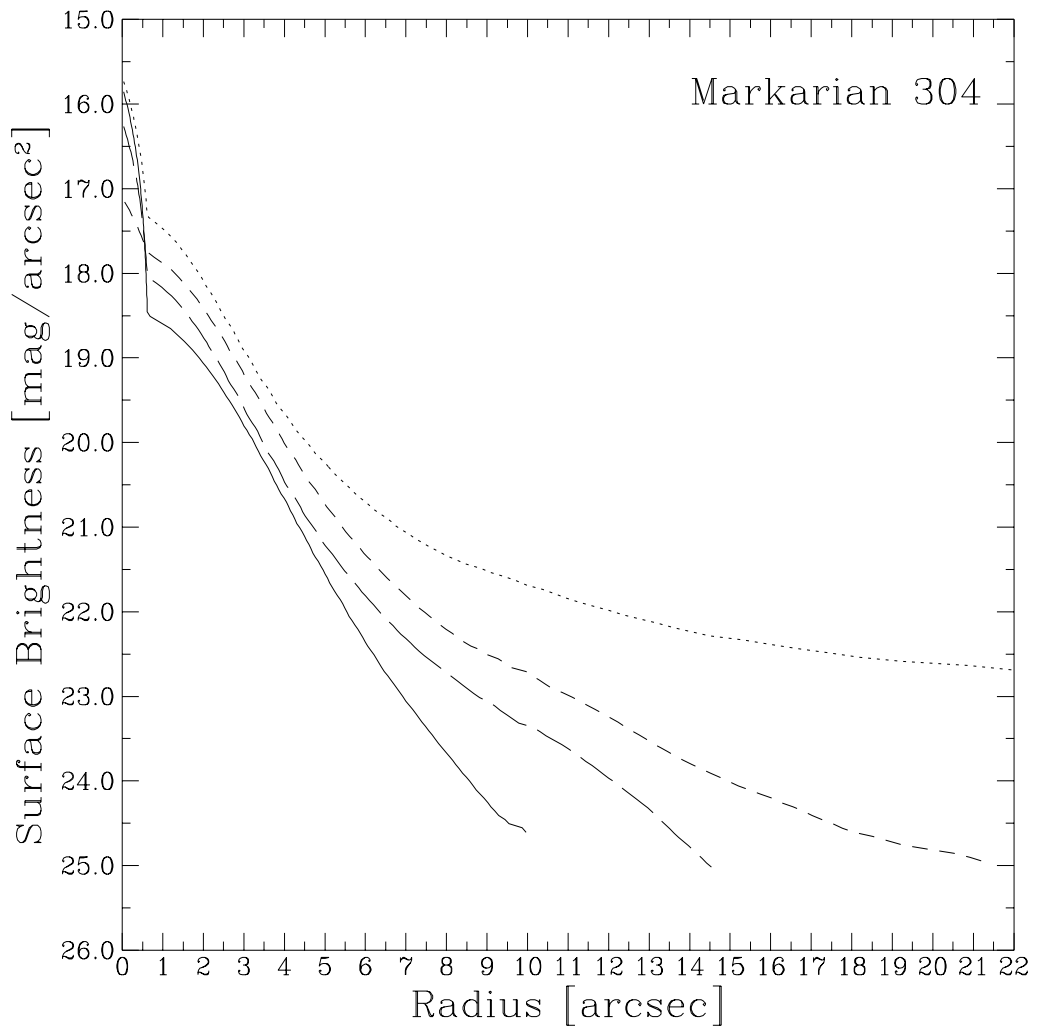


Figure 1: B (solid line), V (long-dashed line), R_c (short-dashed line) and I_c (dotted line) surface brightness profiles for Mrk 304.

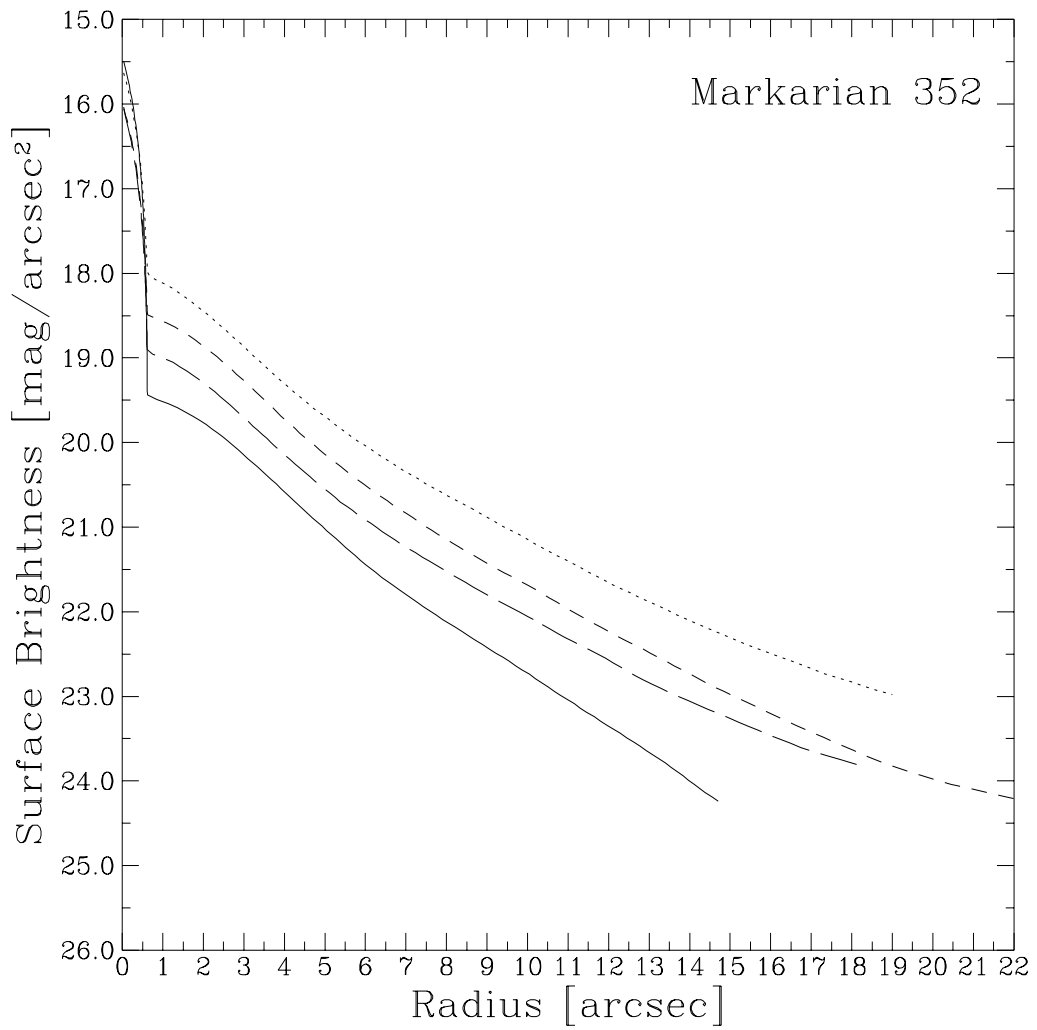


Figure 2: B (solid line), V (long-dashed line), R_c (short-dashed line) and I_c (dotted line) surface brightness profiles for Mrk 352.