Photometric Properties of the barred galaxy NGC 7479

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Introduction

The parameterization of luminous structural components of galaxies is an important step in the understanding of how these systems formed and evolved, as they provide the building pieces of global relations as the fundamental plane, morphological evolution of galaxies and the content of dark matter in galactic halos.

NGC 7479 is a good example to study because, on top of being a strong barred galaxy, bright, with V=11.6, and nearby, distance of 32 Mpc, it is an object that is not well understood despite the several previous studies. It has the strongest bar among 75 galaxies with barstrenght parameter measured in the literature (Peeples and Martini 2006), but has no strong nuclear stellar formation or nuclear activity. The origin of the several asymmetries present on its structural components is not well established in the literature, although has been interpreted as resultant of merger encounter with a small galaxy in the recent past. Another intriguing question is the absence of an inner resonance, that would be expected to slow the gas flow along the bar, as in other cases of barred galaxies with moderate nuclear activity.

Observations

Soar Optical Imager (SOI) + 4-m SOAR telescope: (2005)

Field of view 5.3x5.3 arcmin² , 1pix = 0.154”= 24pc;
Filters: B, V, R and I;
Total exposure: 5 min in each filter;
Seeing: 6 - 8 pix = 1 arcsec;
Sky brightness: 21.5 (m_B).

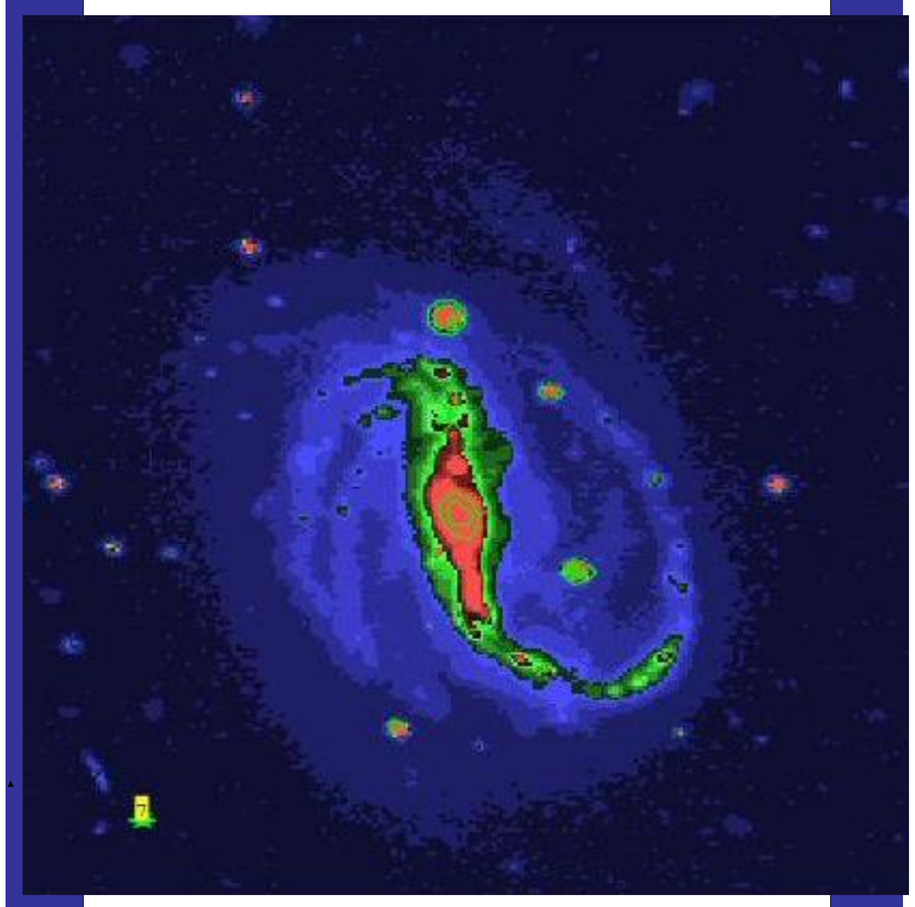
Prime Focus Camera (PFC) + 0.8-m McDonald (1995)

Field of view 46x46 arcmin² , 1 pix = 1.35” = 210 pc; Filters: B, V, R and I;
Total exposure: 30 min in each filter;
Seeing: 3 arcsec ;
Sky brightness : 22.3 m_B

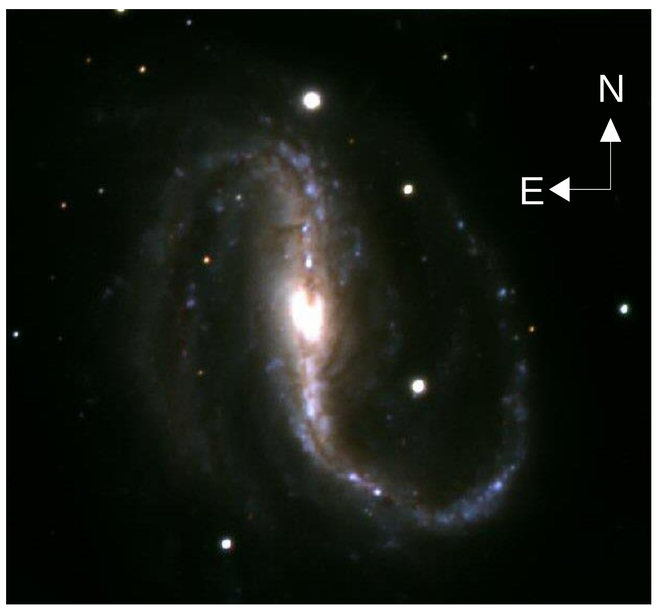
Method:

- Data reduction with IRAF
- Photometric calibration using standard stars; the zero point of SOAR images were calibrated with the McDonald images.
- Isophotal parameters obtained from ellipse fits to the isophotes (IRAF)
- Distribution of dust/cold gas in the inner region determined from color maps
- Structural parameters determined from 1-dim bulge-bar-disc decomposition (IRAF) and 2-dim bar-disc decomposition (Budda).

Results:

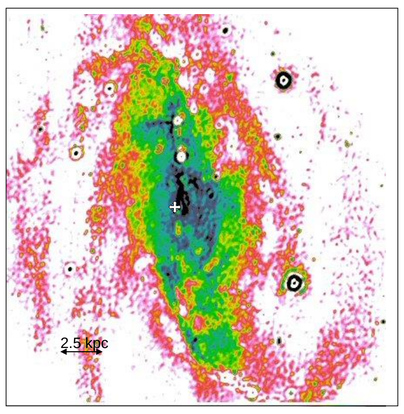


B image of NGC7479 obtained at McDonald Telescope.
The field of view is 200 x200 arcsec(30 kpcx30kpc) .The fainter parts of the disc are at m_B = 26.



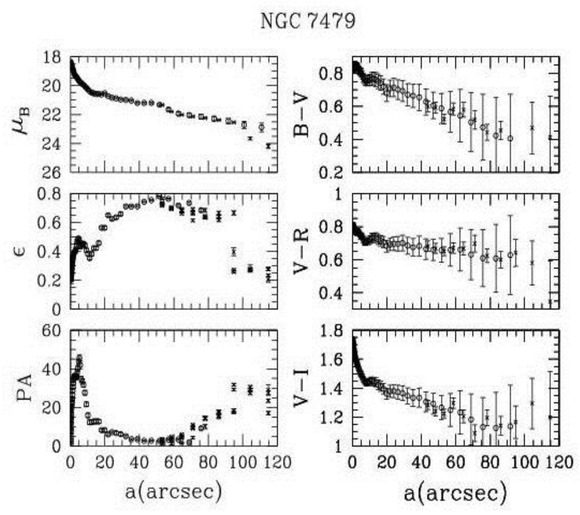
Composite B, V and R image obtained at SOAR Telescope. The field of view is 160 arcsec (25 kpc) wide. The spatial resolution of the image is 170 pc.

Dust structure in the central bar/bulge region



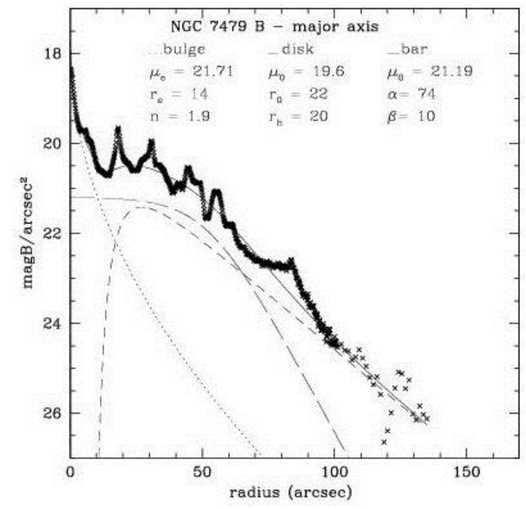
B-V colour map, showing the filamentary and asymmetric distribution of dust in the center region, The darker regions are redder, the lighter ones are bluer. The cross mark the position of the optical center.

Isophotal parameters obtained from ellipse fits to the isophotes



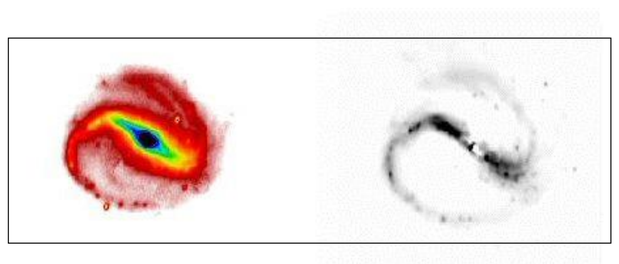
Left panels: isophotal parameters surface brightness, ellipticity and position angle. Right panels: color variation along the isophotes. The variaton of isophotal parameters distinguish the 3 main structural componentes: The bulge, with outer radius a =10”, the bar, between 10”and 55”, and the de disc region, with a > 55”.

Decomposition of the luminosity profile:



B-band luminosity profile along the major axis of the bar, combining data from the two sets of observations. The profile was fit by a combination of a generalized Sérsic bulge plus an inner truncated exponential disc plus a flat bar . The structural parameters of each component are given in the figure. The bulge/disc luminosity ratio is 0.25.

Two-dimensional decomposition



The left figure is the deprojected image, and the right figure is the residual image after the subtraction of the model. The residual image shows that the bar extend to the inner regions of the galaxy, dominating the luminosity distribution.

The two dimensional decomposition was performed with the Budda code (de Souza, Gadotti and dos Anjos 2004), which combines a generalized Sérsic profile with an exponential profile to represent the bulge + disc luminosity distribution. The fitted model has bulge parameters I_0 = 21.2”, r_e = 17” , n=2.1 and disc parameters I_0 =20.7 r_0 = 43”. The bulge/disc luminosity ratio is 0.25.

Conclusions:

• The SOAR broad-band and color images show many dust lanes and arcs that suggest the existence of shocks or resonances at their location.
• The western arm of the galaxy presents a bifurcation that continues beyond the disk border, forming a structure similar to a tidal tail that support the merging hypothesis as the origin of the asymmetries in this galaxy.
• The luminosity profiles are well fitted by different combinations of three functions: a Sérsic bulge with shape parameter n~2 , an inner truncated exponential disc and a flat bar that dominates the luminosity distribution; The 2-dim fit agrees that the bar is the dominant structure in NGC7479.