THE "DOUBLE NUCLEUS" OF M31 IN J, H, AND K

P. HINZ K. HEGE, D. MCCARTHY, M. LLOYD-HART, AND F. MELIA
Steward Observatory, University of Arizona

Hubble Space Telescope images of the nucleus of M31 show a double-peaked structure with the primary peak being offset from the center by approximately 0.5". We observed the central 13" of M31 in the J, H, and K_s passbands to determine the nuclear structure in the near-infrared. Observations were taken at the MMT Observatory, using a low-order adaptive optics system, FASTTRAC II (Gray et. al. 1995). The diffraction limit for the system is 0.25" in K band. PSF images showed correction to 0.5" FWHM. Uncorrected images showed the seeing to be about 1". The images were deconvolved using several methods to check for consistency. We used Iterative-Blind Deconvolution, Richardson-Lucy, and Wiener filter algorithms, getting similar results for each. Measurements suggest the PSF in the deconvolved images is approximately 0.35" FWHM.

The infrared images resolve the two peaks and appear similar to the visible data taken by HST. Both the bright peak (P1) and the dim peak (P2) appear marginally resolved. P1 shows an elongation in the East-West direction (P.A.=80°) while P2 is elongated at a position angle of approximately 60°. Table 1 summarizes an analysis of our J, H, and K_s M31 images, together with the HST WFPC2 archived data in the F555W (V band) and F814W (I band) filters. Both the visible and infrared images were modelled with six parameter elliptical Gaussian surface profiles: amplitude, major and minor axes, position angle, and $\{x, y\}$ coordinates of photocenter. We determined the bulge parameters by using data in annuli from 1" to 6" diameter. The analysis of P1 and P2 was made on images following the subtraction of the underlying bulge. The centroid of P1 is the $\{0, 0\}$ reference for the position vectors $\{\rho, \phi\}$ and e is the eccentricity of the elliptical contours, with position angle θ, of the Gaussian profiles fit to the corresponding structures P1, P2 and Bulge.

Table 1 shows that the structure of the visible and NIR images are very similar, although there is an anomalous increase in separation of the peaks

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 391-392.

https://doi.org/10.1017/S0074180900085326 Published online by Cambridge University Press

		V	I	J	H	K	Average
P1	σ	0".41	0.40	0.49	0.41	0.40	0".42 ± .04
	e	0.19	0.19	0.22	0.20	0.18	0.20 ± .02
	θ	81°	81	72	79	80	79° ± 4°
P2	σ	0".40	0.38	0.40	0.38	0.37	0".39 ± .01
	e	0.22	0.18	0.14	0.14	0.33	0.19 ± .09
	θ	69°	65	67	47	51	60° ± 10°
	ρ	0".778	0.779	0.827	0.783	0.793	0".792 ± .02
	ϕ	239°	235	232	239	240	239° ± 3°
Bulge	σ	1".44	1.47	1.47	1.35	1.39	1".42 ± .05
	e	0.26	0.31	0.31	0.35	0.34	0.31 ± .04
	θ	59°	59	59	58	59	59° ± 1°
	ρ	0".509	0.484	0.365	0.487	0.496	0".468 ± .06
	ϕ	233°	232	238	233	235	234° ± 2°

for the J band. It should be noted that the distance and position angle of the line connecting P1 and P2 are significantly different from the published values of Lauer et al. (1993) They find a separation between the peaks of 0.5" and P.A=223 while our fit finds a separation of 0.79" and P.A.=239. However Lauer et al. were measuring the centroids of the peak while we are fitting a Gaussian model to each of the structures. The peaks have irregular structure which creates the discrepancy, but the model fitting shows that there is little significant difference in morphology of the peaks between the visible and NIR, down to the limiting scale of the NIR images.

The color of P1 and P2 is red with respect to the surrounding bulge with a V-K color excess of approximately 0.3 magnitudes. P1 itself is 0.1-0.2 magnitudes redder than P2. We note the existence of an apparently grey area of absorption just below the line connecting P1 and P2 and approximately due east of P2. This "dark blob" is close to P2 and our measurement of the center of the bulge actually lies in this dark spot. Its existence is consistent in both visual and NIR images. If dust, the grains must be very large compared to typical ISM to show so little color gradient. The region seems compact and not particularly associated with the structure of the surrounding area. Lauer et al. mention the trouble in modelling the nuclear region as the composition of two components corresponding to P1 and P2. The region between the peaks could not be fit by their model and actually seemed to be an area of "missing light." This would appear to be consistent with the absorption structure we see near the P1-P2 axis.

References

Gray et al., 1995, Proc. SPIE conf. on Adaptive Optical Systems and Applications, ed. R.K.Tyson & R.Q. Fugate, 2534, 2

Lauer, T.R. et al. 1993, AJ, 1436