Mid-Infrared Observations of Nearby Radio Galaxies Pictor A and 3C84.

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ABSTRACT

The mid-IR emissions of radio galaxies are important because they grant a picture of the environment surrounding the central black hole. According to the theoretical model of radio galaxies, the central black hole and accretion disk is surrounded by a region of dust and gas. This dust and gas absorbs the energy released from the black hole/accretion disk system and reradiates the energy in the mid-IR bands. Therefore, to understand the inner workings of the system, we must understand how these systems behave in the mid-IR bands. This poster presents data taken with the Gemini North and Gemini South telescopes. While these telescopes are not as flux sensitive as the Spizter Space telescope, they provide a factor of 10 improvement over Spizter (resolution ~3arcsec) in resolution (see figure 1 for sample resolution of Gemini). This high resolution allows comparisons to be made between the mid-IR data and data taken in the optical by Hubble and in the x-ray by Chandra, providing a better overall picture of the objects. These objects are part of a survey of several radio galaxies in the mid-IR. The goal of this work is to provide a baseline of what these objects look like in the mid-IR. Pictor A and 3C84 were selected for this poster because of the objects we have data on, they are the most likely candidates for showing some type of extended structure along with the nucleus. The other objects show only the unresolved nucleus. Once this preliminary result for both objects is confirmed, we will begin the process of comparing the mid-IR data to data available in other wavelengths, including the optical and x-ray bands, to try to form a complete picture of the extended structure.

DATA

Flux of Targets

	8.7 microns	12.3 microns
3C84	14.3 mJy	94.7 mJy
Pictor A	6.05 mJy	21.5 mJy

Table 1: Flux of each target radio galaxy, expressed in mJy. To compute the flux of each target, the total pixel count of the object was compared to the pixel count of a star with a known flux at that wavelength .

Sample Resolution

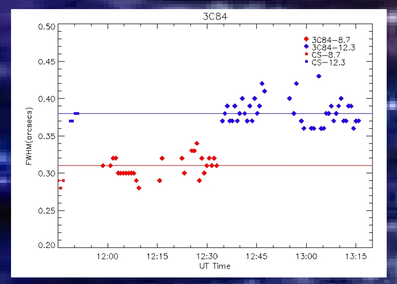

Figure 1: Full width half max verse time. This is a sample of the resolution for an object. The solid lines indicate the average FWHM for the night

Contour Plots of Targets

	Contours(starting with outermost, in sigma above background)															
	microns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3C84	8.7	.67	2.01	3.35	4.69	6.03	7.37	8.71	10.05	11.39	12.73	14.07	15.41	16.75	18.09	19.43
	12.3	.7	2.11	3.52	4.92	6.33	7.74	7.14	10.35	11.96	13.36	14.77	16.18	17.58	18.99	-
Pictor A	8.7	2.88	8.65	14.42	20.19	-	-	-	-	-	-	-	-	-	-	-
	12.3	1.5	4.5	7.5	10.5	13.5	16.49	19.49	-	-	-	-	-	-	-	-

Table 2: Values of contours for each target in sigma above background. The first contour is twice the background level and the last contour is the closest contour to twenty sigma above the background

3C84

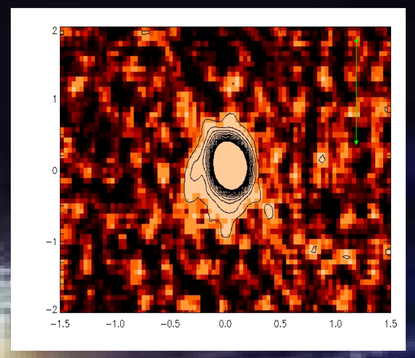

Figure 2: Contour plot of 3C84 at 8.7 microns. Axis is in arcsecs from the center of the object (See Table 2 for contour values) The green arrow indicates the approx orientation of X-ray and radio structure (see Fabian, A.C., et al.2000, MNRAS, 318, L65)

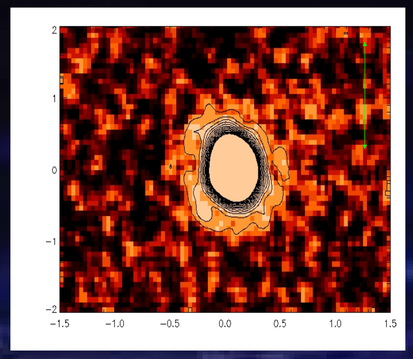

Figure 3: Contour plot of 3C84 at 12.3 microns. Axis is in arcsecs from the center of the object (See Table 2 for contour values) The green arrow indicates the approx orientation of X-ray and radio structure (see Fabian, A.C., et al. 2000, MNRAS, 318, L65)

Pic A

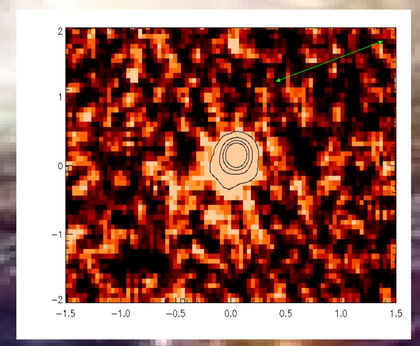

Figure 4: Contour plot of Pic A at 8.7 microns. Axis is in arcsecs from the center of the object (See Table 2 for contour values) The green arrow indicates approx orientation of X-ray and radio structure (see Wilson, A.S., Young, A.J.,& Shopbell, P.L. 2001, ApJ, 547, 740 and references within)

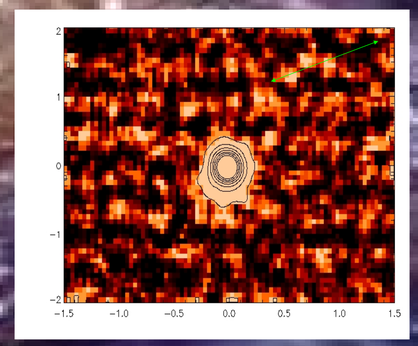

Figure 5: Contour plot of Pic A at 12.3 microns. Axis is in arcsecs from the center of the object (See Table 2 for contour values) The green arrow indicates approx orientation of X-ray and radio structure (see Wilson, A.S., Young, A.J.,& Shopbell, P.L. 2001, ApJ, 547, 740 and references within)

Radial Profiles of Targets

3C84

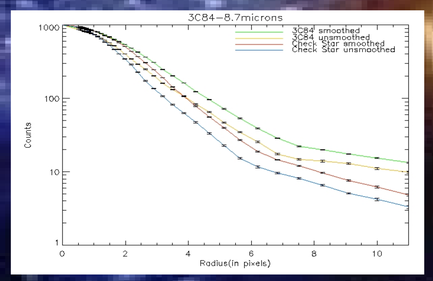

Figure 6: Radial profile of 3C84 at 8.7 microns. All curves have been normalized to 1000 counts as a max. The scale of the x axis is one pixel = 0.1005 arcsecs

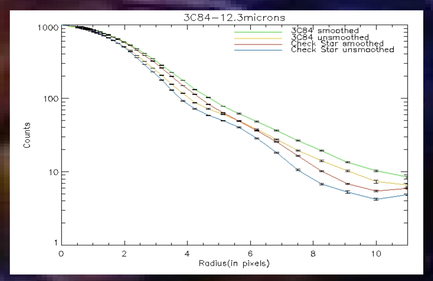

Figure 7: Radial profile of 3C84 at 12.3 microns. All curves have been normalized to 1000 counts as a max. The scale of the x axis is one pixel = 0.1005 arcsecs

Pic A

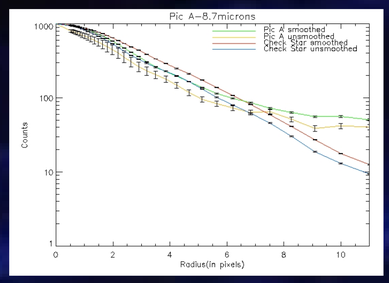

Figure 8: Radial profile of Pic A at 8.7 microns. All curves have been normalized to 1000 counts as a max. The scale of the x axis is one pixel = 0.09 arcsecs

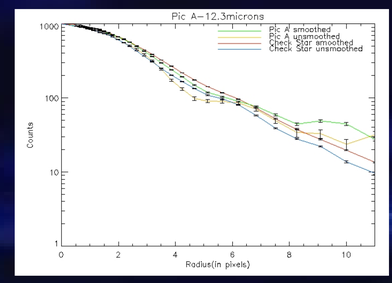

Figure 9: Radial profile of Pic A at 12.3 microns. All curves have been normalized to 1000 counts as a max. The scale of the x axis is one pixel = 0.09 arcsecs

Results

From the above data, we have been able to draw several preliminary results. 3C84 and Pic A show what we believe is an unresolved nucleus with some type of extended structure as shown by the extension of the radial profile of the target when compared to the psf star. Since the radial profiles do not decay as fast as the psf star, this means that the extension seen is most likely not do to any atmospheric or equipment effects, as these would have also affected the psf star. The contours for both these radio galaxies also hint at extended structure, since their first few contours are already two to three sigma above the background. On other targets that did not show extension, the first few contours did not rise above two sigma above background, thus providing more evidence that we are seeing the effects of some kind of extended structure in these two objects. These objects are part of a large survey effort involving radio galaxies in the mid-IR. In addition to these two objects, seven other objects have been observed and analyzed, with papers written about M87 (see Perlman, E.S., et al. 2007, ApJ, 667, 808; Perlman, E.S., Sparks,W.B., Radomski, J., Packham, C., Fisher, R.S., Piña, R.,& Biretta, J.A. 2001, ApJl, 561, L51), Cen A (see Radomski, J.T., et al. 2008, arXiv:0802.4119, ApJ in press), and Cyg A (see Radomski, J.T., Piña, R.K., Packham, C., Telesco, C.M., & Tadhunter, C.N. 2002, ApJ, 566, 675).

Future Work

- Deeper observations of both Pic A and 3C84 to confirm and study the extended structure
- Observations of other nearby radio galaxies to give a broader sample of high resolution mid-IR data for radio galaxies
- Comparison of mid-IR data to optical and x-ray data to identify the sources of the extended structure
- Study of the spectral energy distribution of both the nucleus and extended structure

Acknowledgments

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