A LARGE NEAR-INFRARED IMAGE OF THE GALACTIC CENTER

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ABSTRACT. We have obtained a K band image of the central 30 x 40 arcminutes of the Galaxy at a scale of 1.4"/pixel using a 256 x 256 Pt:Si Schottky barrier diode array detector provided by the Hughes Aircraft Company. The excellent cosmetic quality and large field of this device provide an unprecedented view of the inner Galaxy. Images of the central 10 arcminutes at a scale of 0.9"/pixel in the H (1.65μm) and K (2.2μm) bands produced with the same detector array have been combined to produce a color picture, which clearly shows the circumnuclear molecular ring in absorption; this picture demonstrates directly that the southwestern side of the ring lies in front of, and the northeastern side behind, the Galactic center.

OBSERVATIONS AND RESULTS

The images displayed in this paper were made with a 256 x 256 Pt:Si Schottky barrier diode array detector provided by the Hughes Aircraft Company. Thirty-nine individual frames at wavelength K (2.2μm), each with an exposure time of 180 seconds, taken at the KPNO 1.3m telescope on 24 May 1988, have been assembled to produce the image shown in figure 1. This image covers approximately 30 x 40 arcminutes; the plate scale is approximately 1.4 arcsec/pixel. The frames of the mosaic image were combined using the IRAF routines *irmosaic* and *iralign* developed by L. Davis. Stars as faint as K=12 mag can be seen in this reproduction. This image was obtained in only 2.5 hours, and dramatically illustrates the power of large-format arrays on moderate-sized telescopes.

The dust extinction coefficient at 2.2μm is only about one-tenth of that at 0.5μm. This well-known fact allows near infrared observations to detect the bright clustering of stars at the Galactic center (e.g. Becklin and Neugebauer 1968). Nevertheless, even at 2.2μm, much of the structure in Figure 1 results from patchy extinction (Lebofsky 1979). A dark cloud about 10 arcminutes NW of the nucleus is almost

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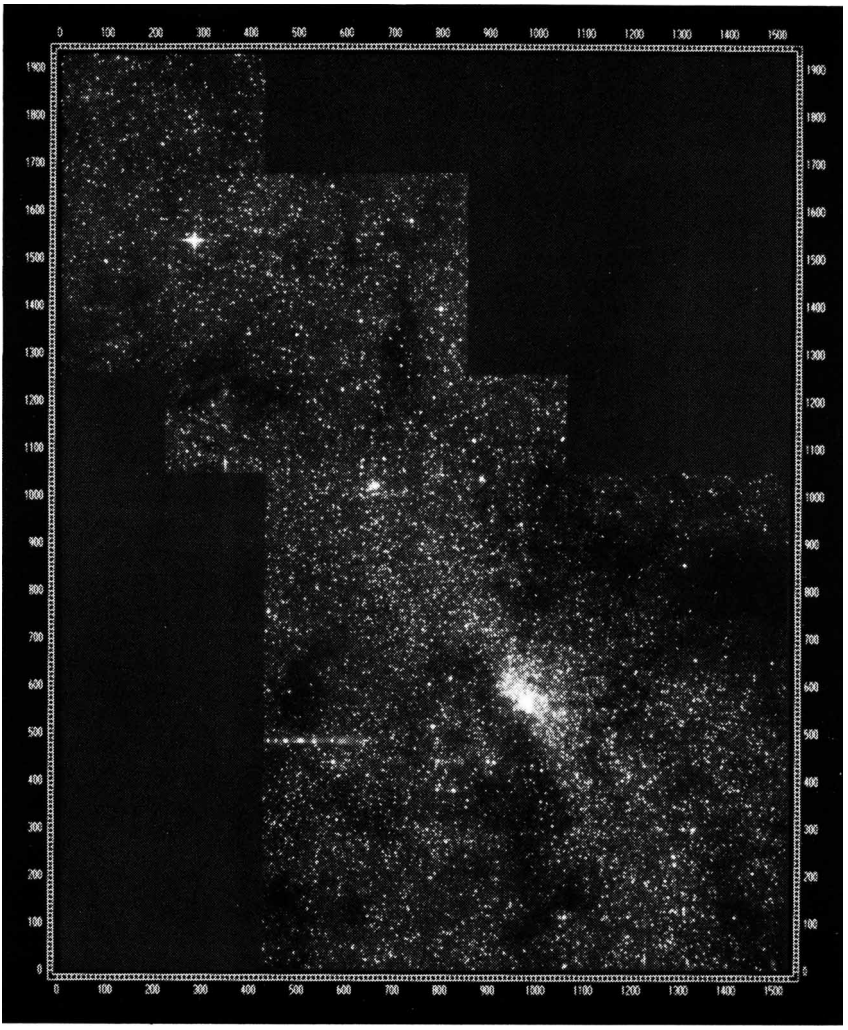

Figure 1: An image of the central 30 x 40 arcminutes of the Galaxy in the K band (2.2μm). Along the galactic plane to the northeast of the nucleus the bright late-type star V747 Sgr and the small cluster AFGL 2004 (Okuda et al, this volume) are conspicuous. The horizontal feature slightly below the nucleus at the left edge of the image is an artifact caused by scattered light.

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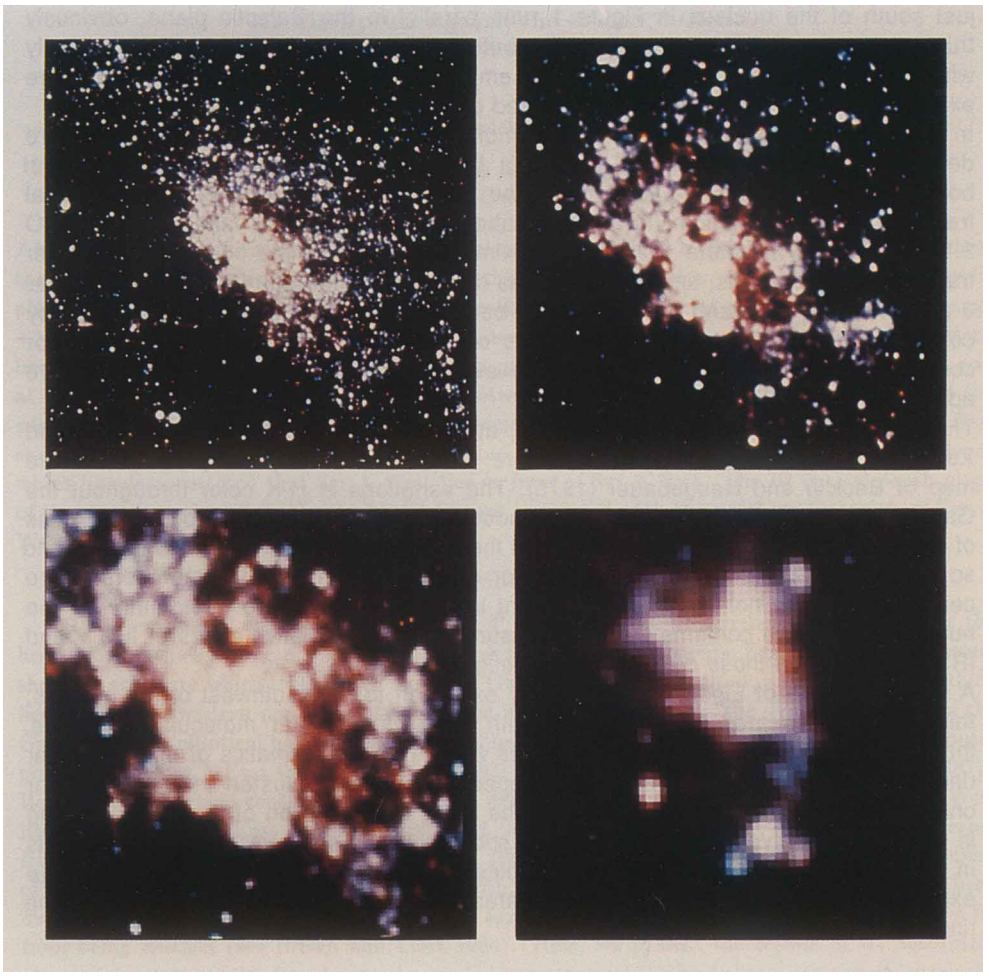

Figure 2: The near infrared color of the Galactic nucleus. These pictures were constructed from images at H (1.65μm) and K(2.2μm); the method of color coding employed is described in the text. All four frames are constructed from the same database; the relative magnification between the frames is X1(upper left), X2 (upper right), X4 (lower left), and X8 (lower right). Individual objects in the X8 frame can be easily identified by comparison with the map of Becklin and Neugebauer (1975).

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devoid of stars, suggesting that it is both optically thick and nearby. A dark dust lane just south of the nucleus in Figure 1 runs parallel to the Galactic plane, obviously truncating our view of the stellar distribution. This dark lane correlates spatially with a molecular cloud seen in ammonia emission (Gusten and Henckel 1983). More examples of such correlations are discussed elsewhere in this volume by Catchpole.

In order to investigate the effects of extinction on our view of the nucleus in more detail, we observed the central region (a field of approximately 10 arcminutes) at both H (1.65μm) and K (2.2μm) using the 256 x 256 Pt:Si array. Nine individual frames at each wavelength (in a 3 x 3 pattern on the sky) were taken at the KPNO 2.1m telescope; the plate scale is approximately 0.9"/pixel, the integration time per frame was 180 seconds, and the seeing (as determined from the resultant images) was 3 arcseconds. The H and K images have been displayed in a color representation by controlling the blue, green and red guns of a video monitor separately; the color coding used was blue=H, red=K, and green=average of H and K, weighted so that IRS16 appears white.

The color image is displayed in Figure 2, at four magnifications: X1, X2, X4, and X8. Individual objects in the X8 frame are easily identified by comparison with the map of Becklin and Neugebauer (1975). The variations in H-K color throughout the Galactic center region are very large, amounting to differential H-K colors in excess of one magnitude. Our emphasis here is on the demonstration of these large effects, and so the well-known (but more modest) color differences between the members of the central cluster are not immediately evident in Figure 2; aperture photometry on the numerical database confirms that our measurement of the relative colors of IRS 7 and IRS 16 agree with those of Becklin and Neugebauer (1975).

A striking feature of Figure 2 is the heavy extinction to the southwest of the nucleus; this feature correlates extremely well with the circumnuclear molecular ring (see, for example, figure 1 of DePoy et al in this volume). The kinematics of this molecular ring are well determined by microwave spectroscopy (e.g. Gusten 1987) except for one ambiguity: which is the front side of the ring? The detection of the molecular ring in absorption resolves this ambiguity, and shows that the southwest side of the ring is in front of, and the northeast side behind, the Galactic center. The very large extinction in the near infrared demonstrates that the radial visual extinction in the ring is well in excess of 10 magnitudes.

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