2MASS and the Galactic Center

1 About 2MASS

The Two Micron All Sky Survey (2MASS) is uniformly scanning the entire sky in three near-infrared bands to detect and characterize point sources brighter than about 1 mJy in each band, with signal-to-noise ratio greater than 10, with astrometric accuracy better than 0.5". It will achieve an 80,000-fold improvement in sensitivity relative to earlier surveys.

2MASS is designed to close the gap between our current technical capability and our knowledge of the near-infrared sky. In addition to providing a context for the interpretation of results obtained at infrared and other wavelengths, 2MASS will provide direct answers to immediate questions on the large-scale structure of the Milky Way and the Local Universe. The optimal use of the next generation of infrared space missions, such as HST/NICMOS, the Space Infrared Telescope Facility (SIRTF), and the Next Generation Space Telescope (NGST), as well as powerful ground-based facilities, such as Keck I, Keck II, and Gemini, require a new census with vastly improved sensitivity and astrometric accuracy than that previously available.

2MASS uses two new, highly-automated 1.3-m telescopes, one at Mt. Hopkins, AZ, and one at CTIO, Chile. Each telescope is equipped with a three-channel camera, each channel consisting of a 256×256 array of HgCdTe detectors, capable of observing the sky simultaneously at J (1.25 μm), H (1.65 μm), and K_s (2.17 μm). The northern 2MASS facility began routine operations in 1997 June, and the southern facility in 1998 March. As of 1999 Jan 26, the sky coverage is 53%.

The University of Massachusetts (UMass) is responsible for the overall management of the project, and for developing the infrared cameras and on-site computing systems at both facilities. The Infrared Processing and Analysis Center (IPAC) is responsible for all data processing through its Production Pipeline, and construction, distribution, and archiving of the data products. The 2MASS project is funding by the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF).

The immediate scientific benefits from the 2MASS survey include: 1) An unprecedented view of the Milky Way nearly free of the obscuring effects of interstellar dust, which will reveal the true distribution of luminous mass, and thus the largest structures, over the entire length of the Galaxy;

2) the first all-sky photometric census of galaxies brighter than $K_s = 13.5$ mag, including galaxies in the 60°-wide "Zone of Avoidance," where dust within the Milky Way renders optical galaxy surveys incomplete. The catalog of >1,000,000 galaxies will provide a rich statistical database, including photometric measurements in three wavelengths and a few structural parameters for large samples of galaxies in differing environments, measured at wavelengths which are sensitive to the stellar populations dominating the luminous mass; and, 3) the statistical basis to search for rare but astrophysically important objects, which are either cool, and thus extremely red (e.g., extremely low-luminosity stars and brown dwarfs), or heavily obscured at optical wavelengths (e.g., dust-obscured AGNs and globular clusters located in the Galactic plane).

2MASS will produce the following data products: 1) A digital atlas of the sky comprising approximately 4 million $8' \times 16'$ (compressed) Atlas Images, having about $4''$ spatial resolution in each of the three wavelength bands; 2) a point source catalog containing accurate positions and fluxes for ~300 million stars and other unresolved objects; and, 3) an extended source catalog containing positions and total magnitudes for more than 1,000,000 galaxies and other nebulae.

2MASS will release the data products on the approximate schedule: 1) The 2MASS Sampler of one northern night's of data is currently available; 2) the first large incremental release of northern hemisphere data in the spring of 1999; and, 3) incremental releases every 6 months to 1 year thereafter, of both northern and southern hemisphere data. Each night of released data will consist of about 250,000 point sources, 2000 galaxies, and 5000 images, or about 0.5 GB of data per night.

2 The Galactic Center

2MASS will characterize the stellar populations and provide precise mapping of the interstellar extinction on small scales over large spatial area toward the Galactic Center. As an example, we show in Figure 1 the color-color diagram based on the $6° \times 8.5'$ 2MASS tile area immediately around the Galactic Center, for ~100,000 stars with $\sigma \leq 0.1$ mag in all three bands. Extinction of $A_V \sim 20$–25 affecting the stars toward the Galactic Center, as well as a range of populations, are readily apparent from this diagram.

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Figure 1: The color-color diagram for the 0.85 square degrees around the Galactic Center from 2MASS near-infrared data. The datapoints have been color-contoured to correspond to signal-to-noise ratio. Also shown are the tracks for dwarfs (*green*) and giants (*black*) from Bessell & Brett (1988, PASP, 100, 1134), and a reddening vector from Rieke & Lebofsky 1985, ApJ, 288, 618).