A Deep Optical/Near-Infrared Imaging Survey of the North Ecliptic Pole

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The IRAC Dark Field, or Why *another* @#!$ extragalactic survey field??

The IRAC instrument is Spitzer's mid-infrared camera. It's dark current and bias are calibrated with dithered images of a dark region of the sky, similar to "skydark" calibrations taken at ground-based observatories. The so-called "IRAC Dark Field" is located near the north ecliptic pole in the darkest possible region of sky and with no bright stars or galaxies nearby. The field is observed for several hours every time the instrument is turned on and off, currently once a month. This gives the field many unique properties:

Extreme Depth - the field has been accumulating exposure time since launch and will do so throughout Spitzer's lifetime. Current depth per point on the sky is >40 hours reaching L(Vega)~25 over a region > 15 arcminutes across. These are the deepest images ever taken by Spitzer, exceeding the GOODS ultradeep survey over 4x it's area. The images are confusion-limited in all bands.

Quality - the data are taken in a special way that ensures that they are unusually clean and free of artifacts.

Periodicity - most importantly, *the data form a time series of extremely deep images taken at weeks-intervals over the course of many years*. No other dataset has this depth and periodicity. It is not possible to acquire a similar dataset as a general observer.

These features enable a wide range of cosmology and variability studies. Initially we are examining variability of mid-IR sources which are probable AGN.

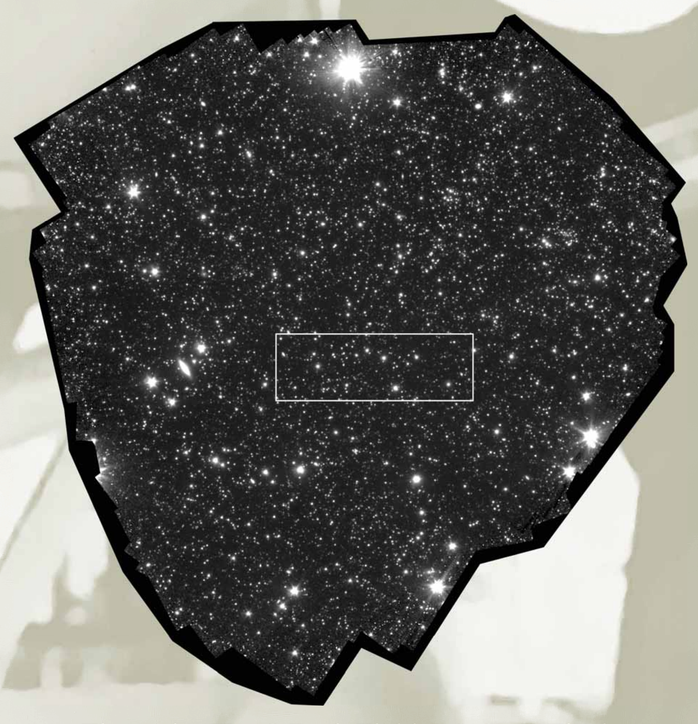
From left to right: Spitzer, HST, Chandra, and Akari (formerly Astro-F).

Although interesting in their own right, the Spitzer data are difficult to interpret without additional wavelength information. The size of the field is ideal in that the majority of instruments today can observe it in a single pointing. The following datasets are already acquired or are scheduled:

- HST/ACS - 50 orbits surveying the field to a 2-orbit depth in the F814W (I-band) filter.
- Spitzer Long-Wavelength MIPS - accompanying ultradeep 24 and 70μm imaging.
- Chandra - a 100 ksec pointing with ACIS-I covering the entire field.
- Akari (Astro-F) - multiband imaging and spectroscopy in the mid-IR.
- Palomar 60 inch - periodic shallower observations are being acquired in the optical.

How does Palomar fit into this project?

The strips at left illustrate the diverse colors in the optical of the infrared objects shown in the center panel. The bottom panel illustrates the extreme depth of the IRAC data.



The entire IRAC Dark Field at 3.6μm. The indicated box is 7.5 arcminutes across and indicates the inset strips shown above.

We have carried out deep imaging (4-8 hours per filter) at ugri with the LFC and K-band with WIRC. The data is currently reduced and analysis is ongoing. The short wavelength data (relative to Spitzer!) are required for derivation of photometric redshifts and for characterization of SEDs. This is particularly vital given the strategy of observing only a single band with HST in order to derive structural morphology - all optical color information must come from the Palomar data. Future followup is likely to include spectroscopy of the brighter objects and LGS imaging of the AGN host galaxies in the near-IR.

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