Spitzer Pipeline Commissioning Observations of DR 6

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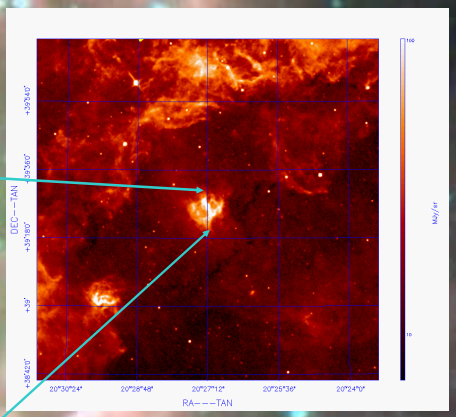
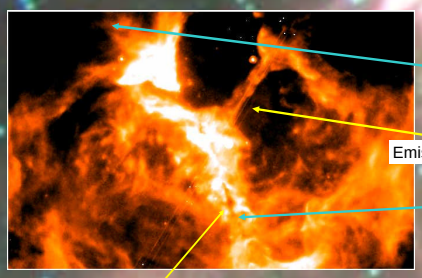
Introduction: As part of the Science Verification phase of the In-Orbit Checkout of Spitzer, IRAC observed the HII region DR 6 and the associated infrared cluster DB7 (Dutra & Bica 2001). DR 6 is at a distance of 1.0 kpc (Comerón & Torra 2001) . The intent of the experiment was to make a representative observation of a region of high source density and structure similar to observations that will be conducted by general observers of Galactic star formation. In addition, these observations provide a stress test of the IRAC data pipeline and the SSC post-BCD software, including the mosaicer, point source extraction and bandmerging software.

An 8 μm image of a 1.5 by 1.5 degree region centered on DR6 from MSX. The HII region is part of the much larger structures of the Cygnus X region. Near the HII region are several infrared-dark filaments which are dense molecular cores (Carey et al. 1998).

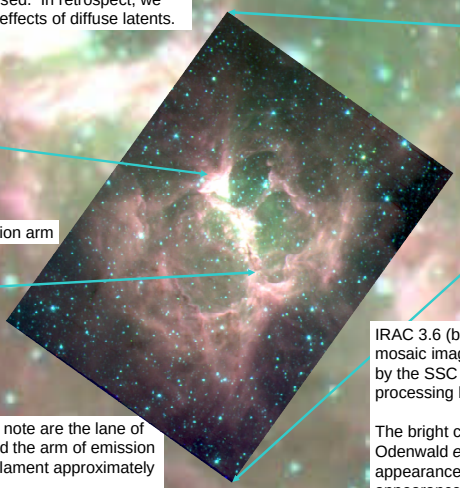


Observations: DR 6 was imaged by IRAC using 12s high dynamic range mode on 27 November 2003. High dynamic range observations consist of set of a 0.6s frame and a 12s frame at each pointing. The map is 20 by 10 arcminutes in size with four dithers at each map position. The total integration time per pixel is 43.2 seconds and the map took 20 minutes to complete. The small cycling dither pattern was used. In retrospect, we should have used a larger dither pattern to better minimize the effects of diffuse latents.



Emission arm

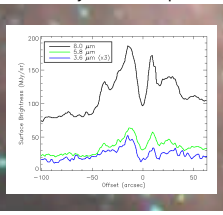
Extinction lane



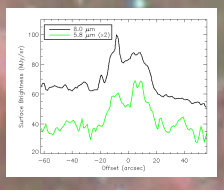
IRAC 8 μm image of the central region of DR 21. Features to note are the lane of extinction running through the middle of the bright filament and the arm of emission denoted by the yellow arrows. There is an actual gap in the filament approximately about a third of the way from the top of the image.

IRAC 3.6 (blue), 4.5 (green) and 8.0 (red) μm color composite of DR 6. The mosaic images in each band are 20 arcmin by 10 arcmin and were produced by the SSC pipeline as a browse quality data (BQD) product. No additional processing has been done on these images.

The bright central bar has the same morphology as the 20 cm maps of Odenwald *et al.* (1986). The bar is similar to DR 21 (Marston *et al.* 2004) in appearance over the IRAC bands. The image has the same overall appearance as the recently released IRAC images of RCW 49. The diffuse emission shown in green is predominantly at 4.5 μm and is most likely Brackett α emission from the hot gas although H_2 line emission will also contribute. At the periphery of the HII region, the emission is mostly at 8.0 μm; emission from PAHs is the major component. There is a good deal of structure in the extended emission, including many cometary shaped globules which are being sculpted by the winds from the central condensation of B stars.

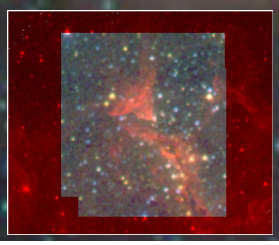


Intensity cuts through the most opaque part of the extinction lane. Assuming a simple extincting slab for the filament, $A_{8\mu m}$ is between 0.5 and 1.5 depending on the amount of emission that is foreground. Using the extinction law of Li & Draine (2001), the corresponding visual extinction is A_V~15-50. The width of the filament is ~0.1pc



Intensity cuts through the middle of the emission arm feature. The emission arm is 0.15 by 0.42 pc is size. The profiles indicate that the emission arm is limb brightened, although the profiles differ in structure between 5.8 and 8.0 μm. The limb brightening may indicate a cavity inside the emission arm and/or it may be due to excitation effects.

Summary: The IRAC images of DR 6 reveal the structure of the dust associated with the HII region in unparalleled detail. Regions of massive star formation like DR 6, DR 21 and RCW 49 share similar characteristics: a dense molecular filament, surrounded by a region of hot gas with a periphery of wind sculpted structures that are bright in PAH emission. Mid-infrared observations are necessary to accurately measure the extinction in the most opaque regions. Observing HII regions with IRAC is both straightforward and efficient.



Central portion of DR 6 at J (blue), K (green) and 3.4 μm (red). The J and K data are from 2MASS. The diffuse emission at 3.4 μm is most likely a combination of PAH emission and H_2 line emission from molecular material associated with the dense dust filament. The yellow point sources are highly extincted stars. Red point sources are potential protostellar candidates. We need to finish the extractions at 8 μm before making a definitive statement.

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The DR 6 data will be available from the SSC archive using the Leopard software (downloadable from http://www.spitzer.ipac.caltech.edu). The AOR request keys are 8081408 and 8081664 in program ID 624.

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