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A Complete 1.1mm Survey of Perseus with Bolocam

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Abstract. We have completed a 7.5 square degree λ=1.1mm map of Perseus using Bolocam. Our map is the largest unbiased survey of Perseus at millimeter wavelengths to date, and covers the same area as the c2d Spitzer IRAC and MIPS maps of Perseus. We find that that the mass function shape is similar to that seen in other clouds and to the local IMF. Despite the large area surveyed, few new sources are found outside the known cluster regions.

1. Introduction and Observations

Nearby molecular clouds such as Perseus, where there is evidence of ongoing star formation, provide the best opportunity to observe stars in the earliest stages of their formation. Most previous (sub)mm continuum mapping of Perseus has been confined to dense cluster regions such as NGC 1333 (e.g. Sandell & Knee (2001)). Here we describe large-scale 1.1mm continuum mapping of the Perseus cloud at the CSO using Bolocam, a 144 element large-format bolometer array (Glenn et al. 2003). These observations complement the Perseus fields observed with IRAC and MIPS as part of the Spitzer Legacy Project, "From Molecular Cloud Cores to Planet Forming Disks" (c2d, Evans et al. (2003)). The completed map includes 40 hours of observations covering 7.5 square degrees, resulting in a 1σ RMS of 15 mJy/beam.

2. Results

Bolocam data are dominated by sky noise, requiring effective sky subtraction. Large scan maps with bright sources, as in Perseus, require special reduction techniques, since the most effective sky subtraction methods also tend to remove much of the source flux and create negative artifacts (Figure 1, left). We developed an iterative mapping routine to correct this; the resulting image of

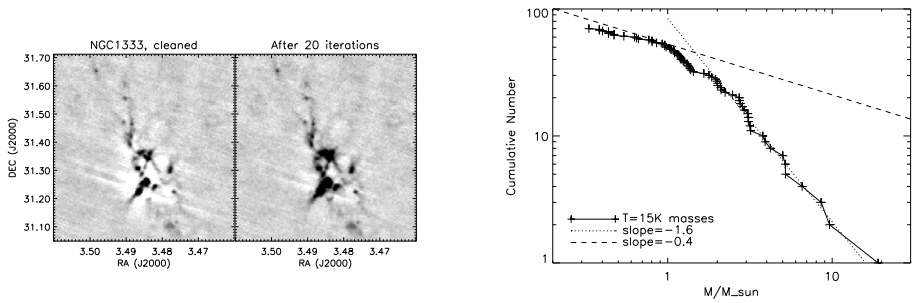

Figure 1. Left: The NGC 1333 region of Perseus before (left) and after (right) iterative mapping, demonstrating the successful recovery of source flux. Right: The cumulative mass function of all 1mm sources in the Bolocam map.

NGC1333 (Figure 1), demonstrates the success of iterative mapping in restoring source flux and reducing negative features.

After a preliminary reduction, 70 sources above 4σ were detected. The integrated flux was measured using circular apertures and the Clumpfind algorithm of Williams et al. (1999) to separate crowded sources. Assuming the dust emission is optically thin, we calculate the mass $M = \frac{D^2 S_\nu}{B_\nu(T_D)\kappa_{1.1}}$, with the 1.1mm opacity $\kappa_{1.1}$=0.01cm^2/g, a gas to dust ratio of 100, dust temperature of $T_D = 15$K, and distance $d = 300$pc. The cumulative mass distribution (Figure 1, right) has a best fit power law slope (N$\propto$M^{-p}) of $p \sim 1.6$. The slope is consistent with other star forming clouds and the local IMF (Johnstone et al. 2000). The slope appears to flatten at smaller masses, but is limited by incompleteness.

3. Spitzer Observations and Follow-up

The c2d Spitzer IRAC & MIPS maps of Perseus complement the Bolocam 1.1mm observations. In regions of extended 1mm emission a lack of Spitzer sources at 24μm and 70μm may indicate the presence of a number of star forming cores in the pre-collapse phase. In addition, several interesting regions have been targeted for high-resolution follow-up with SHARC2 at the CSO ($\lambda = 350\mu$m) and the OVRO interferometer ($\lambda = 3$mm).

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