Pipeline to extract 24 micron point sources from MIPSGAL survey plates

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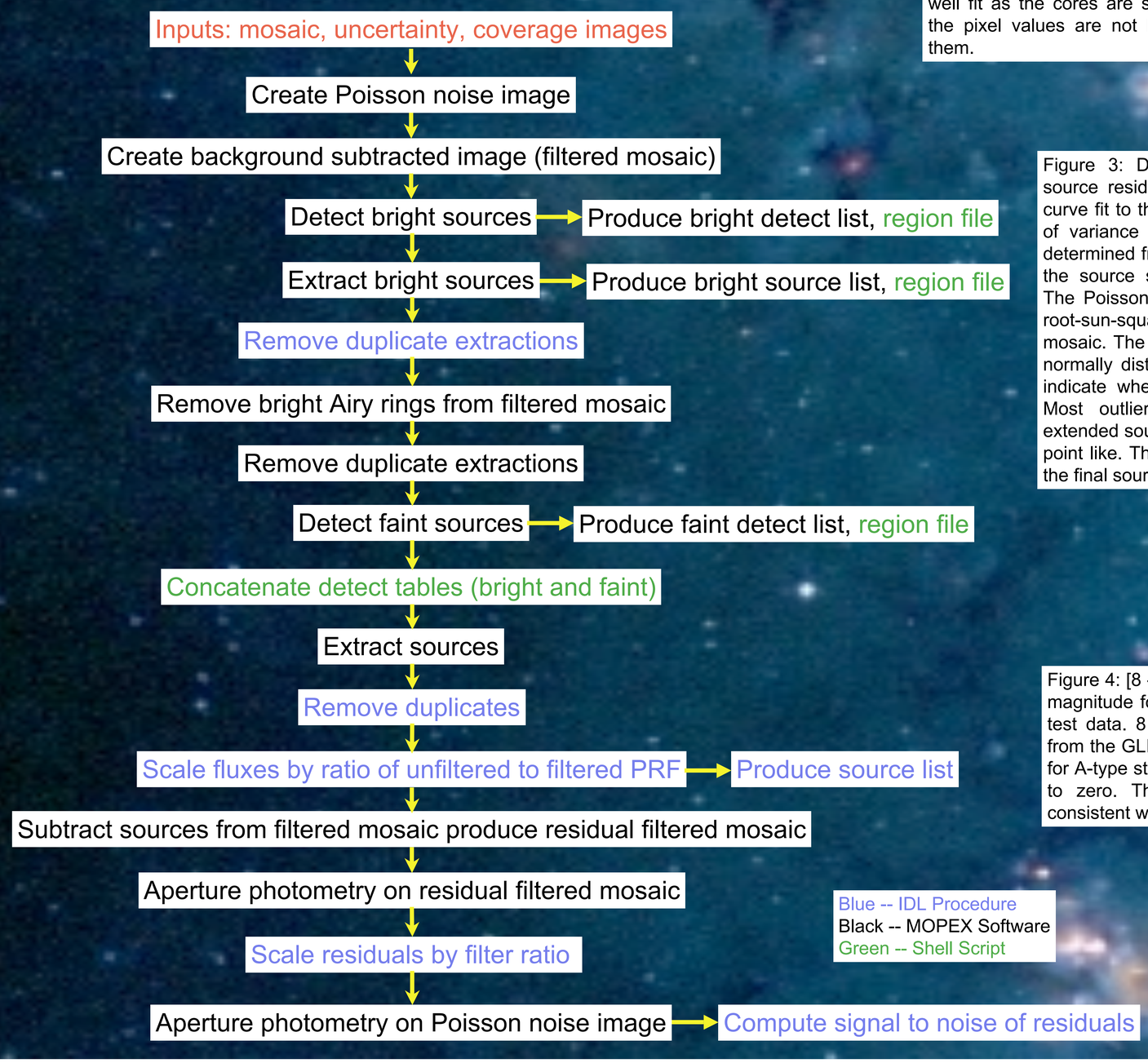
Abstract

We describe a pipeline to extract point sources from the 24 micron "MIPSGAL" survey plates. MIPSGAL is a survey of the inner Galactic plane, covering 220 square degrees, at 24 and 70 micron using the Multiband Imaging Photometer for Spitzer (MIPS) onboard the Spitzer Space Telescope. This survey will provide to the community image mosaics and source catalogs. The resolution of MIPS at 24 micron is 5.9" and, for our survey observations, the theoretical 5 σ detection level for a point source is 1.3 mJy. The inputs for our 24 micron source extraction pipeline are 1^0 by 1^0 images and the corresponding uncertainty and coverage maps. These images have been corrected for latents and various detector artifacts. Our pipeline driver consists of a csh script calling Interactive Data Language (IDL) procedures and Astronomical Point source EXtraction (APEX) module (part of the Spitzer Science Center-provided MOsaicking and Point source EXtraction (MOPEX) package). The procedure we employ to extract the point sources is as follows: first, we use a small-width median filter (filter window size is 12.5") to subtract the bright complex background of the Galactic plane. We then identify bright sources (greater than 200 mJy) on the background subtracted image. These sources have bright Airy rings which we subtract to avoid confusing them with the faint sources. Next, the faint sources are detected and finally, Point Response Function (PRF, very similar to an off center sub-sample Point Spread Function) fitting is performed on all the detected sources. Due to the aggressive filtering used to produce the background subtracted image, we underestimate the source flux. We scale the source flux by the ratio of flux obtained using a filtered PRF to the flux obtained using an unfiltered PRF. We assess the quality of our data by examining the source subtracted mosaic and the signal-to-noise ratio (SNR) of the residuals. In addition, we perform aperture photometry on the residuals from the background filtered image and compare it with the expected uncertainty from the image noise.

Here we present results from our test runs which show that we can reliably extract sources with flux ranging from 1 to 1000 mJy with SNR greater than 3.

Pipeline Description

Our photometry pipeline consists of a csh shell script that drives a step of processing steps using a combination of IDL procedures and the MOPEX post-BCD processing software developed at the Spitzer Science Center (Makovoz 2005; software available at http://ssc.spitzer.caltech.edu/postbcd/). The APEX code in MOPEX does the bulk of the source detection, extraction and source subtraction steps. The major steps of the source extraction pipeline are outlined below:



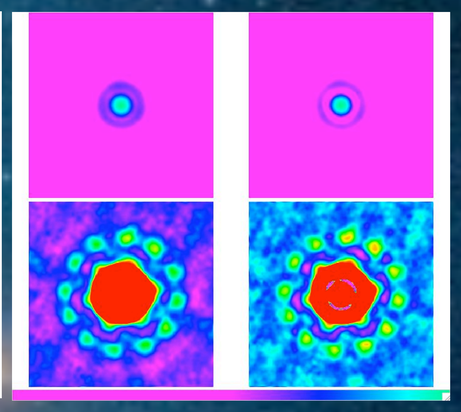


Figure 1: The two PRFs used by the pipeline. The left hand panels are for the PRF constructed from the unfiltered mosaic data. The right hand panels are the PRF constructed from the background subtracted data. Both PRFs were generated using the prf_estimate module in MOPEX. The top panels are a log stretch over the entire dynamic range and the bottom panels are a linear stretch over a small dynamic range to show the wings of the PRFs used. The filtered PRF contains 68% of the flux of the unfiltered PRF.

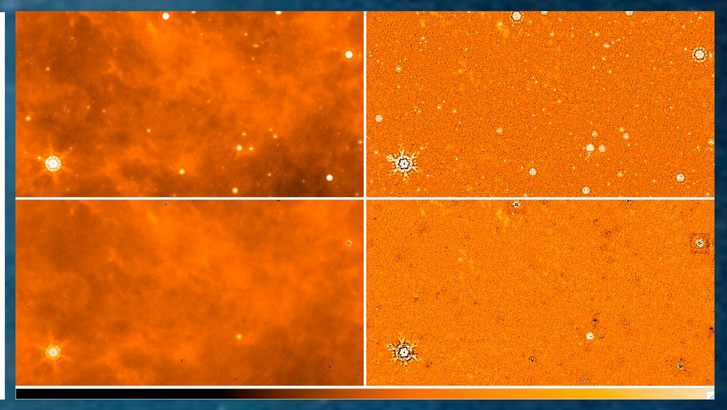


Figure 2: Upper left panel is a portion of a MIPSGAL mosaic around l = 55.9, b = -0.42, the upper right panel is the background subtracted mosaic. The lower left panel is the source subtracted mosaic and the lower right panel is the background subtracted, source subtracted mosaic. Most of the extractions leave residuals that are consistent with the Poisson noise of the source. The brightest sources are not well fit as the cores are saturated and the pixel values are not linearized for them.

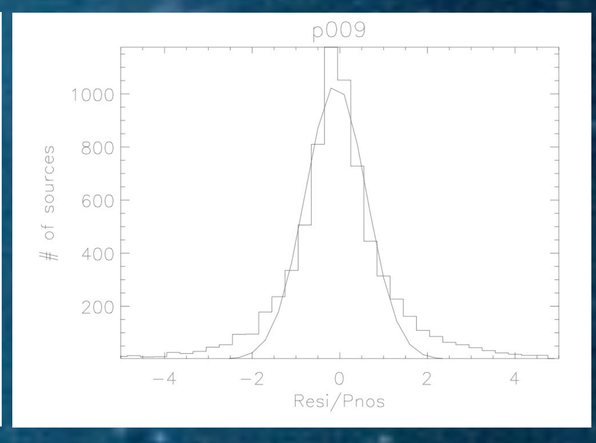


Figure 3: Distribution of the ratio of source residual to Poisson noise. The curve fit to the histogram is a Gaussian of variance unity. The residuals were determined from aperture photometry of the source subtracted filtered mosaic. The Poisson noise was determined by root-sun-squaring the uncertainty mosaic. The residuals are for most part normally distributed. Significant outliers indicate where the source fitting fails. Most outliers are caused by small extended sources which are not actually point like. These objects are rejected in the final source list.

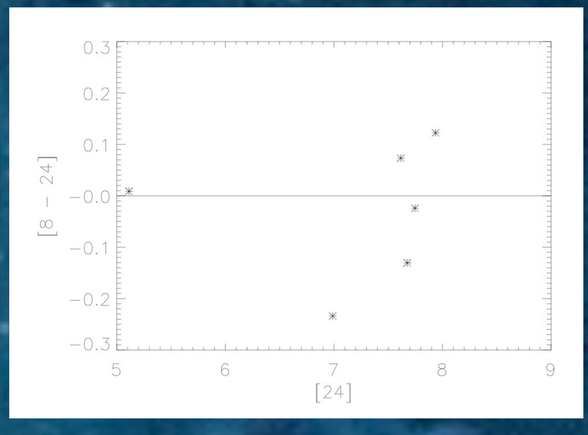


Figure 4: [8 - 24] color versus 24 micron magnitude for A-type stars found in our test data. 8 micron data was obtained from the GLIMPSE survey. As expected for A-type stars the [8 -24] color is close to zero. The scatter in the data is consistent with Poisson noise.

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