

Extracting Photometry from SPIRE Maps

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On behalf of the SPIRE ICC

Map Calibration and Units

Bright Point Source

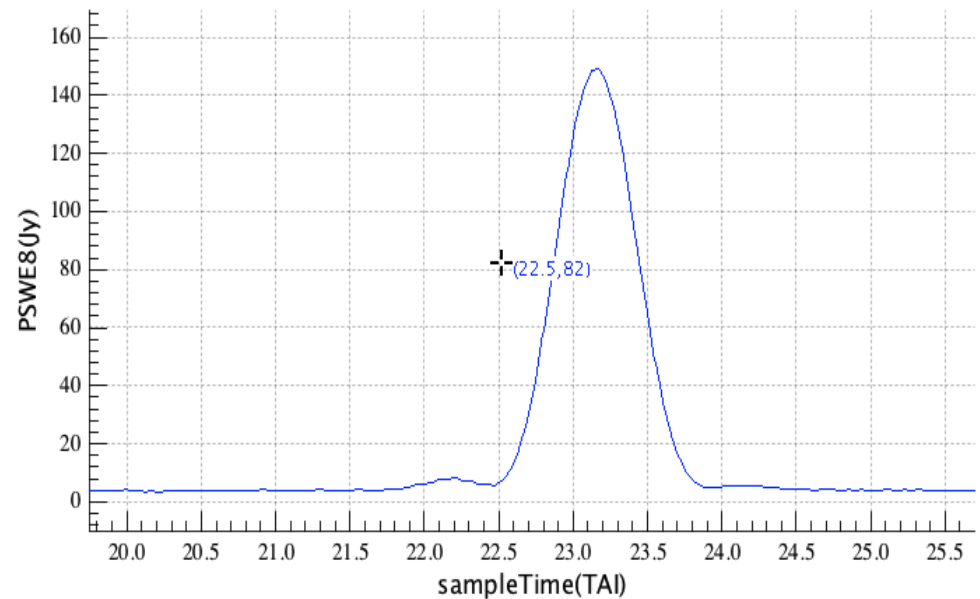
Source Extraction

Extended Emission

SPIRE calibration is defined in a straightforward manner.

- When a detector is scanned directly over a point source, the peak deflection of the signal timeline equals the brightness of the source.

Scan of
detector
PSWE8 over
Neptune,
obsid
1342187440

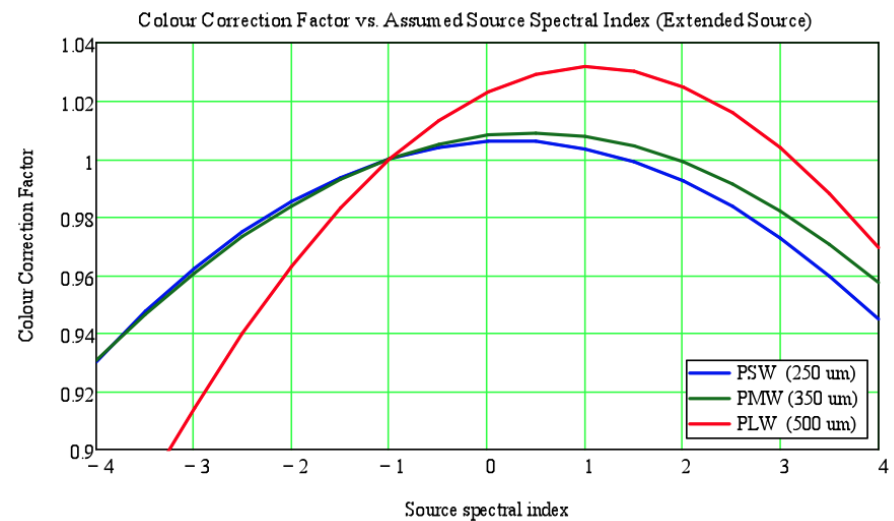
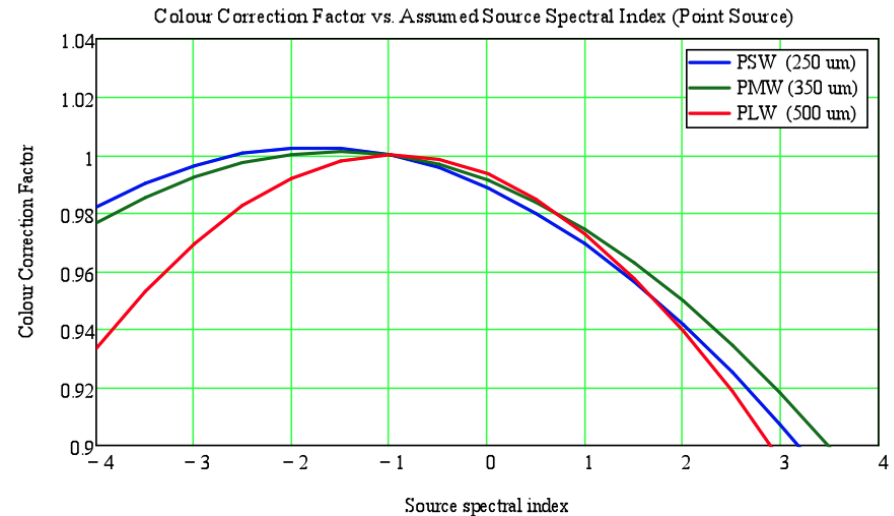


The timeline-based definition leads to some accounting corrections:

- Units are in Janskys per beam
 - Peak value is nominally the brightness
- Calibration applies to the timelines
 - Map-making lowers the peaks
- Calibration is for $\nu \cdot F_{\nu} = \text{constant}$
 - Colour correction is for other spectral shapes
- Calibration is for point sources
 - Correction for extended sources

Colour corrections are given in the SPIRE Observers Manual

- See Section 5.2.8
- Multiply by the value appropriate for your source
- Different corrections for point & extended sources



Use the “fine-scale” areas to convert Jy/beam to other units

The fine-scale beam areas were measured from Neptune maps with 1 arcsec pixels

250 micron: 426 sq arcsec
350 micron: 771 sq arcsec
590 micron: 1626 sq arcsec

The “convertImageUnit” task will change maps to Jy/pixel or MJy/sr.

- Which technique to use?
- Estimating uncertainties
- Peak fitting demo

Peak-fitting is recommended for point sources

- Gaussian-fitting on maps gives good results for bright sources
 - Gaussian is a good approximation for radii up to (22,30,42) arcsec
- Fitting Gaussians to timelines is underdevelopment by the ICC
 - Will offer better results for 100mJy+ sources
- Aperture photometry is possible
 - Official corrections not yet available, so you'll have to derive your own.

Combine these in quadrature to estimate the uncertainty

- Uncertainty in the fitted amplitude
 - Includes the instrument & confusion noise (min of ~ 5 mJy)
- 2-3% of flux density for uncertainty in the pixelisation correction
- 7% of flux density for calibration uncertainty
 - 2% relative (band-to-band) uncertainty
 - 5% is Neptune model (does not apply to SPIRE colours)

Point Source Photometry Demo

- Target: Gamma Draconis
 - Model fluxes: (254, 130, 64) mJy
- Source fit task in HIPE to fit Gaussians
 - interactive
 - Resides in script `Spire_Photometry_GammaDra.py`

- Inside HIPE: DAOPhot & Sussetractor
- DAOPhot Demo

Two source extractors are available within HIPE

- `sourceExtractorDaophot`
- `sourceExtractorSussextractor`

Both can be run as Tasks, and both can accept input source lists

You must compute corrections yourself

- ICC has found flux dependent correction for Sussextractor

The simplest operation of the extractors users the FWHM of each band

- Averages for nominal pixels:
 - 250 micron: 18.2 arcsec
 - 350 micron: 24.9 arcsec
 - 500 micron: 36.2 arcsec
- You can supply your own PRF image
- The fine-scale beam areas are needed (or convert the images in HIPE) for fluxes
 - (426, 771, 1626) sq arcsec

Corrections are still needed for extractor outputs

- Need an aperture corrections appropriate to FWHM
 - About 25-30%
- Colour corrections still needed.

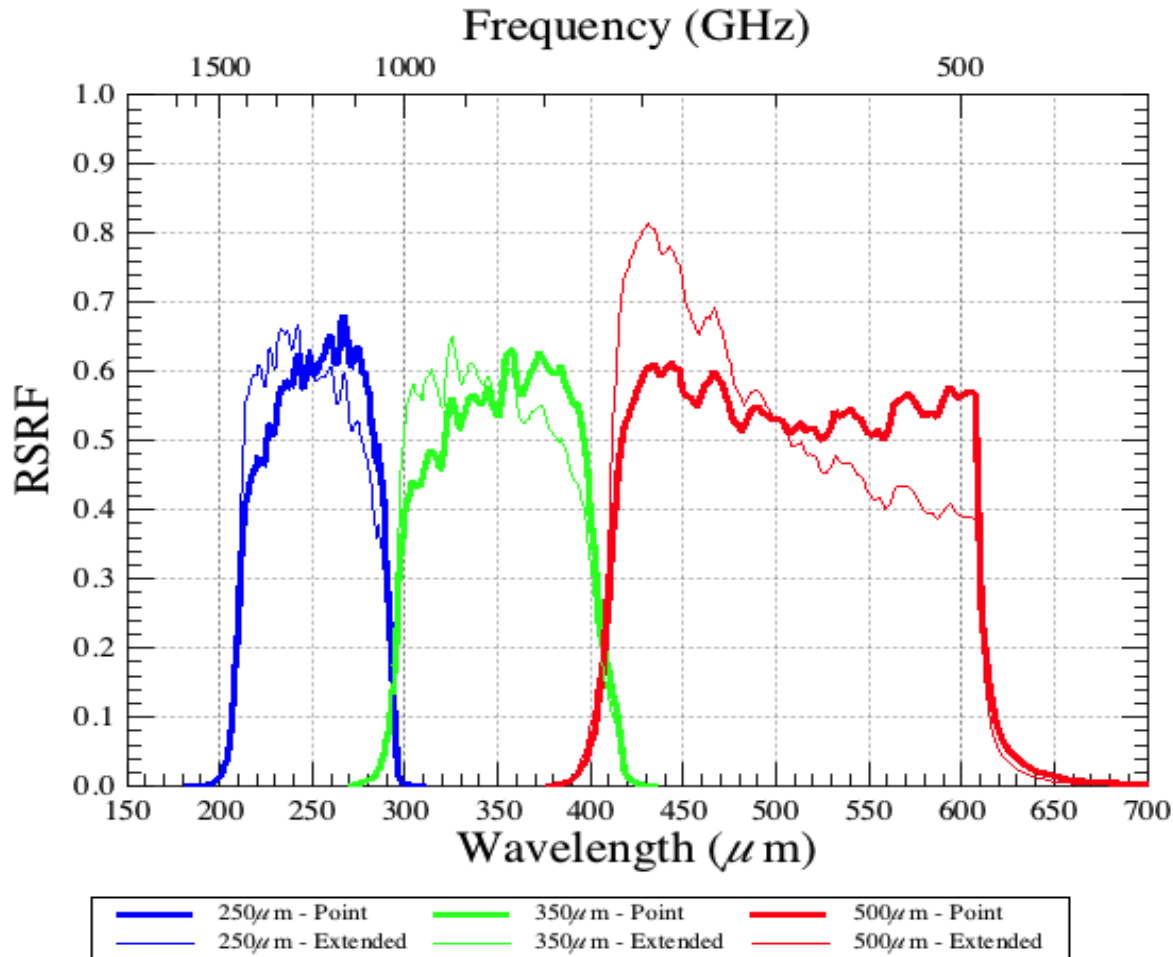
Source Extractor Demo

- Using Gamma Draconis again
- Interactive: DaoPhot
- Simplest operation shown
 - Using average FWHM, Gaussian approx
 - Not showing PRF usage

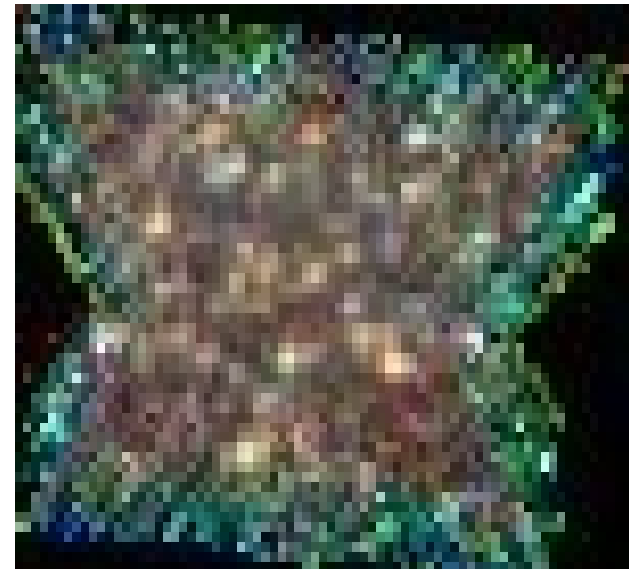
- Spectral response for extended sources
- Caveats

Extended Emission

The extended spectral response differs from that for point sources



- Caveats for extended emission
- No absolute level
 - Could get from Planck data
- Map-making technique can effect extended emission
 - Baseline removal
- CIB fluctuations at a faint level



- Unit correction & extended correction must be applied
- Correct units e.g. to MJy/sr
 - convertImageUnit task
 - Fine beam areas
- Multiply by these factors to get the extended relative spectral response function
 - 250 micron: 0.9939/1.0113
 - 350 micron 0.9898/1.0060
 - 500 micron 0.9773/1.0065