Extracting Photometry from SPIRE Maps

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On behalf of the SPIRE ICC

Photometry from SPIRE Maps

Map Calibration and Units

Bright Point Source

Source Extraction

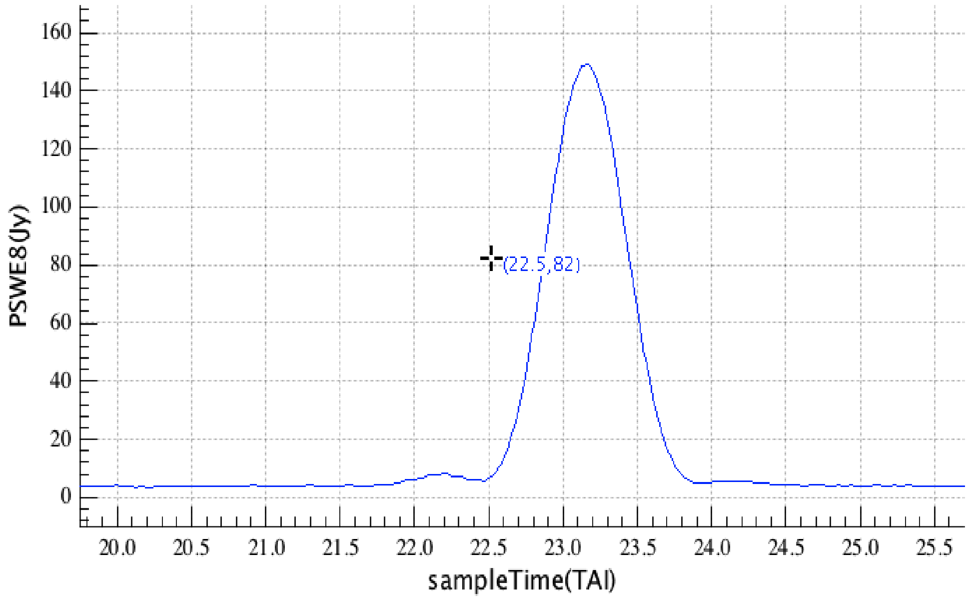
Extended Emission

Map Calibration & Units

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



Map Calibration & Units

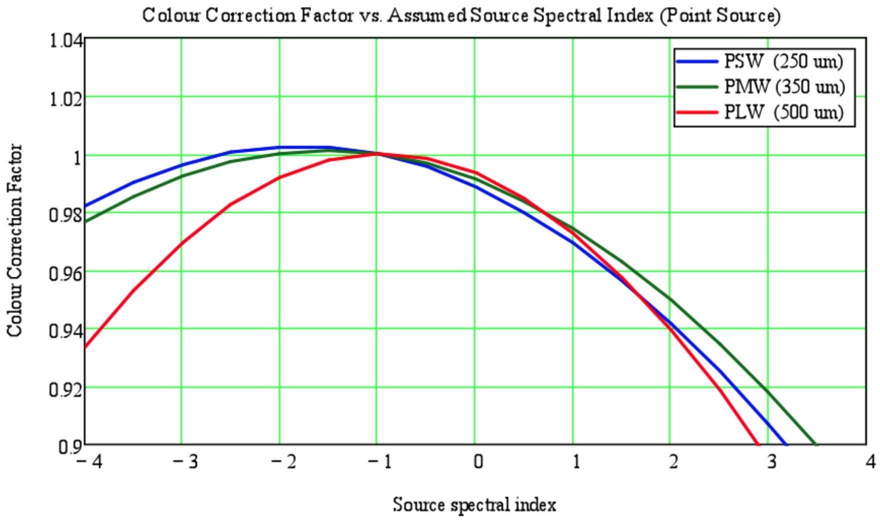
The timeline-based definition leads to some accounting corrections:

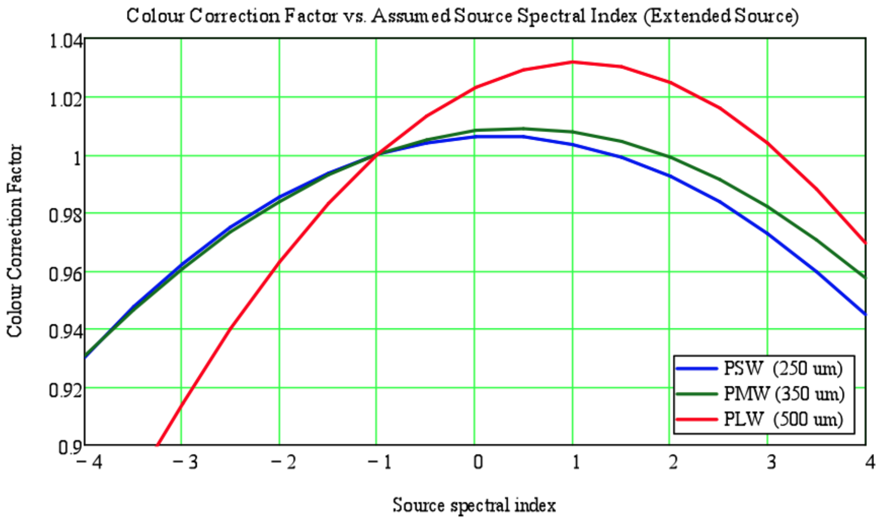
- Units are in Janskys per beam
  - Peak value is nominally the brightness
- Calibration applies to the timelines
  - Map-making lowers the peaks
- Calibration is for nu*Fnu = constant
  - Colour correction is for other spectral shapes
- Calibration is for point sources
  - Correction for extended sources

Map Calibration & Units

Colour corrections are given in the SPIRE Observers Manual

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





Map Calibration & Units

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
500 micron: 1626 sq arcsec

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

Bright Point Source

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

Bright Point Source

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.

Bright Point Source

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/beam
- Source fit task in HIPE to fit Gaussians
  - interactive
  - Resides in script Spire_Photometry_GammaDra.py

Source Extraction

- Inside HIPE: DAOPhot & Sussextractor
- DAOPhot Demo

Source Extraction

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

Source Extraction

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

Source Extraction

Corrections are still needed for extractor outputs

- Need an aperture corrections appropriate to FWHM
  - About 25-30%

- Colour corrections still needed.

Source Extraction

Source Extractor Demo

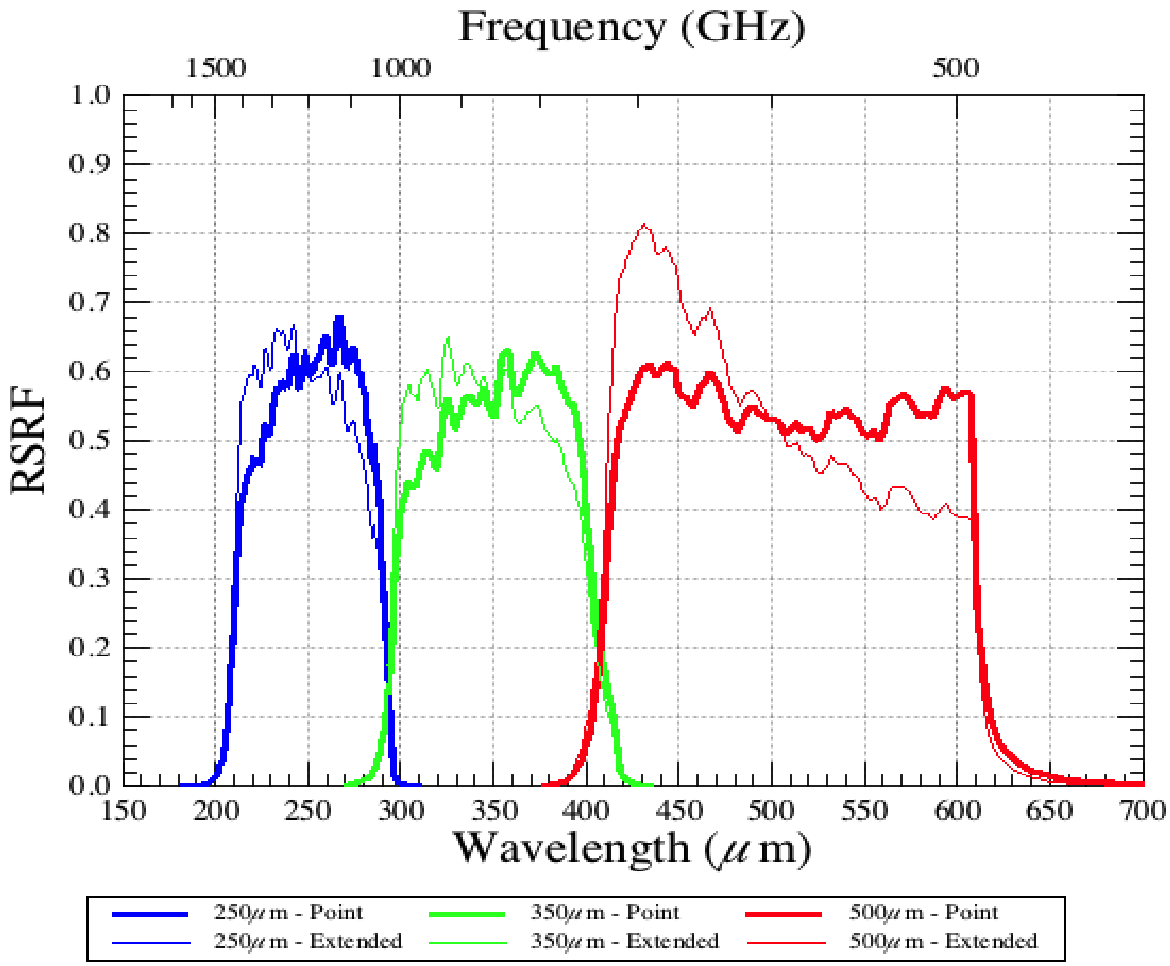
- Using Gamma Draconis again
- Interactive: DaoPhot
- Simplest operation shown
  - Using average FWHM, Gaussian approx
  - Not showing PRF usage

Extended Emission

- Spectral response for extended sources
- Caveats

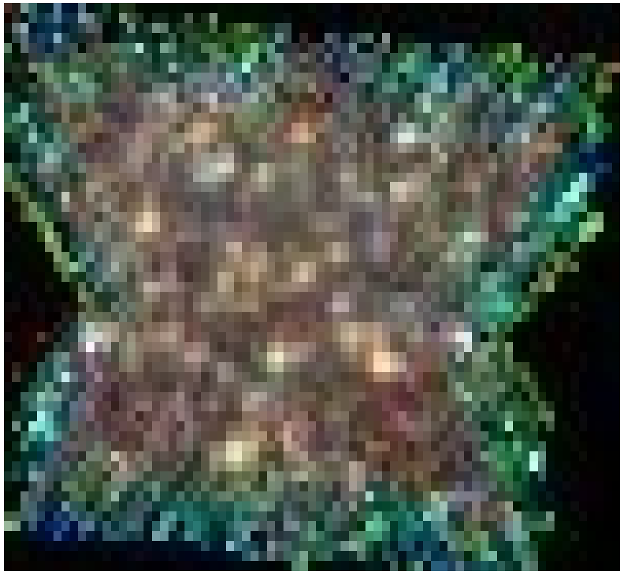
Extended Emission

The extended spectral response differs from that for point sources



Extended Emission

- 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



Extended Emission

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 (convert RSRF-weighted flux density to monochromatic flux density, by dividing K_{4E}/K_{4P} from the SPIRE OM, Section 5.2.8)
  - 250 micron: 0.9939/1.0113
  - 350 micron 0.9898/1.0087
  - 500 micron 0.9773/1.0065