SPIRE Extended/Point Source Photometry

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on behave of SPIRE map-making test team

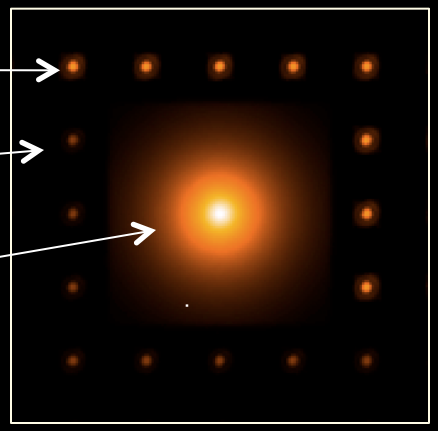
Simulations:

nominal (0.7x0.7 deg^2, 8 brt, 8 fnt)

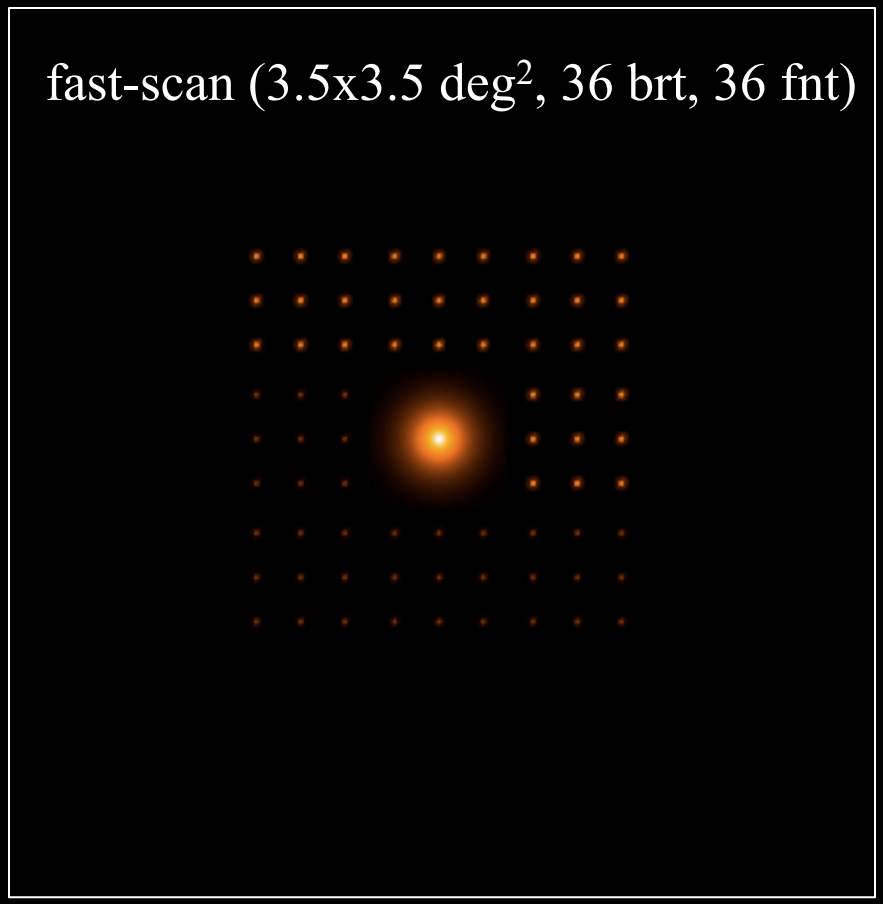
bright point sources (f = 300 mJy)

faint point sources (f = 30 mJy)

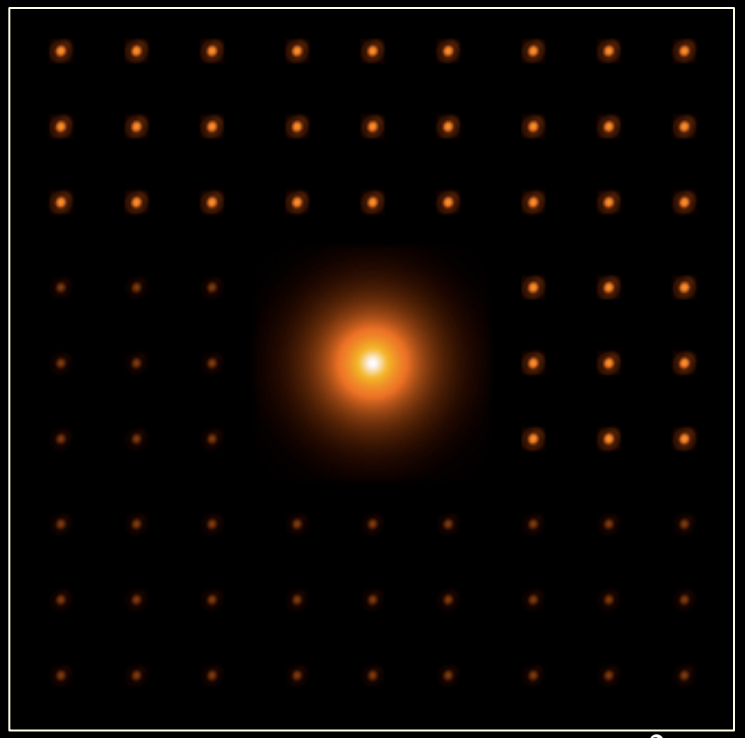
extended source (e-folding length =1.5')



fast-scan (3.5x3.5 deg^2, 36 brt, 36 fnt)



parallel (1.4x1.4 deg^2, 36 brt, 36 fnt)



Point Sources – Results from PSF Fitting

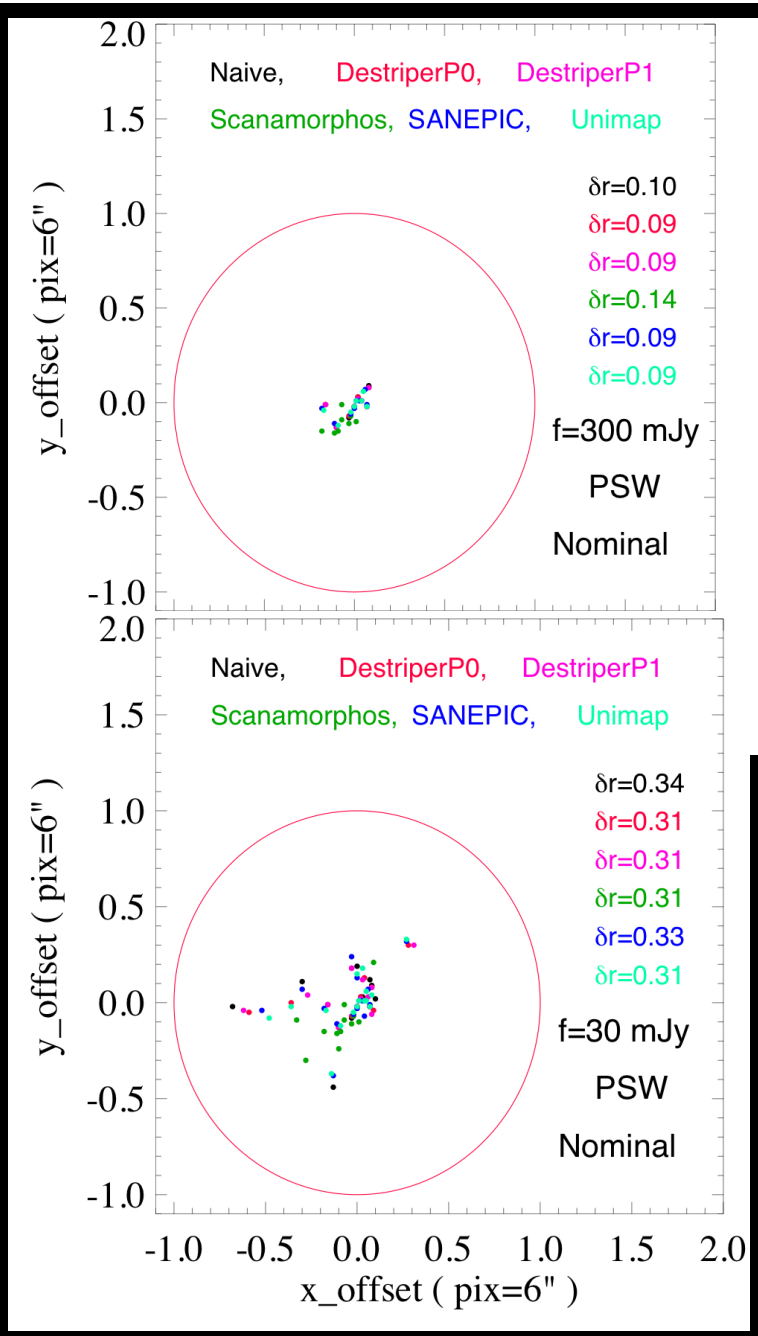
- Source Extractor: Starfinder (good for point sources in crowded fields)
- PSFs: constructed from truth maps (including pixelization effects)
- Checked:
  - Astrometry (position offsets)
  - Faint source detection rate
  - Flux errors

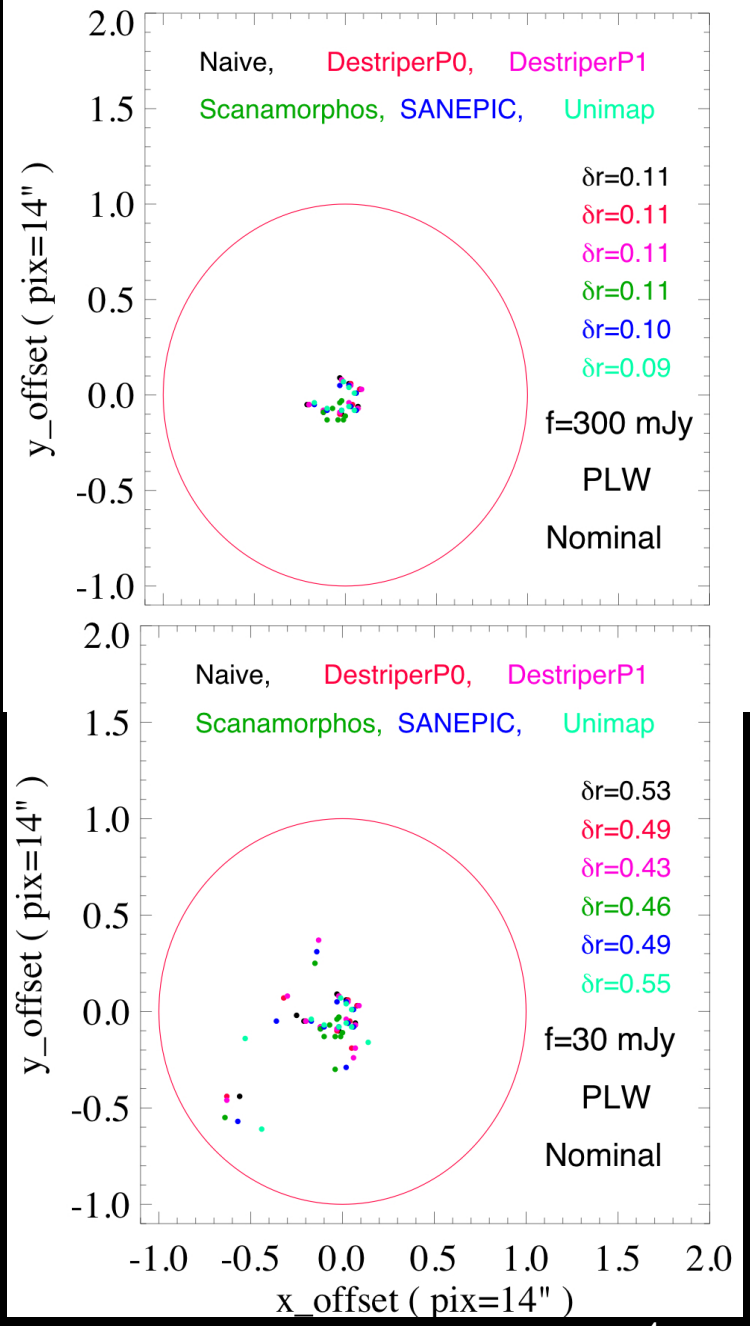
Position offset:

Bright sources (300 mJy) →

Faint sources (30 mJy) →

Nominal mode



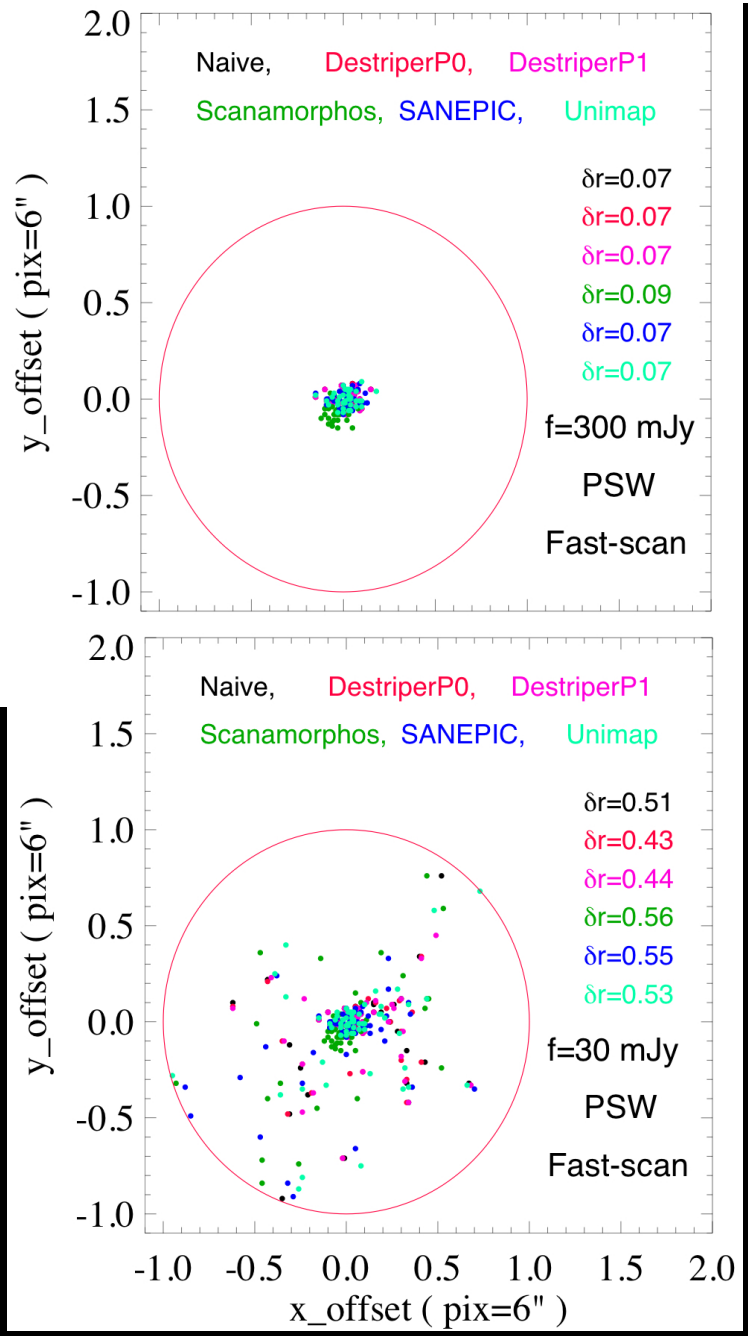


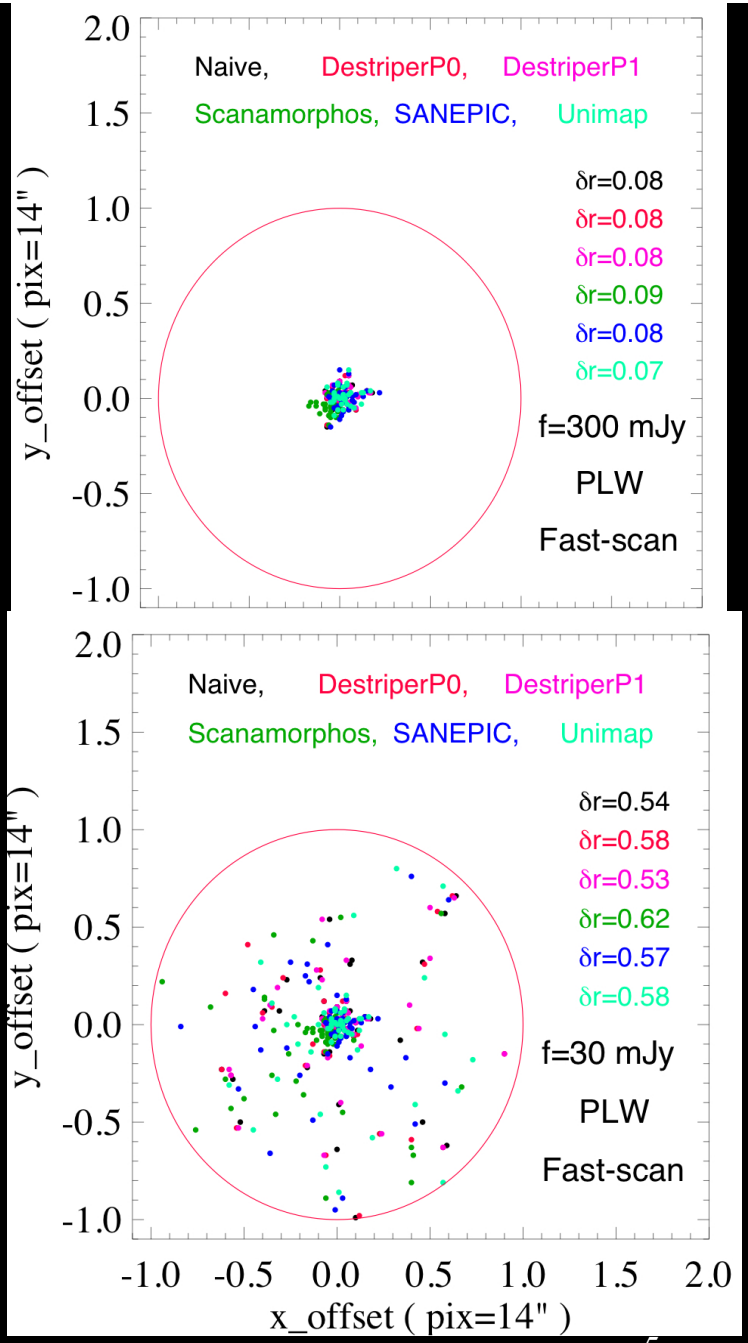
Position offset:

Bright sources (300 mJy) →

Faint sources (30 mJy) →

Fast-scan mode



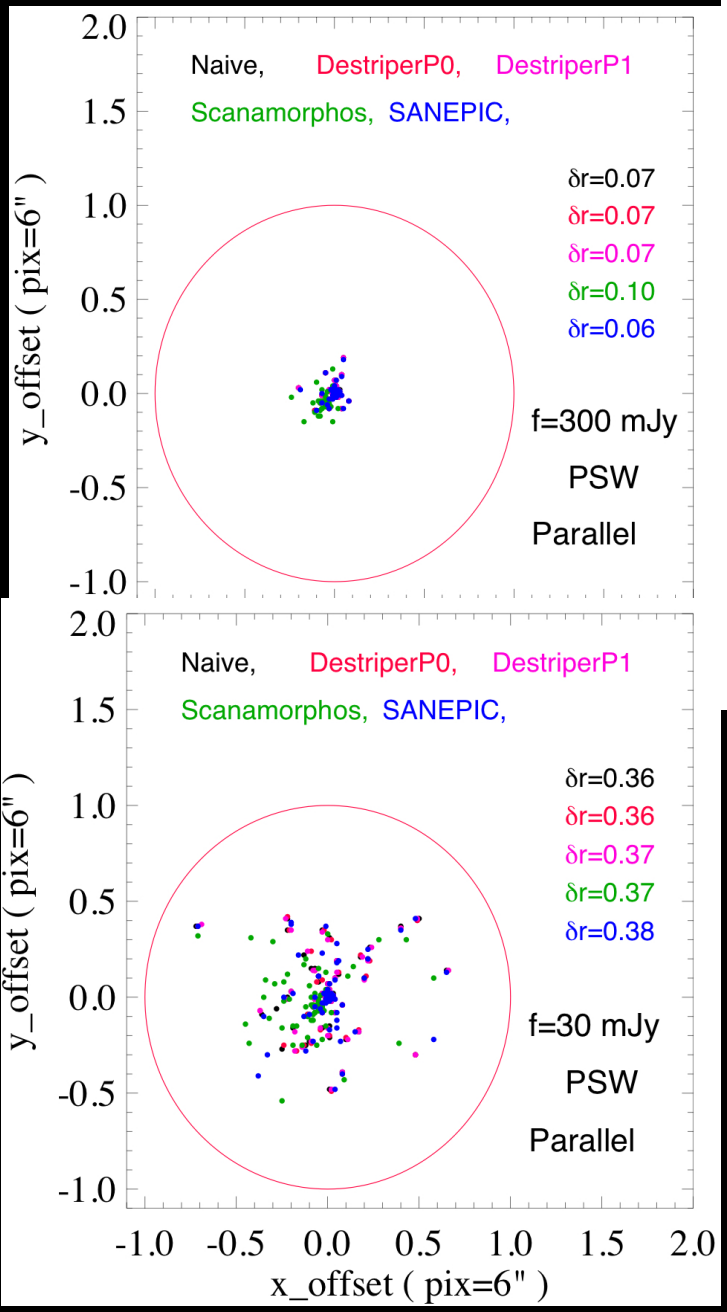


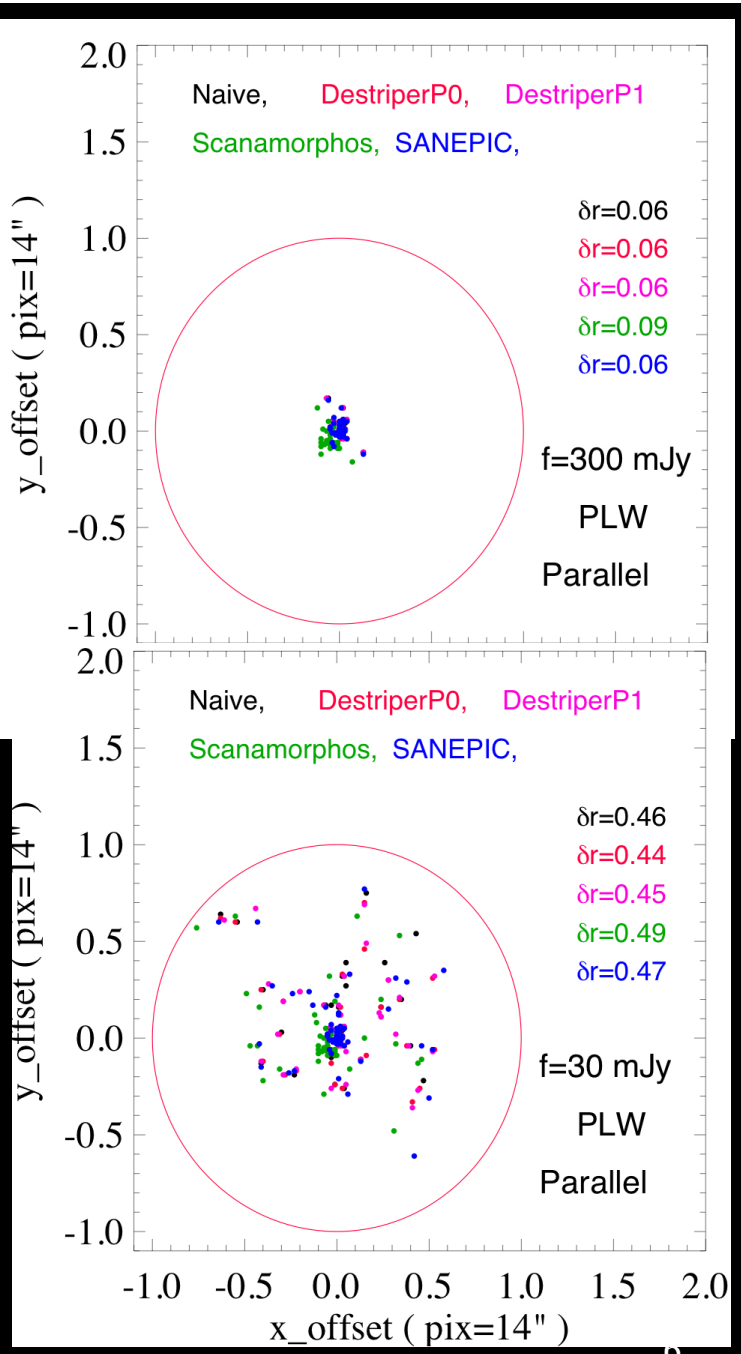
Position offset:

Bright sources (300 mJy) →

Faint sources (30 mJy) →

parallel mode



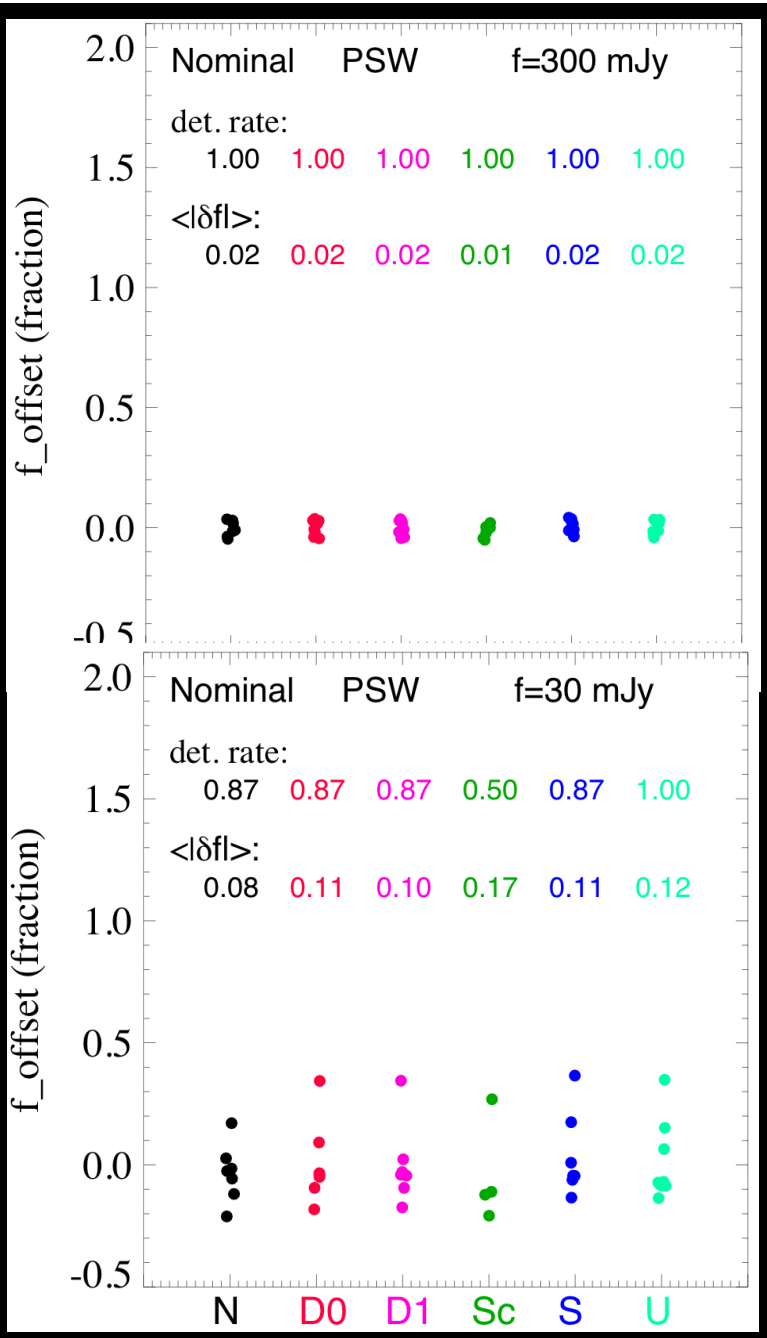


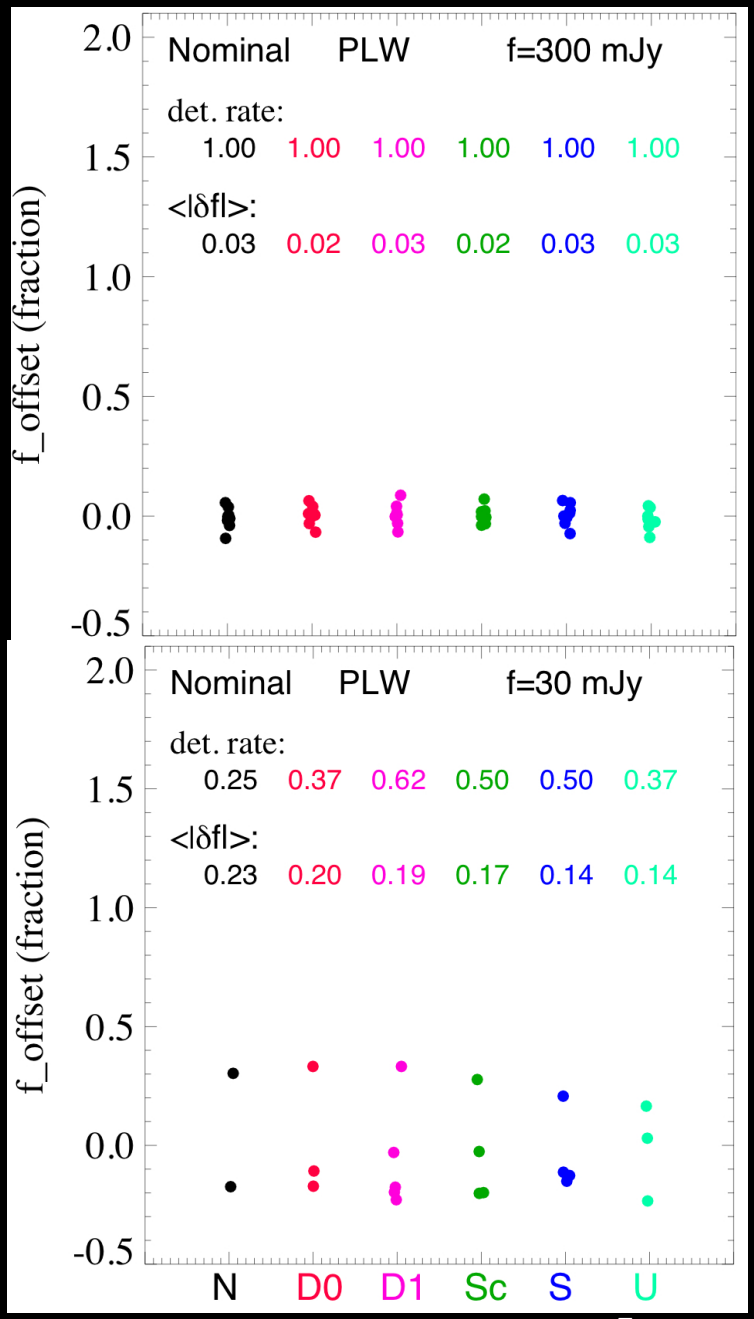
Flux deviation:

Bright sources (300 mJy) →

Faint sources (30 mJy) →

nominal mode



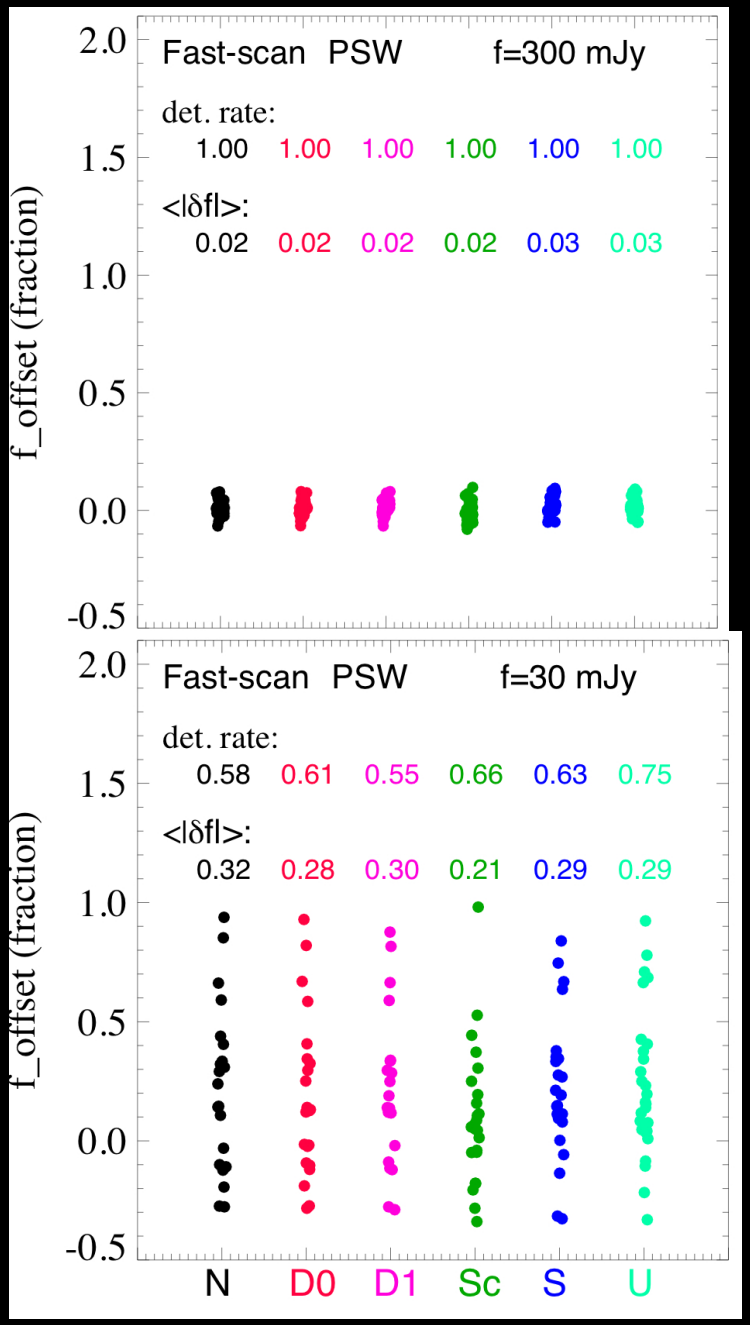


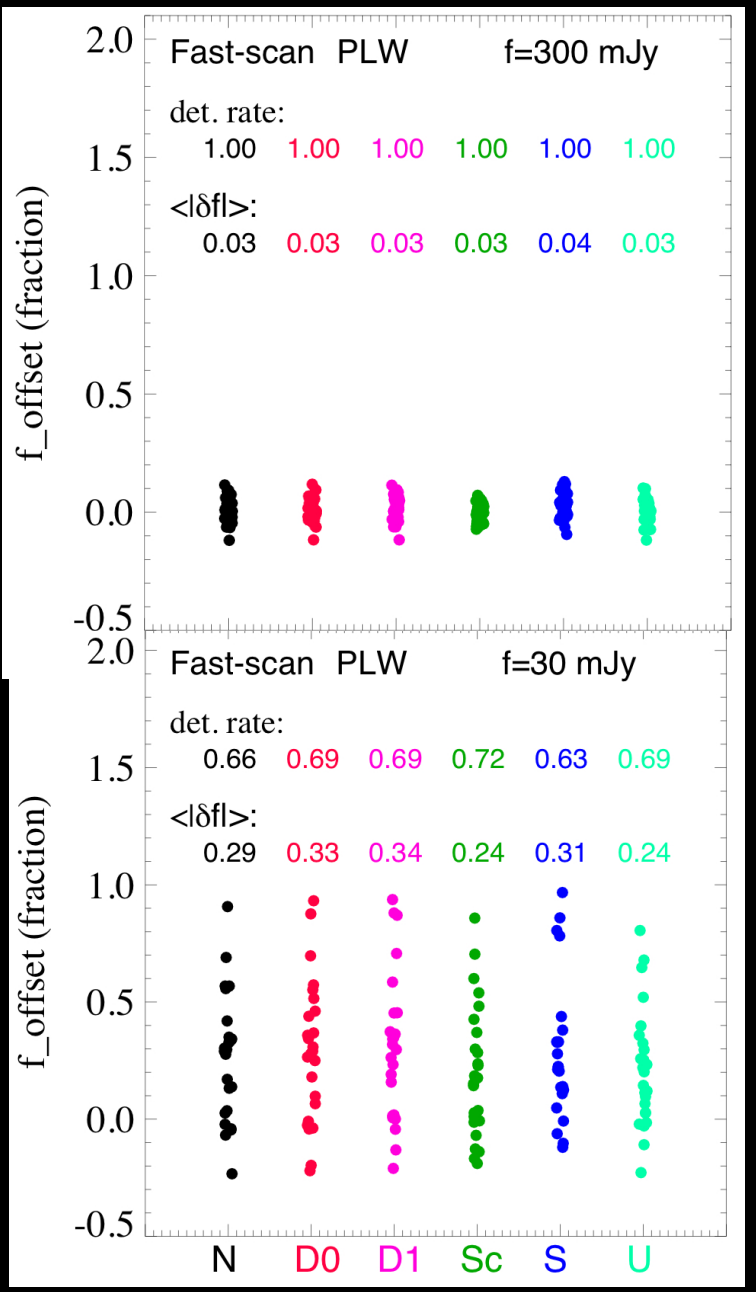
Flux deviation:

Bright sources → (300 mJy)

Faint sources → (30 mJy)

Fast-scan mode



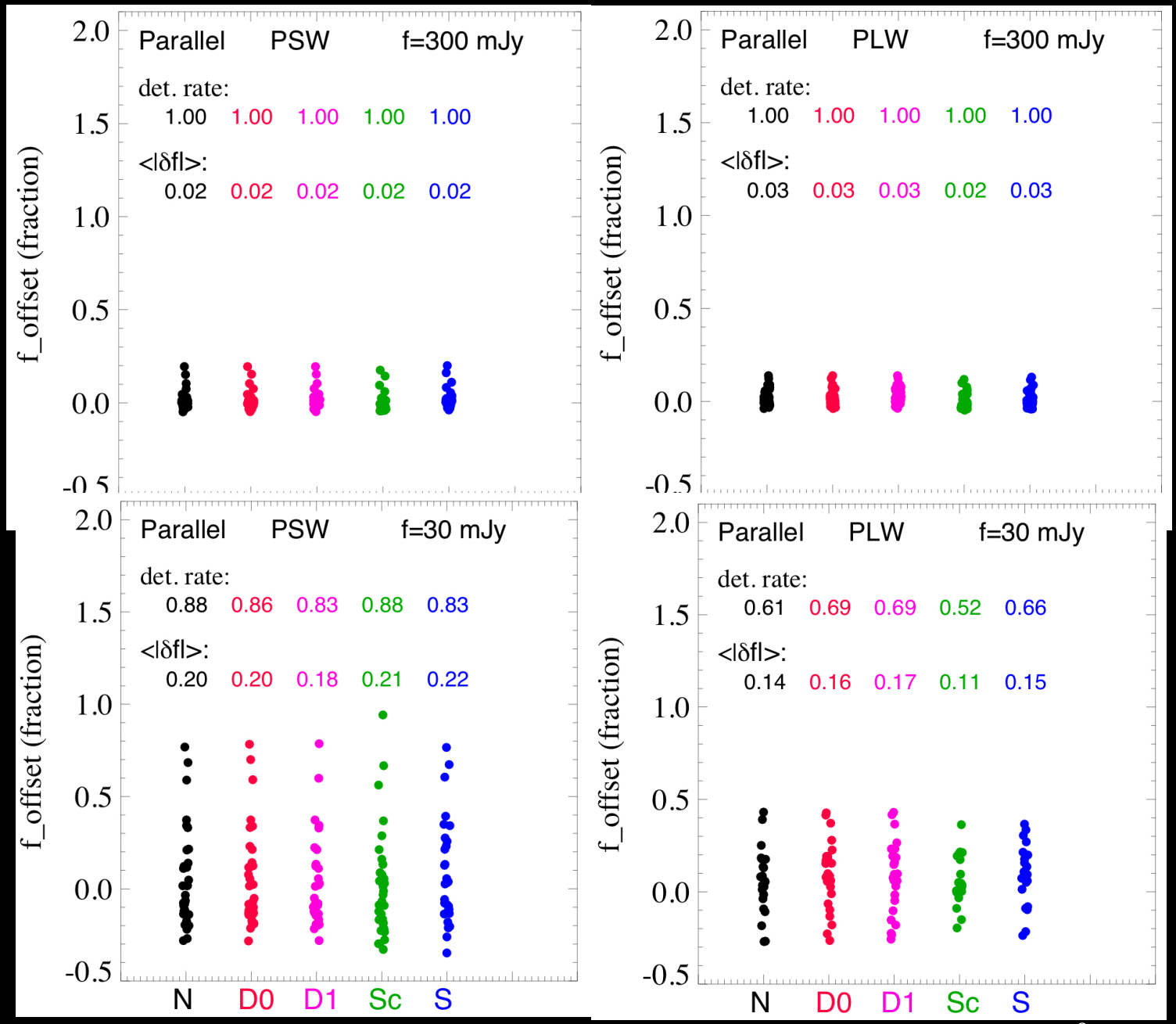


Flux deviation:

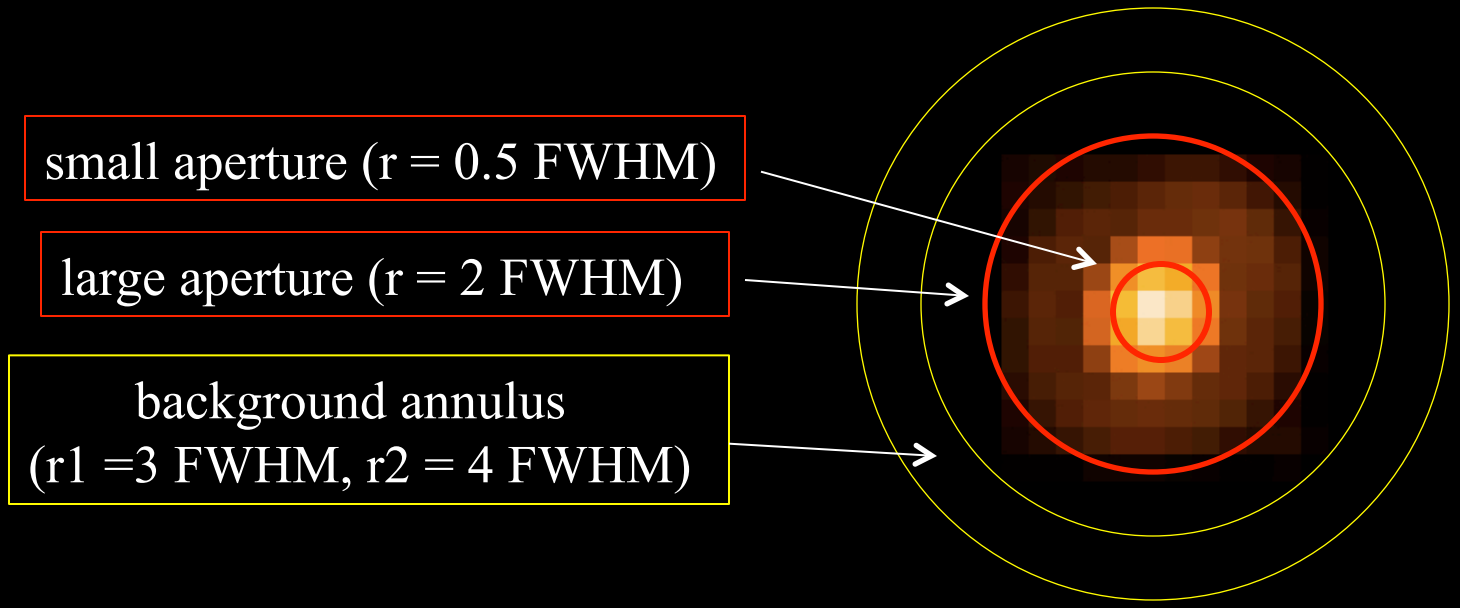
Bright sources → (300 mJy)

Faint sources → (30 mJy)

Parallel mode



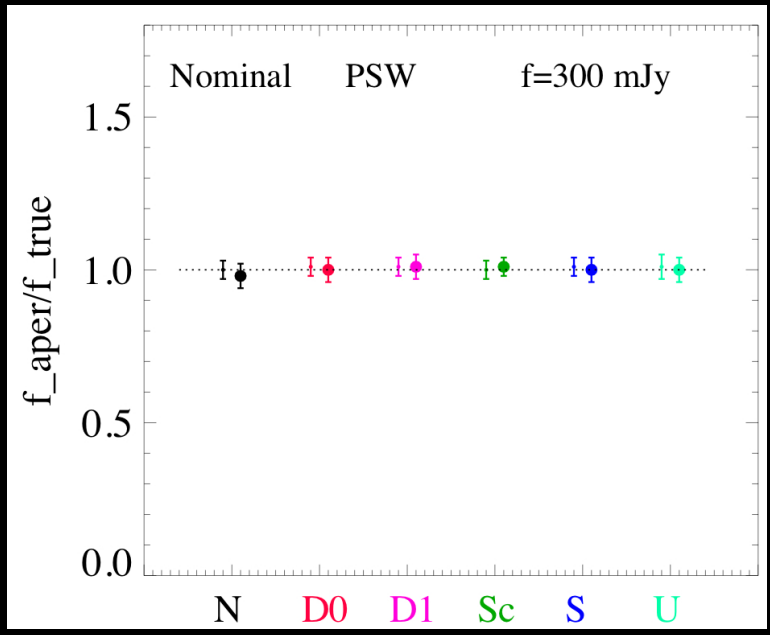
Point Sources – Results from Aperture Photometry

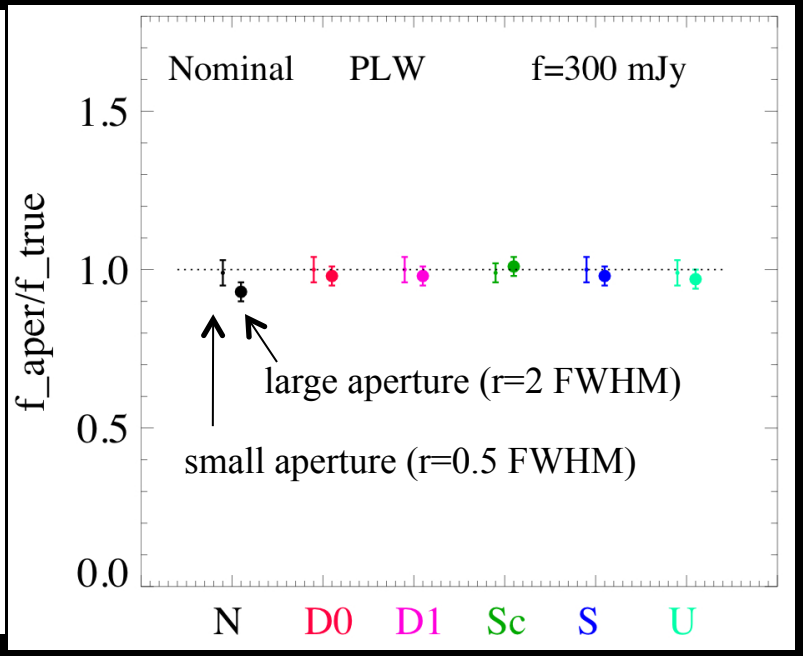


- small aperture photometry: sensitive to position offsets
- large aperture photometry: energy conservation in map-making
- results are reported in f_aper/f_true, f_true is the flux measured using the same aperture on the truth map (this is to avoid the uncertainty due to aperture correction).

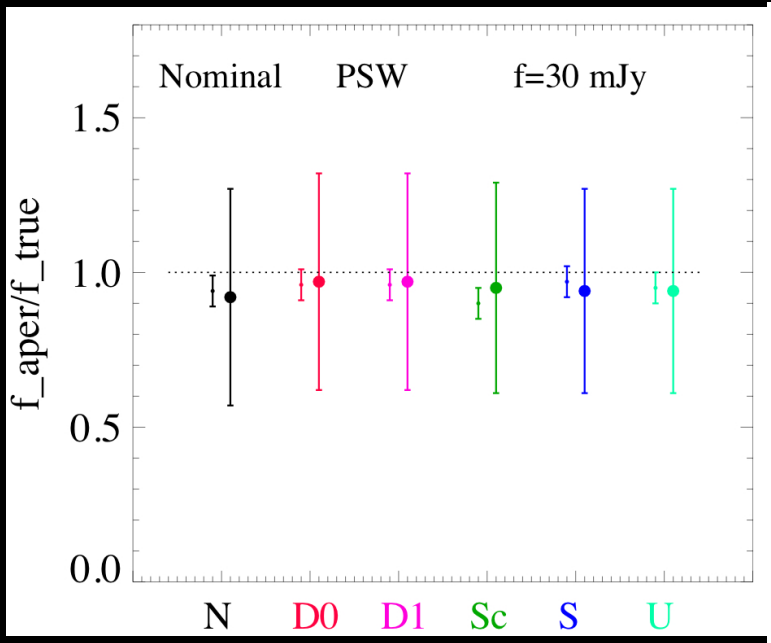
Aperture photometry:

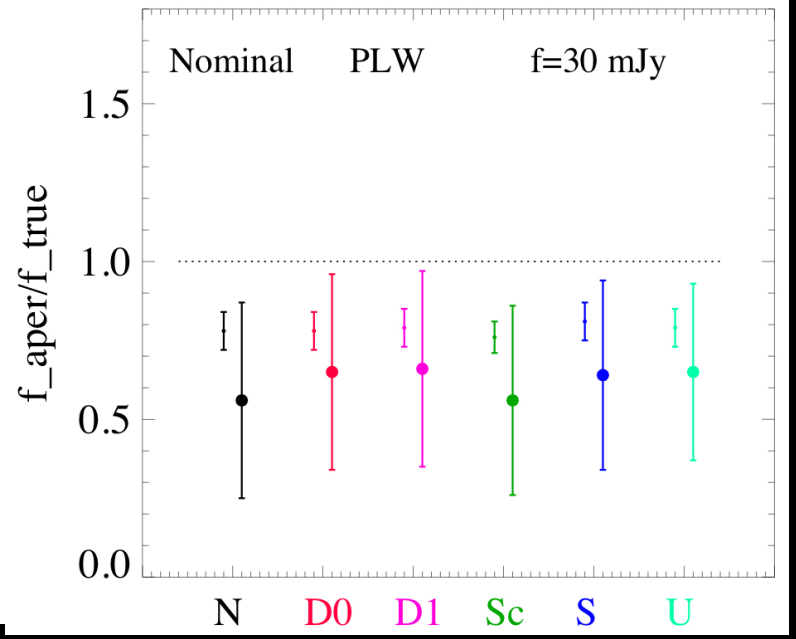
Bright sources (300 mJy) →





Faint sources (30 mJy) →





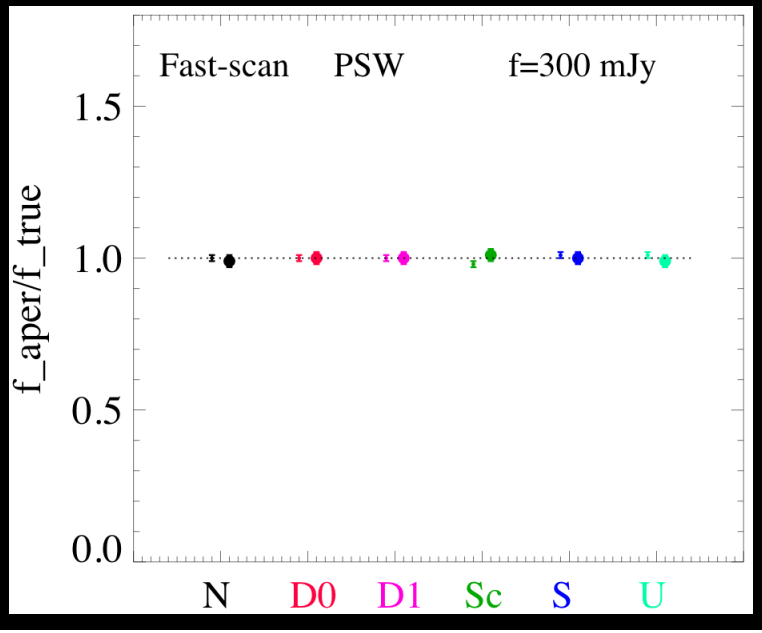
nominal mode

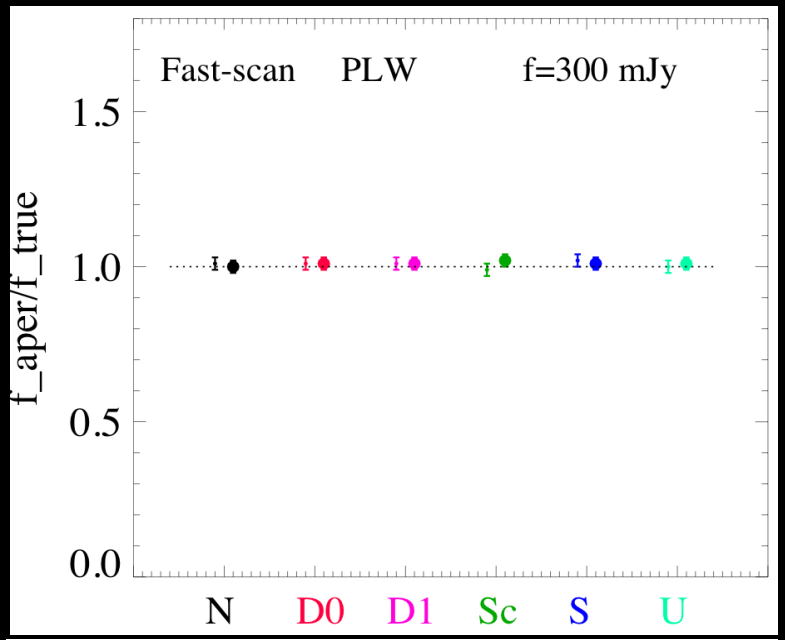
Aperture photometry:

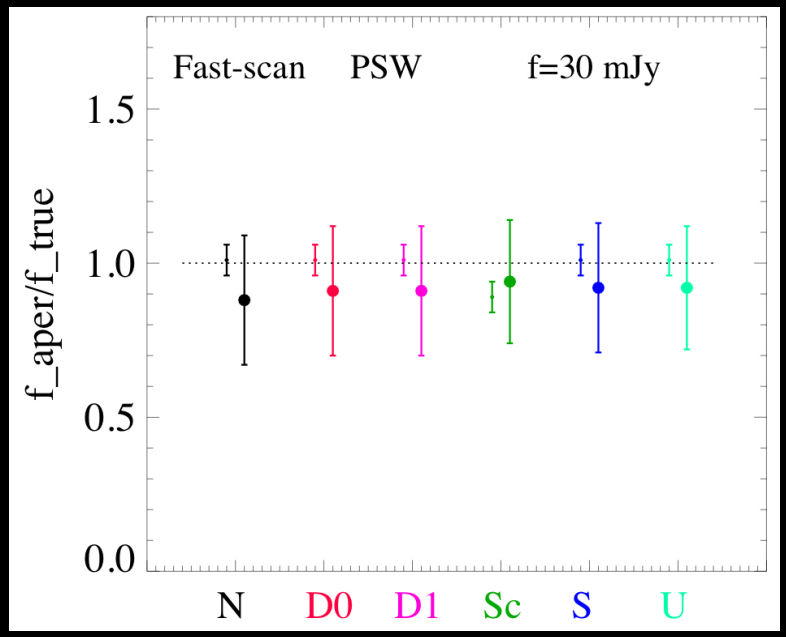
Bright sources (300 mJy) →

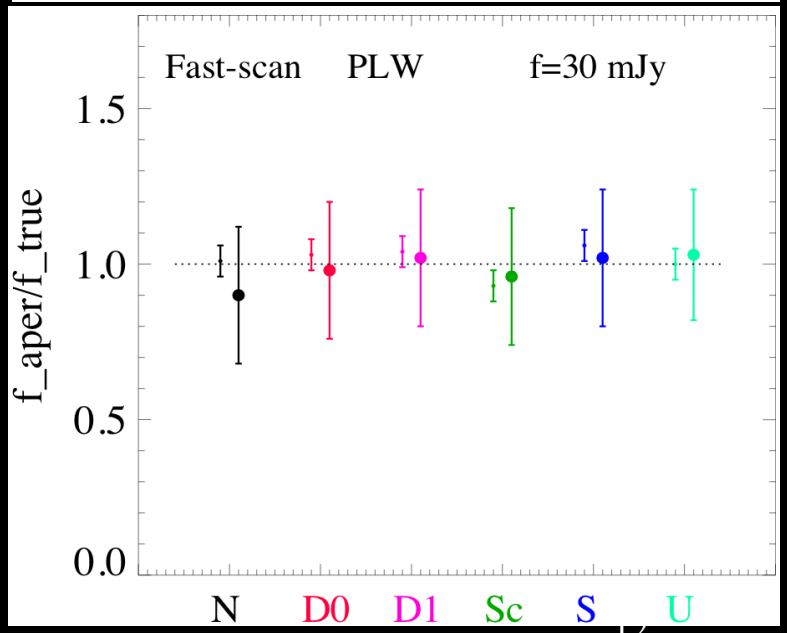
Faint sources (30 mJy) →

Fast-scan mode







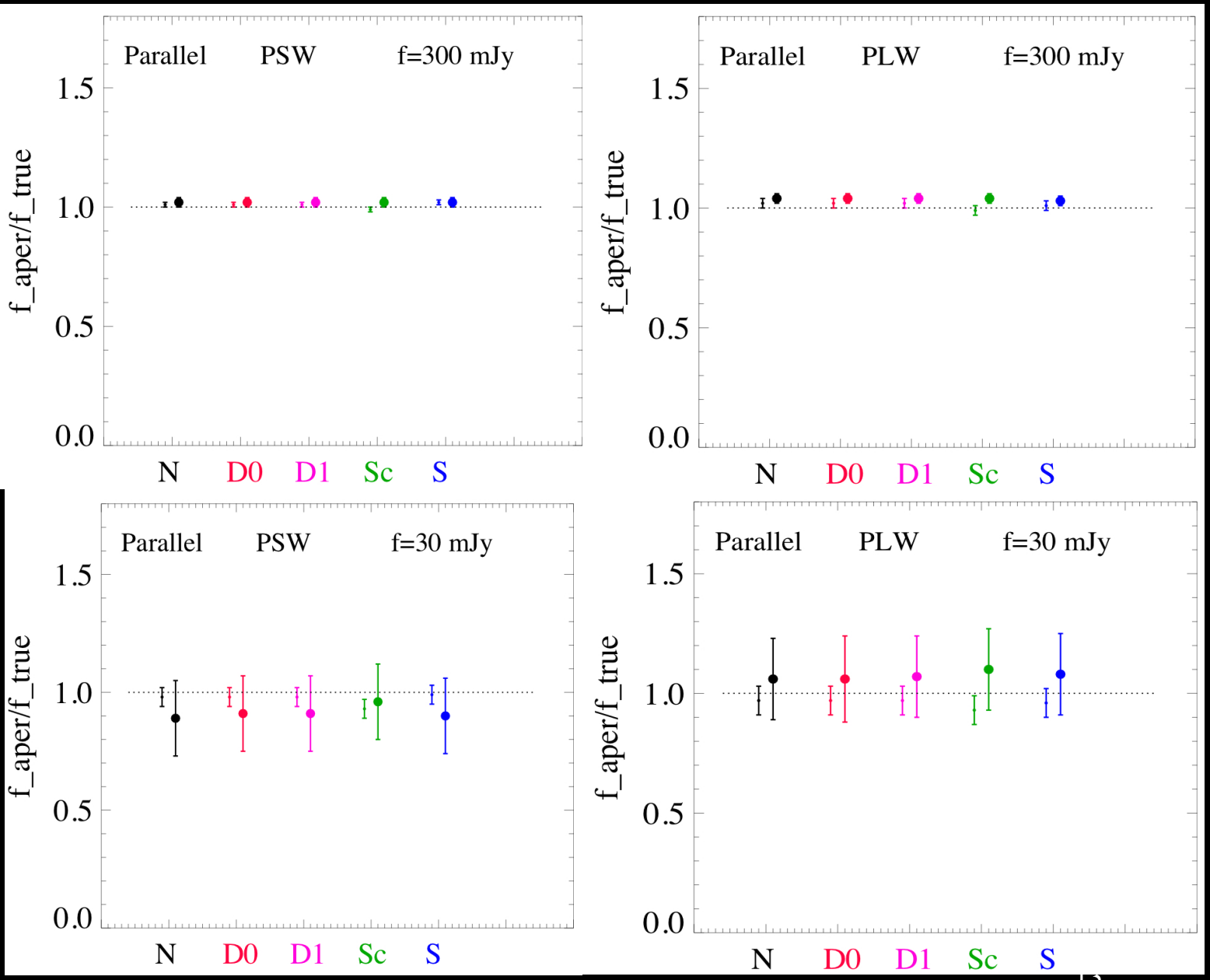


Aperture photometry:

Bright sources (300 mJy) →

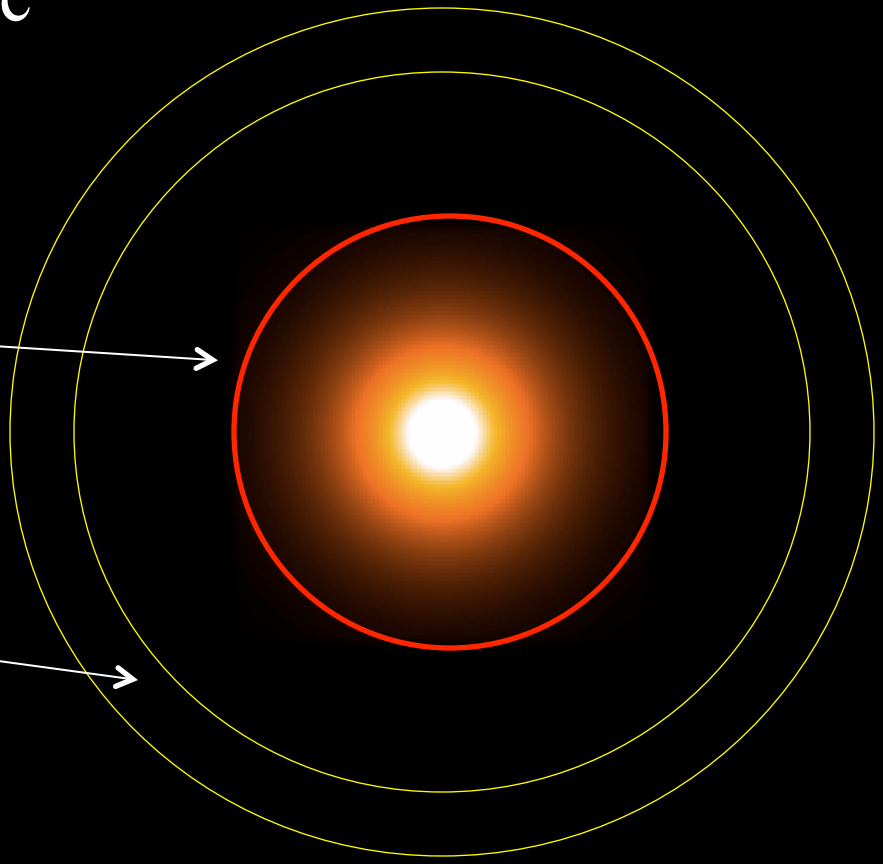
Faint sources (30 mJy) →

parallel mode



Extended Source – Results from Aperture Photomery

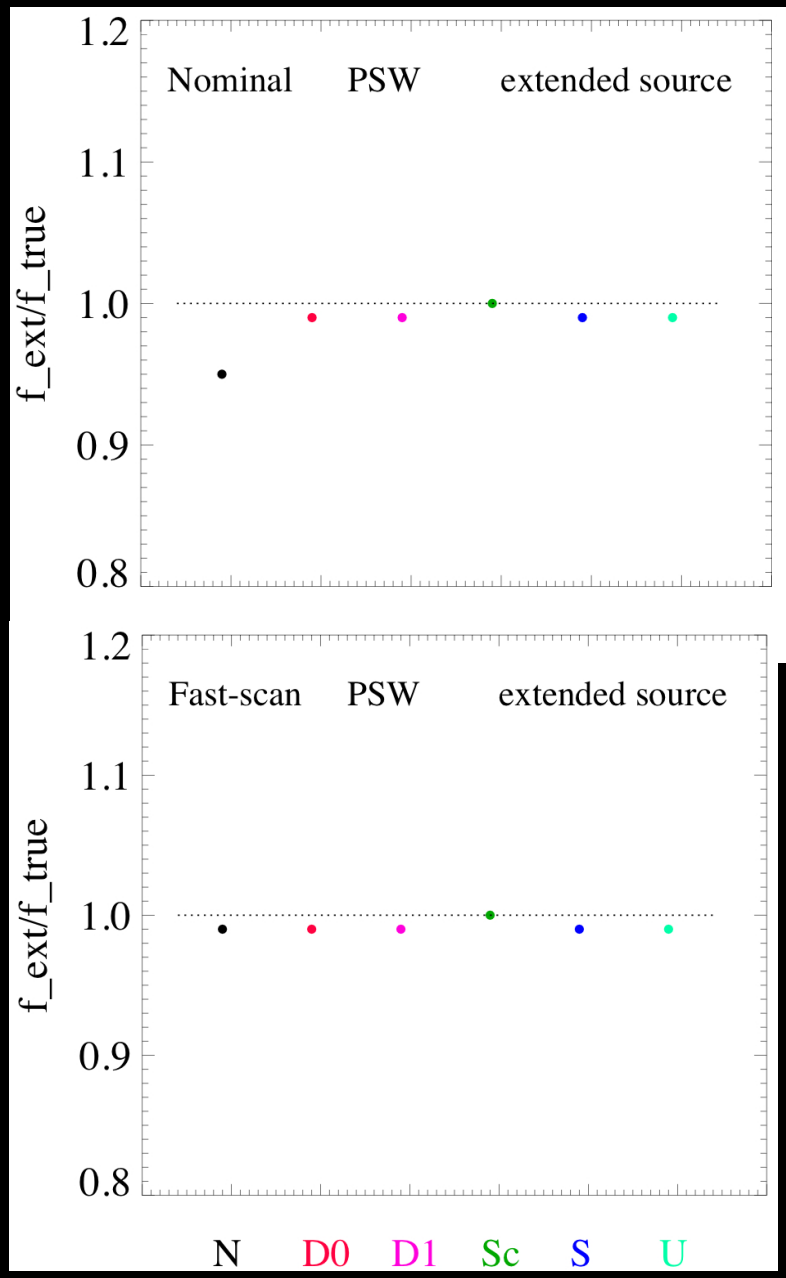
- Extended source: 1 exponential disk at map center
- e-folding length = 90 arcsec

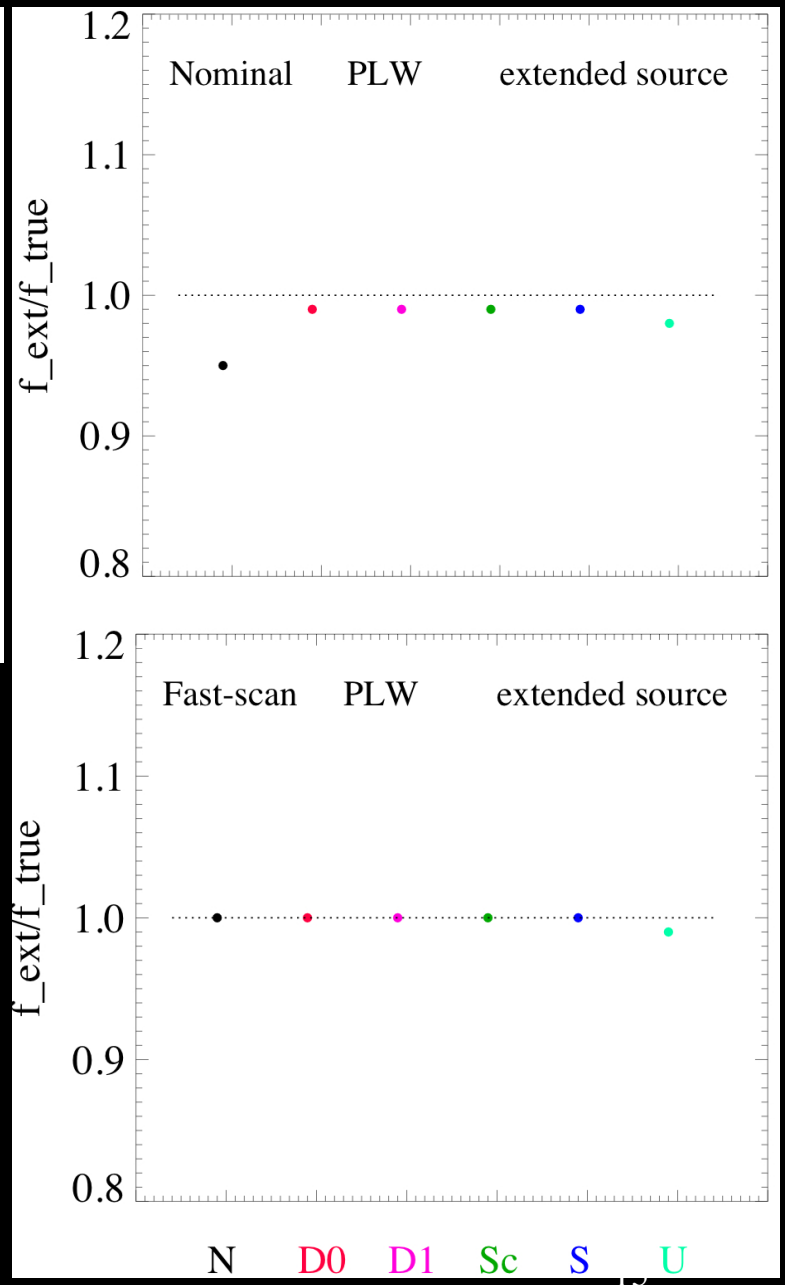


Extended source photometry:

Nominal mode →

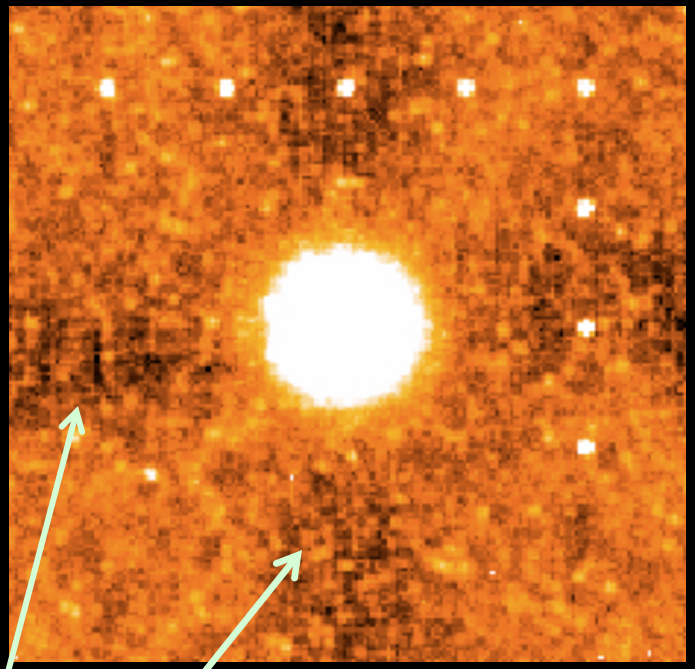
Fast-scan mode →



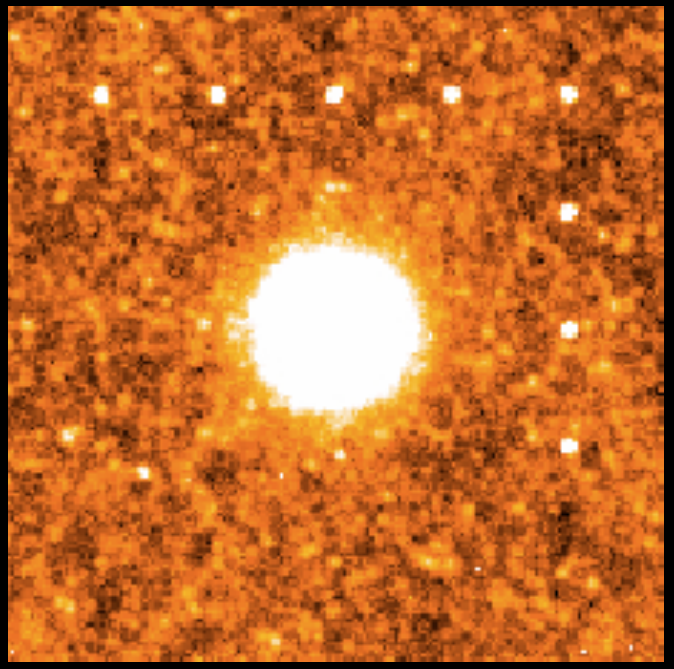


- For naïve maps, the under-estimation of fluxes of extended sources is a known issue, which can be resolved within HIPE:

Naïve, default median baseline removal



Naïve, baseline subtraction with ROI (region of interest)



Shadows due to baseline over-subtraction

PLW, nominal case (0.7 deg x 0.7 deg)

Summary

- Both PSF fitting and small aperture photometry show small position errors (< 0.1 pix) for bright point sources. In some cases, maps made by Scanamorphos show slightly larger errors.
- Photometry for bright point sources in maps made by all map-makers have small errors, indicating good energy conservation in the map making.
- The position and the flux errors for the faint sources are significantly affected by the confusion noise. It appears that no mapmaker stands out in detecting the faint sources and minimizing the errors.
- For the photometry of extended sources: in some cases, maps made by Naïve mapper are significantly affected by a known bias due to the over-subtraction of the baseline. Other maps have no such issue.