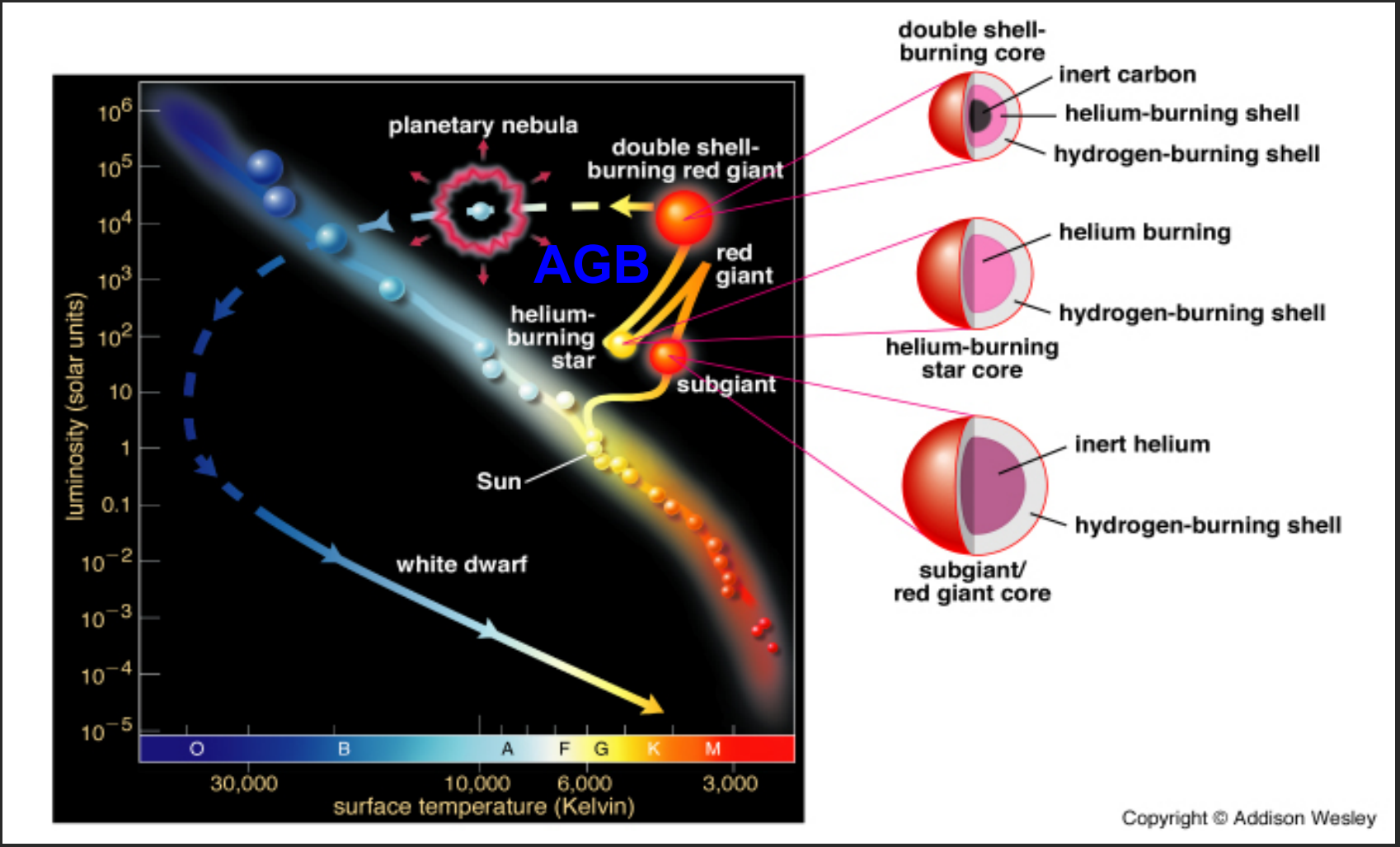
Search for the extended dust emission around evolved stars with AKARI/FIS

-- first results --

Nick Cox (@ESAC)

in collaboration with Pedro García-Lario (@ESAC)
and with help of the AKARI FIS support team

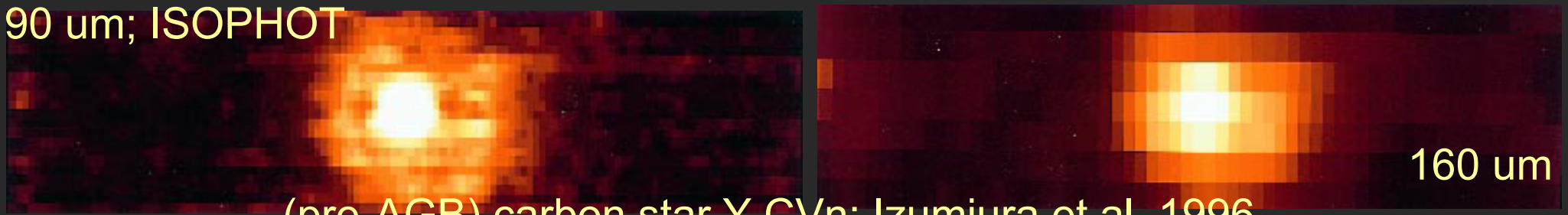
Late stages of stellar evolution



AGB → post-AGB → proto-PN → PN

Mass loss & cold dust shells

- AGB stars have high mass loss of upto 10-5 Msol/year, but the mechanism and evolution of mass loss rates are poorly understood. It drops to 10-7 Msol/year (with episodic increases to 10-6) when the star evolves to post-AGB / proto-PN phase.
- Spherical CS shells conitinue to drift away, pushed by post-AGB wind and transformed into aspherical PNs with fast outflows. For young PNe and proto-PNe the outer shells are not yet disrupted by fast post-AGB winds -> preserve fossil record orginal AGB mass loss.
- Structure of extended dust emission depends on mass-loss mechanism (constant rate vs. fluctuations) which is important to the stellar evolution.
- Earlier ISOPHOT observation of 2 post-AGBs suggested episodic mass loss (Speck et al. 2000), while recent Spitzer observation revealed no CS shells (Do et al. 2007). Extended dust shells seen with ISOPHOT around C-rich stars (Izumiura et al. 1996).



(pre-AGB) carbon star Y CVn; Izumiura et al. 1996

Far-Infrared survey of post-AGBs and (proto) planetary nebulae

- **Objective**: Trace distribution of cool dust in extended shells of post-AGB objects
- **Method**: Pointed AKARI observation in compact source photometry mode at FIR wavelengths with FIS
- **What**: 13 evolved stars: post-AGB, proto-PN and PN

HST/NASA/ESA; Rubin et al.

Blue Planetary

HST/NASA/ESA

Stingray Nebula

Riera et al. 2003

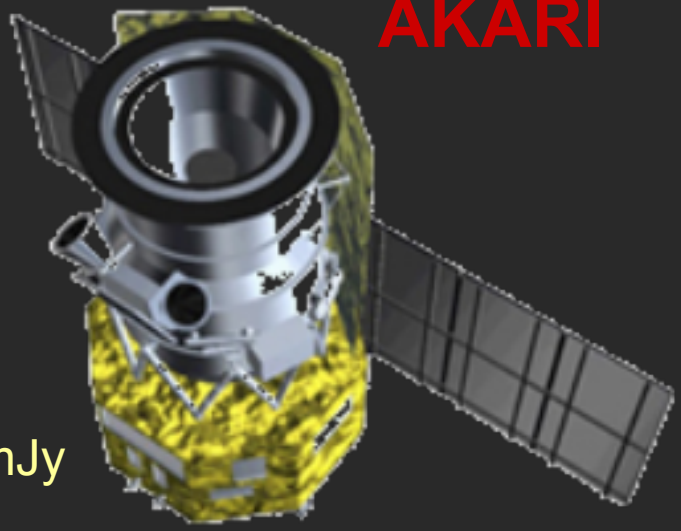
GLMP 621

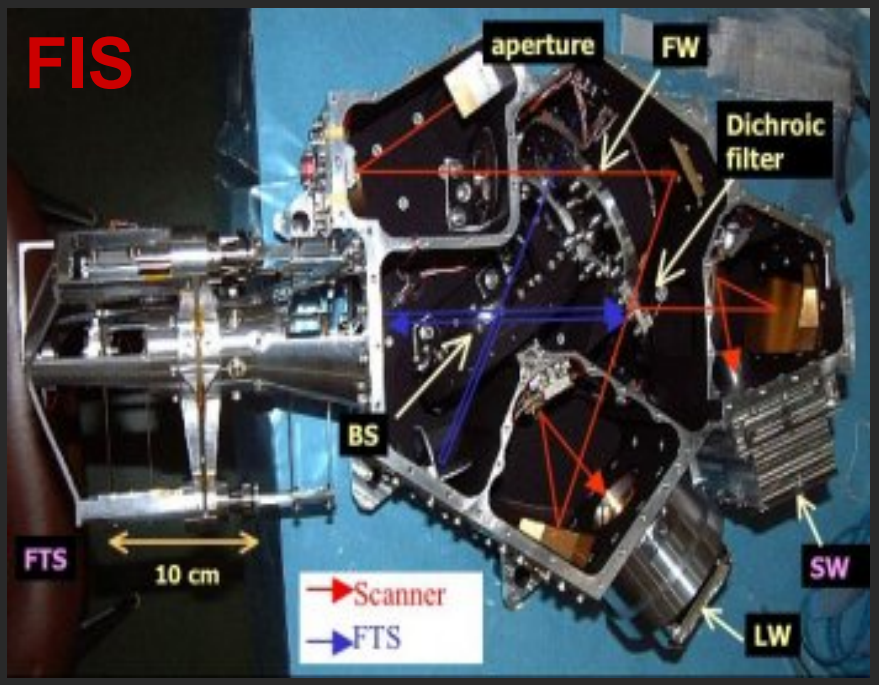
HST/NASA/ESA; Siodmiak et al. 2008

GLMP1052

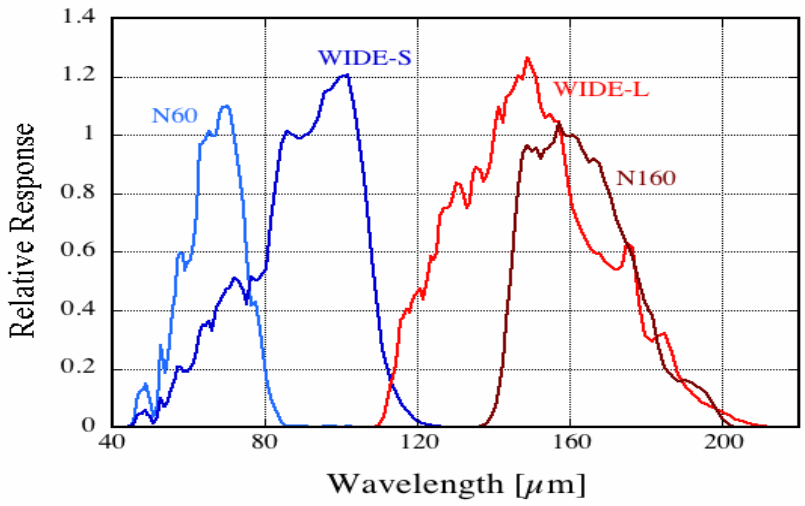
Far Infrared Surveyor on AKARI

- Four Ge:Ga detector arrays (SW: 20x2/3 monolithic and LW: 15x2/3 stressed) with four filters:
  - 2 narrow band at 65 [N60] and 160 [N160] um
  - 2 wide band at 90 [Wide-S] and 140 [Wide-L] um
- Detector pixel size: 27" (SW) and 44" (LW) [12 dead pix]
- Spatial resolution: ~0.7' (SW) and ~1' (LW)
- Image map size: 10' x 40' (FIS01 mode)
- Point source 5sigma noise; SW: 110, 34; LW: 350, 1350 mJy
- 30 min per observation (4 scans each 157.5s)



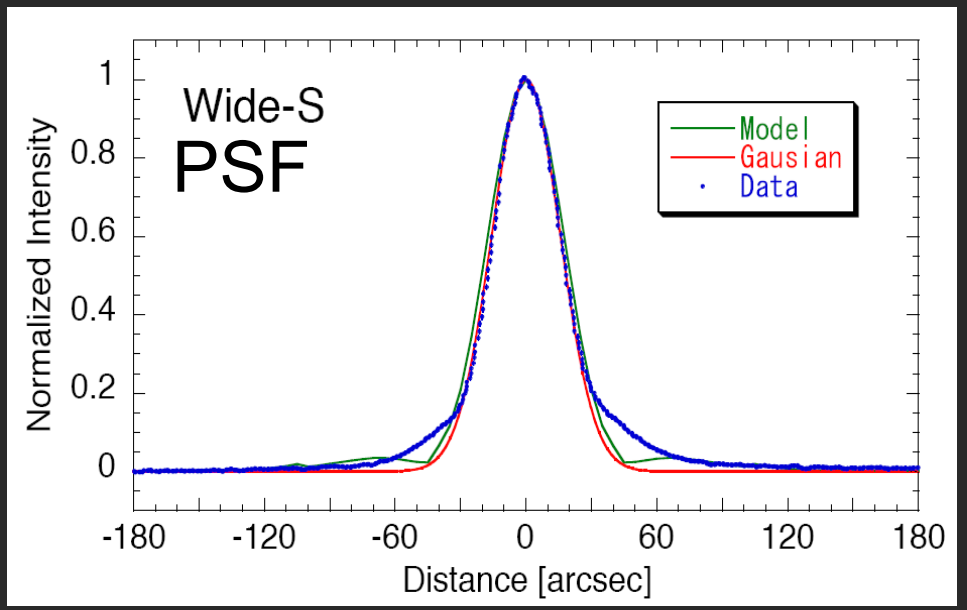


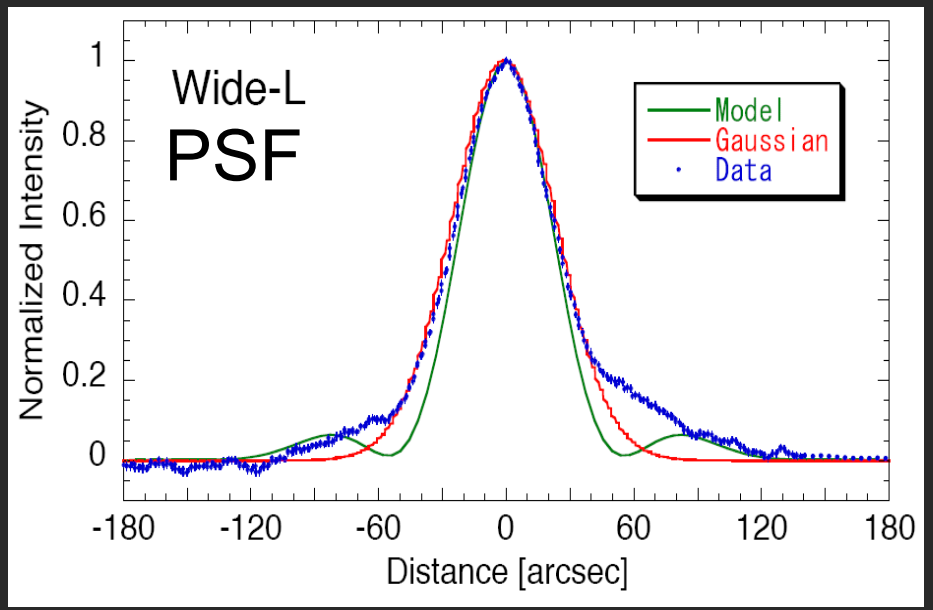
Spectral Response 4 FIS filters



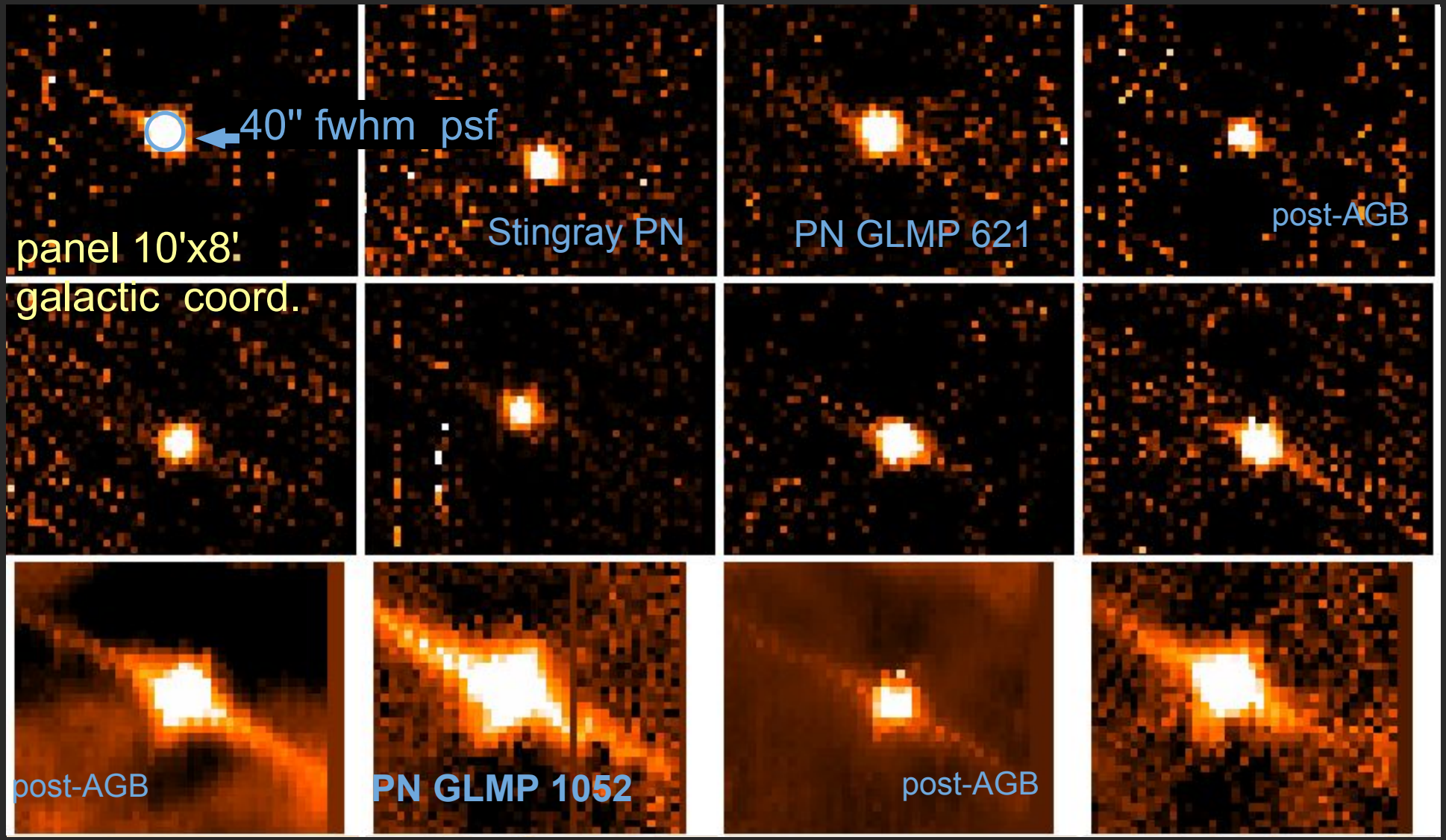
Data processing

- FIS Slow Scan Toolkit (ver. 20070914) [Verdugo et al.]
- Default grid: SW to 15" and LW to 30"
- PSF (Ceres) FWHM: ~40'' and ~60'' for SW and LW resp.
  PSF excess along scan direction at signals lower than 5~20% of peak
- bad-pixel correction, stray-light removal, median & boxcar filters
- data artifacts: * cross-talk (SW): 10%; * ghosts (narrow <-> wide): 10%
  ➡ possible solutions foreseen in future pipeline release.
- Maps in MJy/sr (abs. calib. from zodiacal light (SW) and IR cirrus (LW))
- IRAS - FIS point source positions within 10" (SW), 20-30" (LW)



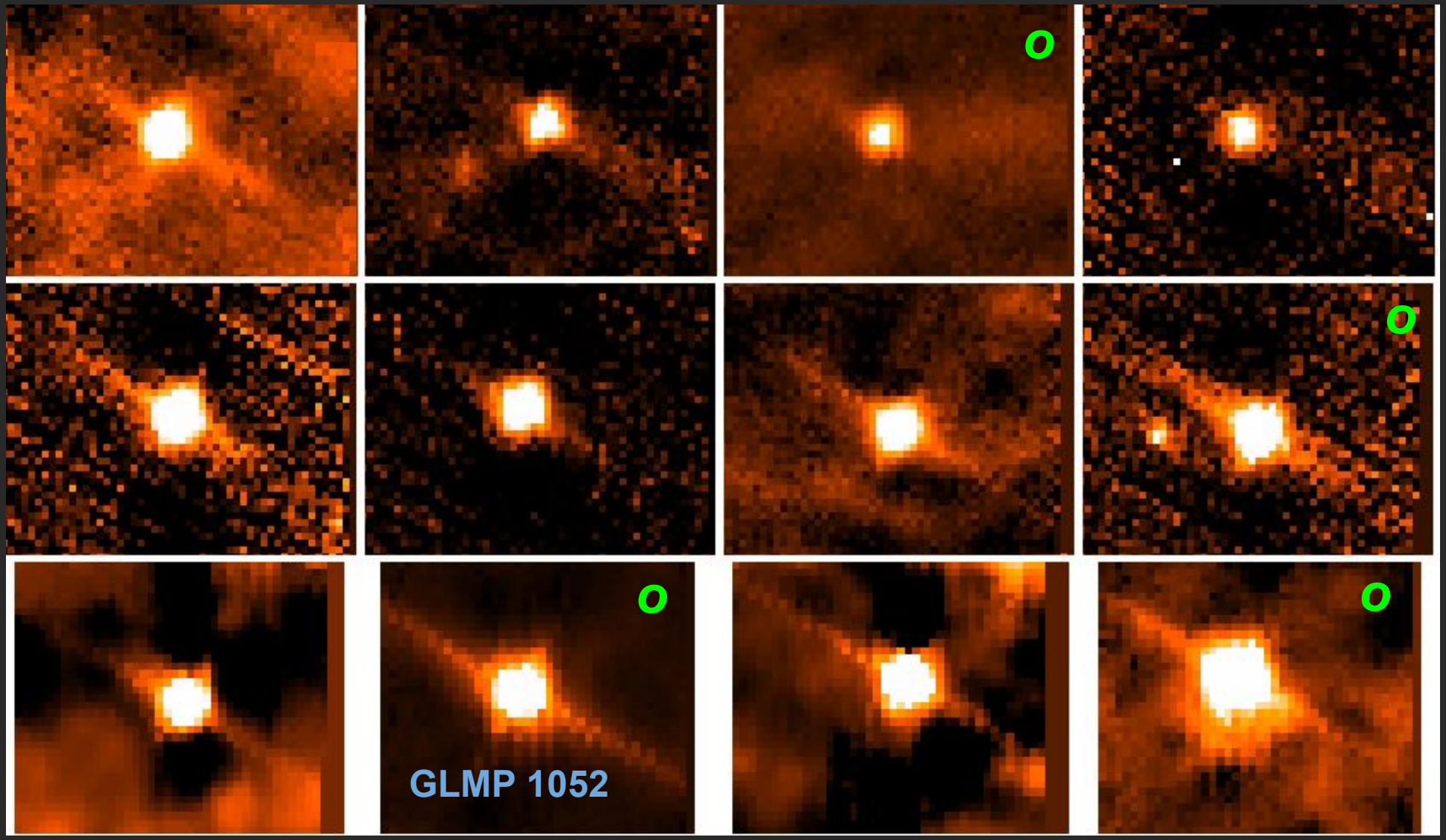


N60


40" fwhm psf
panel 10'x8'
galactic coord.
Stingray PN
PN GLMP 621
post-AGB
post-AGB
PN GLMP 1052
post-AGB

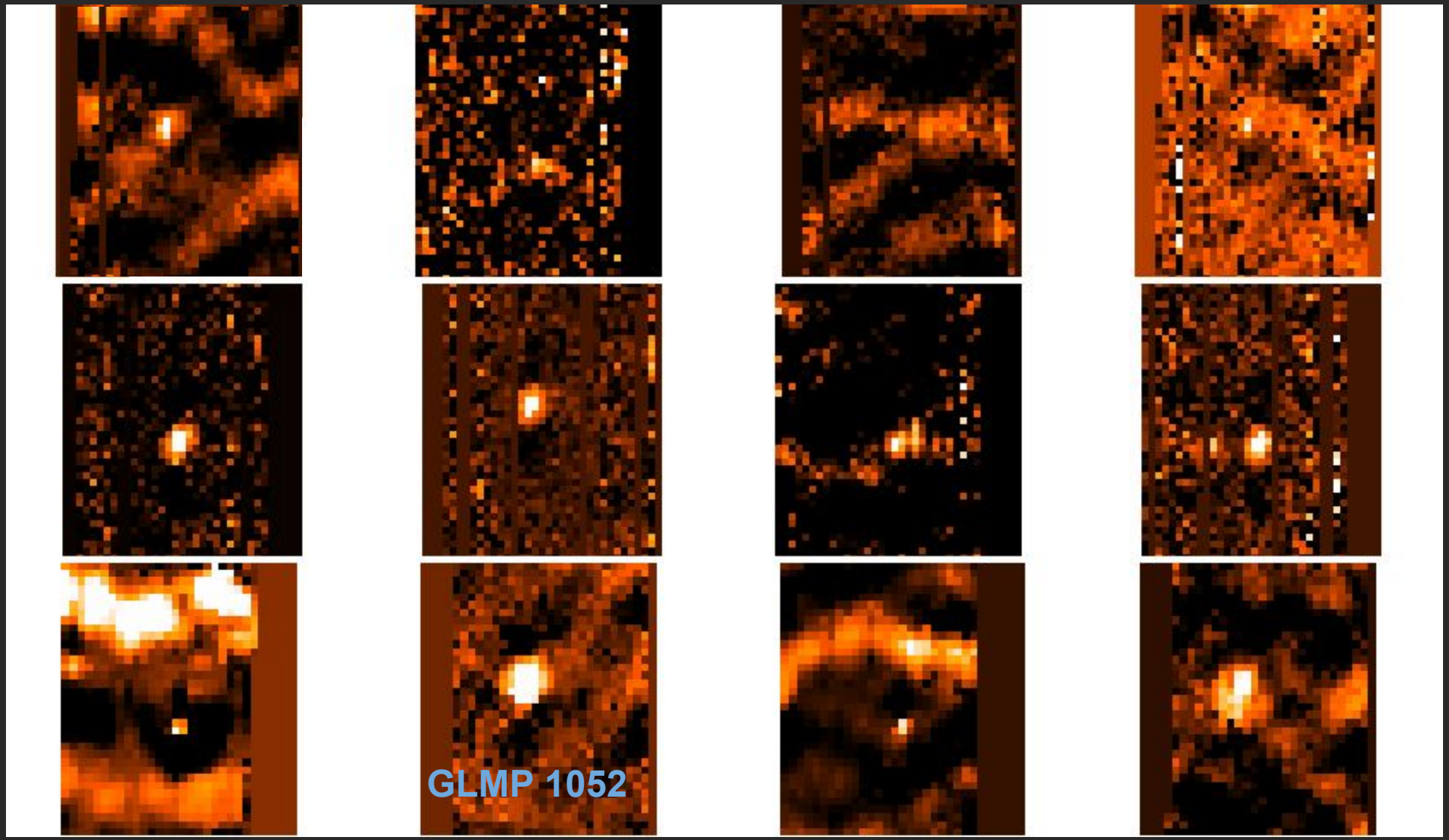
[65 um]

Wide-S



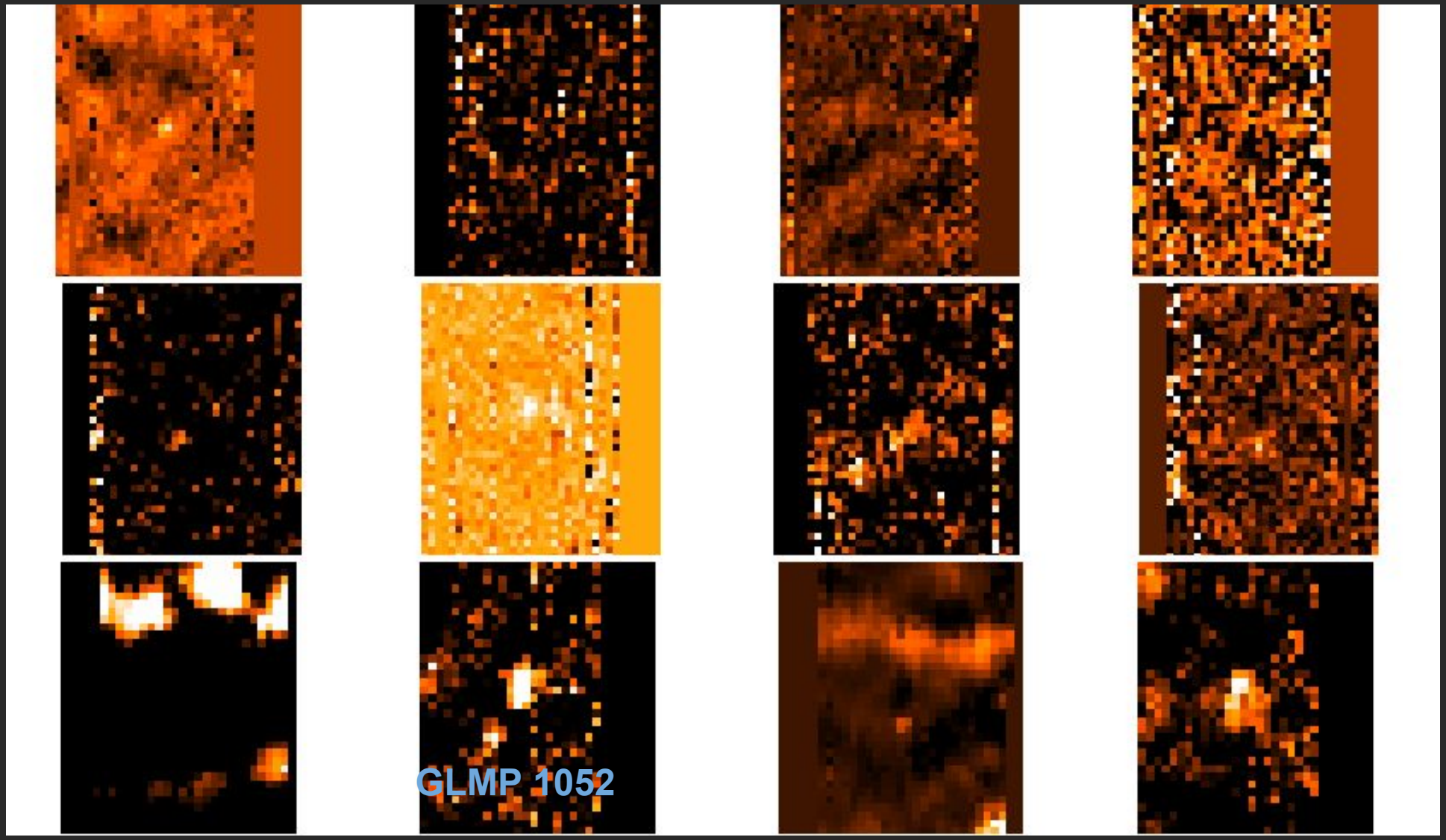
[90 um]

Wide-L



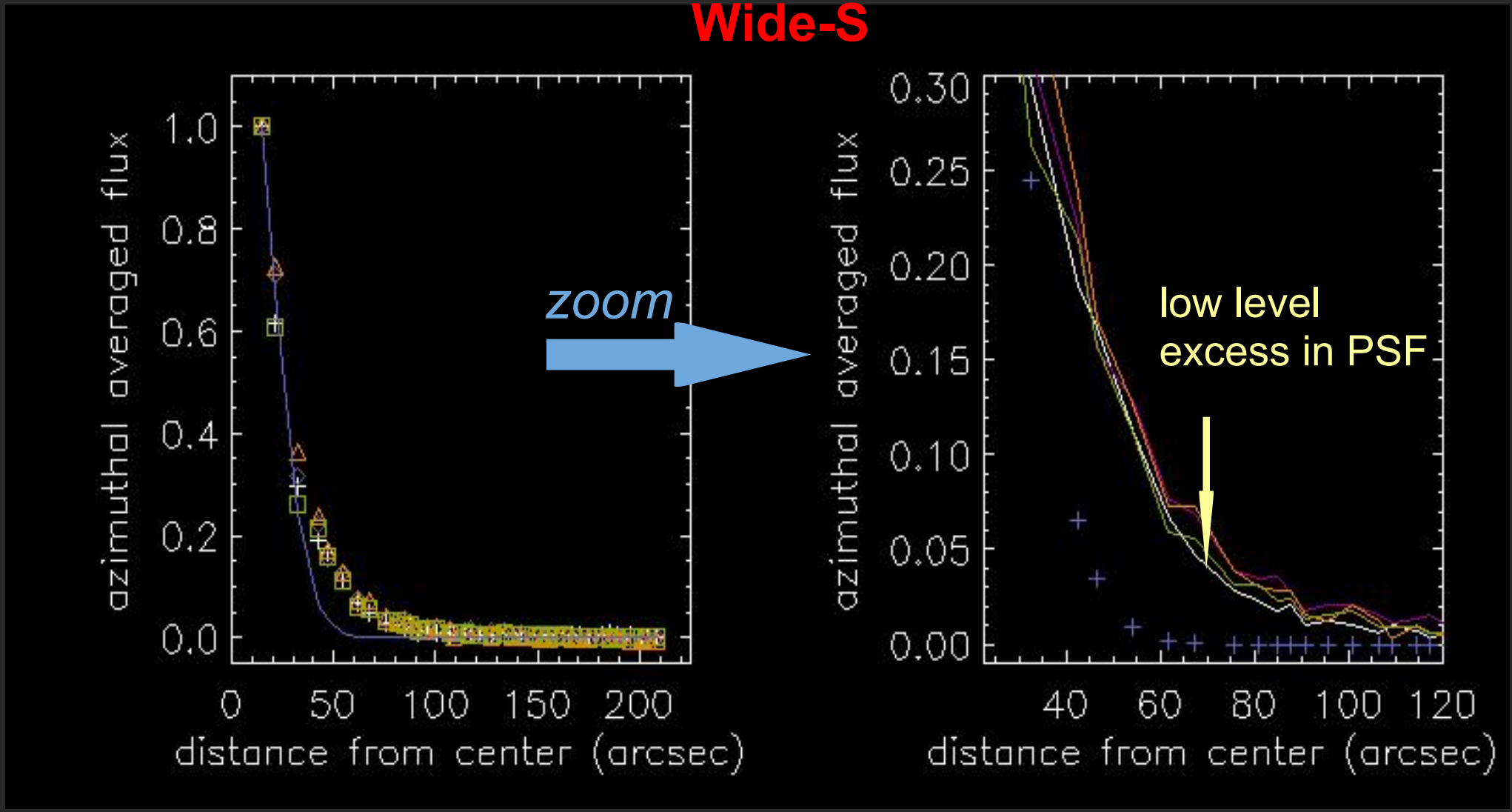
[140 um]

N160



[160 um]

Point-source radial profiles / PSF



Aperture photometry / absolute flux

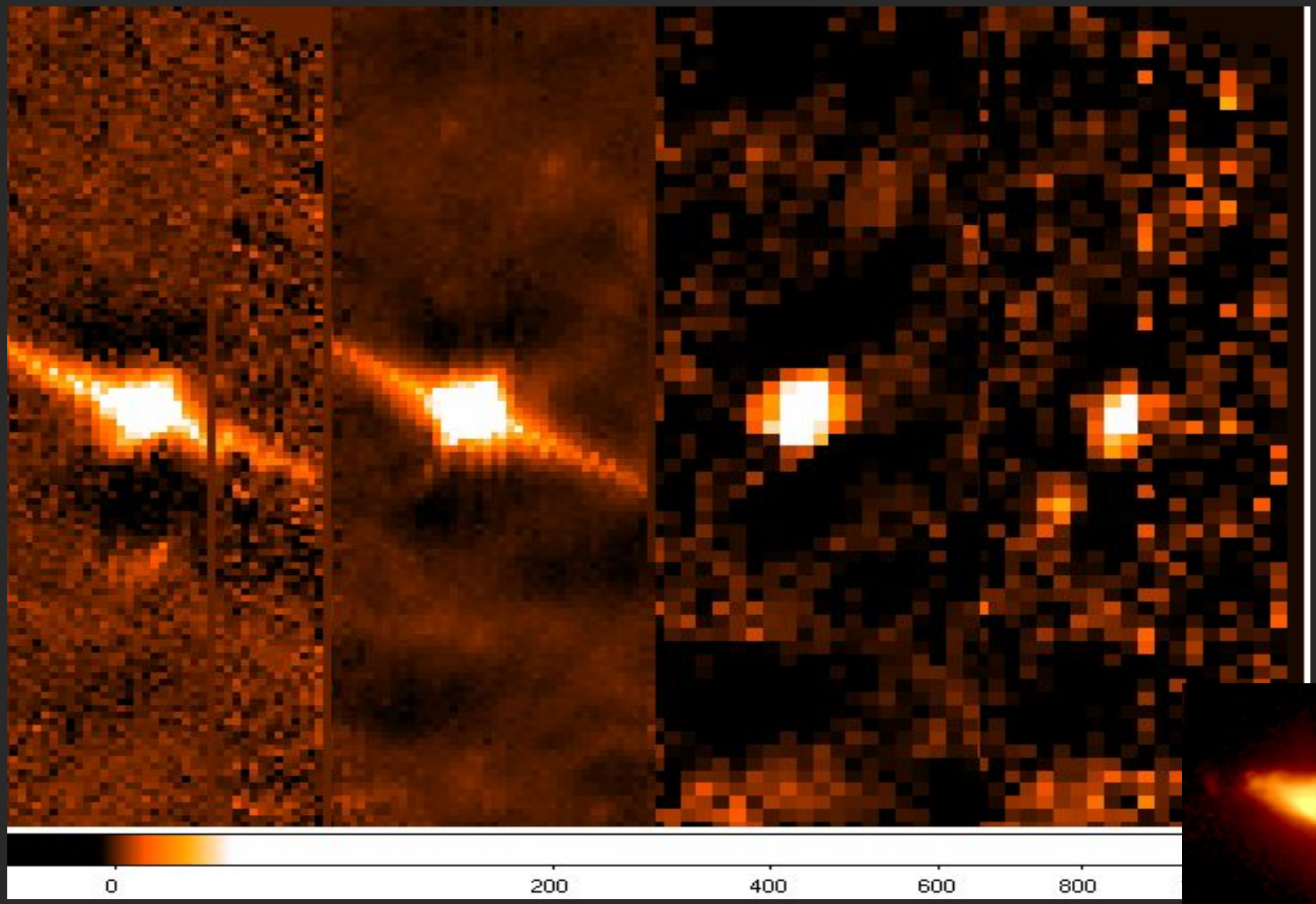
- Standard aperture flux measurement

    1. Image brightness in MJy/sr (zodiacal light and IR cirrus)
    2. Colour correction (apply blackbody or power-law)
    3. Aperture correction (based on asteroids, stars & galaxies)
    4. Point-to-diffuse correction (systematic; flux & colour independent)

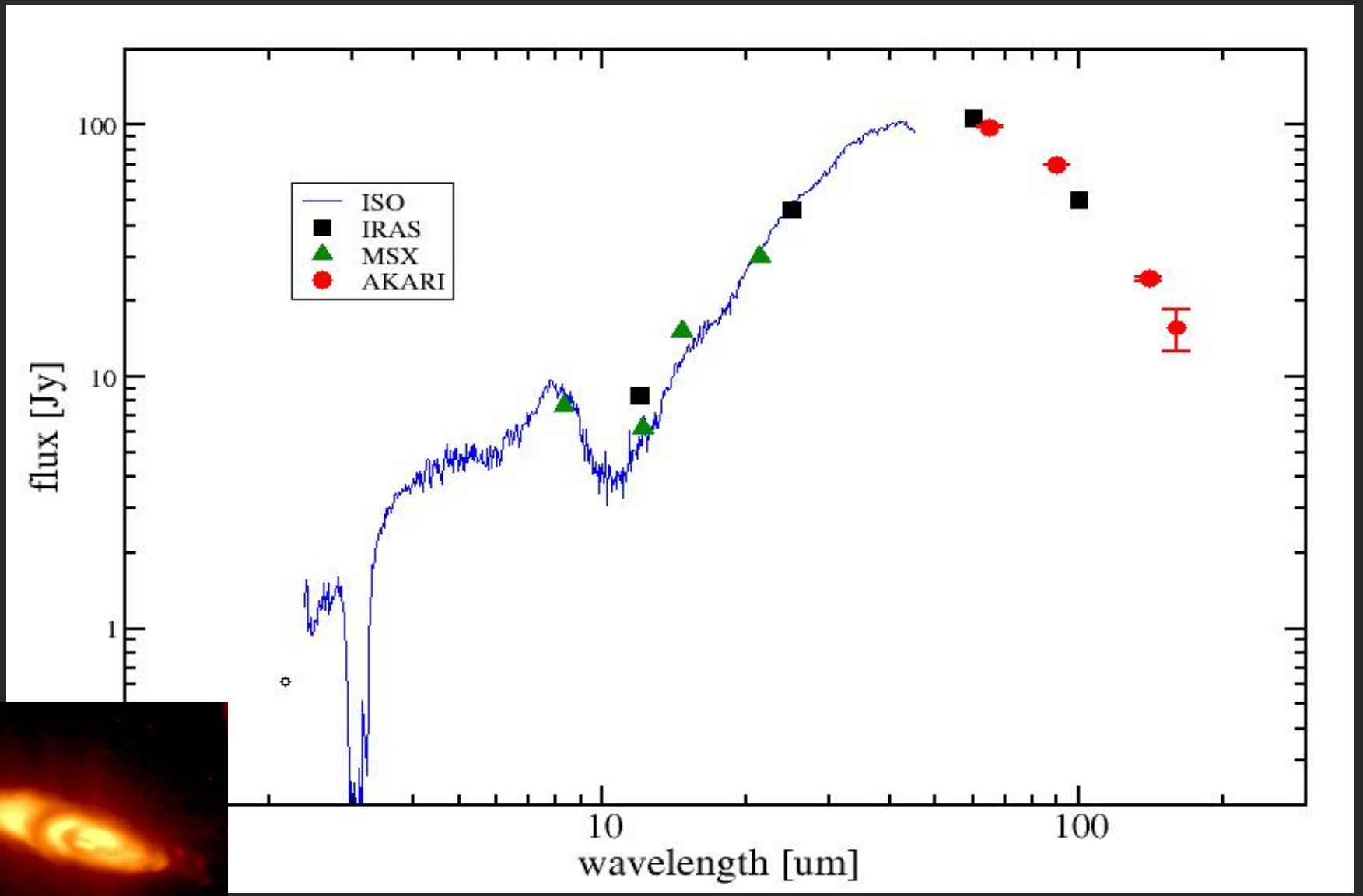
- Verify Spectral Energy Distribution (SED)

Application: GLMP 1052

[65 um] *[90 um]* *[140 um]* *[160 um]*

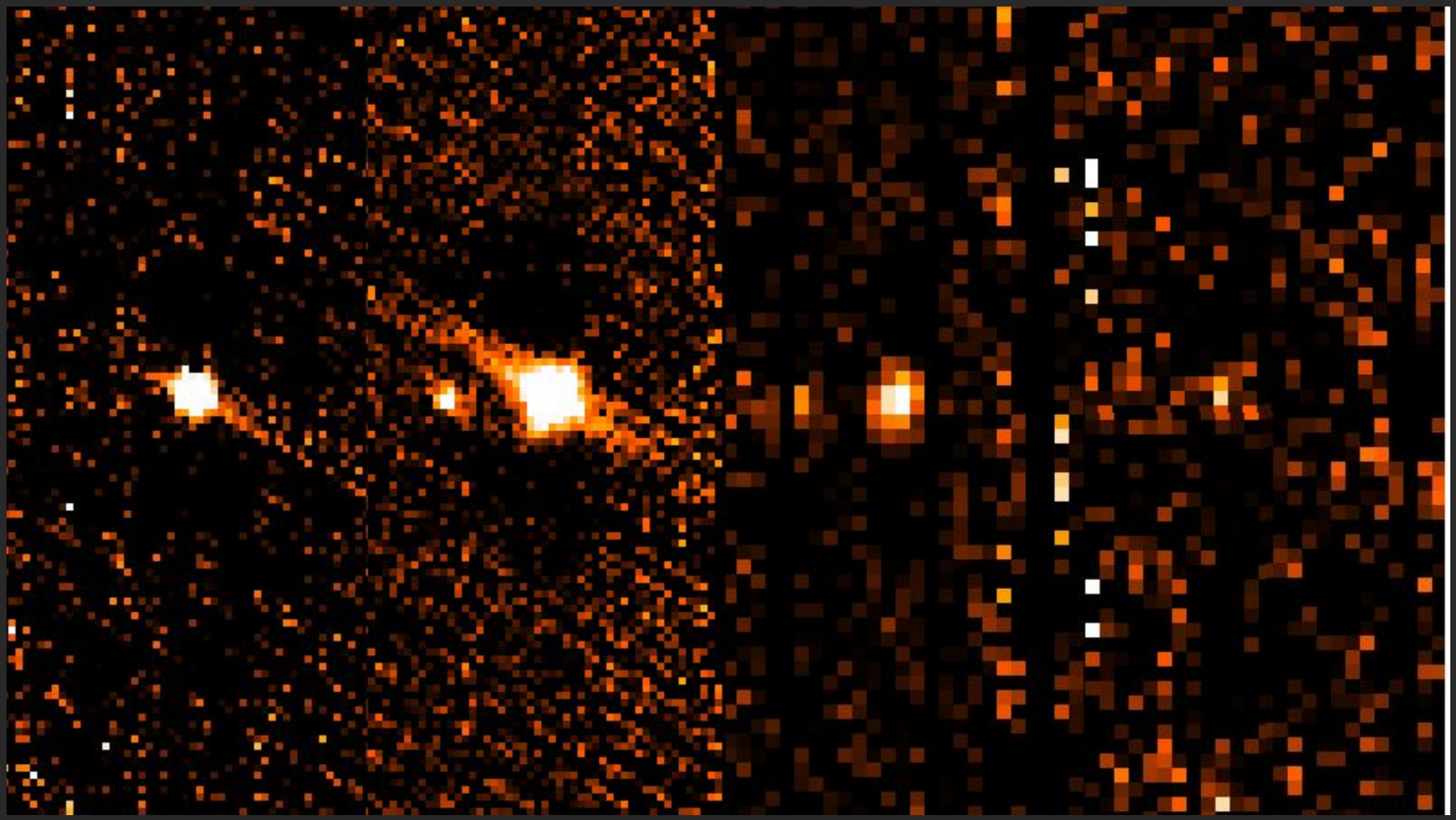


Result: GLMP 1052



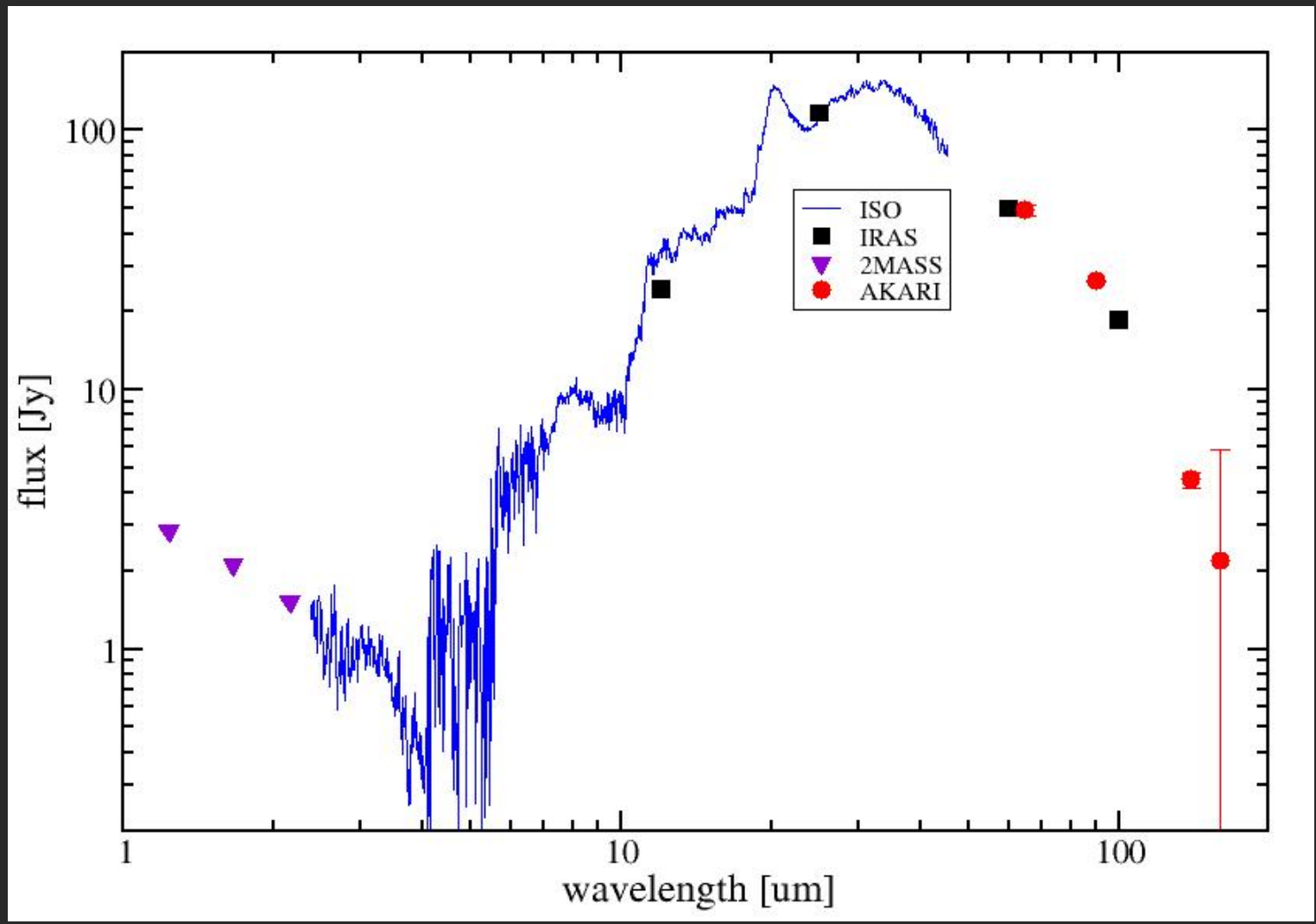
Application: IRAS 07134+1005

[65 um] *[90 um]* *[140 um]* *[160 um]*



CDS mode

Result: IRAS 07134+1005



First results...

- ALL targets appear to be point sources (PSF-like)
- Absolute calibration of FIS AKARI seems ok, also for CDS mode
- Very weak extended emission may only appear when deconvolving with an accurate PSF (to be derived)

and prospects

- Need to test if with higher sensitivity and resolution of Herschel no extended emission is detected.
- Possible use as (cross)-calibrators with Herschel