Herschel PACS and SPIRE Map-Making Workshop

Galactic winds in NGC 4631*

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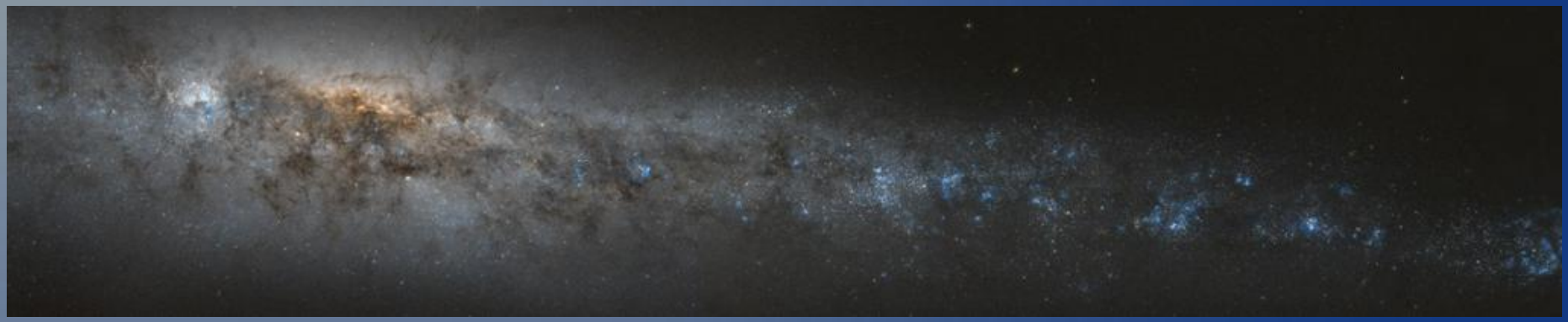
Outline

- Science Goal
- Herschel Observations/PACS
- NGC 4631: MADmap
- NGC 4631: Scanamorphos
- Herschel/PACS and Spitzer/IRAC: Comparison
- Summary

NGC 4631



Credit: Nikolaus Sulzenauer. Hubble, WFPC2

Edge-on spiral galaxy in the constellation Canes Venatici (z = 0.002021, 7.62 Mpc). NGC 4631 has a nearby companion, NGC 4627, a dwarf elliptical galaxy.

Credit: Galex

Science Goal

- Exploring the Dust Content of Galactic Winds with Herschel (nearby starburst galaxies)
- To map the detailed distribution of cold (T < 100 K) dust in a sample of starburst galaxies known to have outflows
  - Where is the cold dust in large-scale outflows?
  - Outflowing dust and Host galaxy

Faint Extended Emission

Herschel Observations/PACS

- 5 Galaxies
- LargeScanMapping mode at 70+ 160mm
- Medium scan speed (20”/s)
- 7 scan directions. 50/60/70/110/120/130/140 deg. ~1.5 hr each.
- MapScanCrossScan: 4.0”
- MapScanLegLength : 6.0'
- MapScanNumLegs: 76

NGC 4631: MADmap

The Microwave Anisotropy Dataset mapper (MADmap)

- Optimal map-making algorithm designed to remove the uncorrelated 1/f noise from bolometer Time Ordered Data, e.g., no “striping”
- NHSC/PACS Web Tutorials. PACS-401. L25_scanMapMadMap.py . Author : Cate Liu and Babar Ali
- Computing requirements. Blue Channel, all observations takes ~130 Gb RAM!

Check #5: pixel-to-pixel electronic offset correction

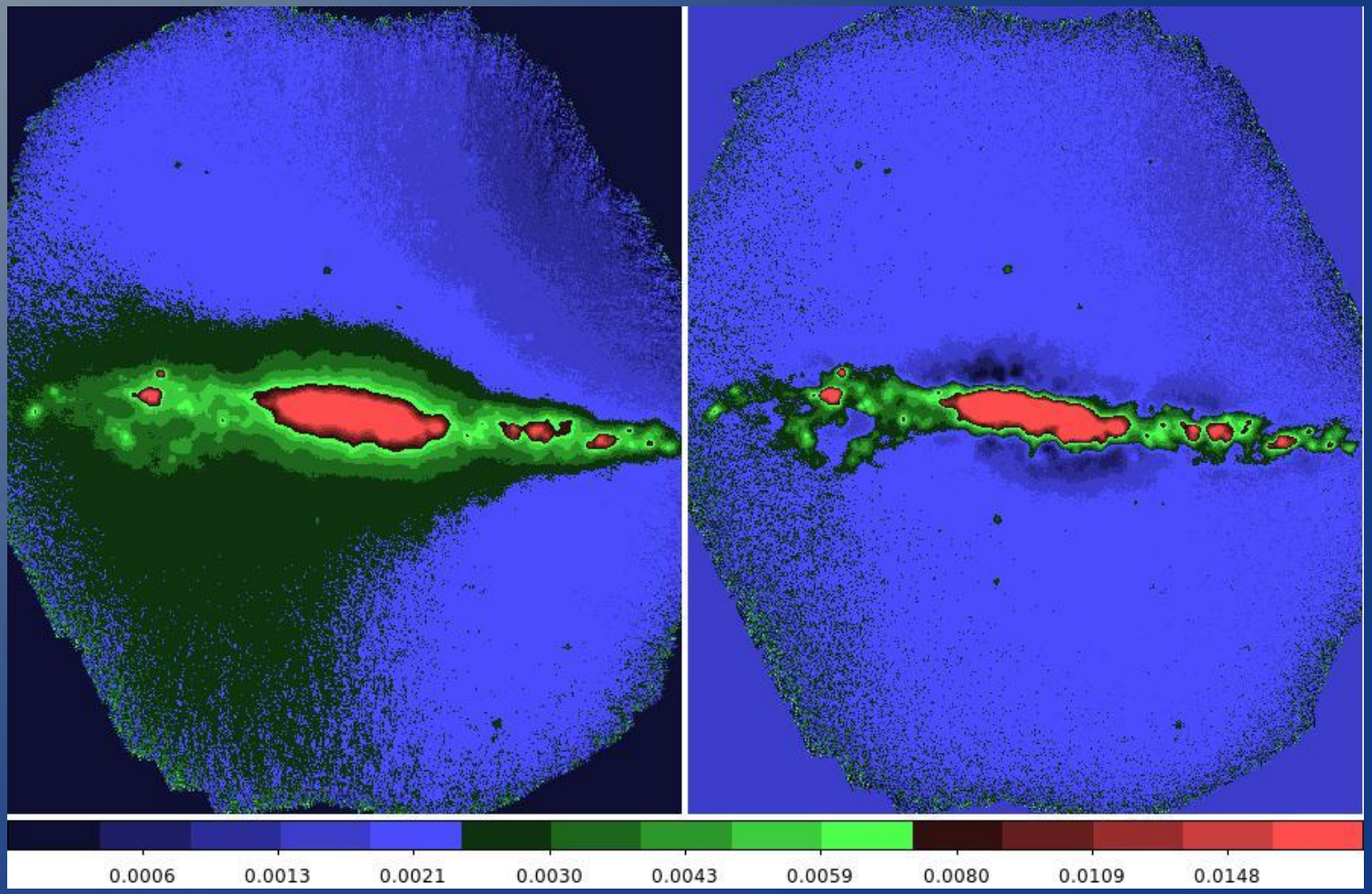
NGC 4631: MADmap

The Microwave Anisotropy Dataset mapper (MADmap)

PACS/Blue at 70 mm. 7 scan directions.

Left: Global drift correction model 1 (default). Bin size 1000, PolyOrder=1

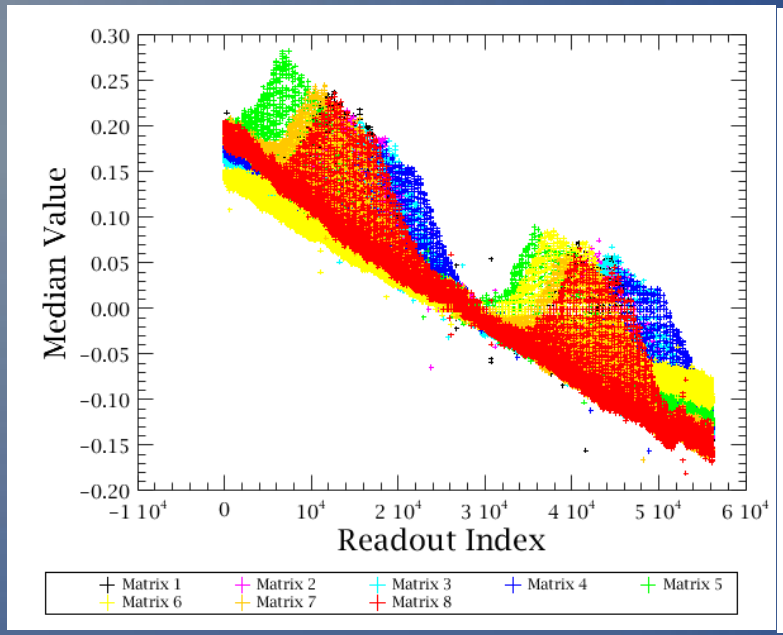
Right: Baseline drift , segmenting time-streams. Bin size 1000, Segment size 10000 and PolyOrder 1. Sensitive to the emission from the galaxy

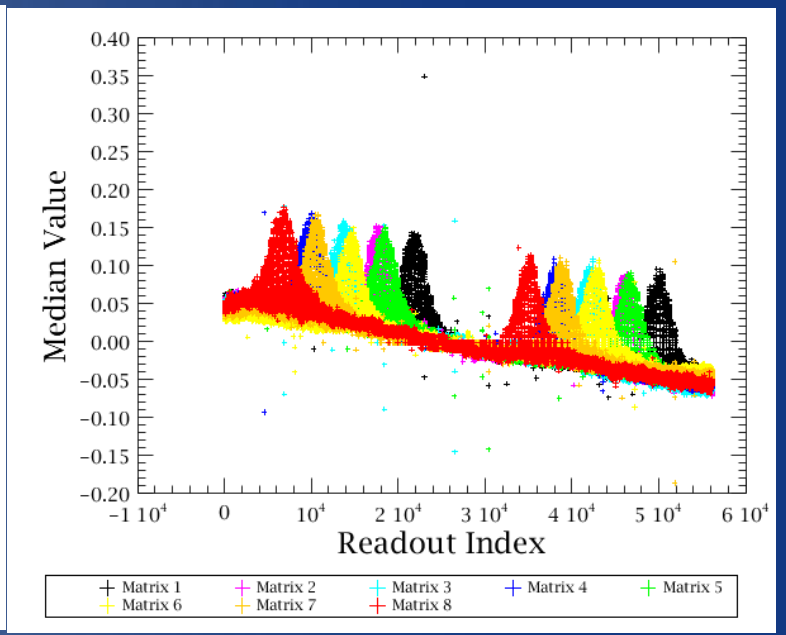


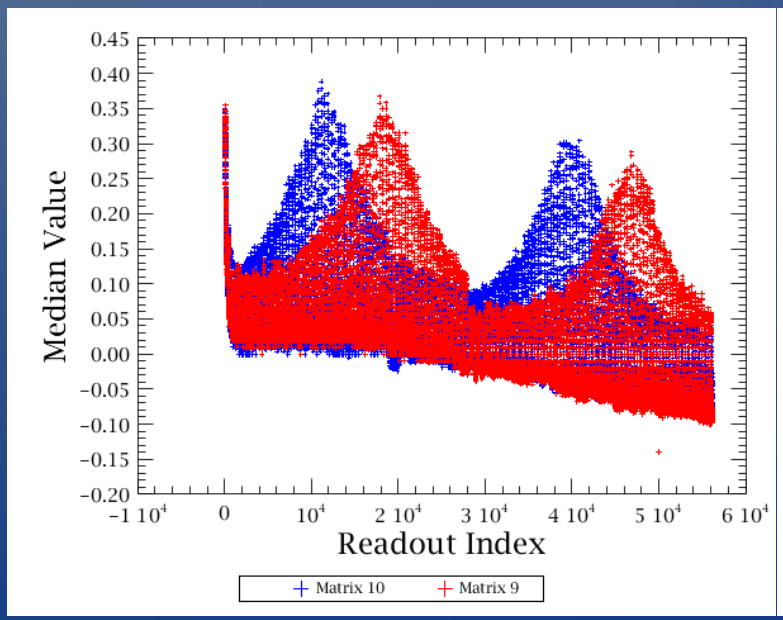
Proper fit is important!!!

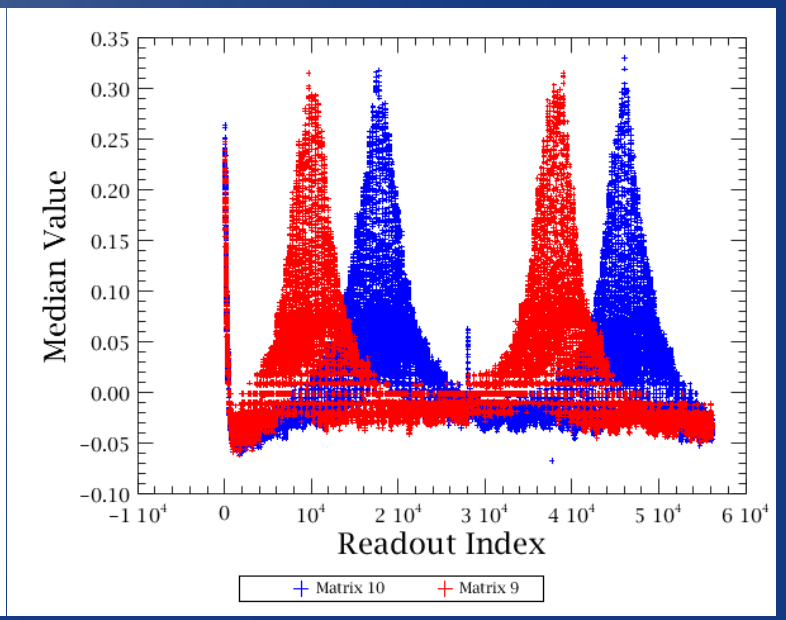
NGC 4631: MADmap

Solution (work in progress): Create a customized drift model to fit only the points where the galaxy emission is negligible









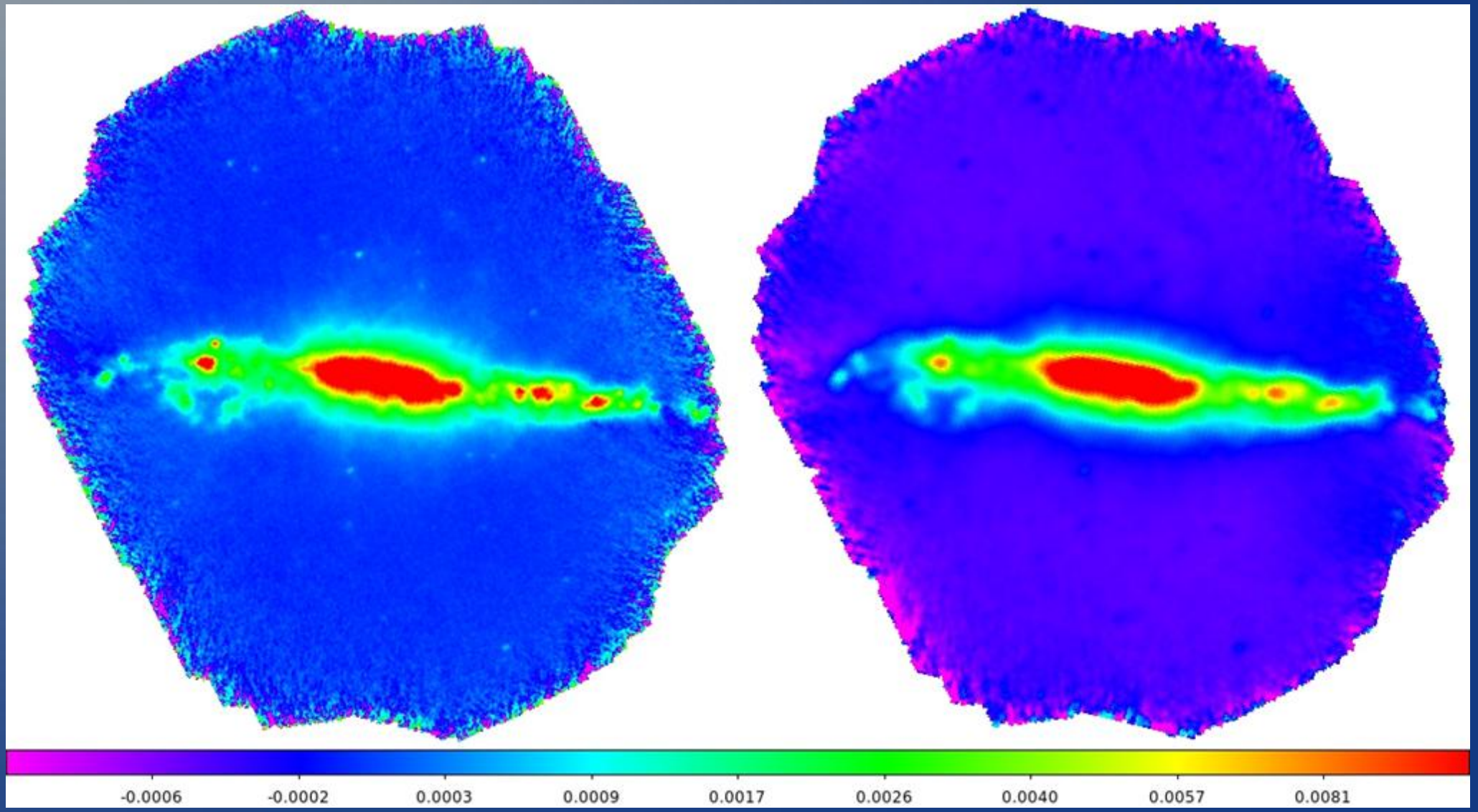
NGC 4631: Scanamorphos

Scanamorphos v20. Hélène Roussel. Roussel, H. 2012 (arXiv:1205.2576)

- Scanamorphos v20
- Scanamorphos is designed to remove the low-frequency noise
- It makes use of the redundancy built in the observations to derive the brightness drifts directly from the data themselves
- Minimum user input. Pre-procesing: convertL1ToScanam.py (HIPE) and convert_hcssfits_pacs.pro (IDL)
- The files must be entered in an order such that scan directions alternate from one scan to the next. 50/110, 60/120, 70/130 and 140 deg.

NGC 4631: Scanamorphos

Scanamorphos v20. Hélène Roussel. Roussel, H. 2012 (arXiv:1205.2576)

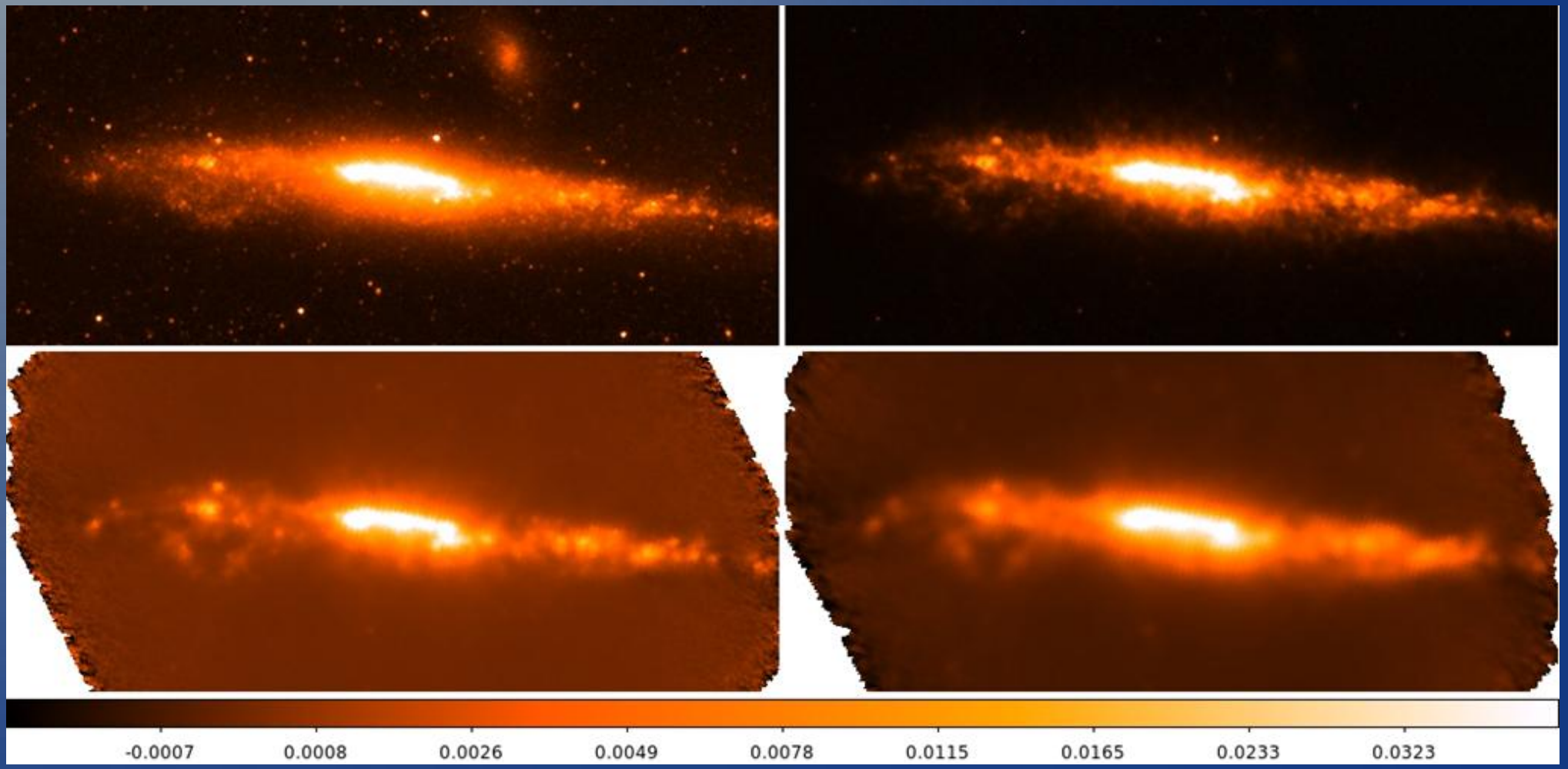


PACS 70mm. Scale: Asinh. Pixel Size: 1.40" PACS 160mm. Scale: Asinh. Pixel Size: 2.85"

Herschel/PACS and Spitzer/IRAC: Comparison

Spitzer/IRAC Ch2: 4.5 mm (~1.2”/pixel)

Spitzer/IRAC Ch4: 8.0 mm (~1.2”/pixel)

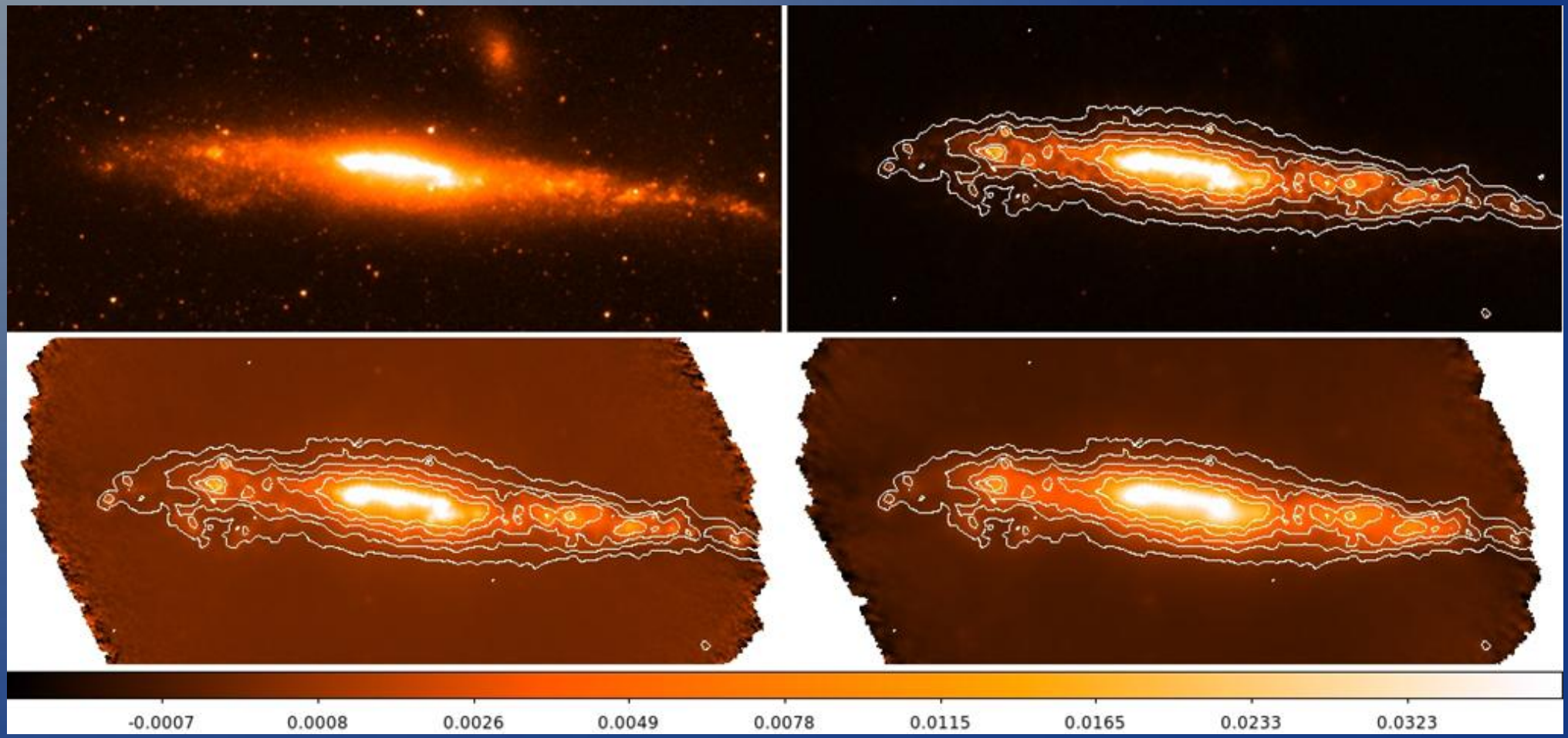


Spitzer mosaics from: McCormick, Veilleux, & Rupke (2013)

Herschel/PACS and Spitzer/IRAC: Comparison

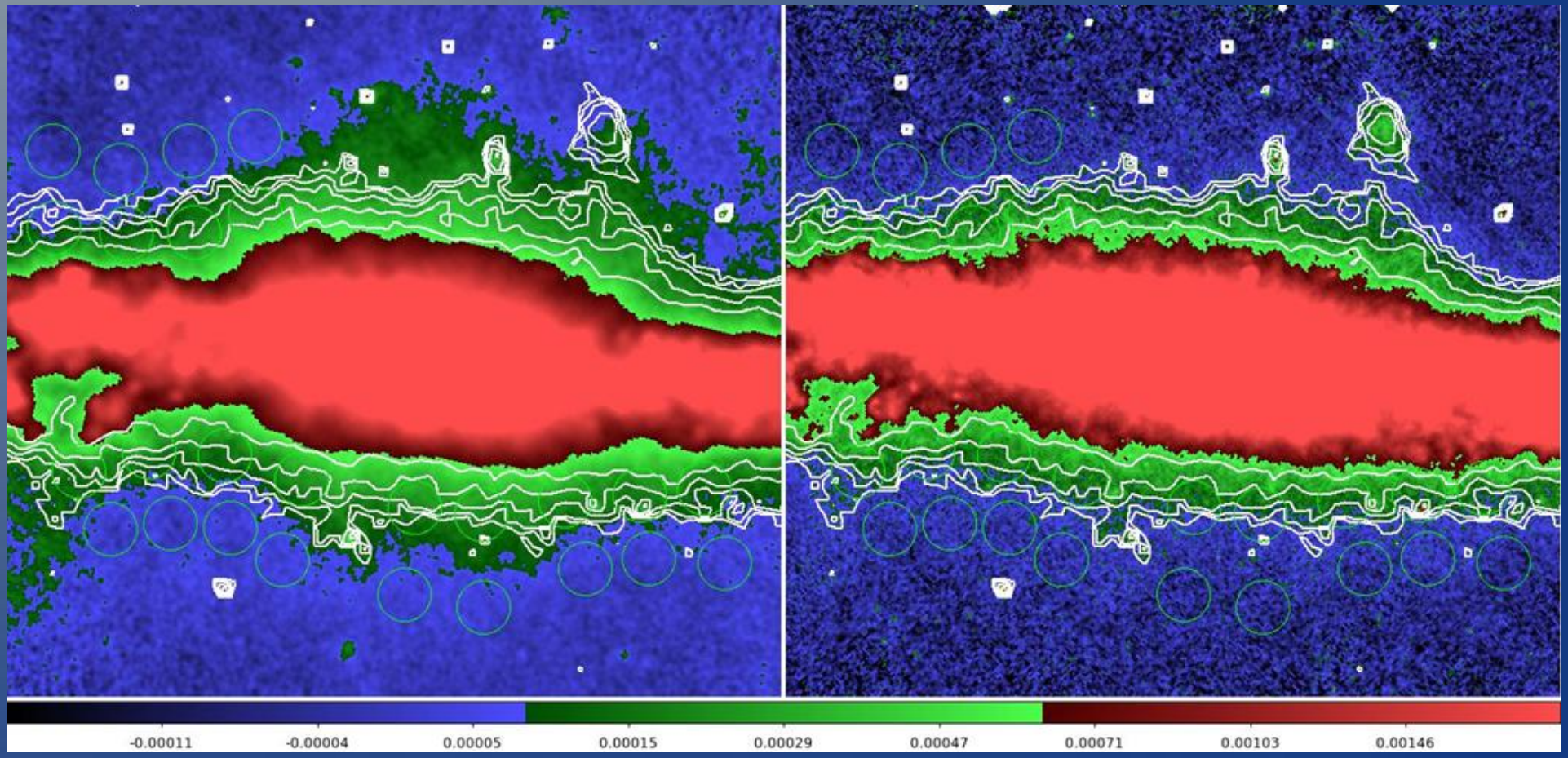
Spitzer/IRAC Ch2: 4.5 mm

Spitzer/IRAC Ch4: 8.0 mm



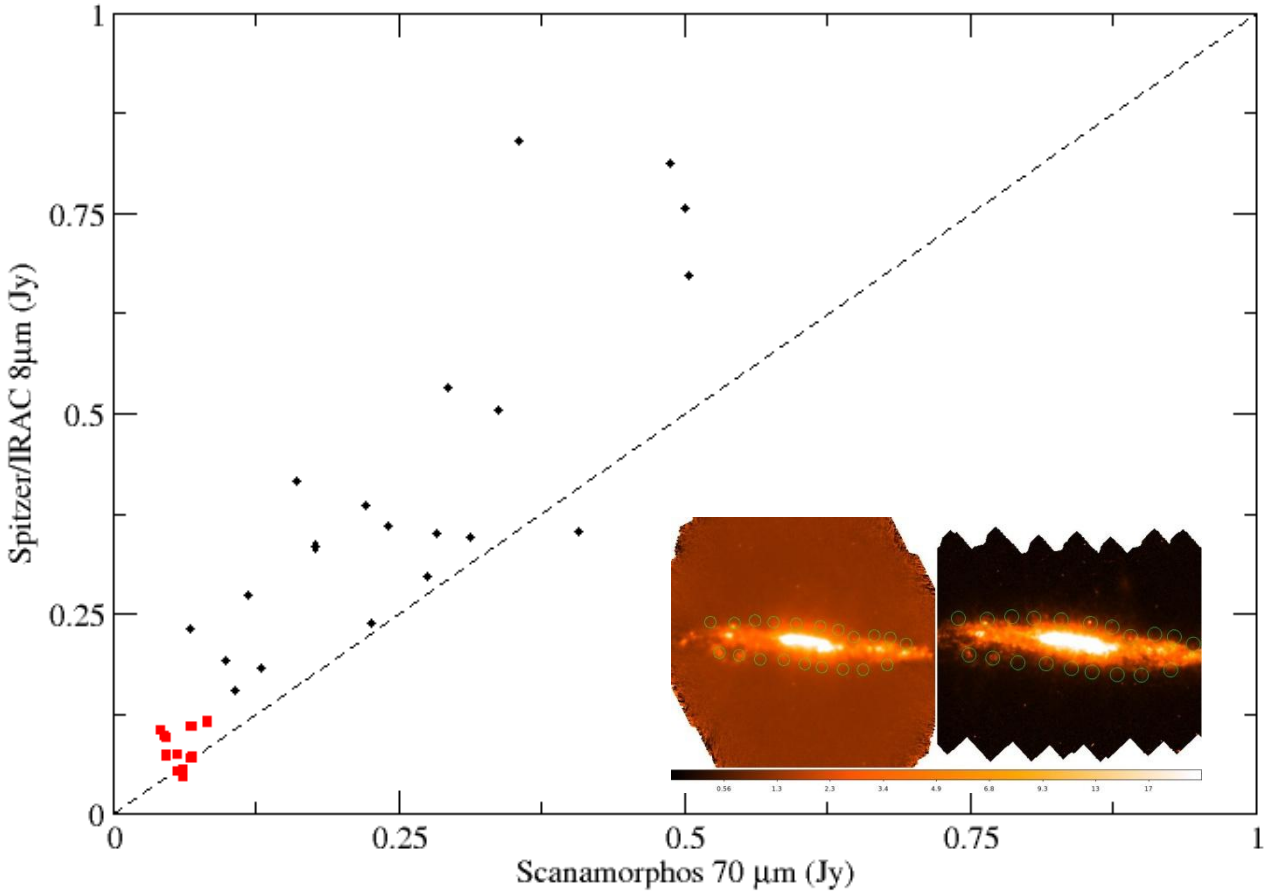
IRAC Ch4 (8 mm). White Contour, 5 levels, Asinh scale: 0.5, 0.87, 1.45, 2.61, 5 mJy/Sr. Melendez et al. In prep

Herschel/PACS and Spitzer/IRAC: Comparison



Melendez et al in prep

Herschel/PACS and Spitzer/IRAC: Comparison



Summary

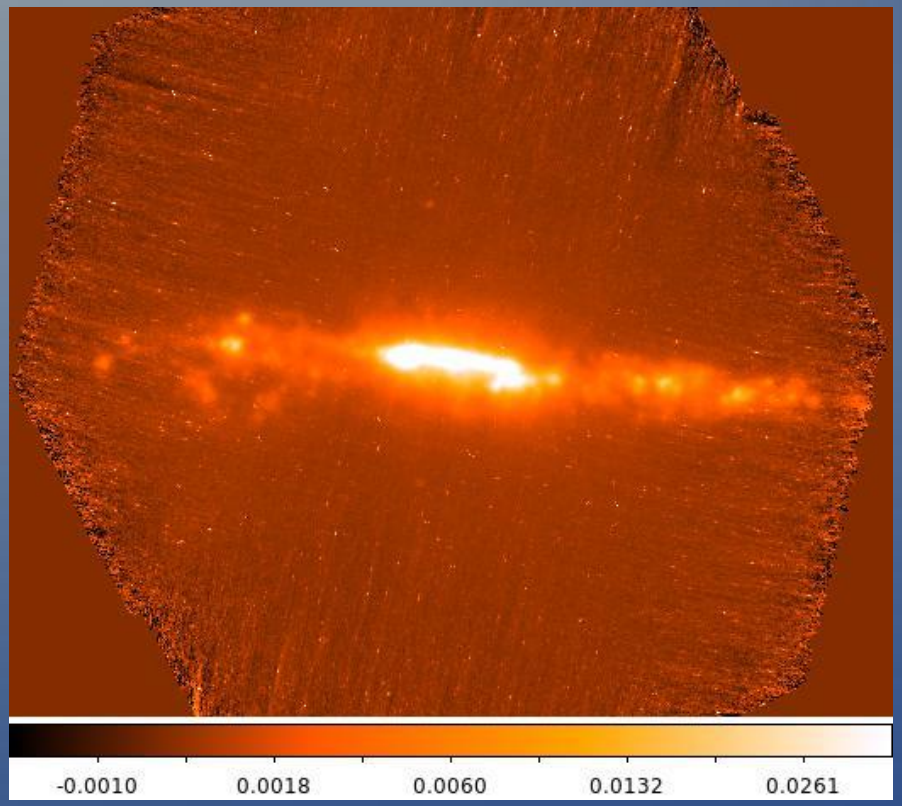
- MADmap and Scanamorphos are designed to remove the 1/f noise and bring up the faint diffuse emission from the galaxy.
- Scanamorphos maps are in good agreement with Spitzer/IRAC

MADmap. PhotGlobalDriftCorrection Task.

PLEASE READ: These are not meant to be user friendly routines (yet). There are a number of assumption and quite possibly errors. Please contact the author but don't expect smooth sailing!!! Babar Ali

Given our science goals is important to compare at least two map making algorithms. Therefore, I am still working on getting the best possible map using MADmap

MADmap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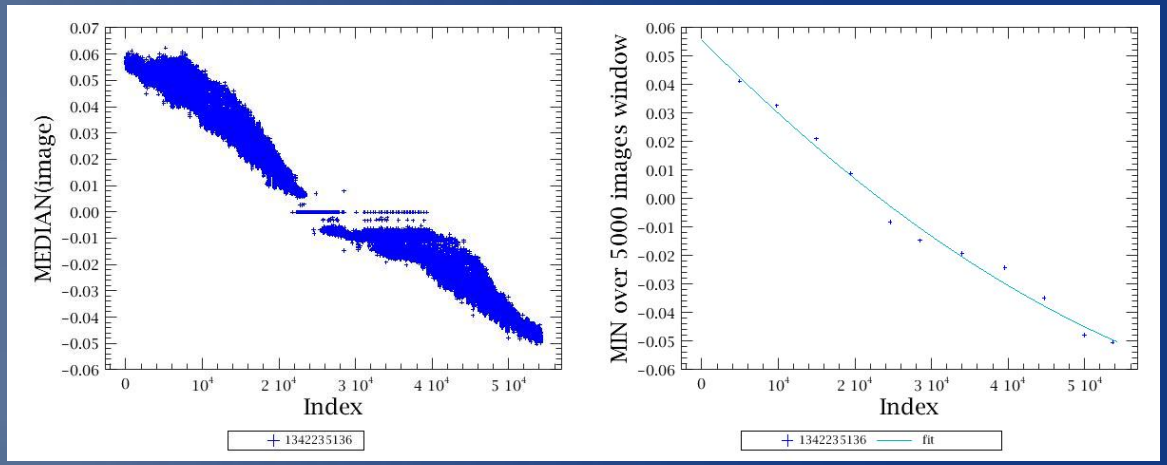
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MIN over 5000 images window
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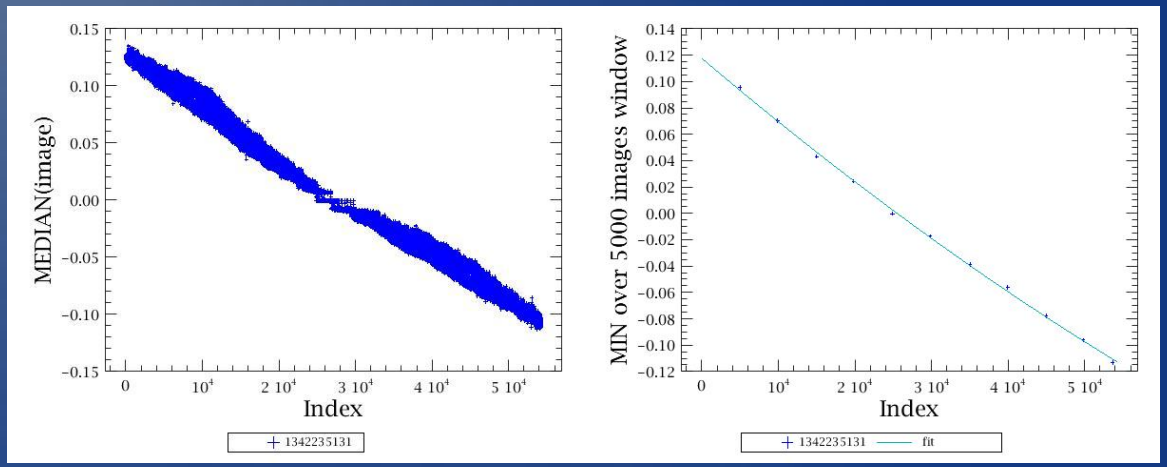
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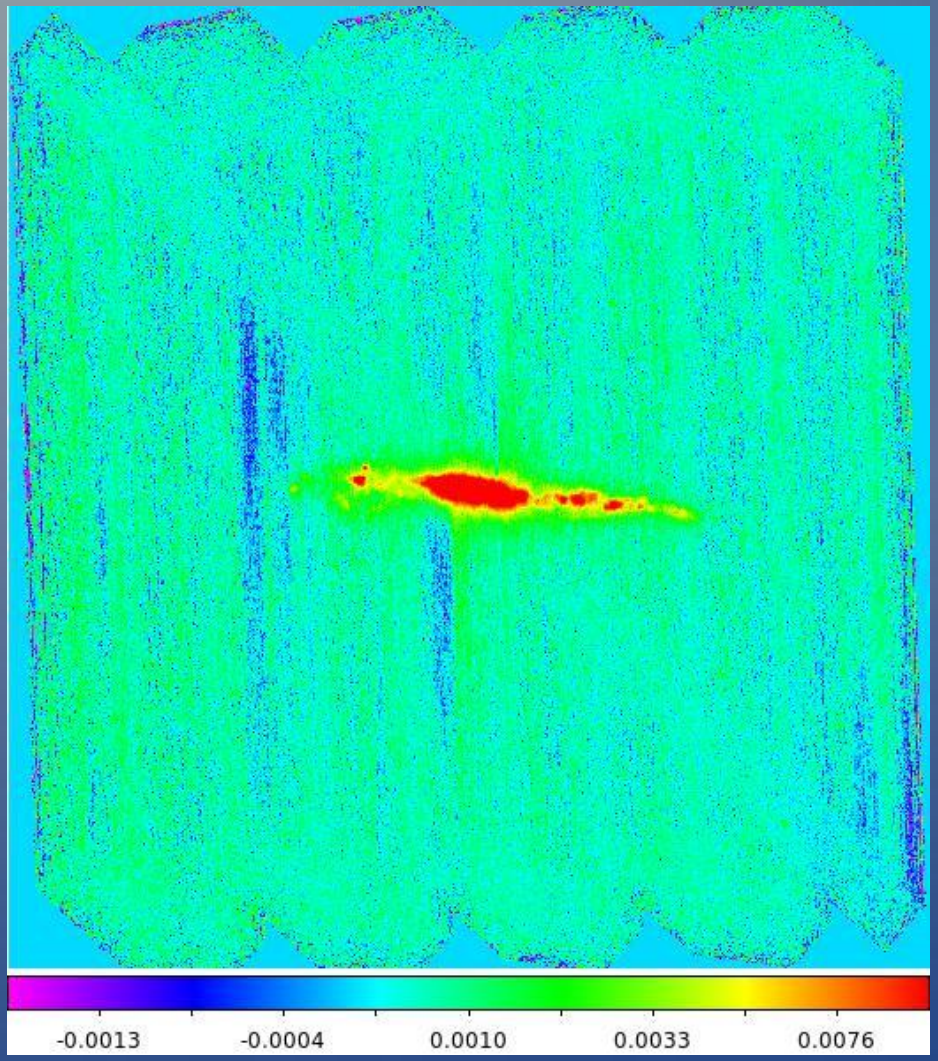
MADmap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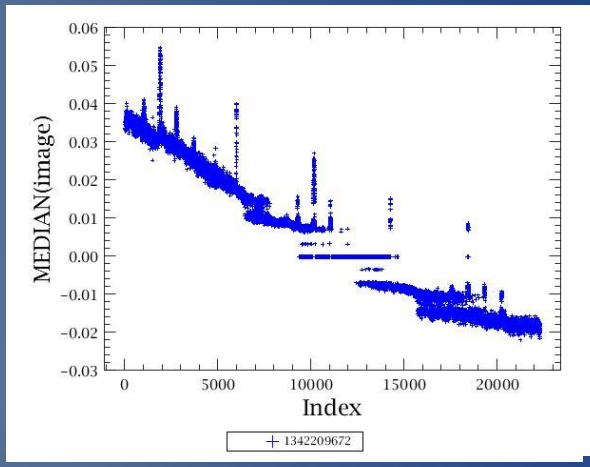
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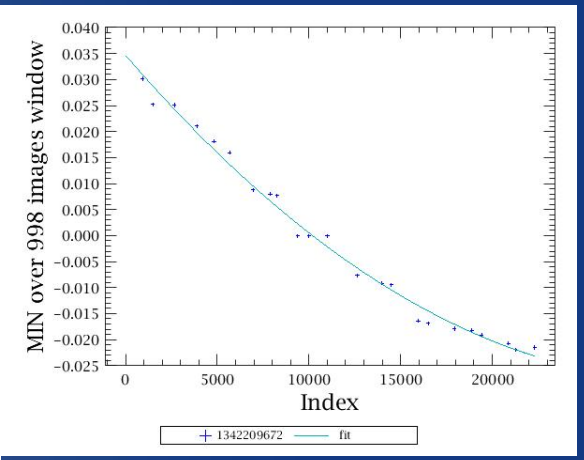
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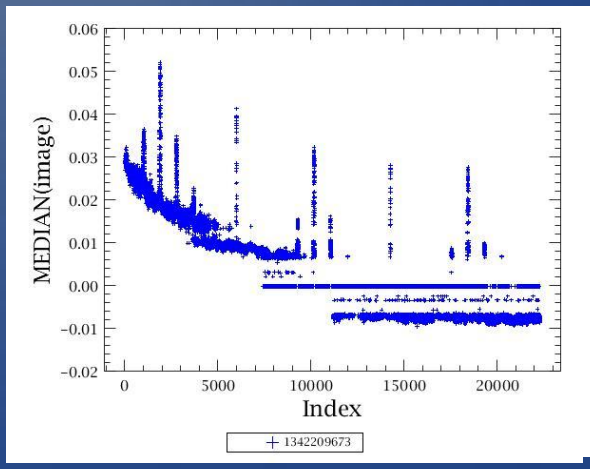
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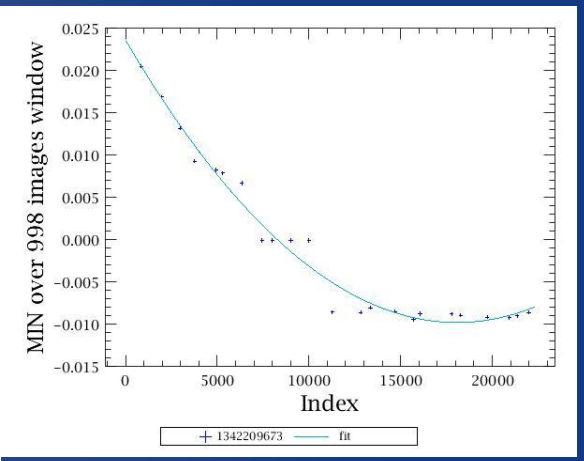
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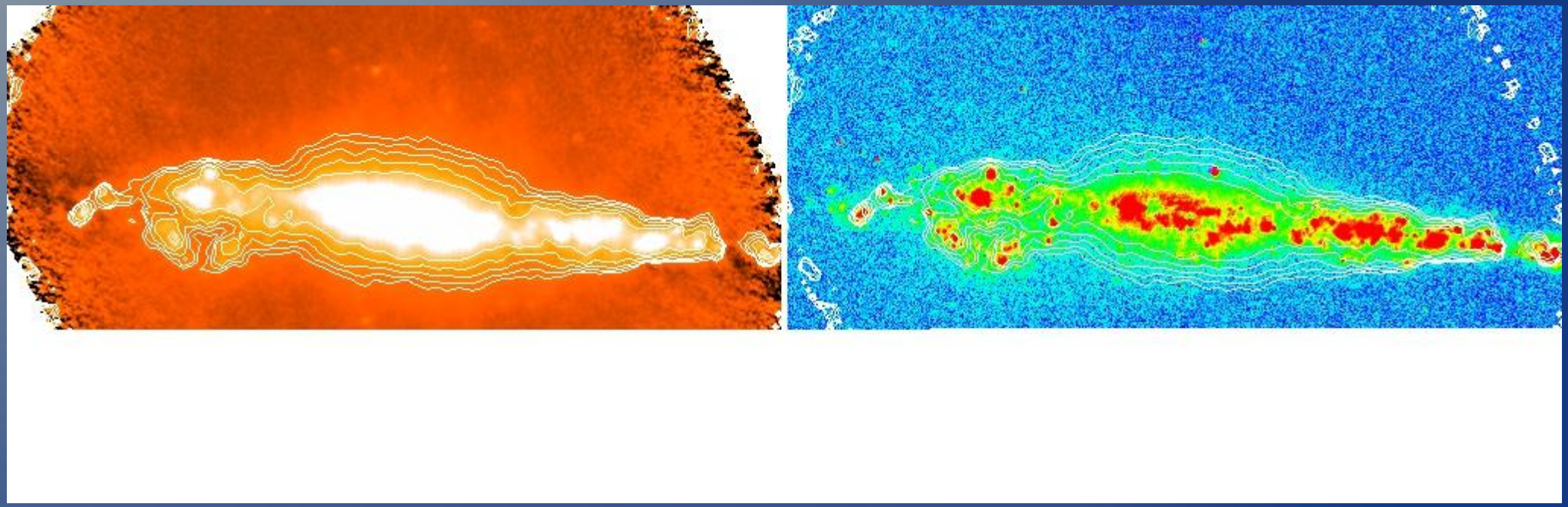

PACS 70mm/Scanamorphos