Extending the Spatial Resolution of WISE: resolving phenomena in Nearby Galaxies

Frank Masci

IPAC/Caltech

Goals

- Boost the scientific return of nearby galaxy research by complementing the WISE Extended Source Catalog with a Resolution-enhanced (HiRes) Image Atlas

- Goal: match spatial resolution across λ's - usually higher in existing UV,optical,near-IR archives
    - relationship between star-formation, stellar/gas mass, age, extinction, morphology on ~ same scales?

- With measurements available for many galaxies, we can determine:
    - which parameters govern internal evolution, color and metallicity gradients
    - better census of SF/HII regions, their spatial distribution, what fraction optically obscured?
    - where does star formation occur with respect to the bulge, bar and disk, spiral arms and rings? If interactions enhance star formation, where in the galaxy do these occur?
    - link between AGN activity, star-formation, and morphology?
    - what drives/maintains star formation and dust distribution? Can density wave theory explain it all?
    - spatial distribution of PAH emission, input energetics, IMF

Example: M51 coadd vs HiRes
R G B = w4, w3, w2

Composite from default atlas co-adds:
Native FWHM ~ 6″ (w1,w2,w3), 12″ (w4)

Composite of HiRes images:
FWHM ~ 2.8″ (w1,w2,w3), 7.2″ (w4)

Case study on M51

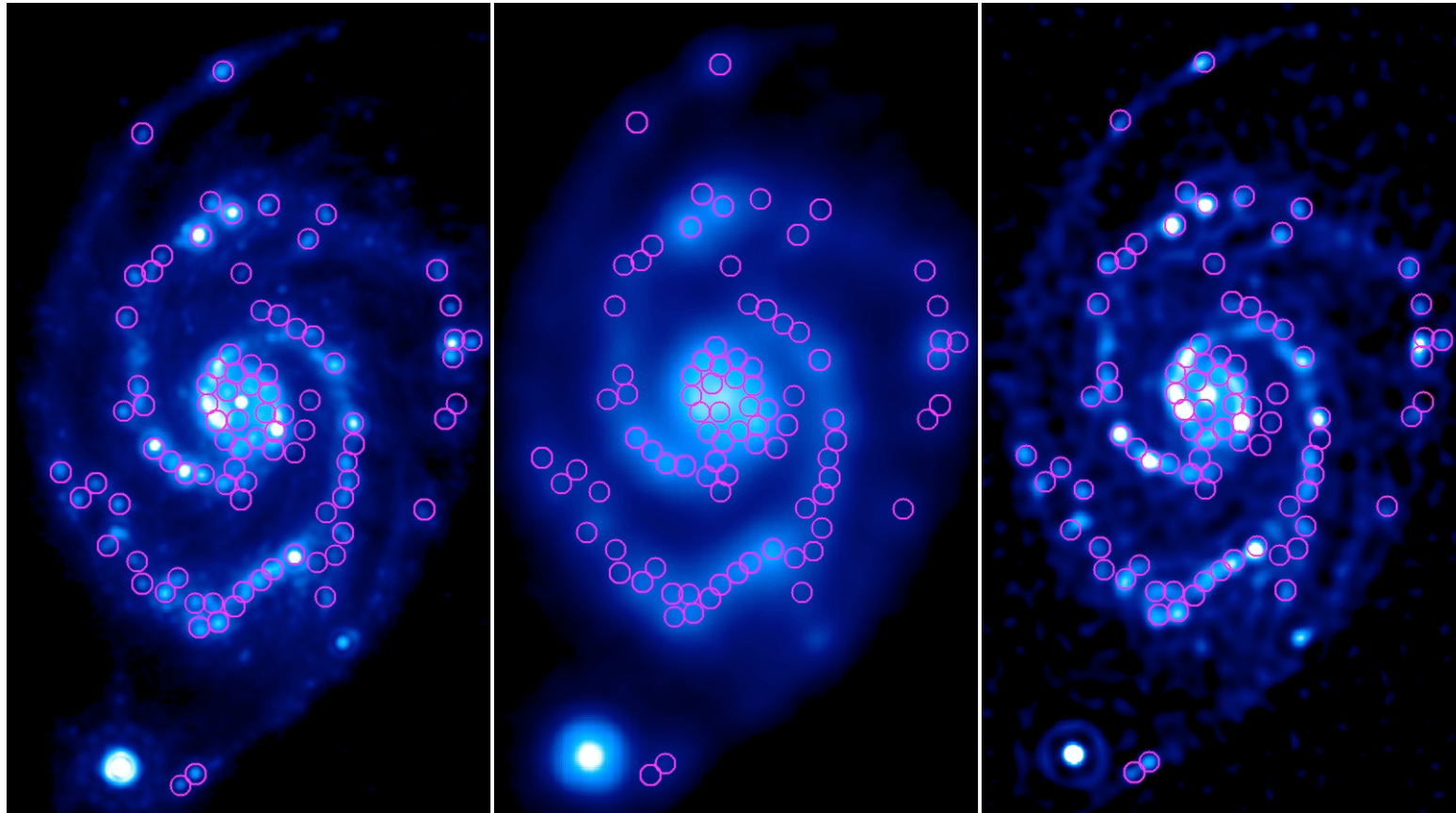MIPS-24μm ~5.7″ fwhm   W4 default atlas <u>coadd</u> ~15″ fwhm   W4 HiRes ~7.2″ fwhm

- diameter of selected SF regions ~ 550 pc (14″ at distance of ~8.2 Mpc)
- <u>Note</u>: W4 sensitivity here is lower than MIPS-24. HiRes quality depends on depth-of-coverage

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M51 HII region Photometry: WISE vs Spitzer

- aperture photometry performed off HiRes mosaics
- IRAC and MIPS photometry is from Calzetti et al. 2005
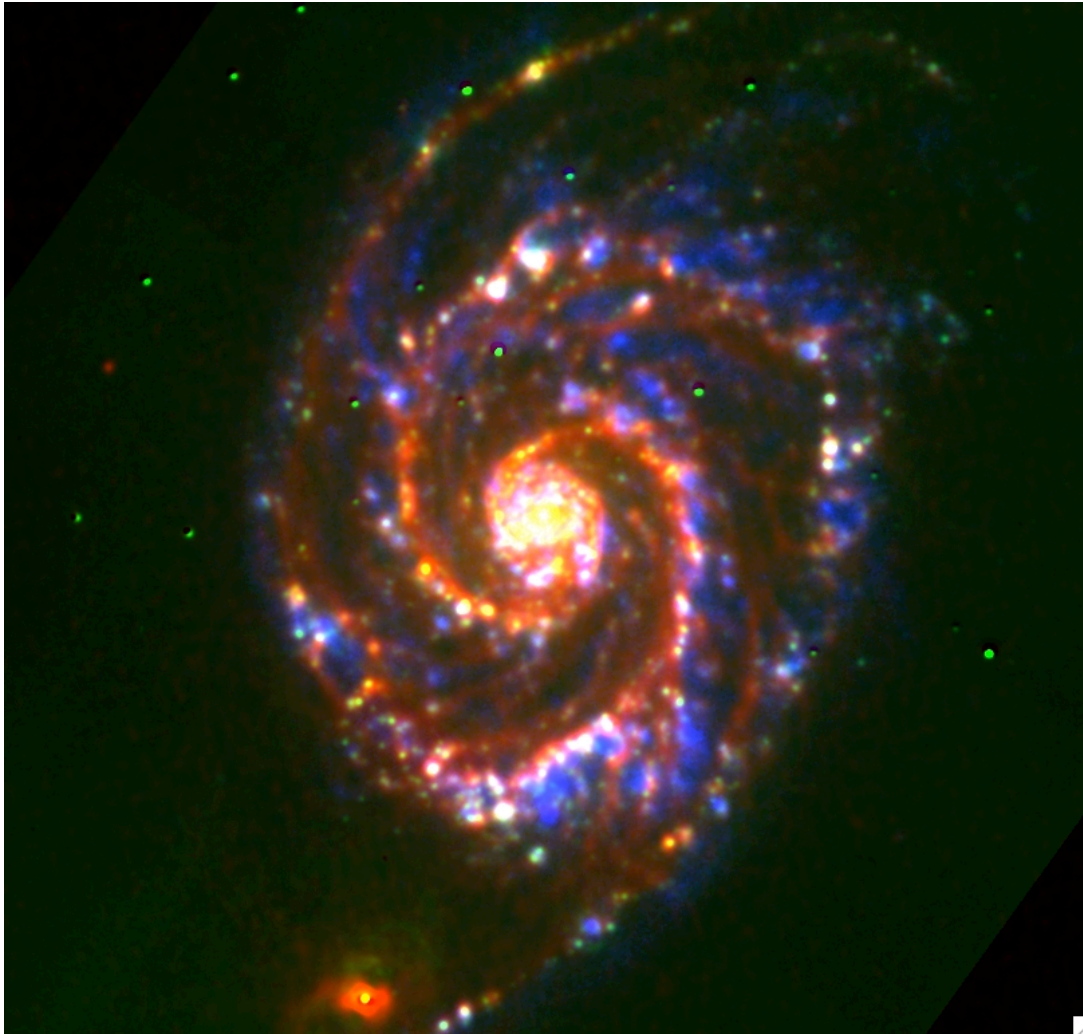- W4/MIPS-24μm and W3/IRAC-8μm consistent with average SED of SA-type galaxy

Log[L(W4)] versus Log[L(MIPS-24)]

Log[L(W3)] versus Log[L(IRAC-8)]
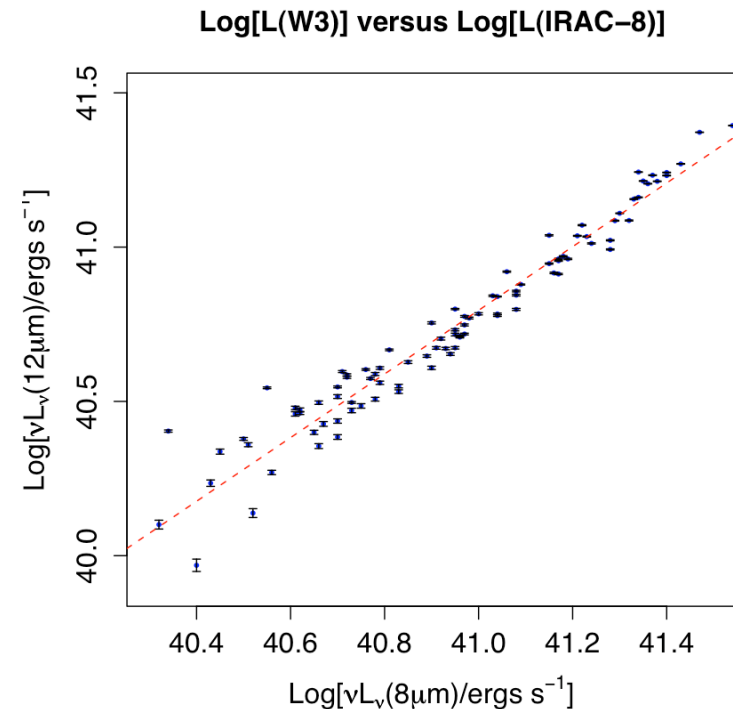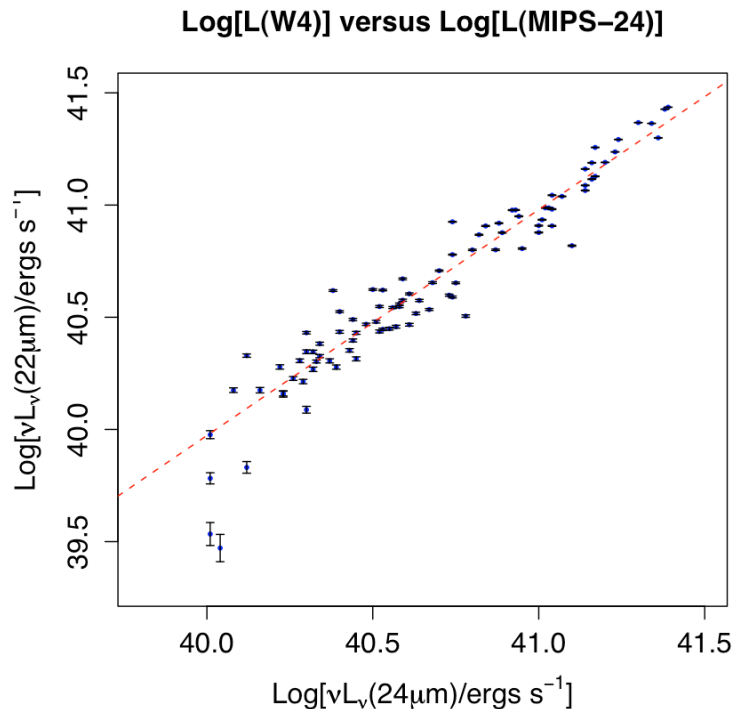
Samples mostly PAH emission

R G B =
W3, Hα, FUV(*GALEX*)

- Hα from SINGS project, continuum subtracted and smoothed to W3 resolution (2.8″)

- *GALEX* beam ~ 4.6″
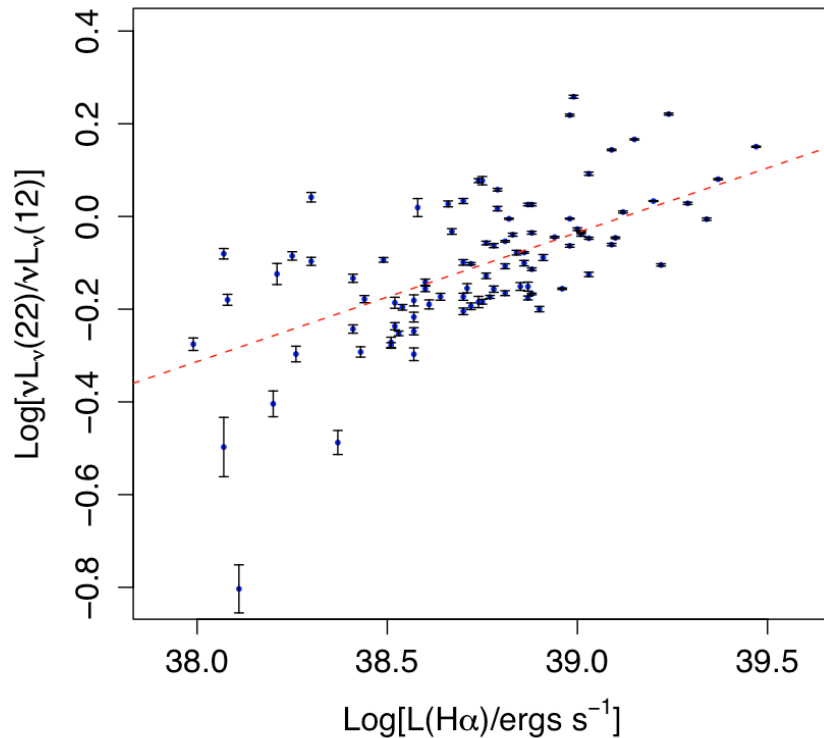
- UV is low where w3 is high
  ⇒ dust extinction

M51 extinction estimates using W4 / Hα

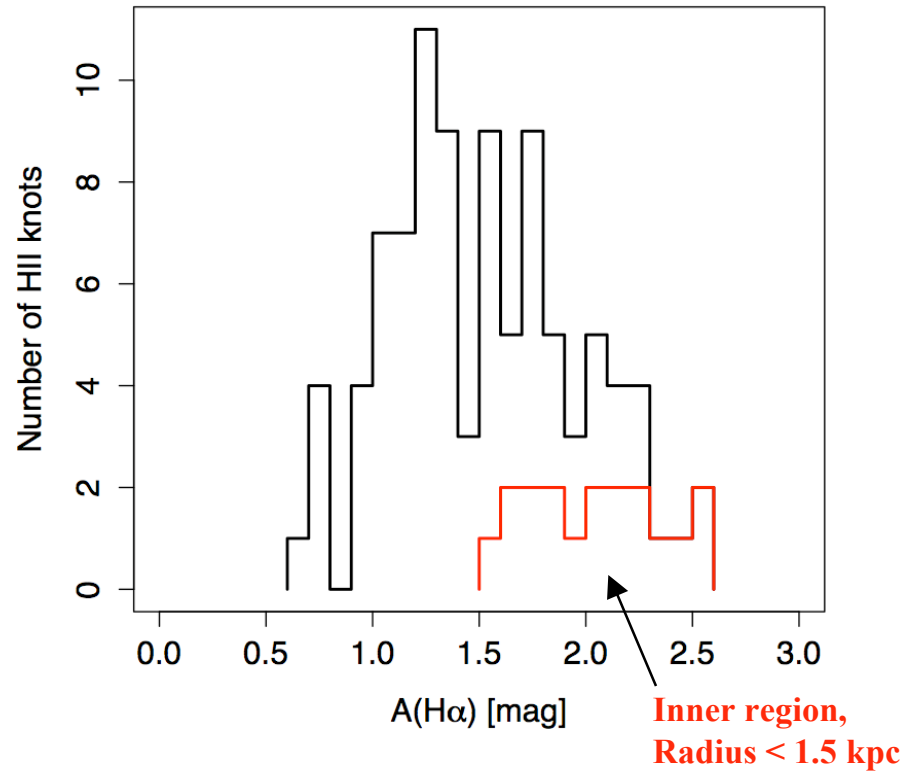**Log[W4/W3] versus Log[Halpha]**

Motivated by MIPS-24 [Kennicutt et al. 2007]:
A(Hα) ~ 2.5Log[1 + 0.038L(W4)/L(Hα)]

Consistent with Hα/Paα ratios from
Calzetti et al. (2005)

Summary and Expectations

- WISE will be crucial to understanding galactic structure, star formation, AGN activity, stellar mass and their link across galaxy types. Our goal is to optimize this by matching to higher spatial resolutions at other wavelengths

- Construct an all-sky HiRes Image Atlas of Galaxies with angular size > 2 arcmin - feasible limit
    - corresponds to a typical 15 kpc spiral at ~ 26 Mpc
    - at this distance, can resolve SF clumps down to ~380pc (w1-3) and ~800pc (w4)
    - from 2MASS, expect ~ 1600 - 2000 galaxies to this limit

Default co-add: W2,W3,W4   **HiRes: W2,W3,W4**

NGC6118
D ~ 25.4Mpc

~ 3' ~ 20kpc

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8
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