



AWAIC tool

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# AWAIC: A WISE Astronomical Image Co-adder (and HiRes'er!)

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# What's (Who's) AWAIC?



AWAIC tool

- A generic image co-addition and/or resolution enhancement (HiRes) tool
- Can now install on your laptop or desktop. Create your own custom co-adds or HiRes'd versions
- Features:
  - creates science quality products as well as the occasional WISE Image Of the Week
  - throughput/gain matching of inputs to a common photometric zero-point
  - background (offset) matching using planar fitting
  - outlier detection/flagging and masking of bad pixels
  - co-addition options: input/output overlap-area weighting, drizzle, or PRF-interpolation
  - deconvolution method: an extension of Richardson-Lucy, includes: ringing and noise suppression, allows for spatially varying PSFs, weighting using priors, quality diagnostics
  - ancillary products: uncertainty images (from *priors* or derived *a posteriori*), depth-of-coverage maps, images of outlier locations and saturated regions, pixel S/N maps
- You are the first beta testers
- HiRes applications are numerous, e.g:
  - resolve anything Spitzer sees to ~ the same S/N
  - match resolution across wavelengths
  - detect sources well below the native confusion limits (improve completeness)



# Downloads Page




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<http://wise2.ipac.caltech.edu/staff/fmasci/awaicpub.html>

Links to tar files are password protected (WSDC “proj” server)

Two platforms  
only for now!



## AWAIC: A WISE Astronomical Image Co-adder (Downloads Page)



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### Instructions

1. Click to download the appropriate AWAIC package for your platform:
  - [Mac OSX v10.4 and above \(Intel 32 or 64 bit processors only\)](#) [~1.8 GB unpacked]
  - [Linux RedHat \(x86 32 or 64 bit processors only\)](#) [~1.8 GB unpacked]
2. This will be deposited in a folder where your downloads normally go. Move it to an area with >~ 5 GB of disk space. This need not be where your image data resides. Input image lists to AWAIC are flexible and may contain file paths to anywhere on your system. This minimum disk size accounts for additional files made when running one of the examples.
3. Unzip your downloaded "\*.tar.gz" file if not automatically done by your system (e.g., "gunzip \*.tar.gz").
4. Unpack (or untar) the package, e.g., "tar -xvf \*.tar". This will create the AWAIC root directory, e.g., "awaic-macintel-3.7.4/". Delete the relic tar file after unpacking.
5. cd into this root directory and read the [README](#) file therein on how to set up your environment and get started.

### Documentation

Here's the main software description and usage document: [awaic-v3.7.4.pdf](#). This is included in the above distributions (under subdirectory "docs/" in the unpacked root directory).

see 'advisories & caveats' section!



# Packaged Examples



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- Five example (test) scripts (with data) are provided in the distribution using different data/applications. Start with one of these and tailor it to your needs
- *awaic\_coadd\_wise*: make co-add of IC342 from WISE frames (any band). All params optimized for WISE co-adding!
- *awaic\_hires\_wise*: make HiRes of IC342 from WISE frames (any band). All params optimized for WISE HiRes'ing!
- *awaic\_coadd\_mips*: make co-add of M51 from MIPS 24 $\mu$ m frames (any band). All params optimized for MIPS 24 $\mu$ m co-adding.
- *awaic\_hires\_mips*: make hires of M51 from MIPS 24 $\mu$ m frames (any band). All params optimized for MIPS 24 $\mu$ m HiRes'ing.
- *awaic\_hires\_sim*: test hires on simulated frames to explore uncertainty estimation and HiRes performance.



# Example Script Input Spec



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Need to specify footprint location and geometry, input frame lists, and you're ready to run, e.g:

```
#=====
# WISE band number: 1,2,3,4:
set band = 1
# Right Ascension of footprint center [deg]:
set ra = 56.70208333
# Declination of footprint center [deg]:
set dec = 68.09611111
# Rotation of footprint: +Y axis W of N: 0 <= rot < 360 [deg]:
set rot = 199.5
# E-W footprint dimension for rot = 0 [deg]:
set sx = 0.45
# N-S footprint dimension for rot = 0 [deg]:
set sy = 0.45

# Filename containing list of input intensity frames:
set inimlist = wise/ImageList${band}.txt
# Filename containing list of input mask frames (if available):
set inmsklist = wise/MaskList${band}.txt
# Filename containing list of input uncertainty frames (if available):
set uninclist = wise/UncertList${band}.txt
#=====
```



# Input (calibrated L1b) Frames



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- Query frames overlapping with your footprint and download using WISE image server:  
<https://ceres.ipac.caltech.edu/applications/WISE/IM/>
- For available data, see:  
<https://ceres.ipac.caltech.edu/applications/WISE/STATS/>

**WISE Image Service**  Pass 1  Provisional  Simulated

Dataset: Search for WISE  L1b Images or  Atlas Images

Input Mode:  Single Input  Multiple Inputs

▼ **Search by Position or Object Name**

? Coordinates or object name:

? Region size:

? Subimage size:  ? Most centered image only:

- Pass 1 (v3.5-processed) data recommended. Best astrometry  $\Rightarrow$  will give best registration

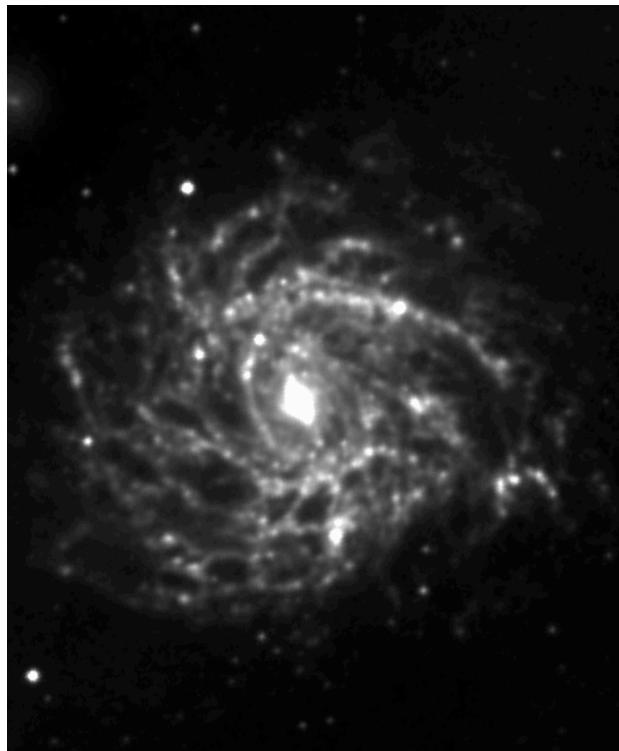


# WISE Example in Package (IC342)

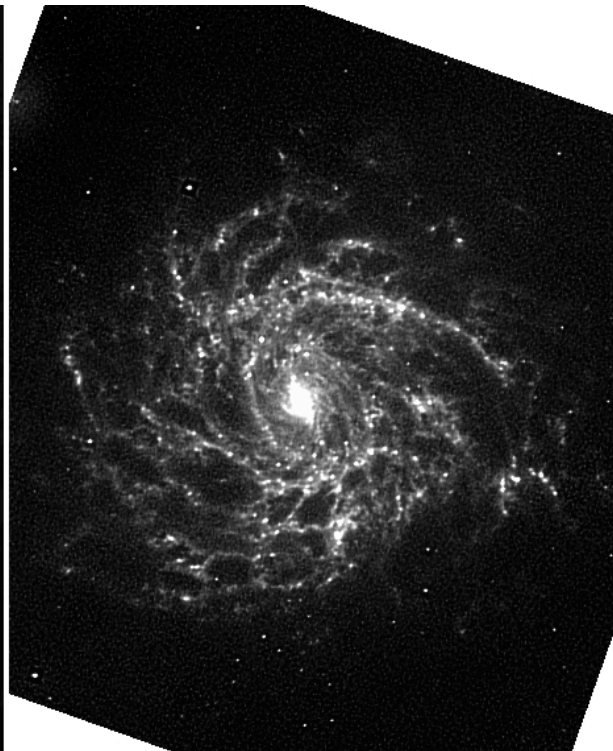


AWAIC tool

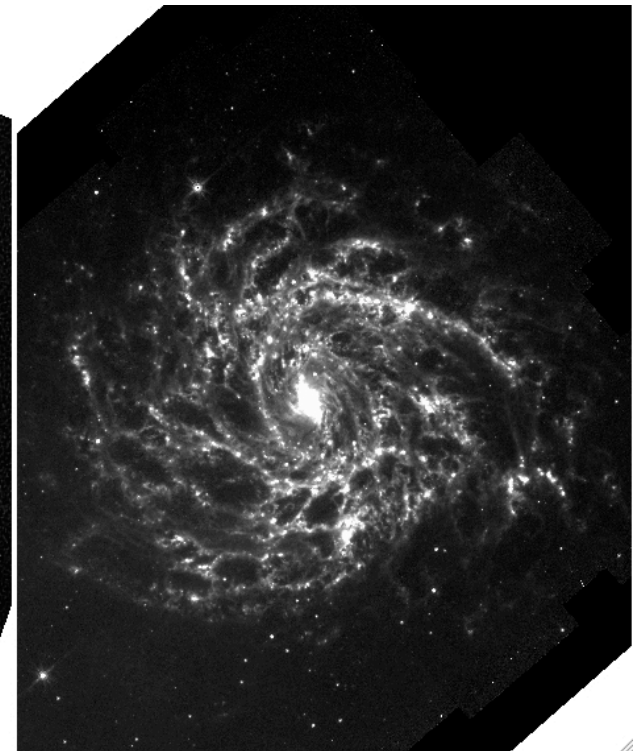
W3 default co-add



W3 HiRes (FWHM ~ 2.4")



IRAC 8 $\mu$ m (FWHM ~ 2")



⇒ can reduce native beam-sizes by factor of  $\sim 2.5$  for depths  $> \sim 14$

⇒ turned WISE into a 100 cm Telescope! Not quite, S/N is  $\sim$  same since HiRes amplifies noise





# IC342 HiRes Composite

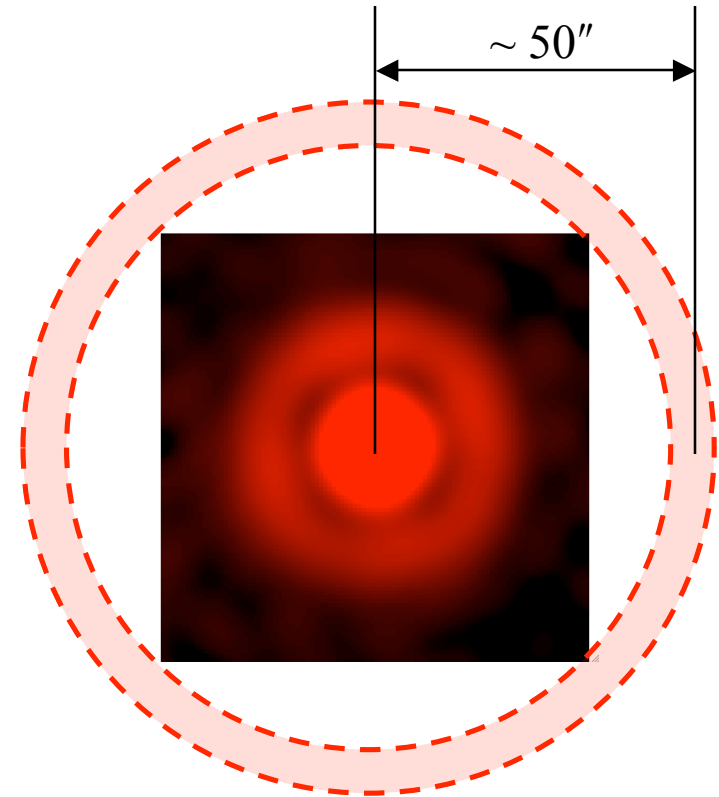


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Color composite: **R G B** = W4+W3+W2



Beware the 2nd Airy ring in W4!  
not captured by template PSF in package



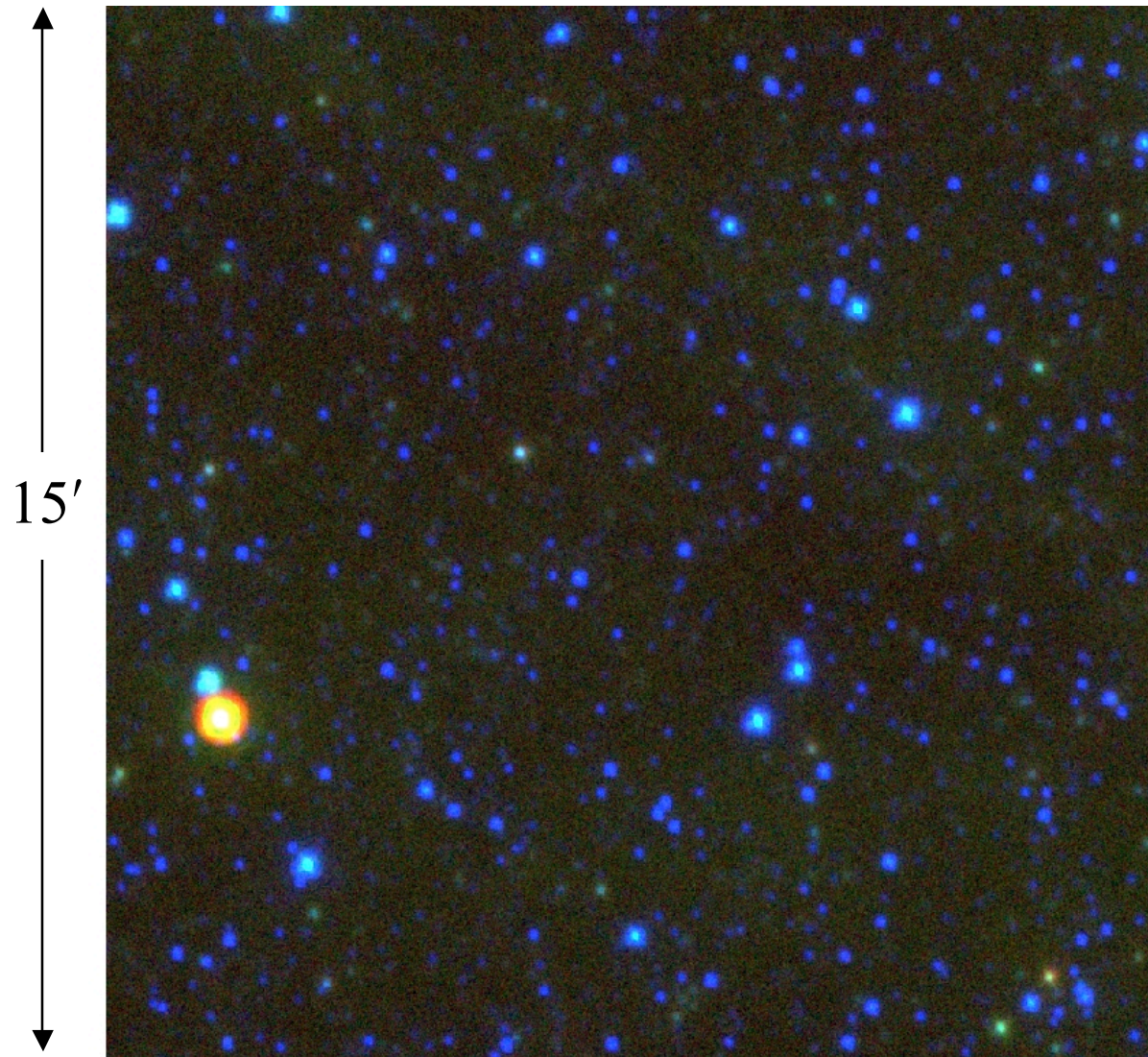




# South Ecliptic Pole Deep Field



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**R G B** = W4+W3+W2 coadd

- Median depth: ~ 300 frames acquired since Mar 23 (v3.5 proc.)
- 5-sigma point-source sensitivities  
W2, W3, W4:  
~ 12.6, 85.6, 607.9  $\mu$ Jy



# HiRes of W3 SEP



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Plain PSF-interpolated coadd

HiRes [non-converged],  $\sigma(\text{beam}) \sim 17 \mu\text{Jy}$

