WISE - the Wide-field Infrared Survey Explorer

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UCLA

Project Overview

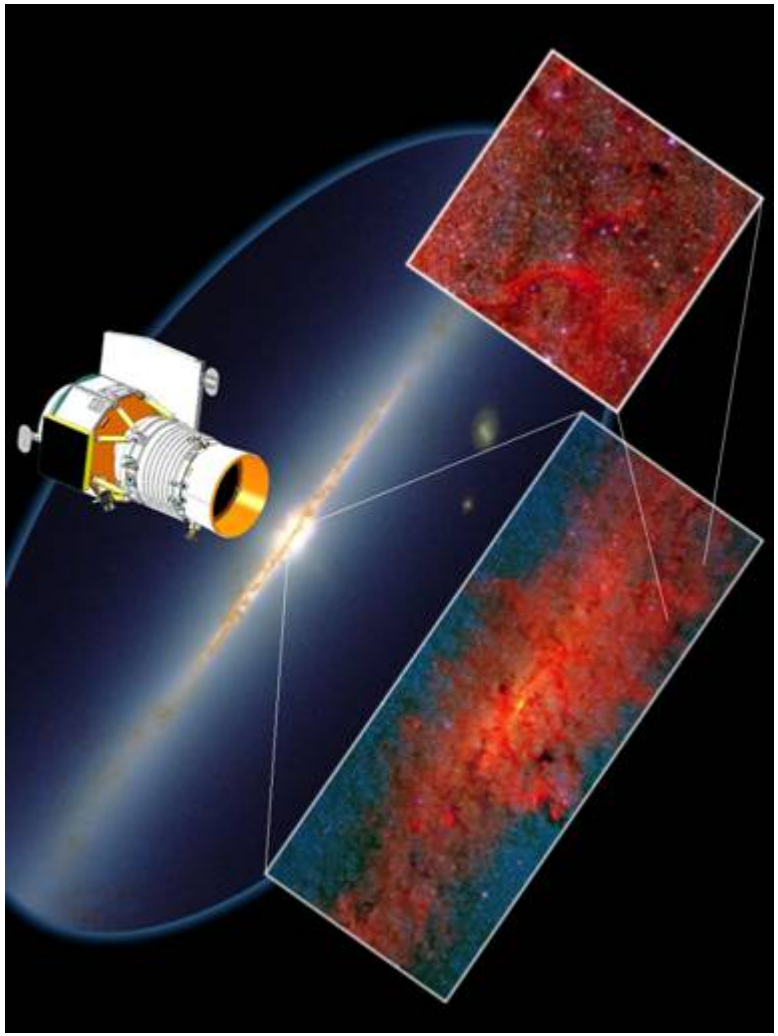
Science

- *Sensitive all sky survey with 8X redundancy*
  - *Find the most luminous galaxies in the universe*
  - *Find the closest stars to the sun*
  - *Provide an important catalog for JWST*
  - *Provide lasting research legacy*

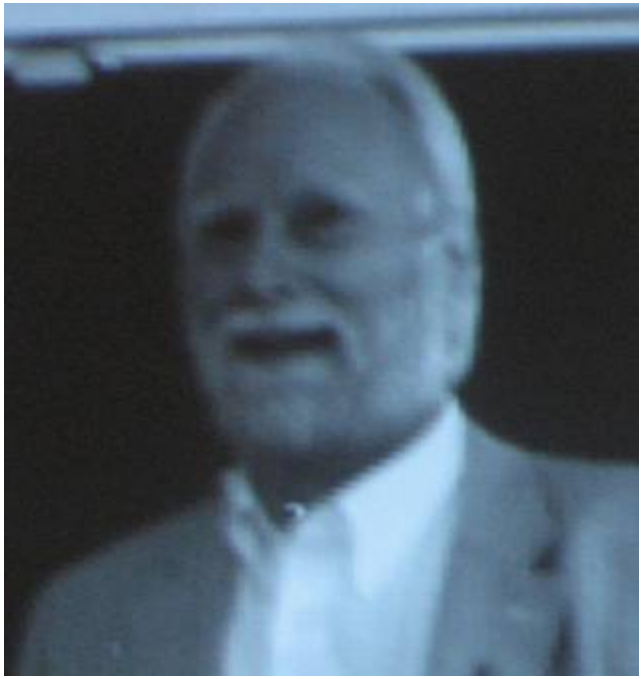
Salient Features

- *4 imaging channels covering 3 - 25 microns wavelength*
- *40 cm telescope operating at <17K*
- *Two stage solid hydrogen cryostat*
- *Delta launch from WTR: 14 Dec 2009*
- *Sun-synchronous 6am 530km orbit*
- *Scan mirror provides efficient mapping*
- *Expected life: 10 months, actual 7.7-9.5*
- *4 TDRSS tracks per day*

Wide Field Infrared Survey Explorer



Infrared



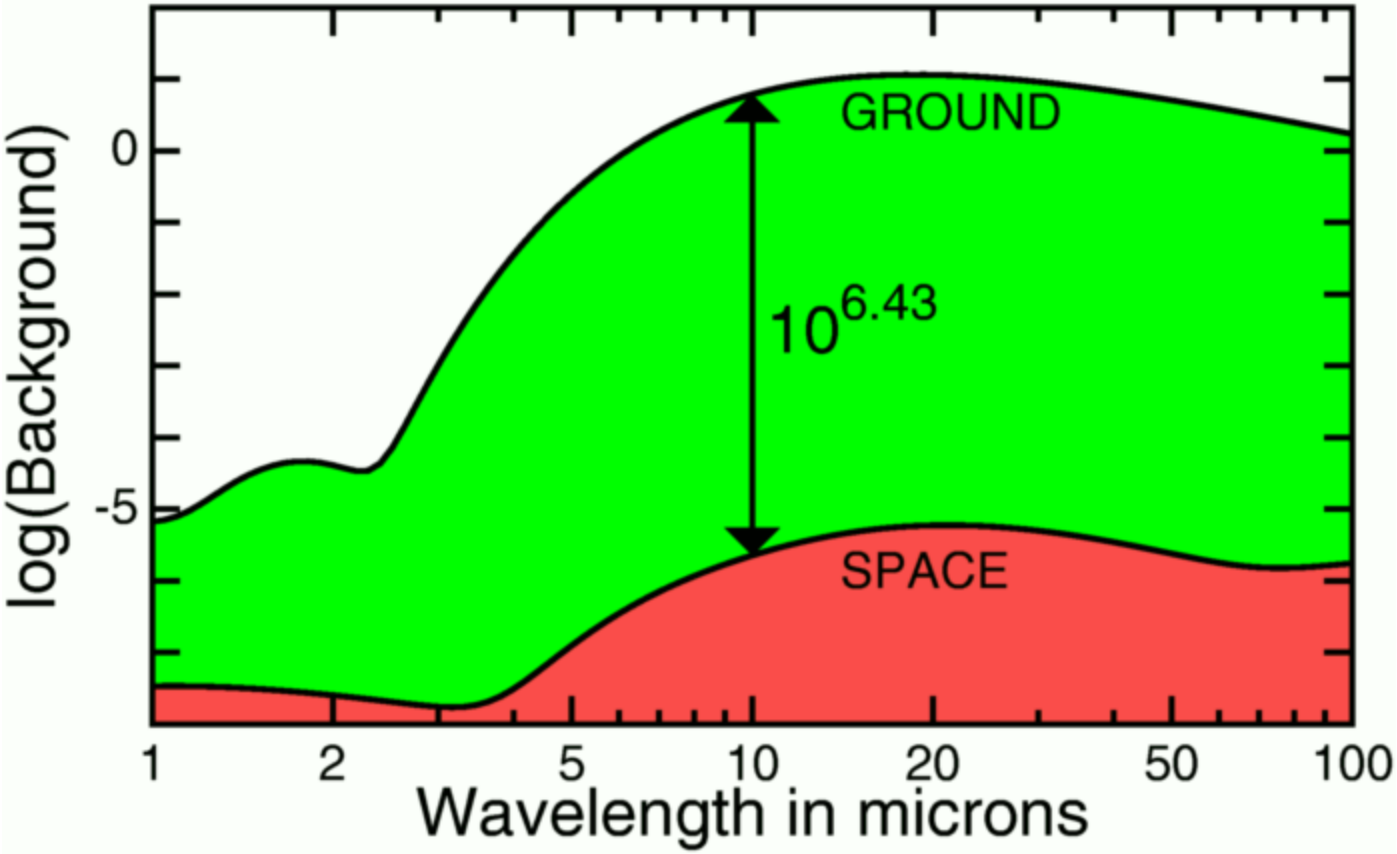
- Optical
- Reflected light

Near-IR
different colors

Thermal-IR
emitted radiation

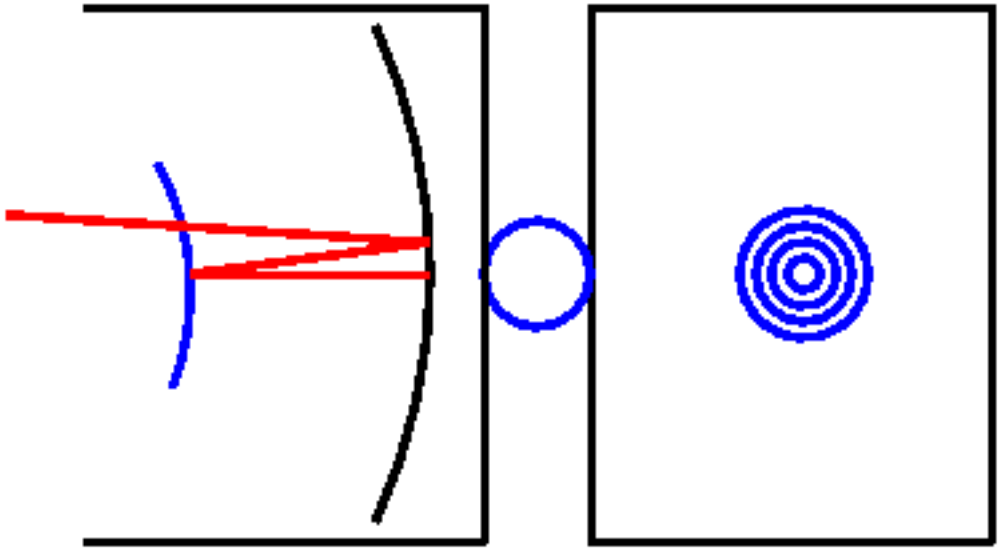
Why Space?

"Ground-based infrared astronomy is like observing stars in broad daylight with a telescope made out of fluorescent lights" — George Rieke.



40 cm WISE telescope in space equals six thousand 8-meter telescopes on the ground!

Animated Scan Mirror Icon



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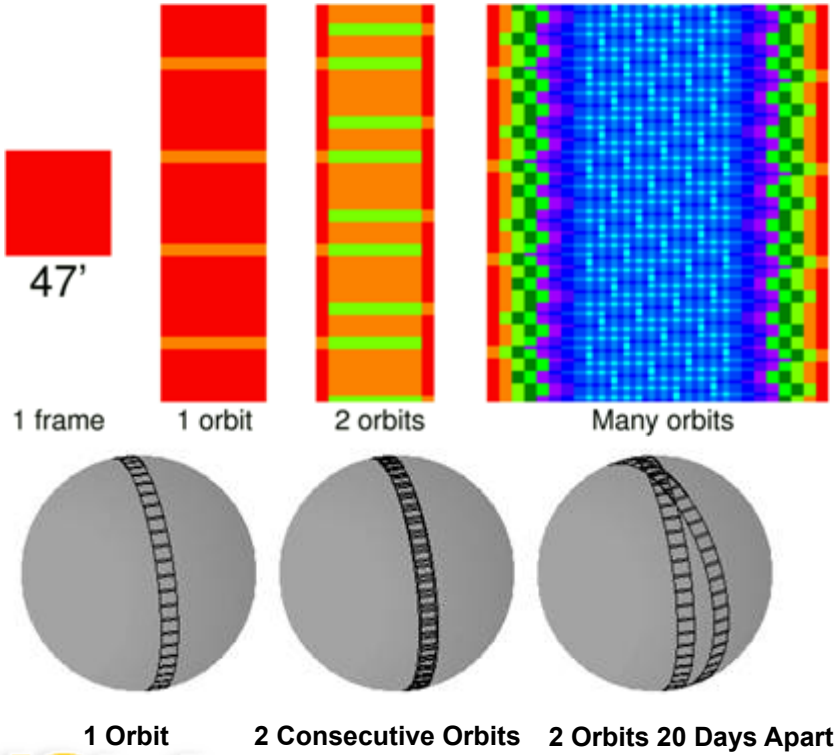
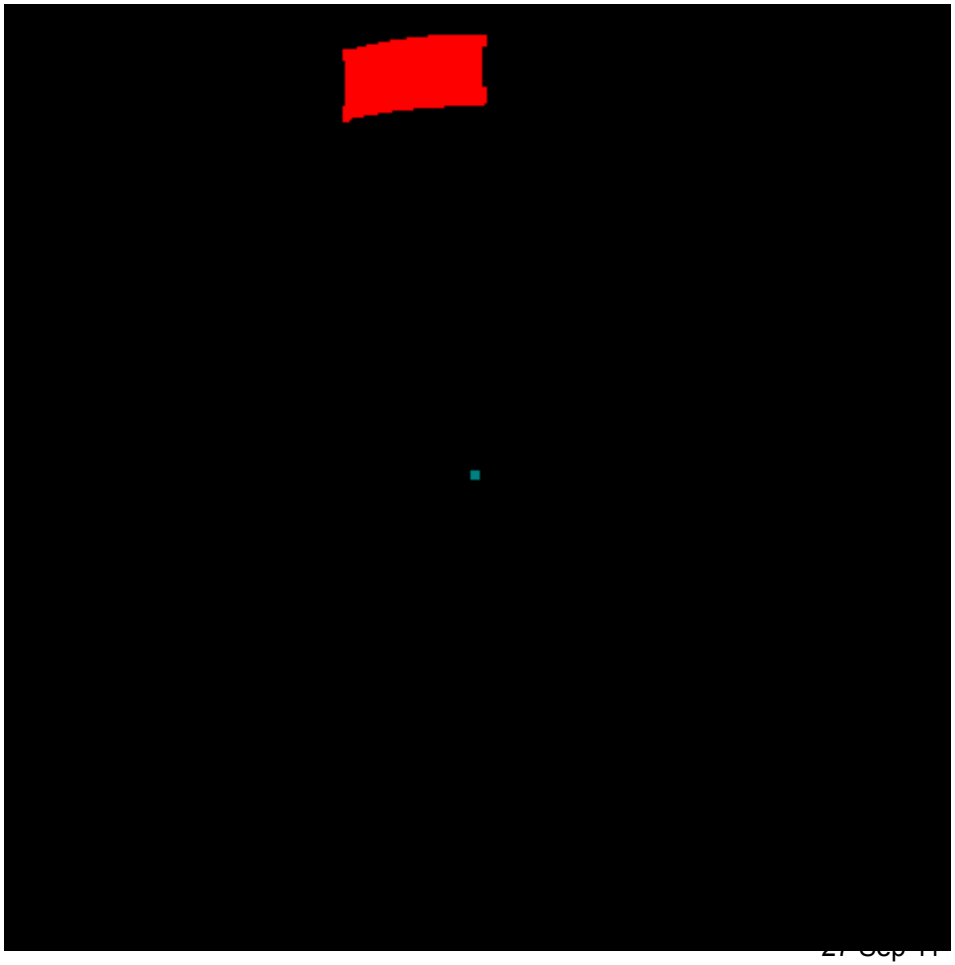
WISE Survey Strategy Provides Minimum of 8 Exposures Per Position

- Scan mirror enables efficient surveying
  - 8.8-s exposure/11-s duty cycle
- 10% frame to frame overlap
- 90% orbit to orbit overlap
- Sky covered in 6 months observing



- Single observing mode
- Minimum 8, median 14 exposures/ position after losses to Moon and SAA



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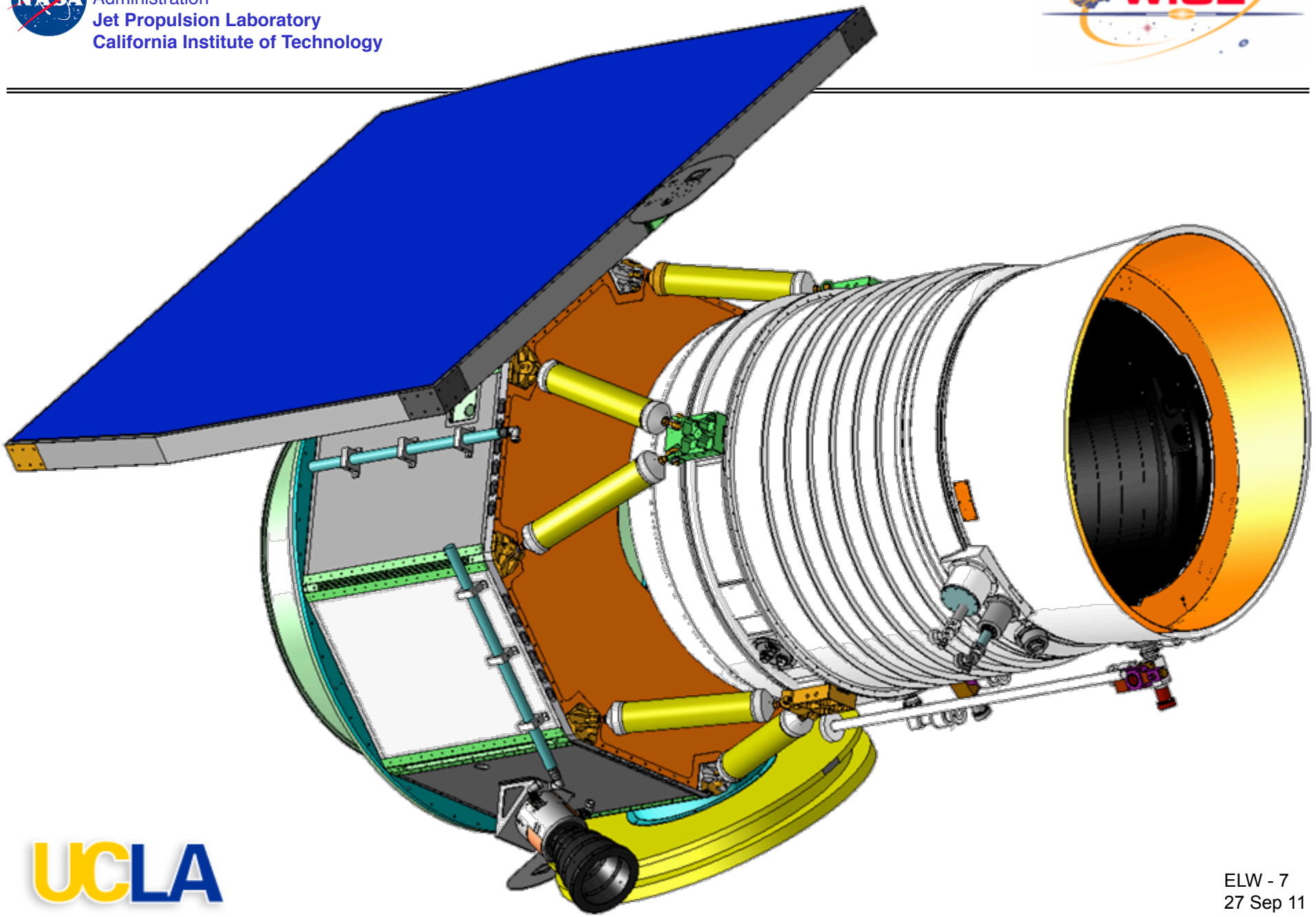
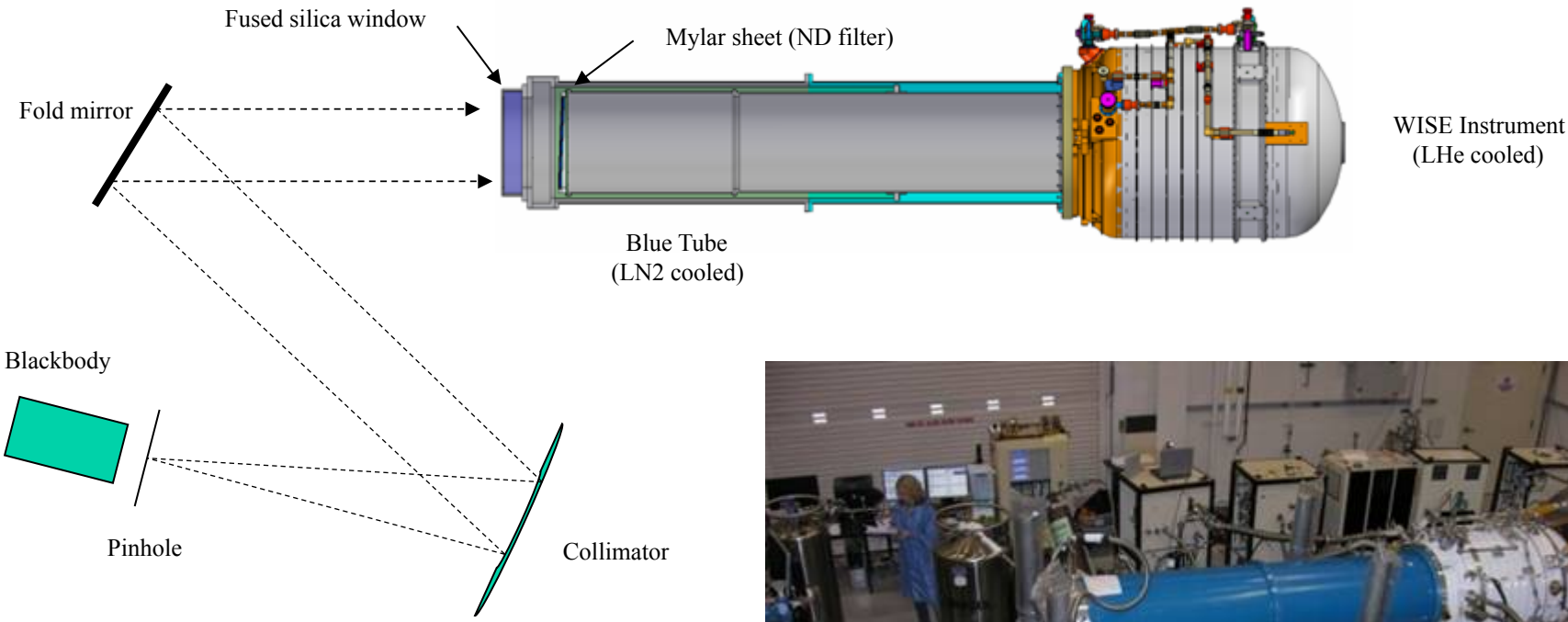


Pre-Environmental Blue Tube Test



- Four Blue Tube Tests have been completed
  - BT1 and BT2 developed configuration
  - BT3 measured defocus
  - BT4 confirmed pre-environmental focus
- Baselined B1 image quality
- Report: *WISE Focus Verification* (SDL/09-157)

S/C+Instrument

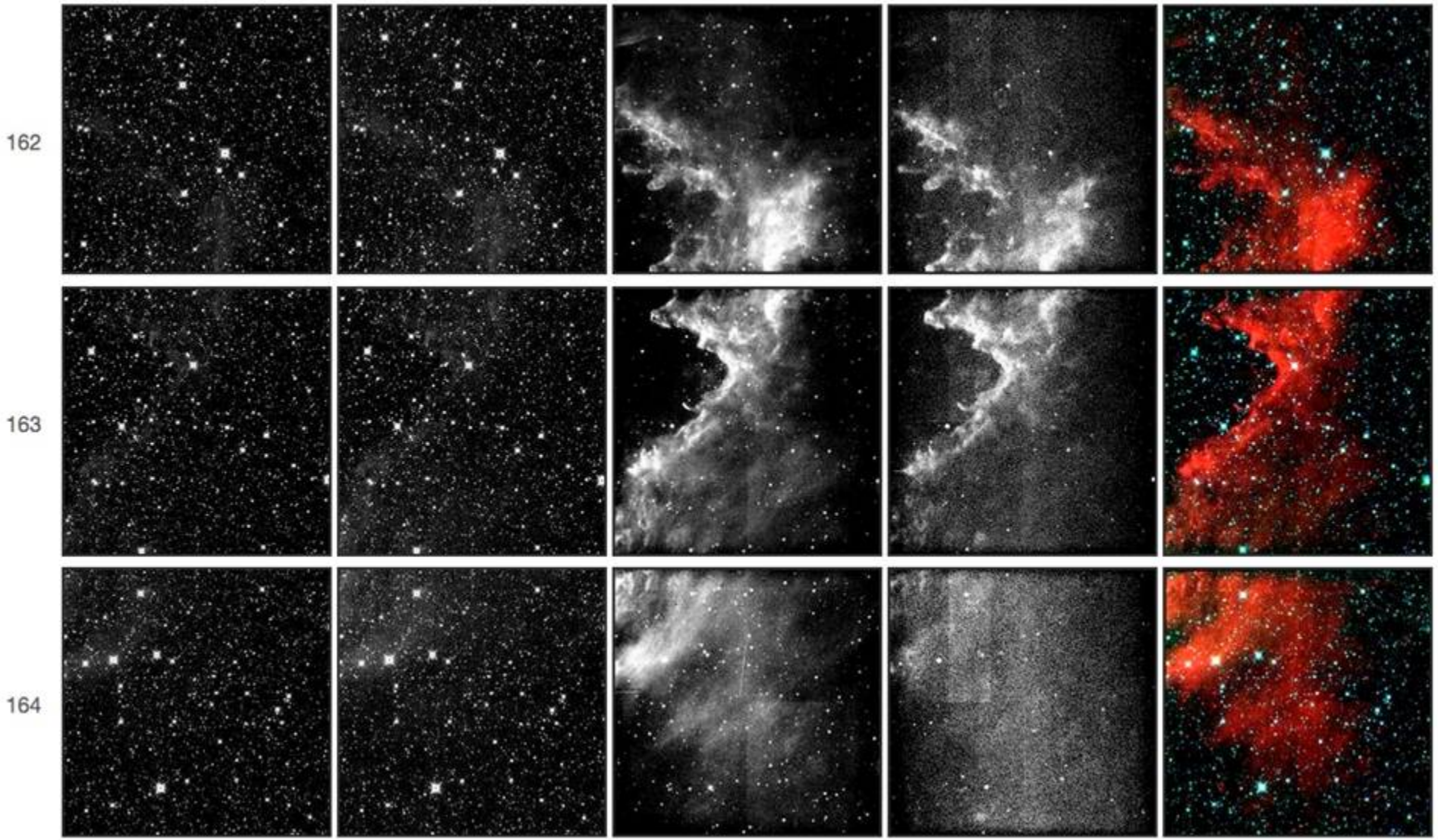
Arriving at VAFB

WISE in the Fairing

Cooling Still Needed

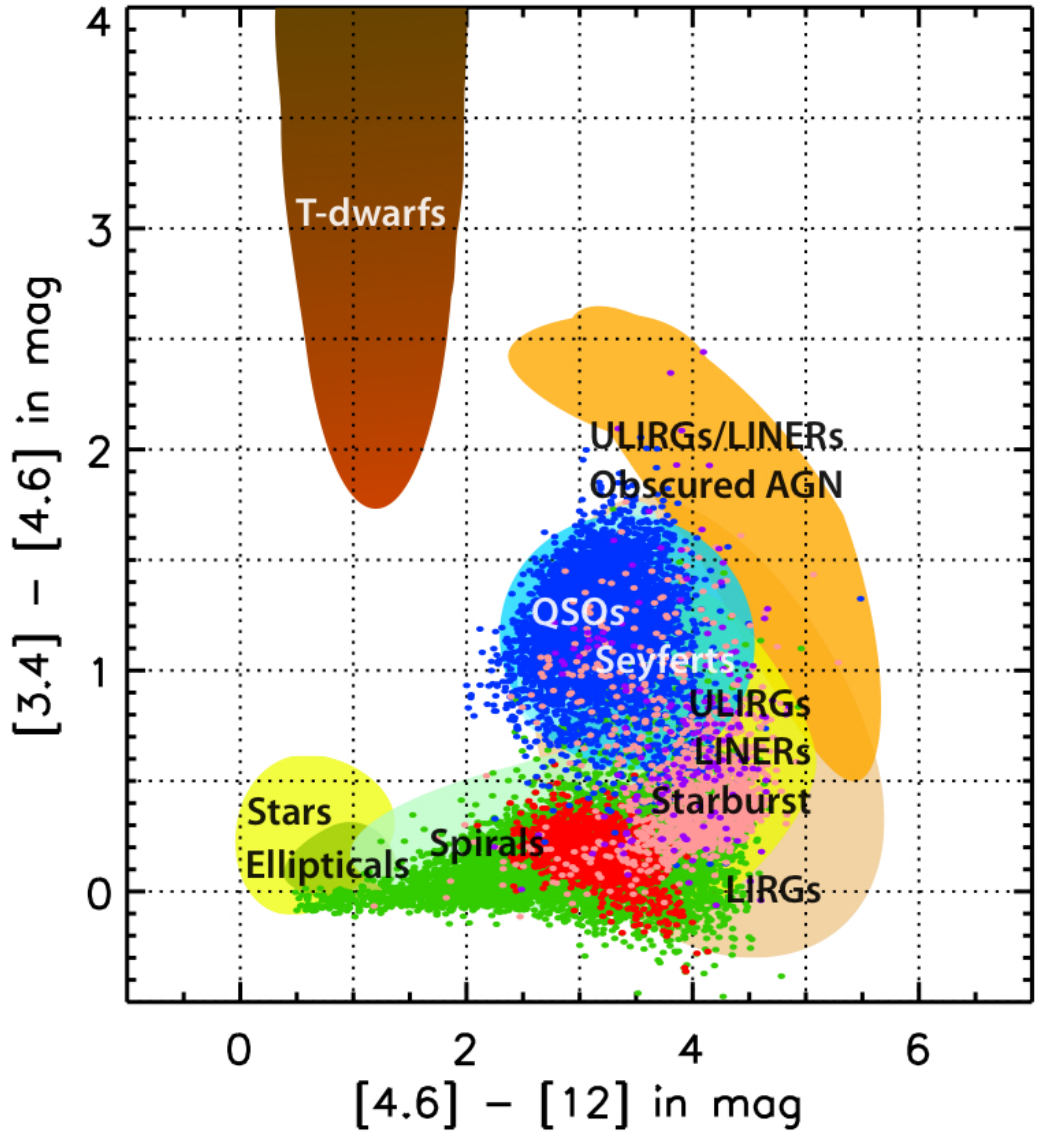
- The cryostat required 24x7 maintenance following completion of the hydrogen fill.
- Two 500 liter liquid helium dewars were transported to level 5 of SLC2 daily, from Nov 20 to Dec 14.

On to Survey Mode



- 33 seconds in the life of WISE, 3 of >7000 frames/day

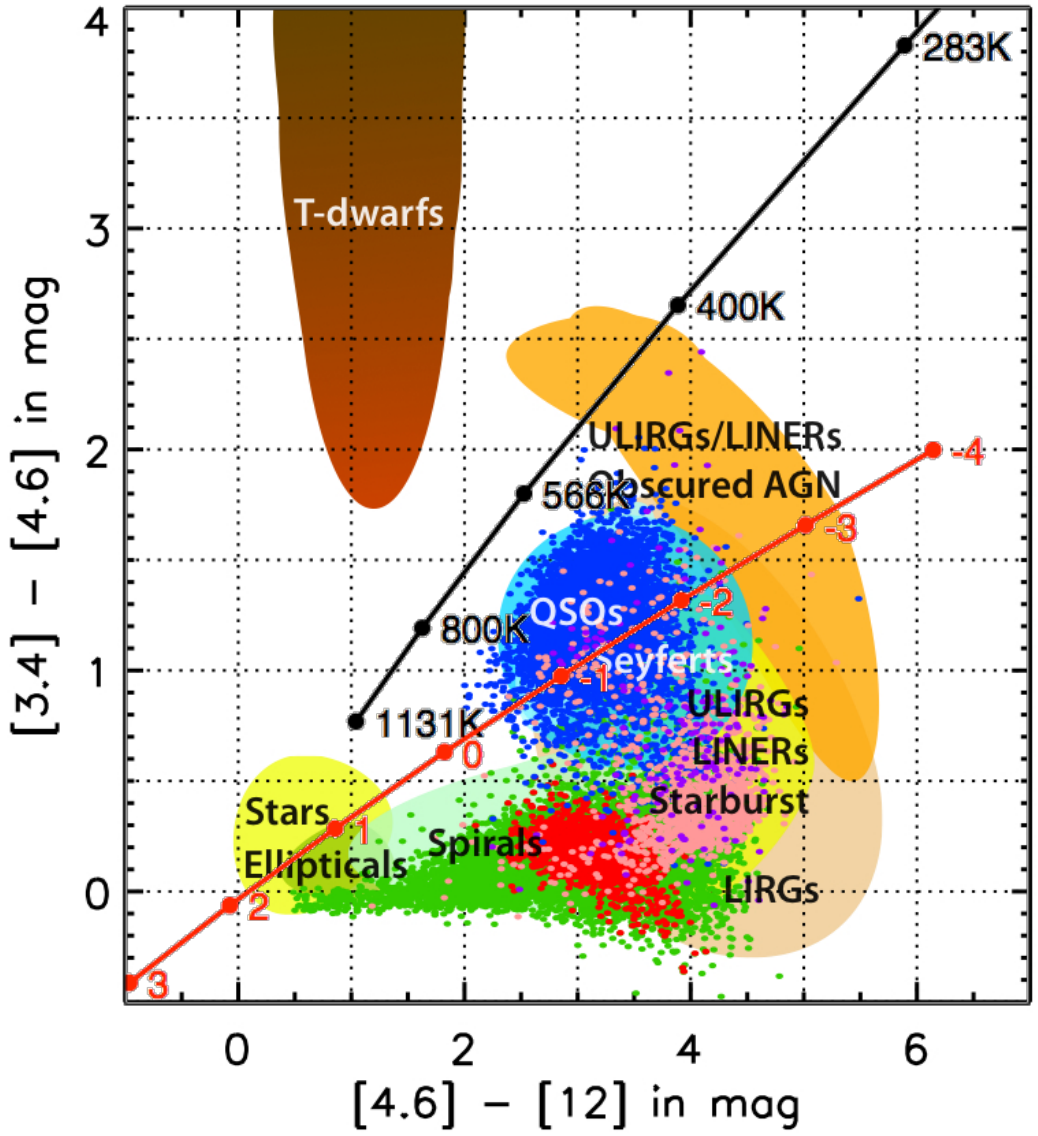
Inhabitants of WISE Color Space



SDSS Classifications:

- Galaxies
- z ~ 0.4 LIRGs
- Local LIRGs
- Local ULIRGs
- QSOs

Inhabitants of WISE Color Space

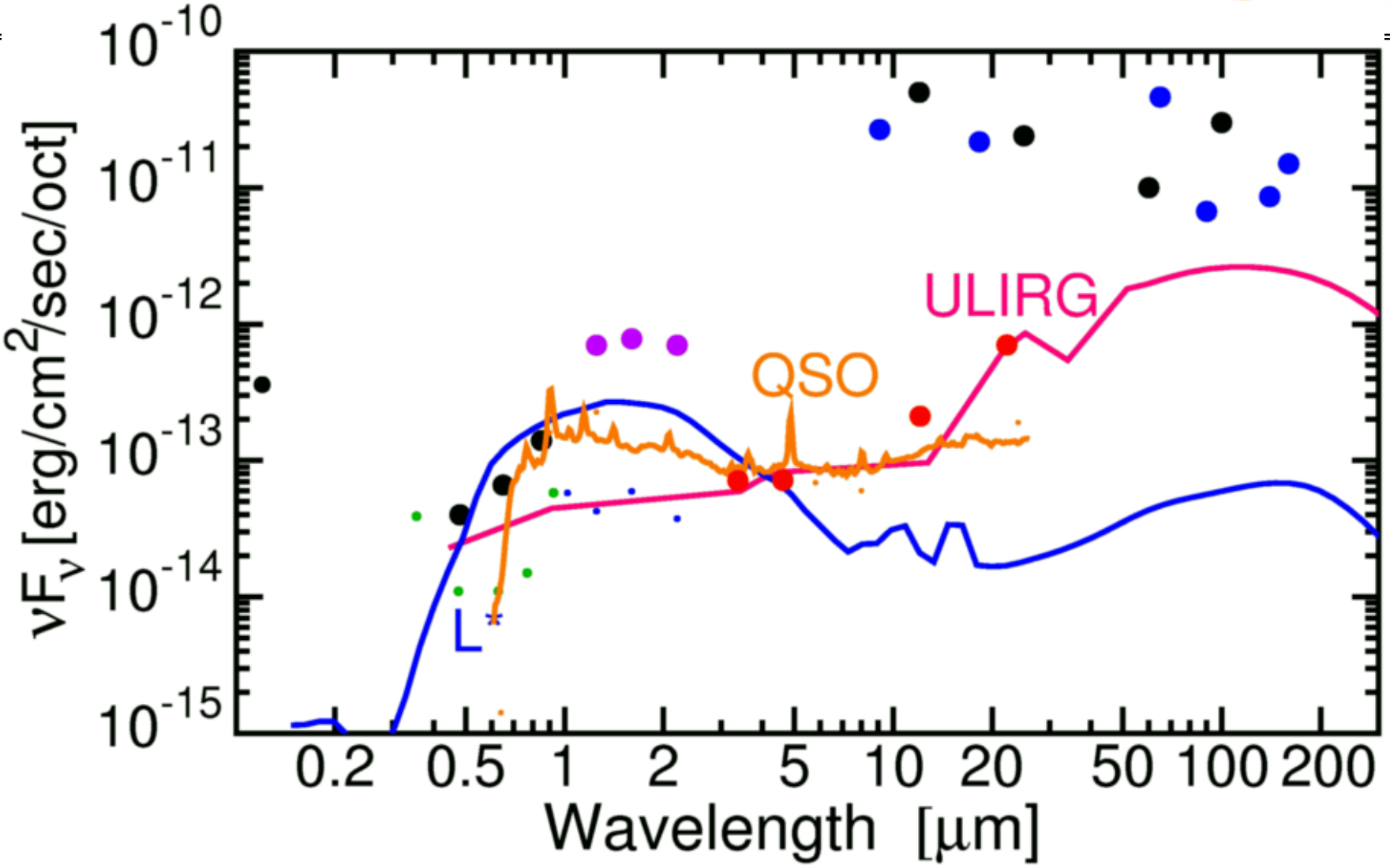


SDSS Classifications:

- Galaxies
- z ~ 0.4 LIRGs
- Local LIRGs
- Local ULIRGs
- QSOs

- Blackbodies
- Power Laws

The far-off Universe



L* at z=0.33, z=6.4 QSO, z=3 ULIRG: FSC15307 x 3

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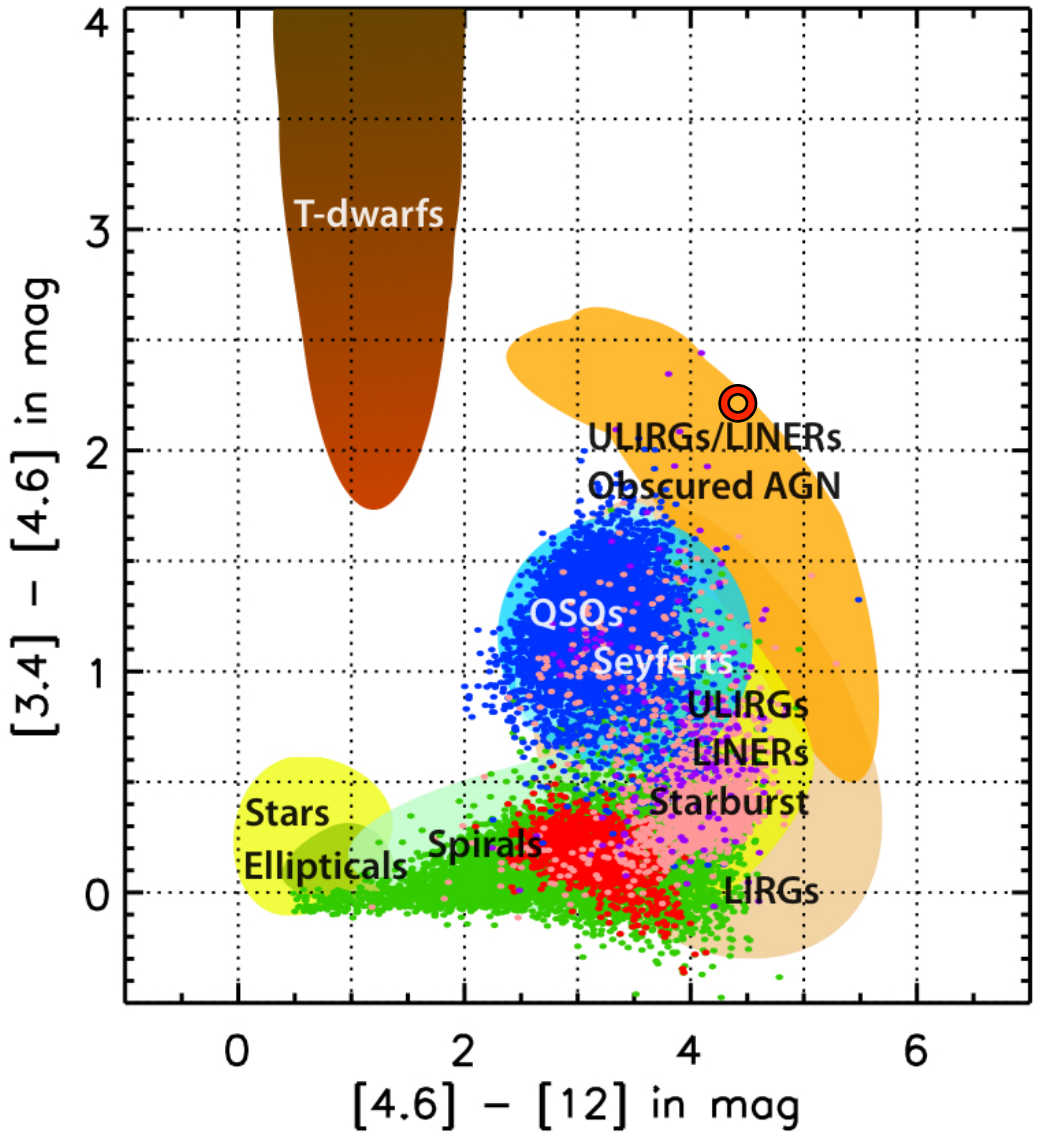
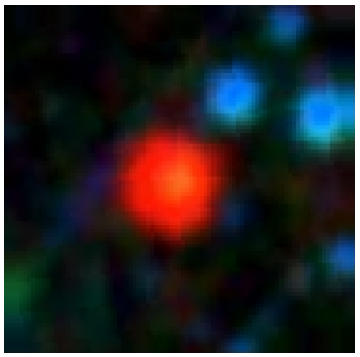
Wide-field Infrared Survey Explorer (WISE)

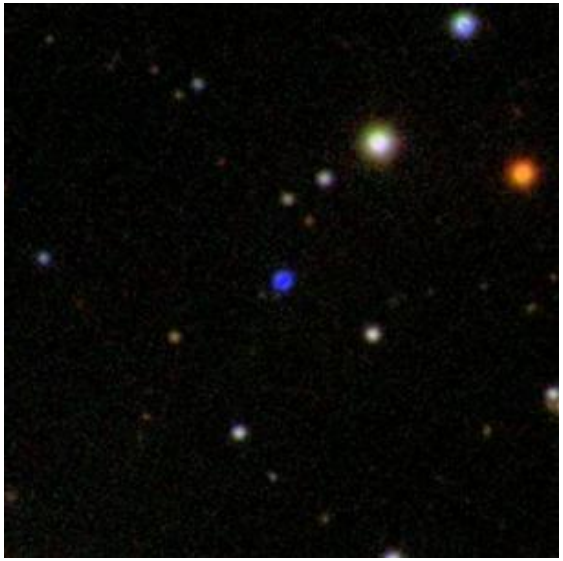
WISE Color Space
A Very Red…Blue Compact Galaxy





WISE image

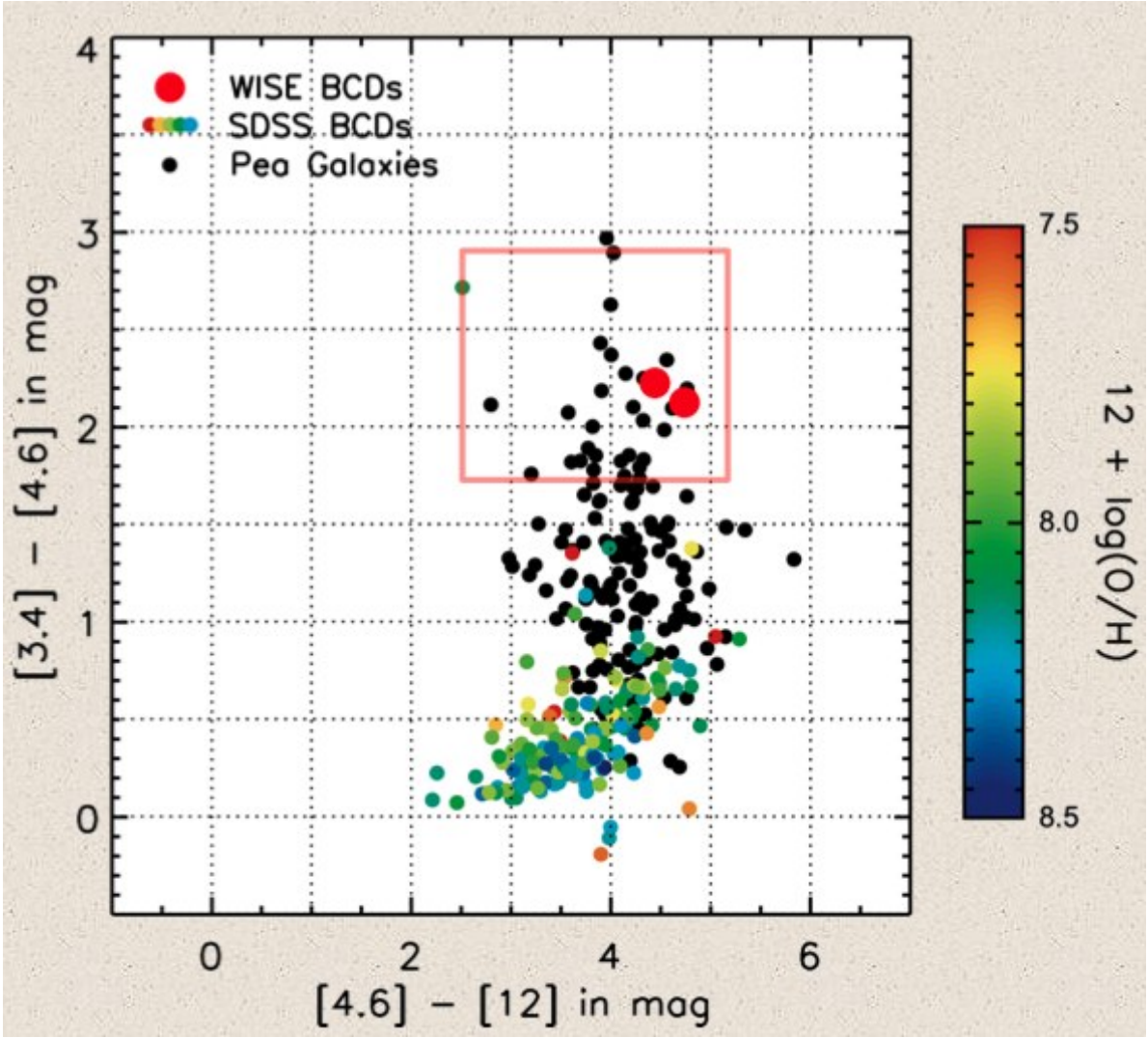
- z=0.0425
- Z ~ 1/12 $Z_{\odot}$



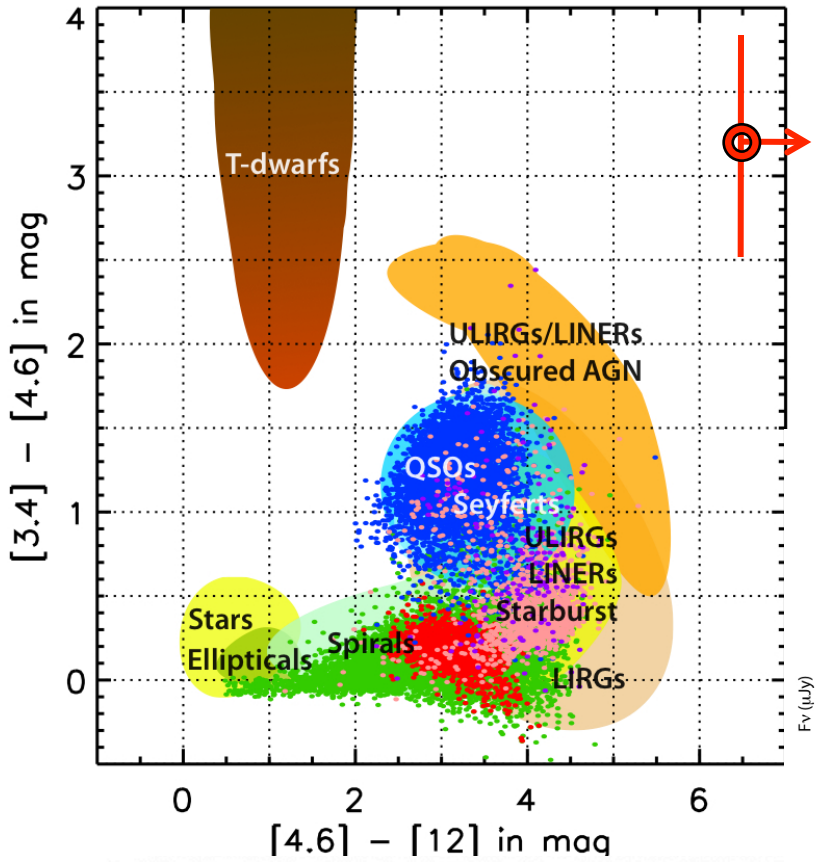
SDSS image

BCDs & Green Peas

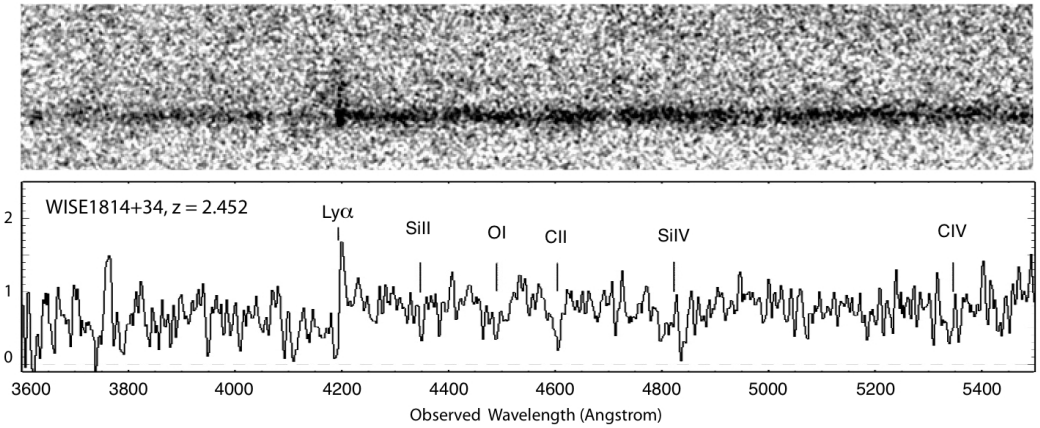
- WISE colors of BCDs and green peas
- From C-W Tsai etal poster 333.11 at the Jan 2011 AAS meeting
- Griffith etal, 2011 ApJL, 736 L22 (arXiv:1106.4844)

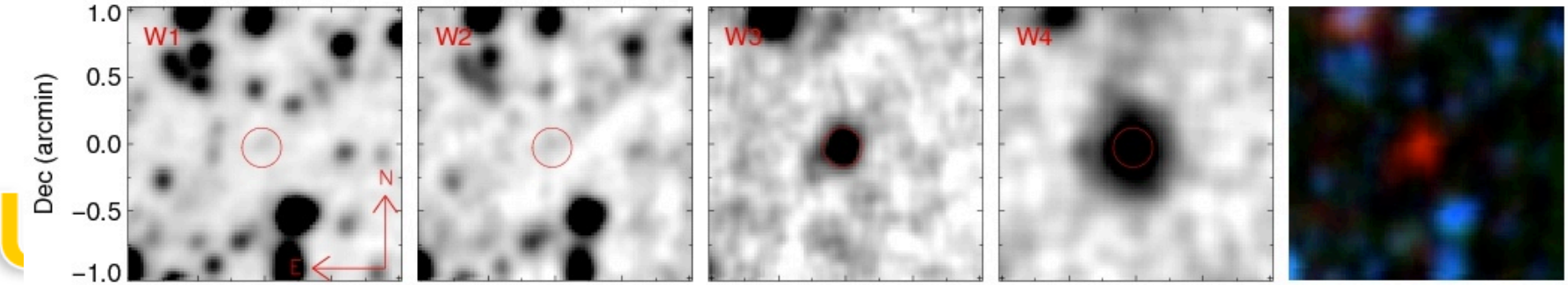


WISE Band 1 and 2 Dropouts



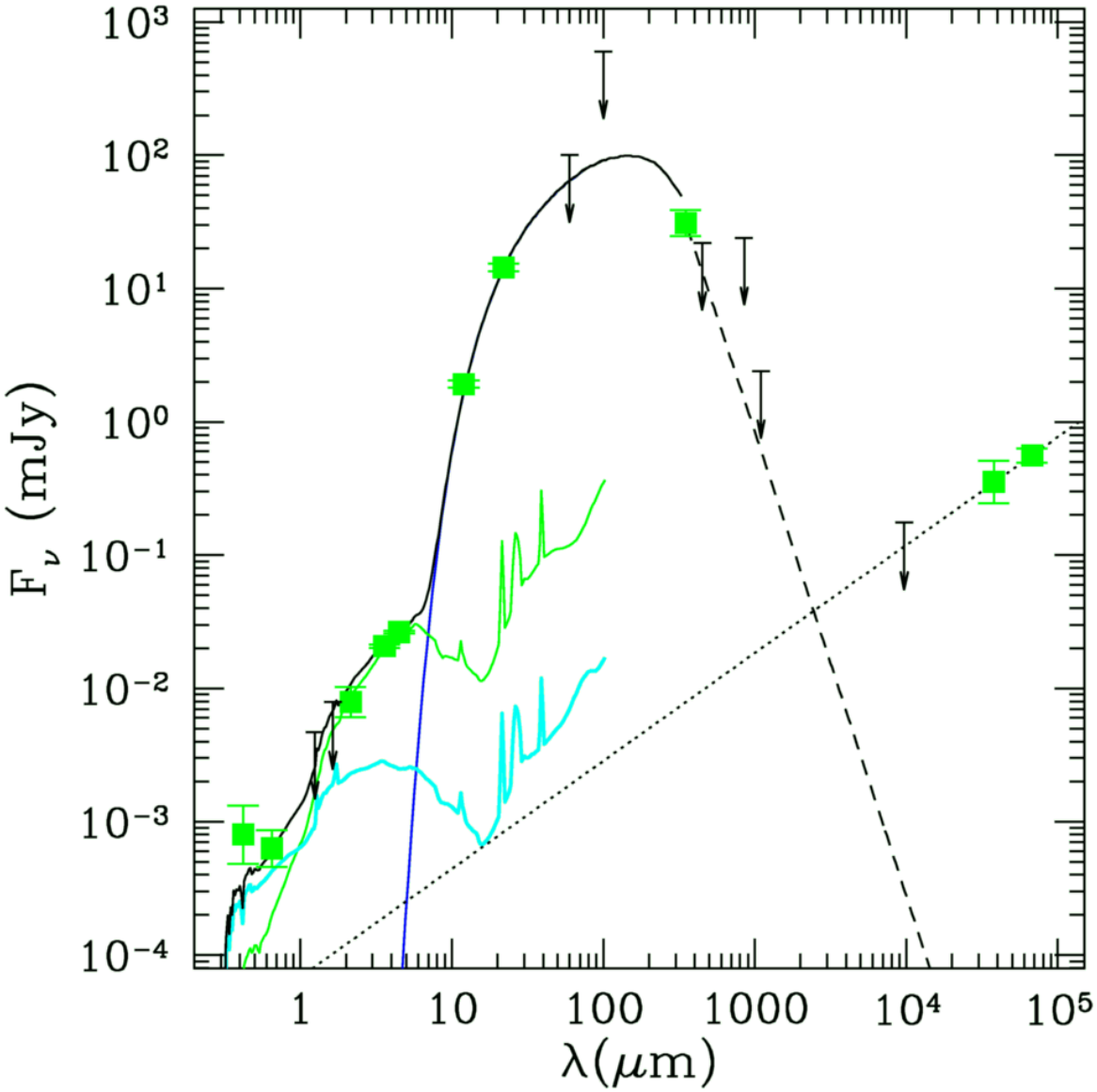
- W1 > 17.4 and W2 > 15.9 and (W3 < 10.6 or W4 < 7.7)
- W1814+34 (Eisenhardt et al 2011, Bridge et al 2011)
- z=2.452
- Extended Lyman alpha emission (~40 kpc)





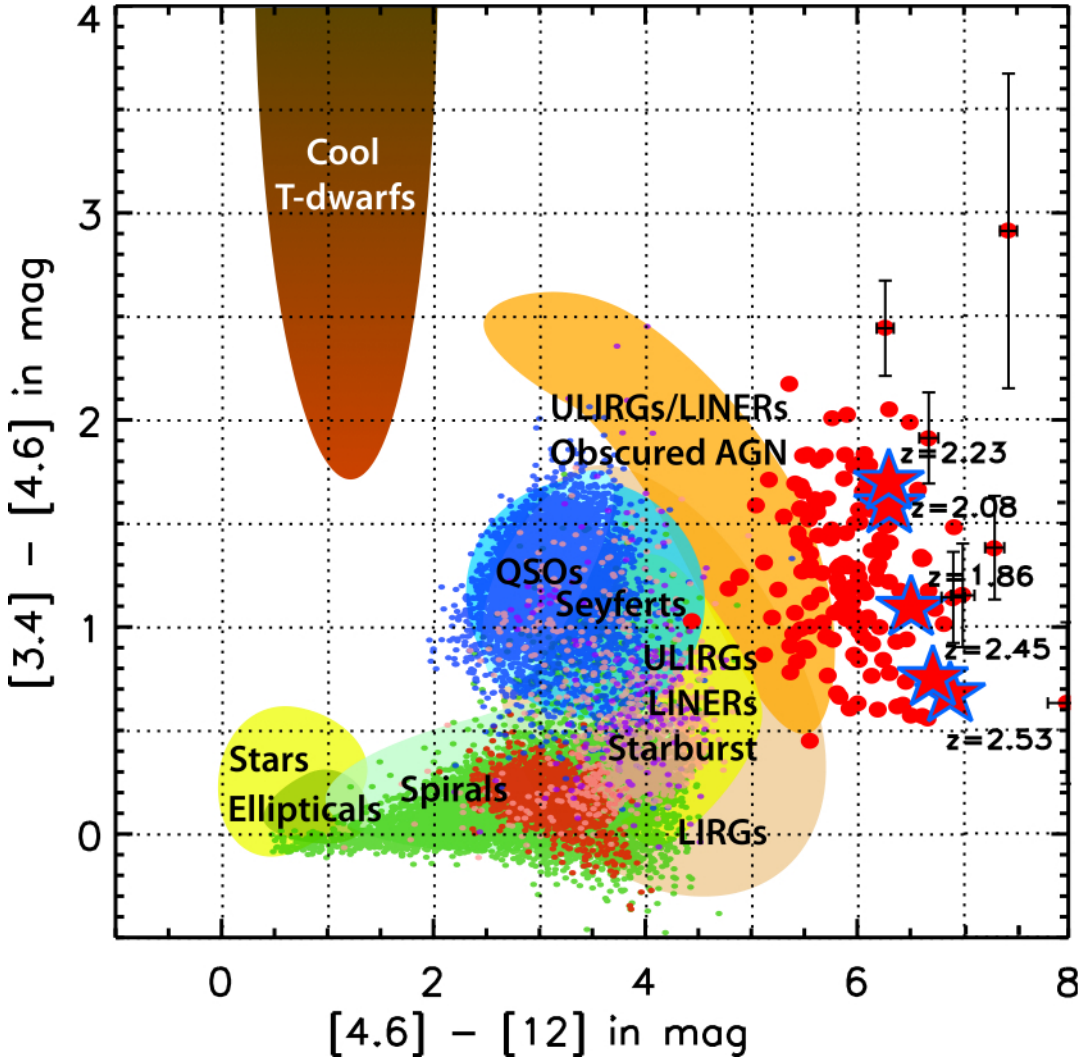
SED of W1814+34

- AGN with $A_V = 50$
- Starburst
- Spiral Galaxy
- Warm Spitzer data to get 3.6 & 4.5 μm since WISE did not detect it at 3.4 & 4.6 μm.
- SHARC II (CSO) at 350 μm
- VLA radio data
- Peak $\nu L_\nu = 10^{13.38}\ L_\odot$

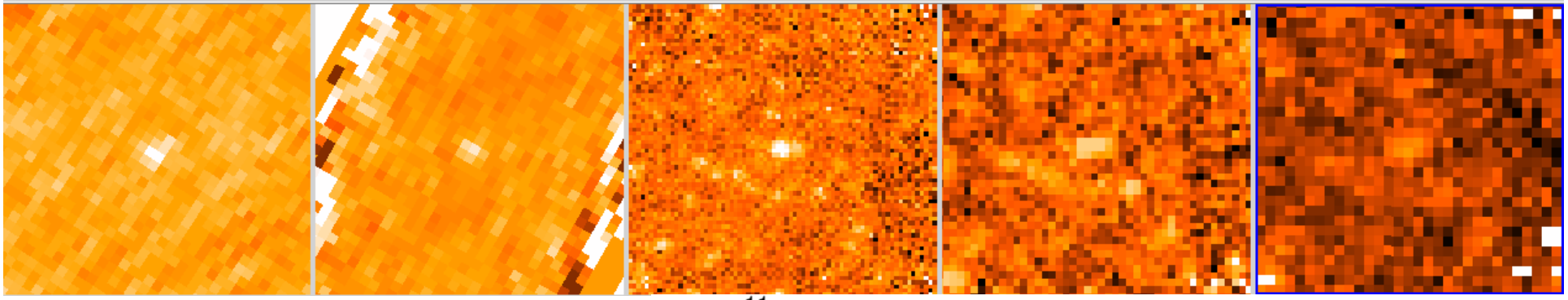


Warm Spitzer Followup

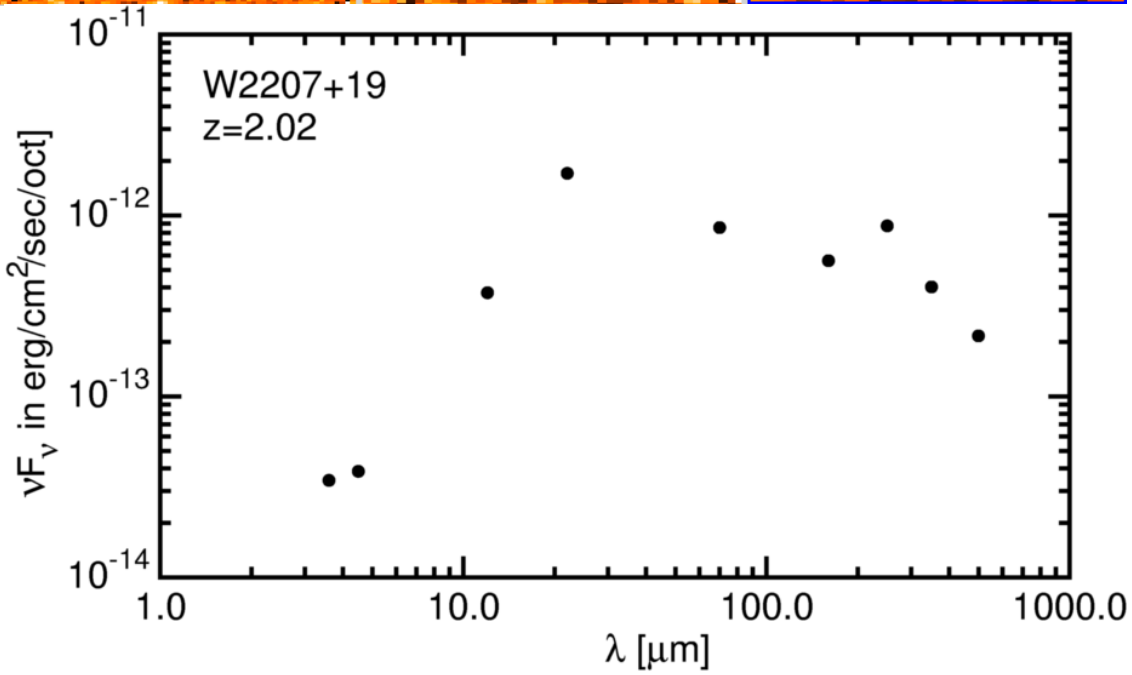
- Objects not detected by WISE at 3.4 & 4.6 μm can be measured using warm Spitzer
  - bigger mirror
  - longer integration times
- Synergy between surveys and great observatories



Herschel Followup Program

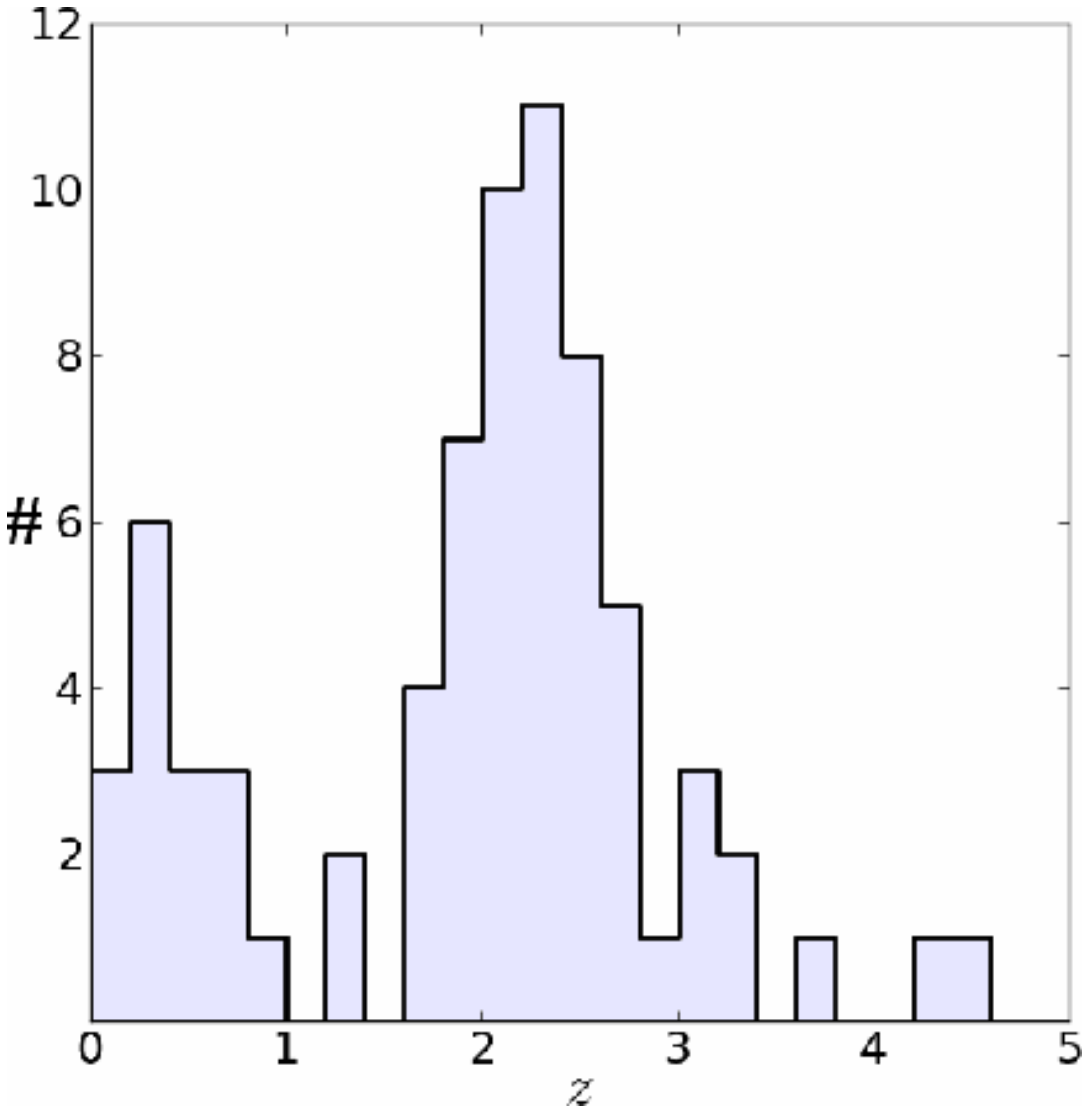


- Example: W2207+19
- Warm Spitzer at 3.6 & 4.5 μm
- WISE at 12 & 22 μm
- Herschel at 70, 160, 250, 350 & 500 μm
- Peak νF_ν at 22 μm
- Peak $\nu L_\nu = 10^{13.13}\ L_\odot$



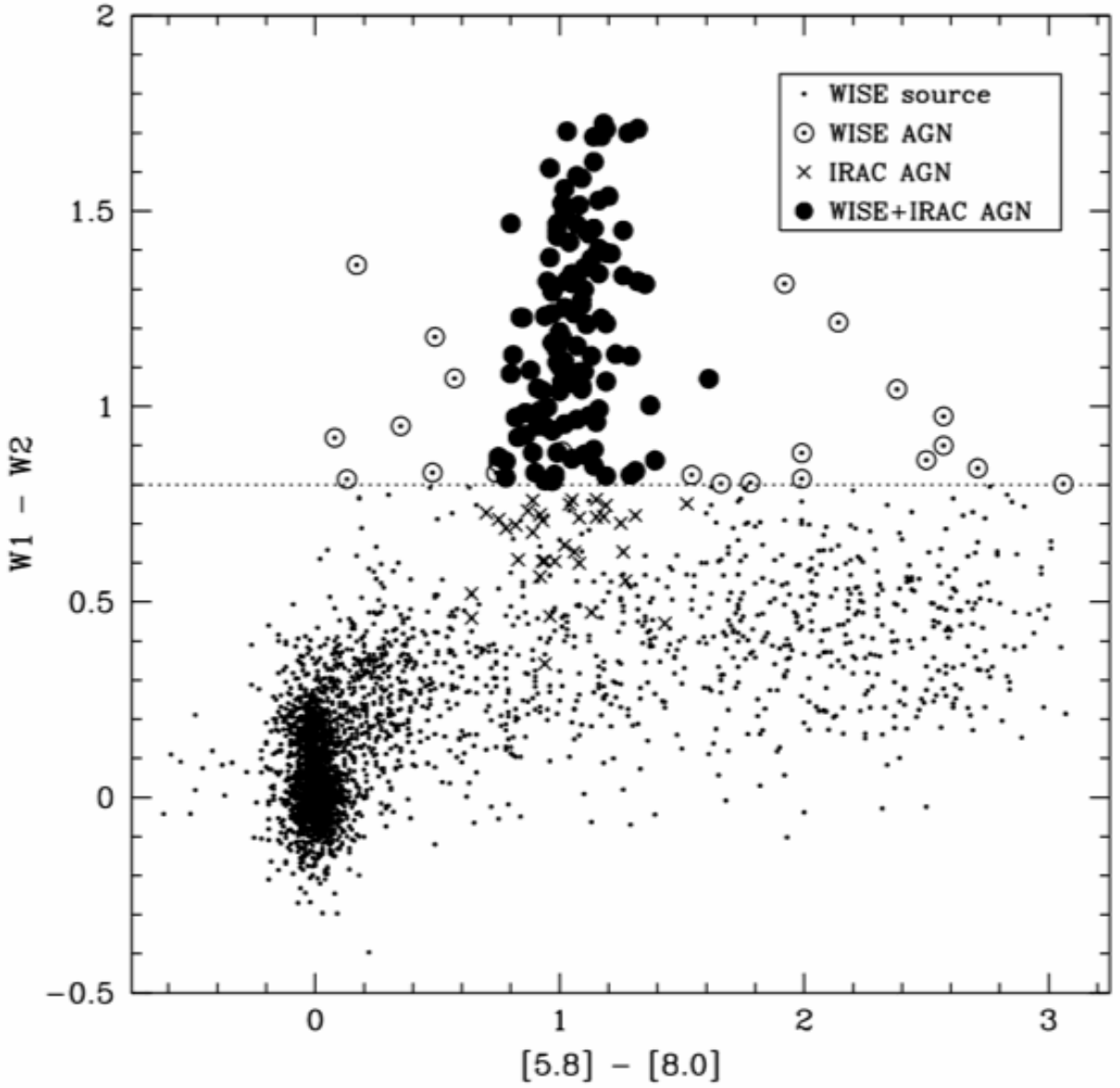
Many W12 drops

- About 1000/sky
- High percentage with high z's: see histogram
- Spitzer followup usually picks up 3.6 and 4.5 μm flux
- Herschel followup usually detects far-IR flux

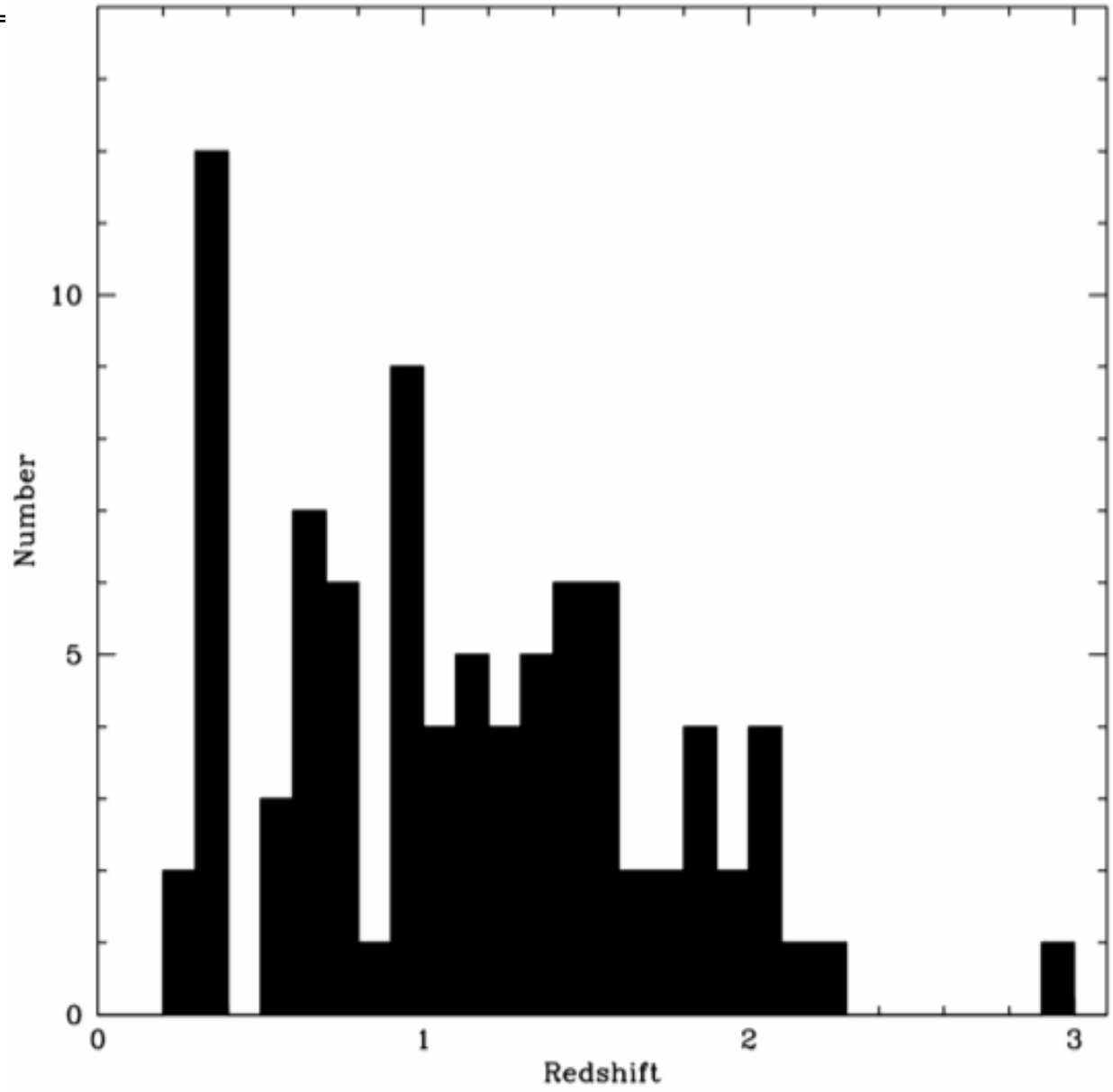


AGN Selection

- Stern et al poster 333.15 at the Jan 2011 AAS meeting
- Density 70/sq.deg
- 60% have published z's in COSMOS field

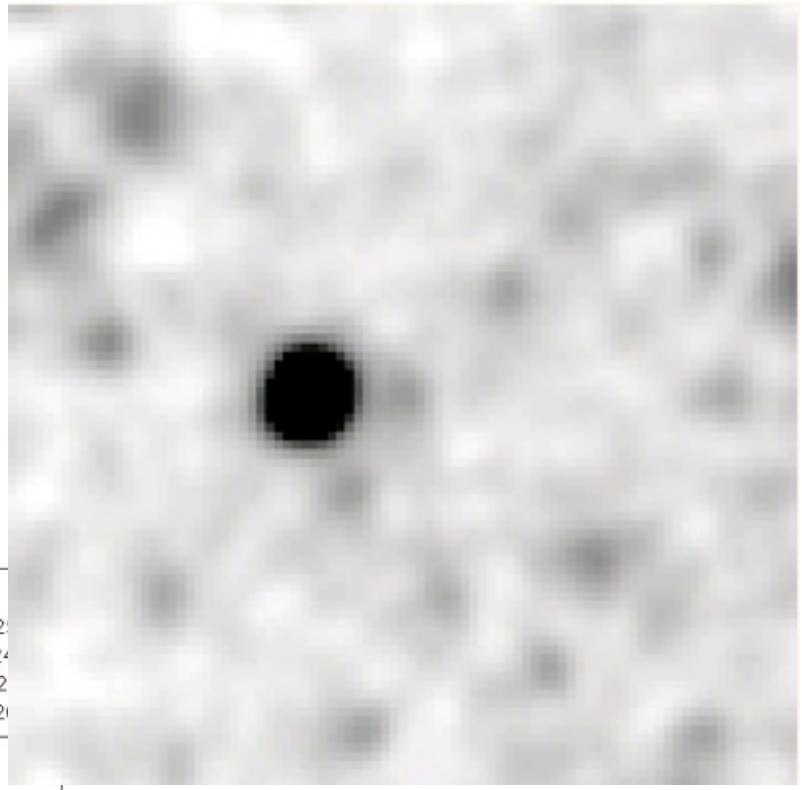


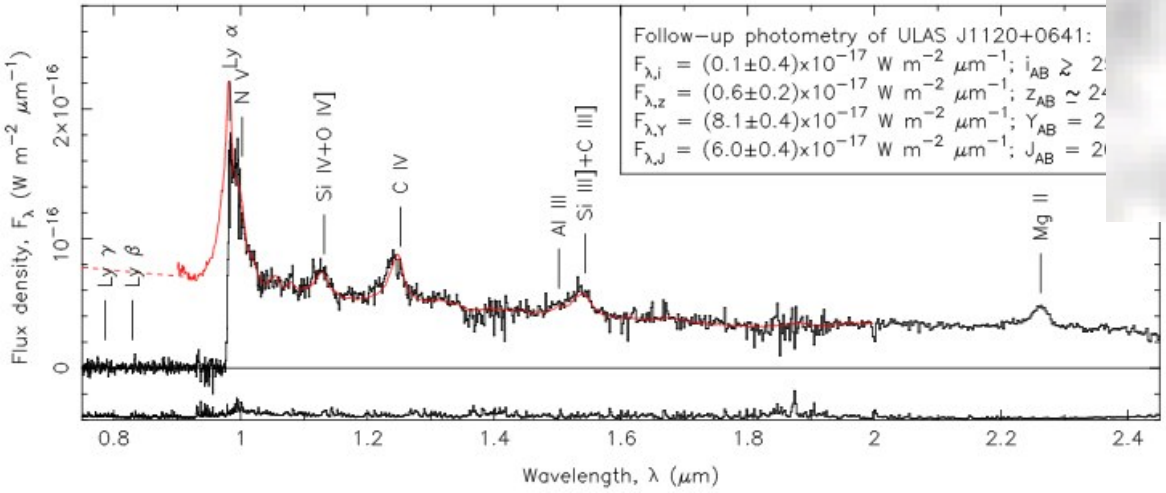
Z-distribution



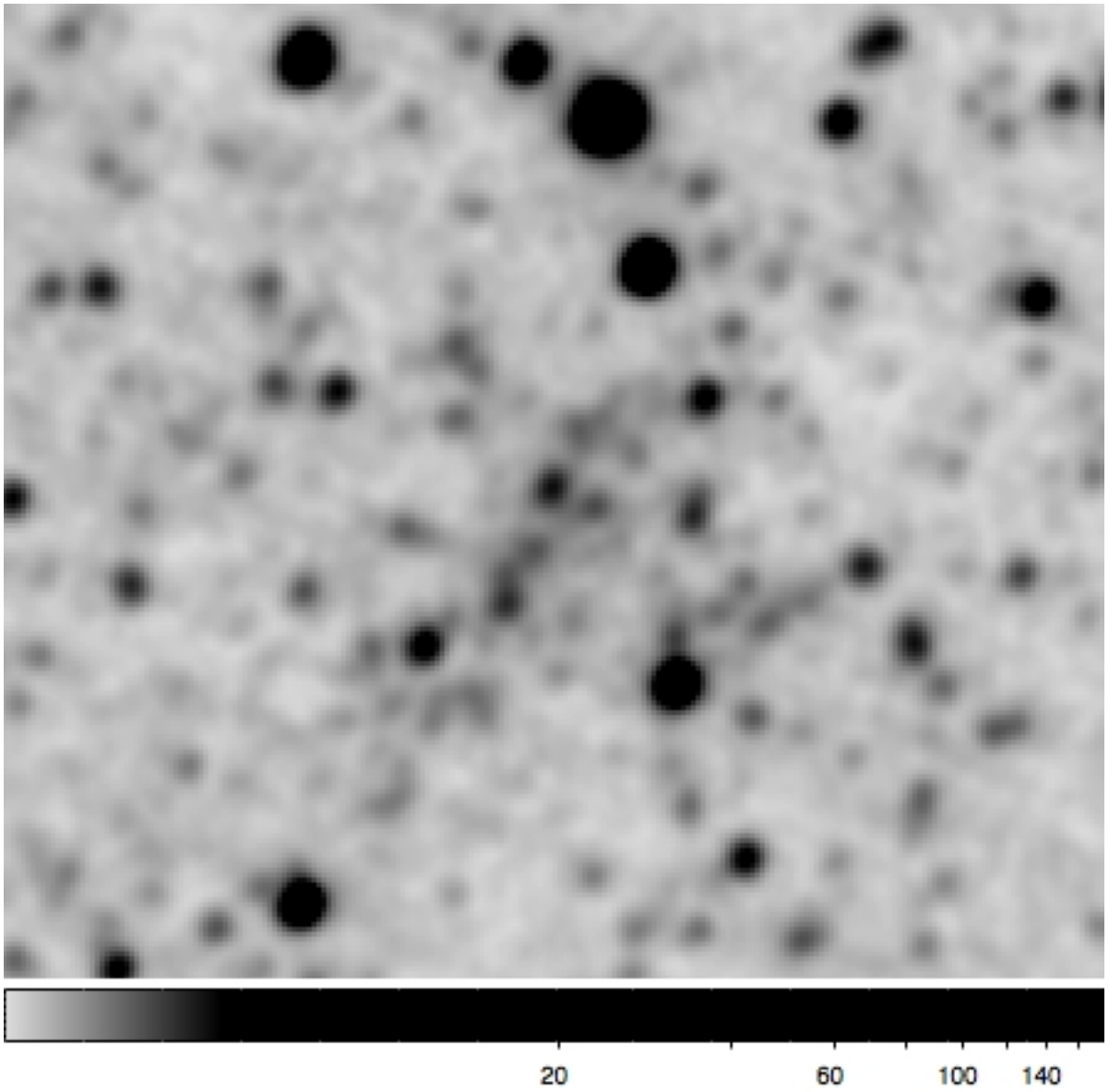
ULAS 1120+0641

- W1-W2 ≈ 1.17±0.31
- ≈43±8 μJy at 3.4 μm
- z = 7.085
- Mortlock etal, 1106.6088

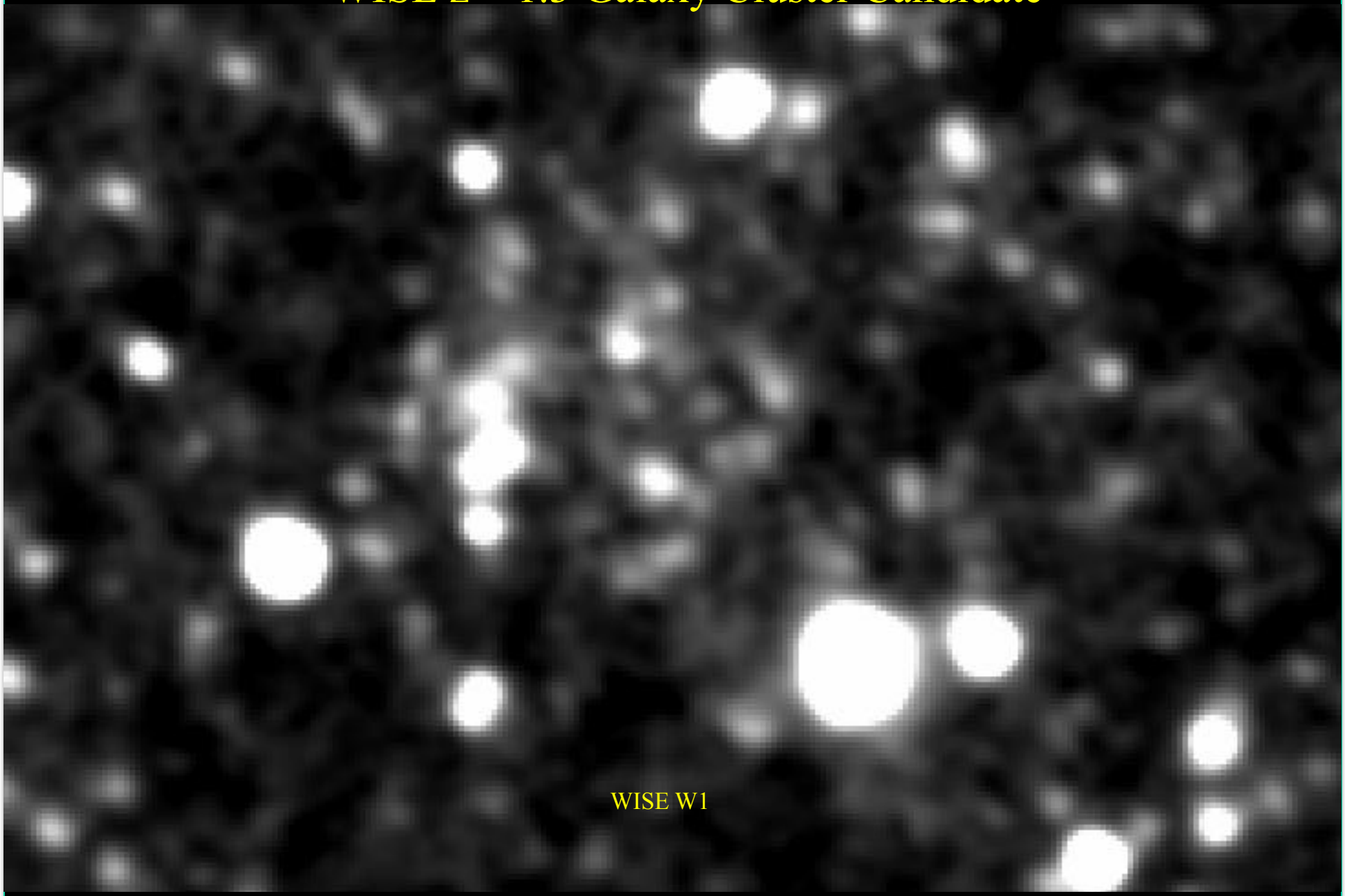




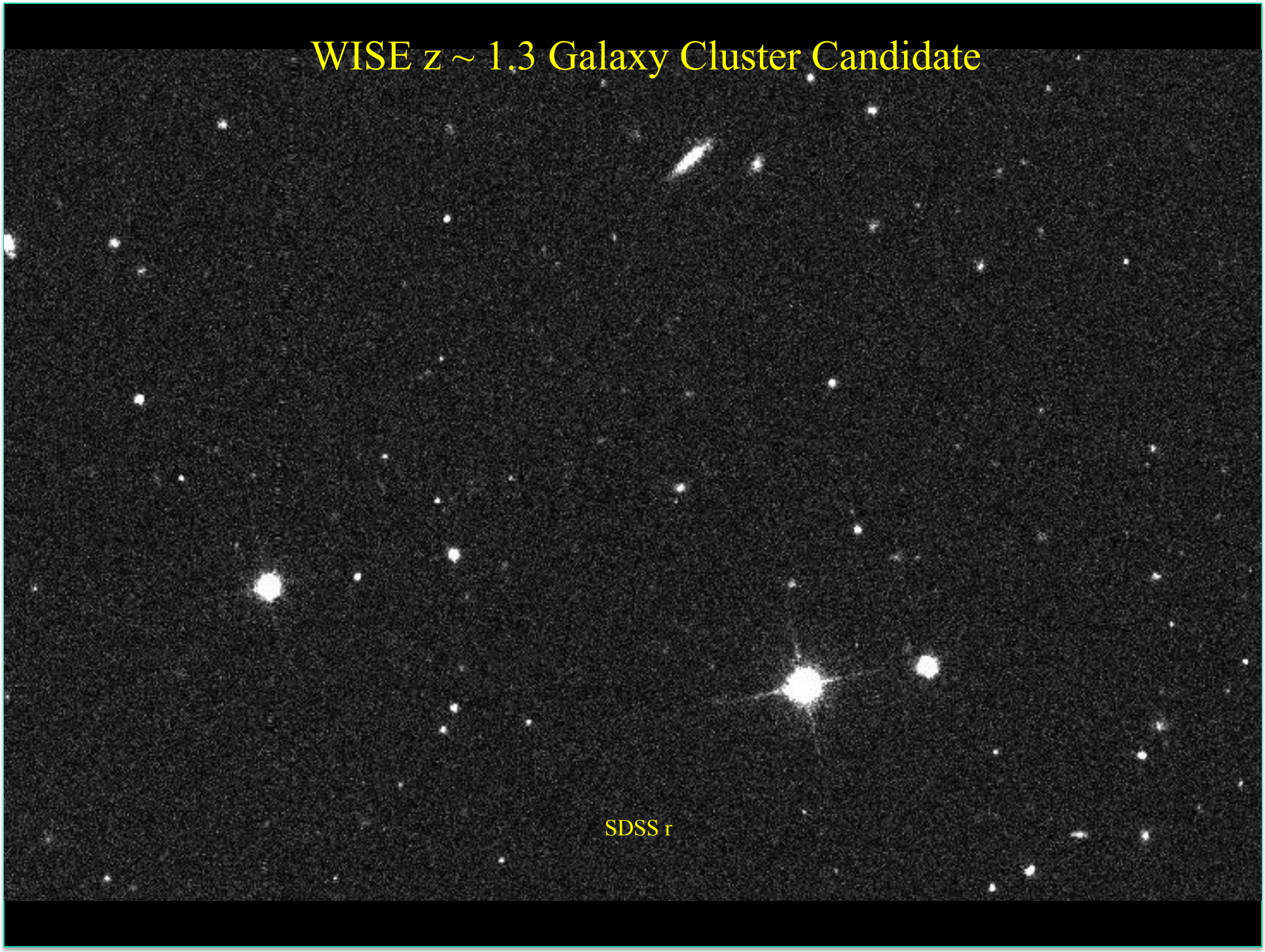
W1 image of SPT z=1.13 cluster

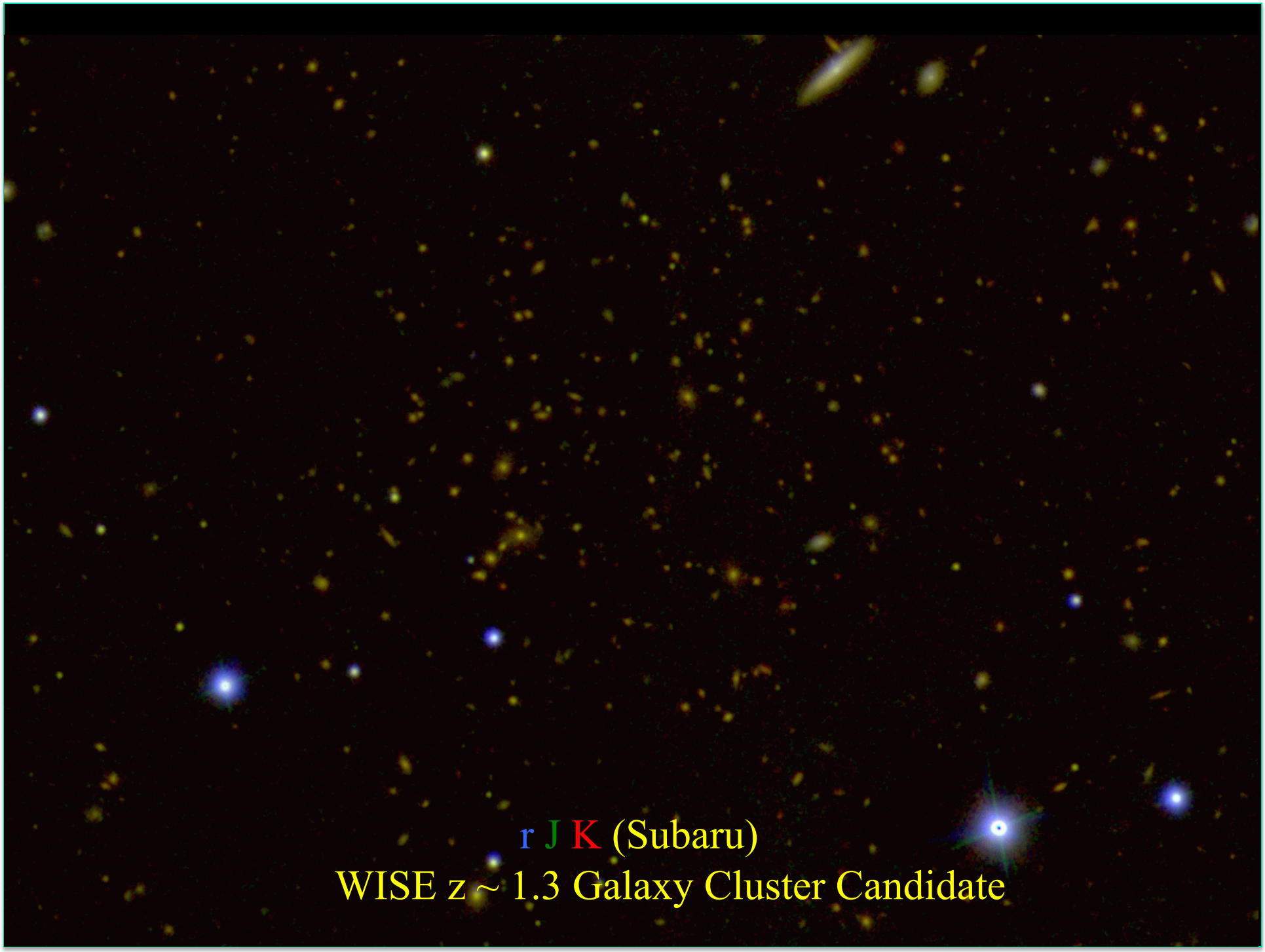


WISE z ~ 1.3 Galaxy Cluster Candidate

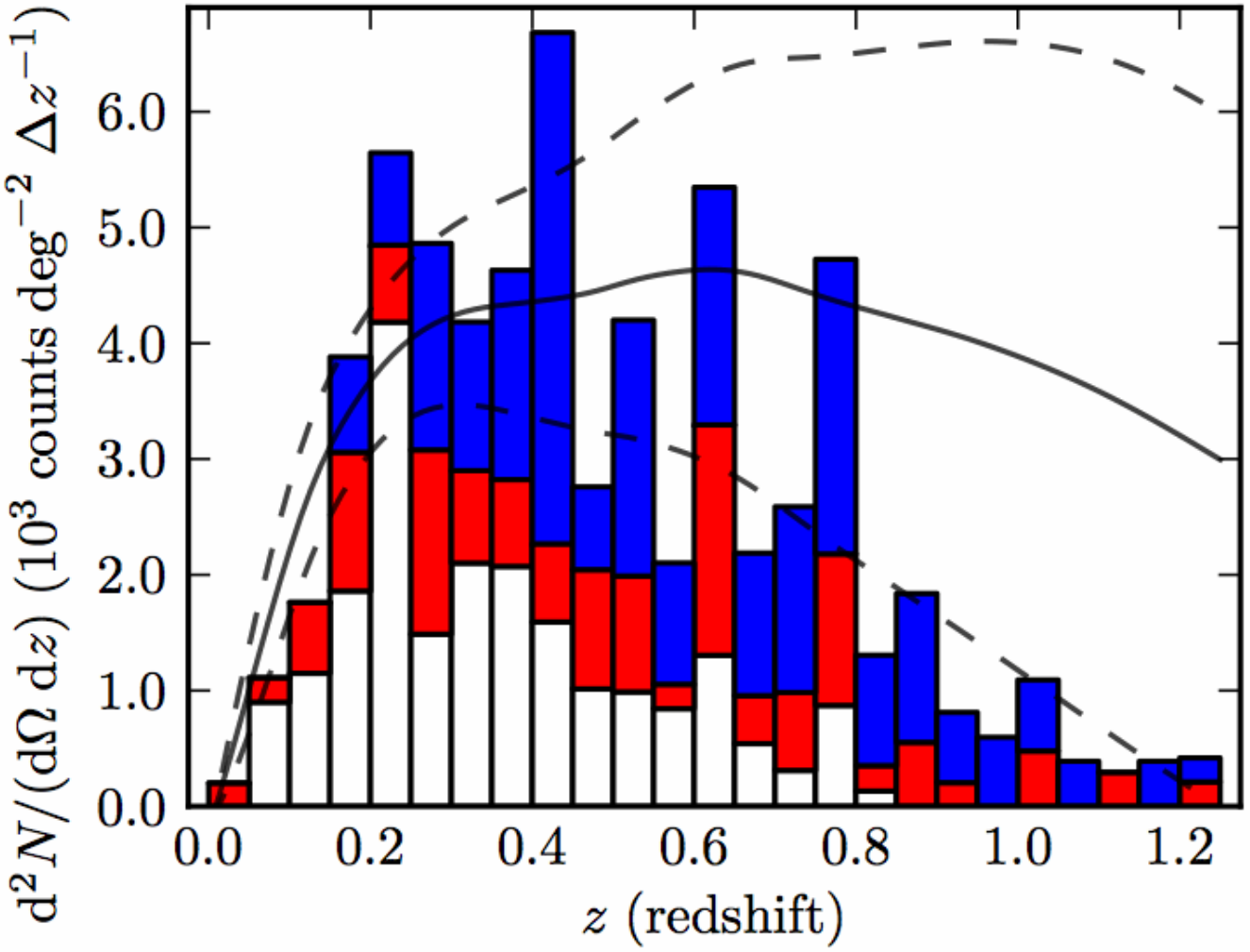


WISE z ~ 1.3 Galaxy Cluster Candidate

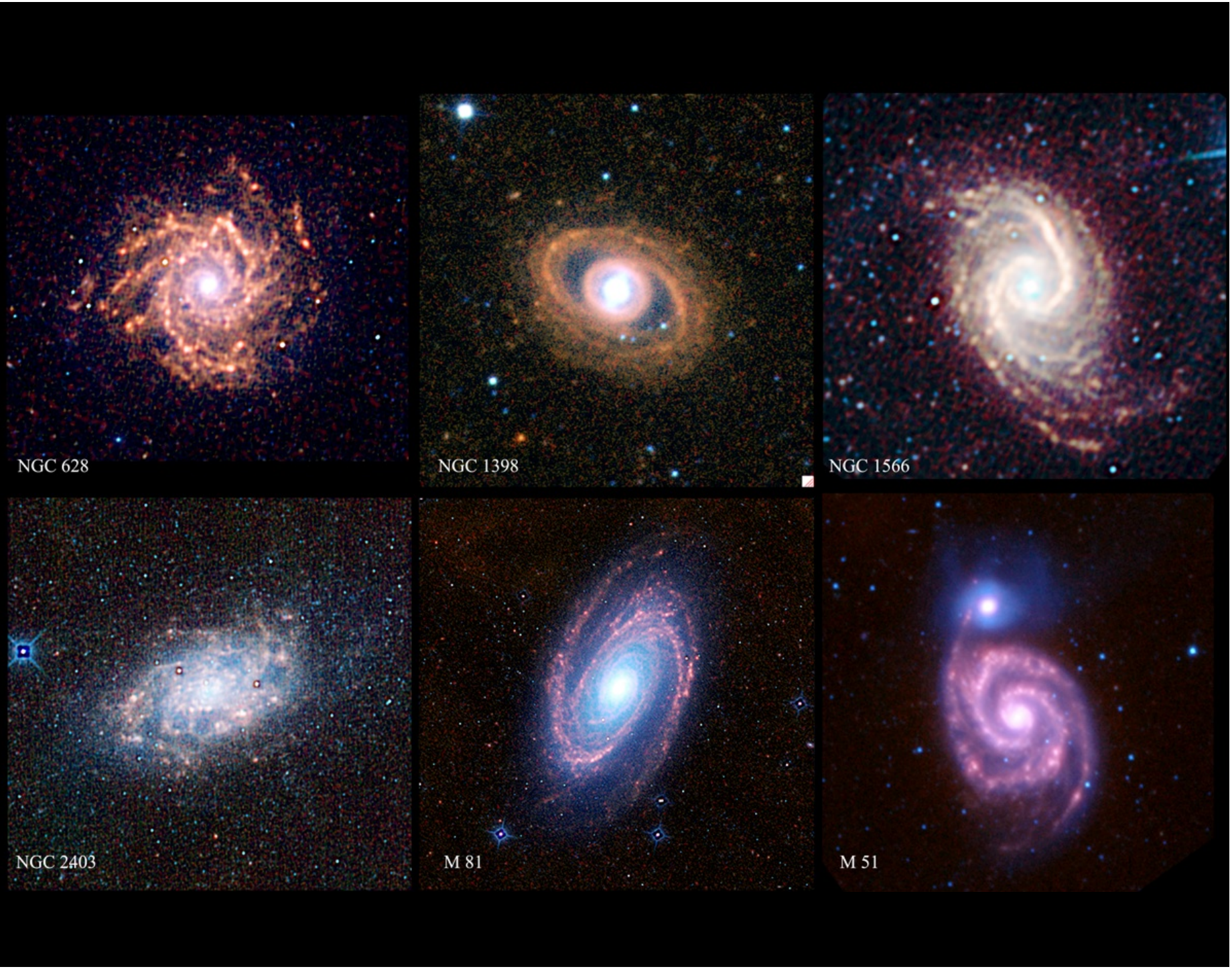


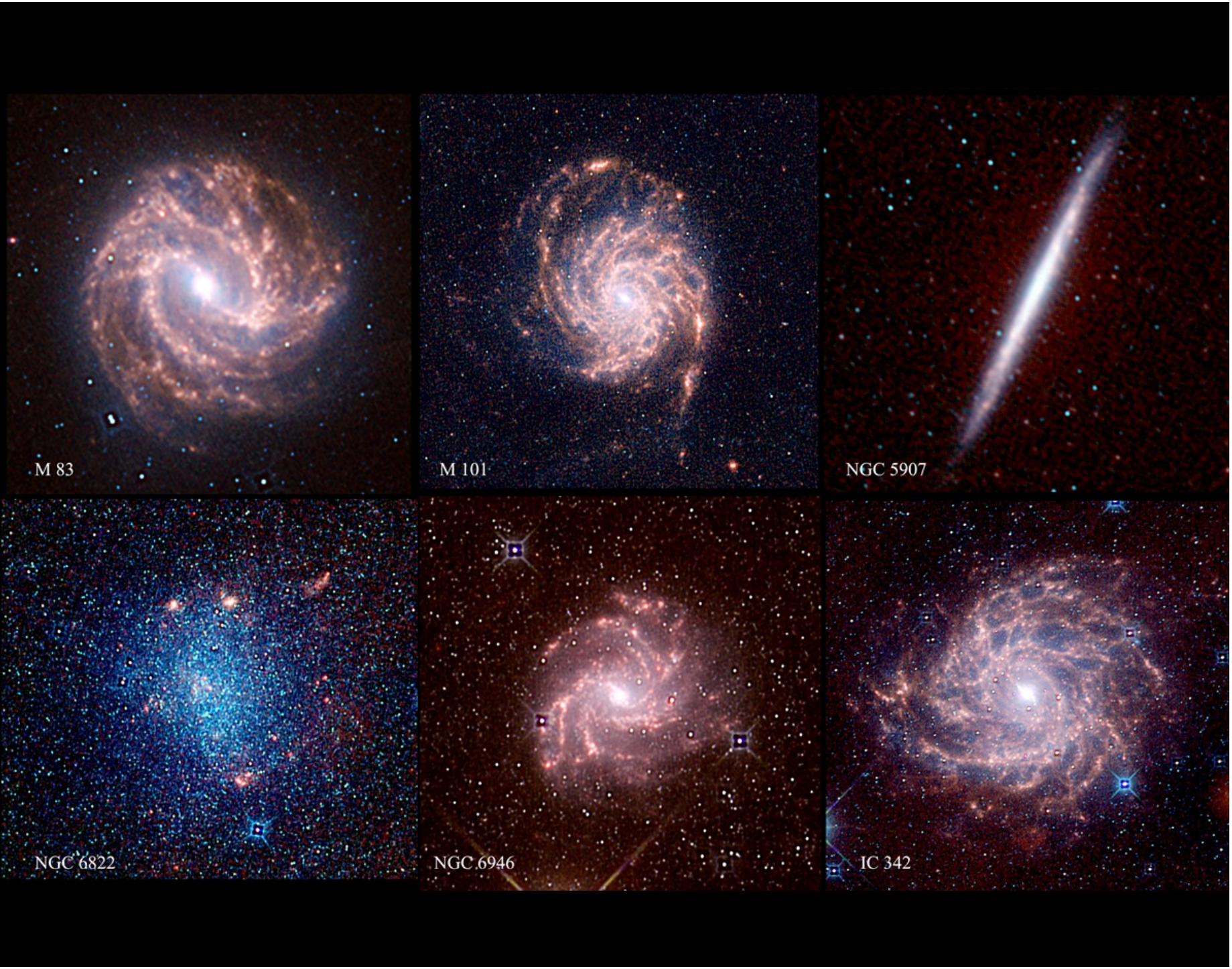

r J K (Subaru)
WISE z ~ 1.3 Galaxy Cluster Candidate

Median WISE source z ~ 0.5



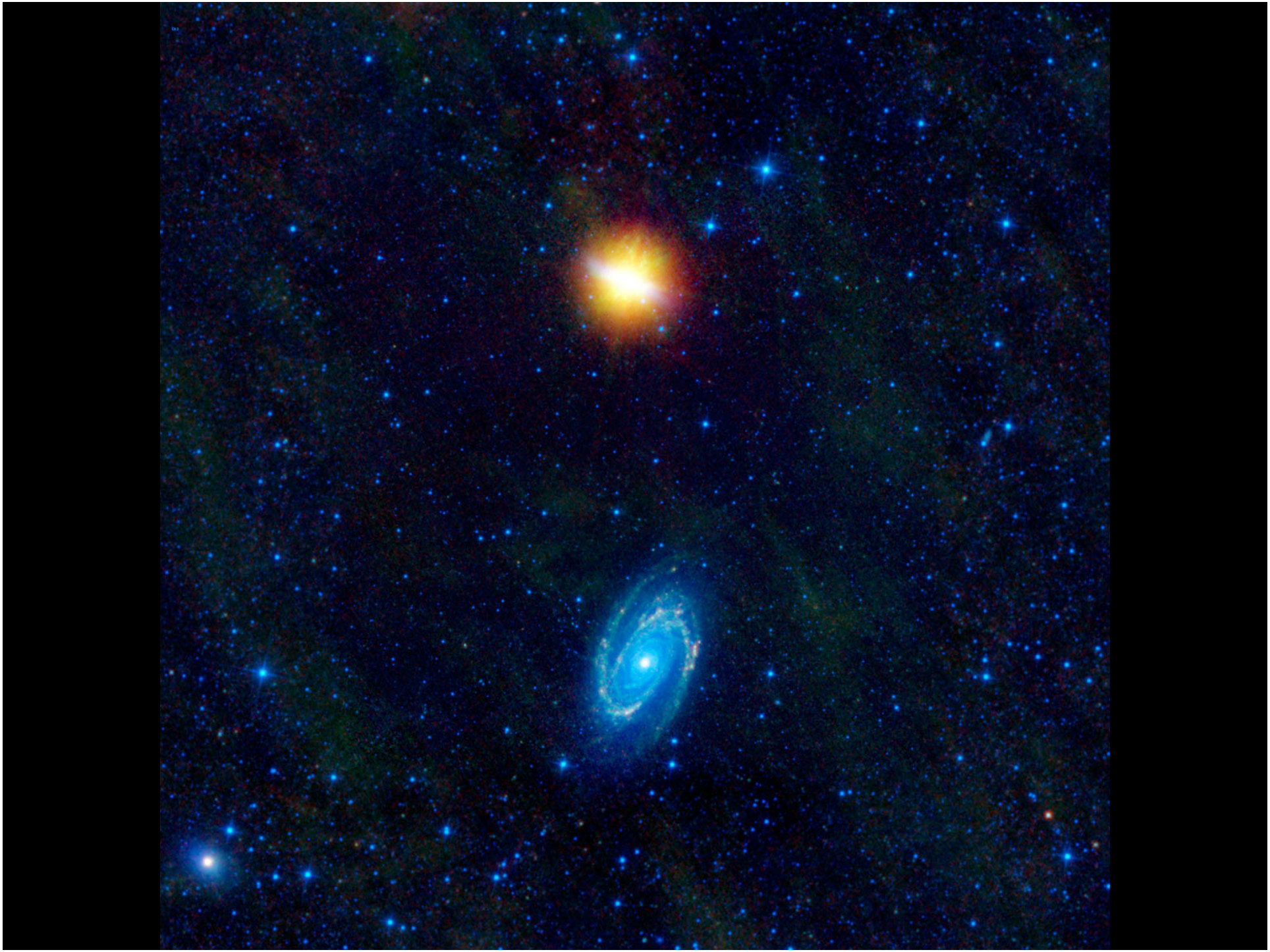
- White bars are W1 > 120 μJy, Red 80 < W1 < 120, Blue < 80. Curves are for W1 > 80 μJy


NGC 628
NGC 1398
NGC 1566
NGC 2403
M 81
M 51

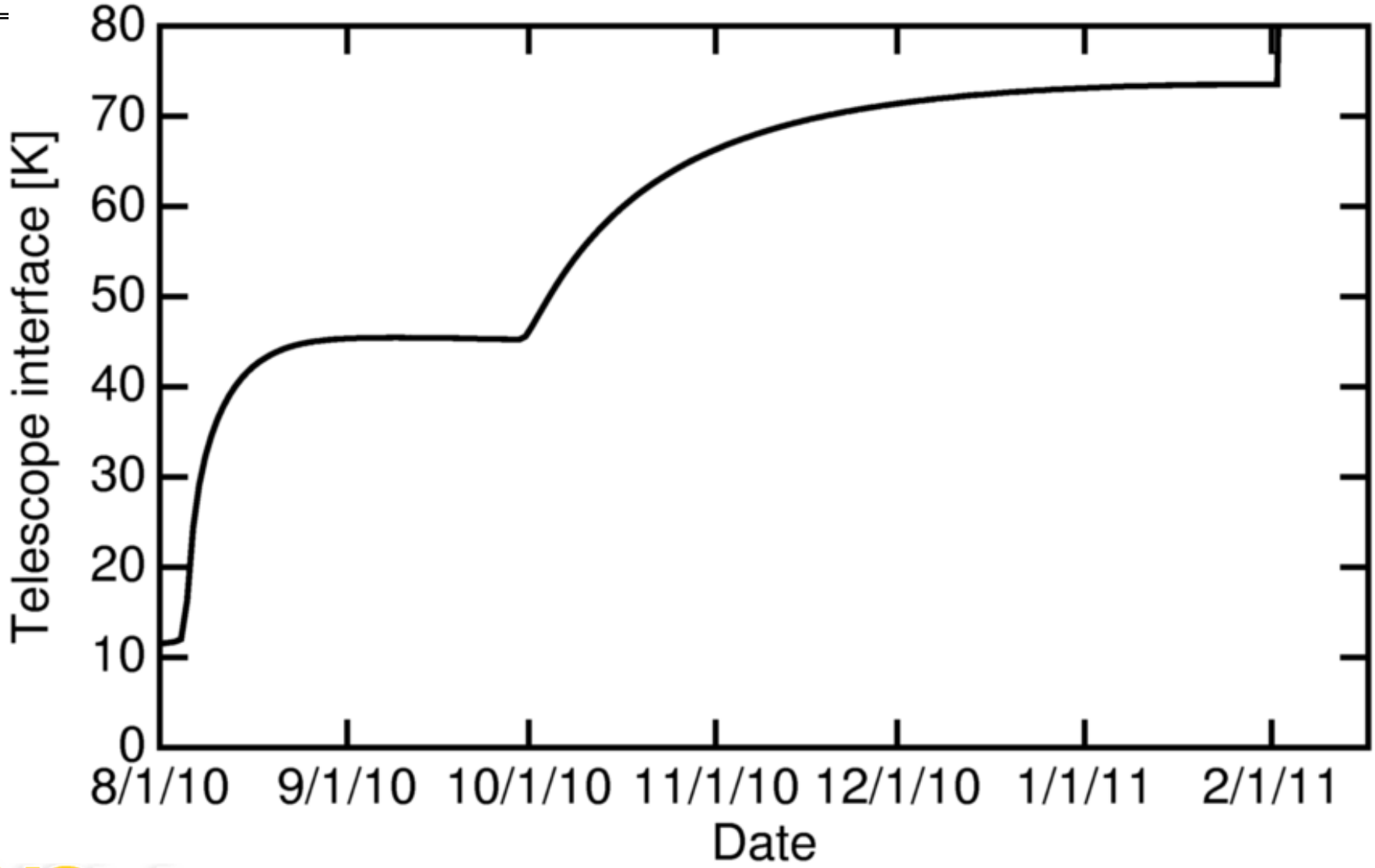

M 83
M 101
NGC 5907
NGC 6822
NGC 6946
IC 342

Early Release Observations

- Released Wednesday 16 Feb 2010

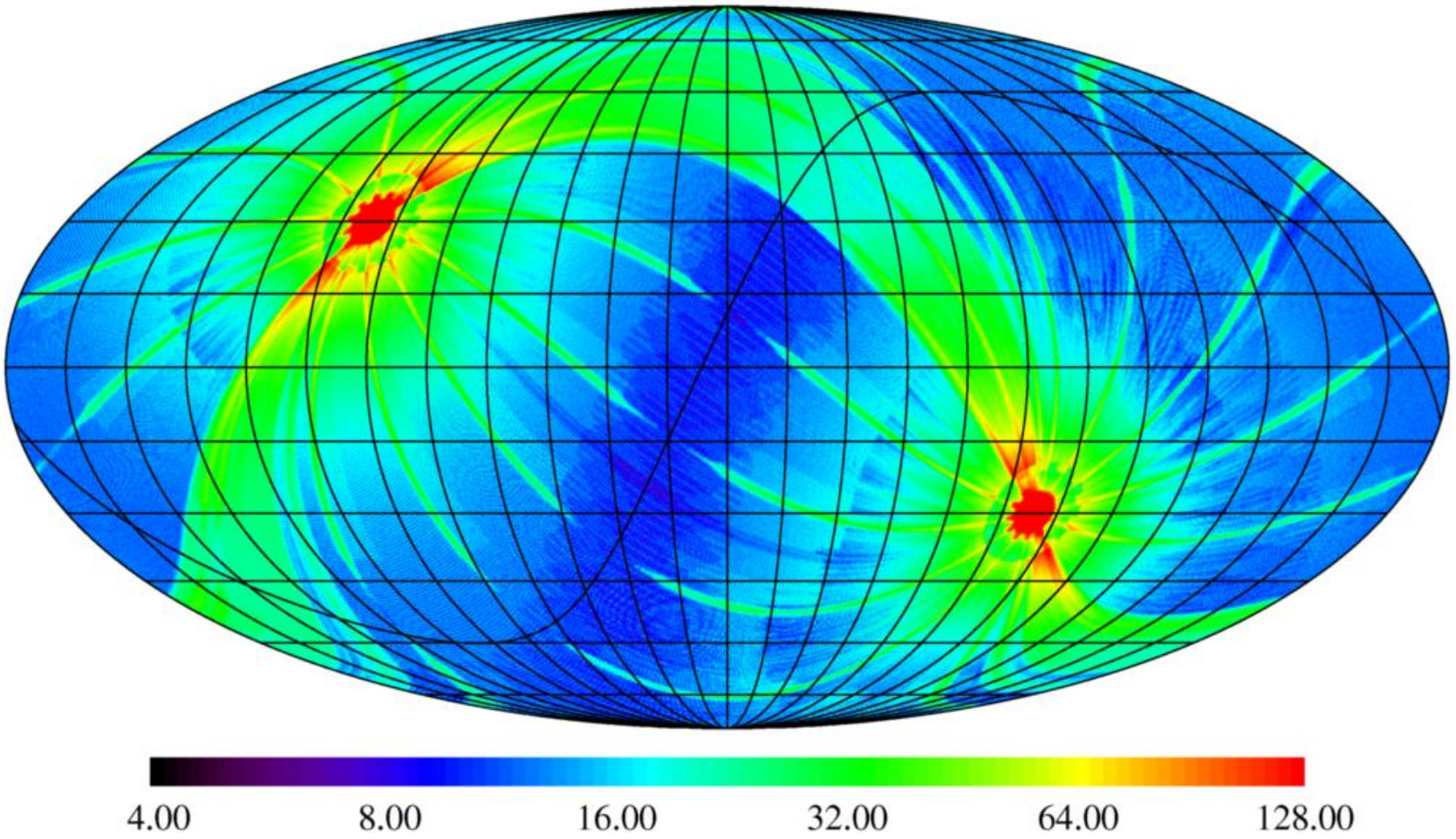


Telescope Temperatures



4 Band Coverage to 5 Aug 2010

Actual Coverage Achieved for W4



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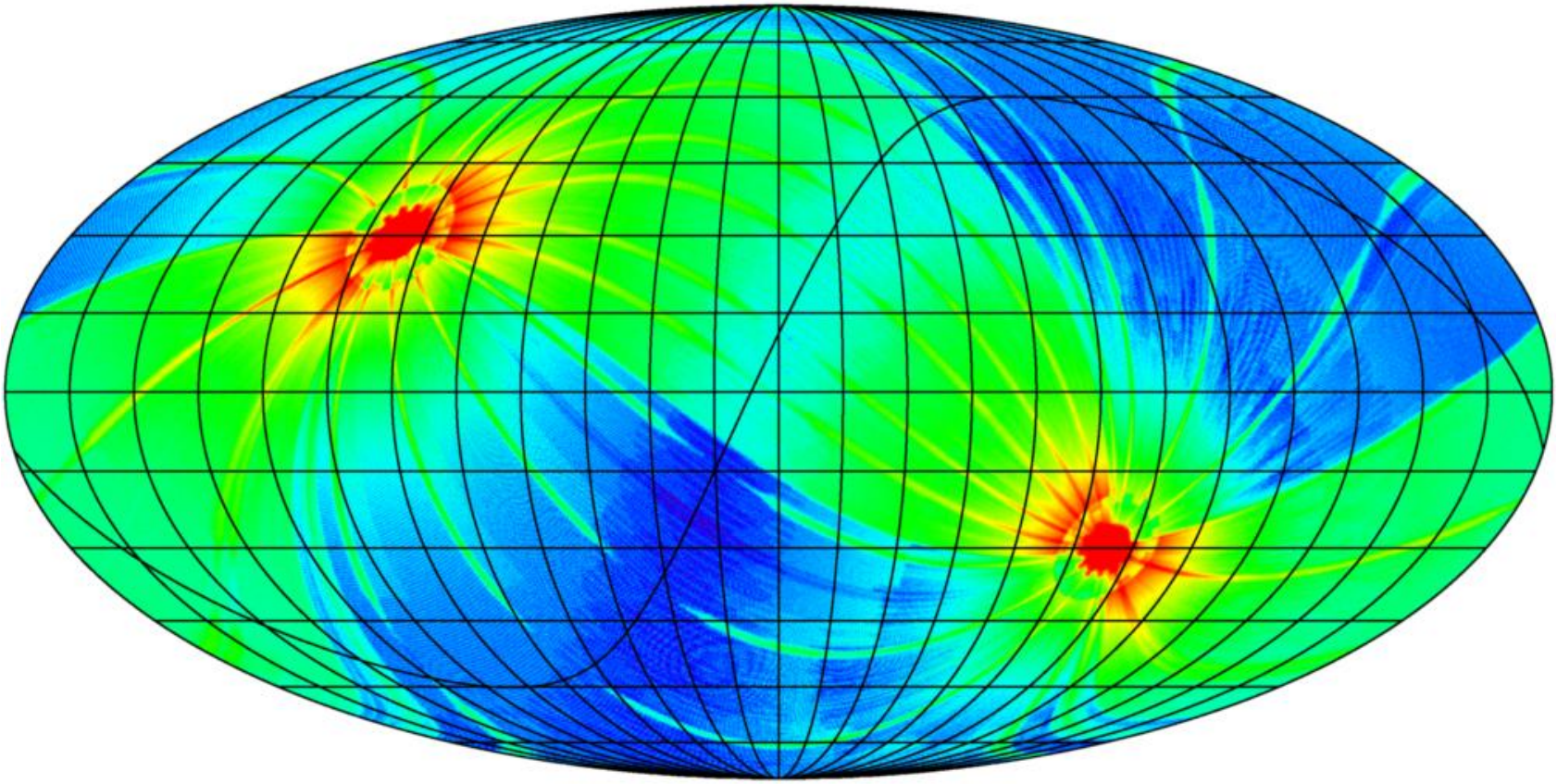
Wide-field Infrared Survey Explorer (WISE)

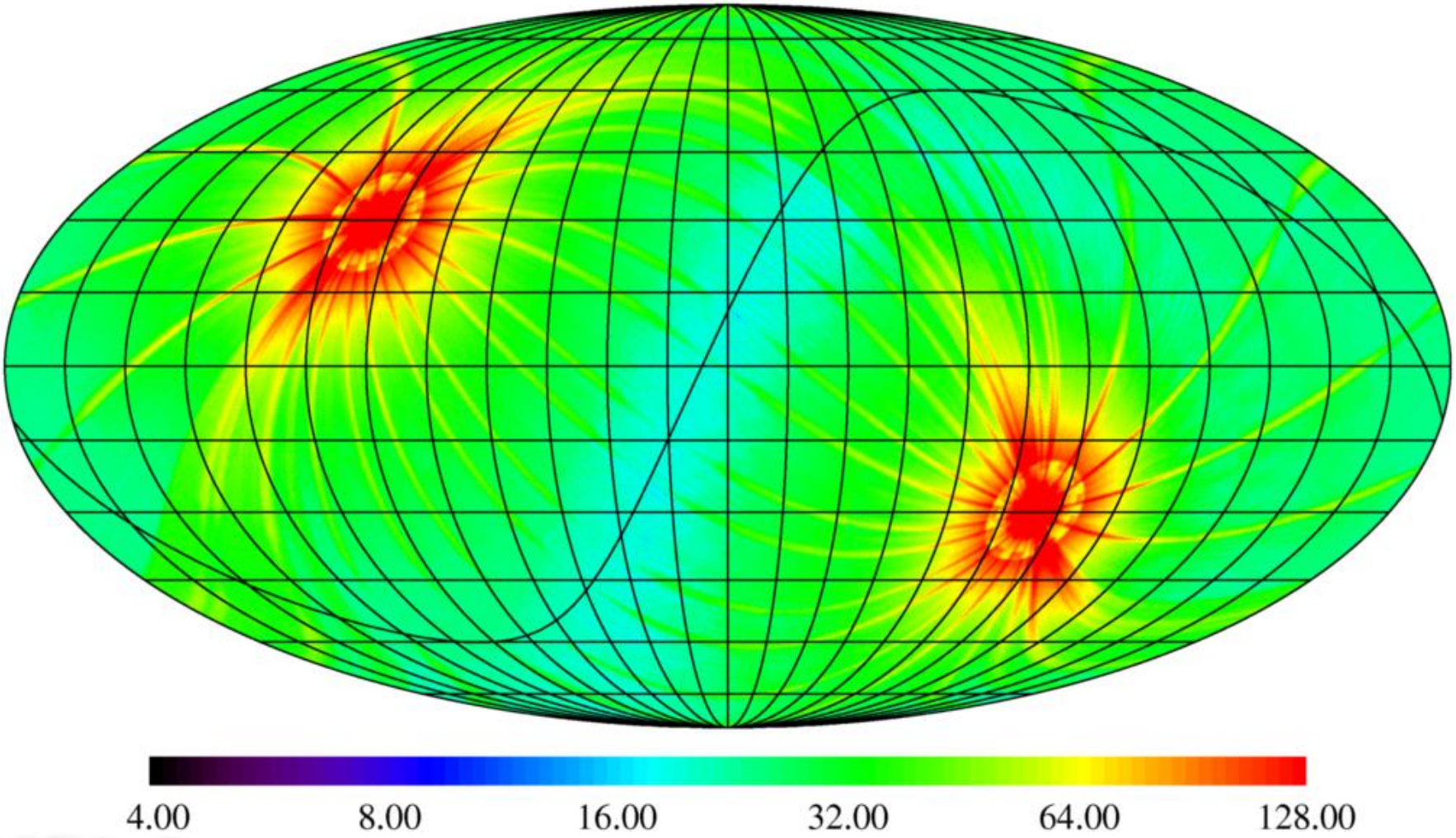
End of Cryo Coverage

1884474 frames thru 10-273.0; 68.0% to 16x+



Final 2 band coverage

2784184 frames thru end of mission



Ten trillion pixels observed!

WISE Summary

- Launched 14 Dec 2009
- Band centers 3.4, 4.6, 12 & 22 microns
- Sensitivity should be better than 0.08, 0.11, 1 & 6 mJy
- Saturation at 0.3, 0.5, 0.7 & 10 Jy point sources
- Angular Resolution 6, 6, 6 & 12 arc-seconds
- Position accuracy about 0.15 arc-seconds 1σ 1-axis for high SNR
- Completed all-sky survey 17 July, big tank ran out hydrogen 5 Aug, little tank empty on 29 Sep, two-band survey for asteroids continued until 1 Feb 2011.
- Data release plans:
  - Preliminary release of 57% of the sky on 14 April 2011
  - Final release Spring 2012
- Data products include image atlas and source catalog

http://wise.astro.ucla.edu