

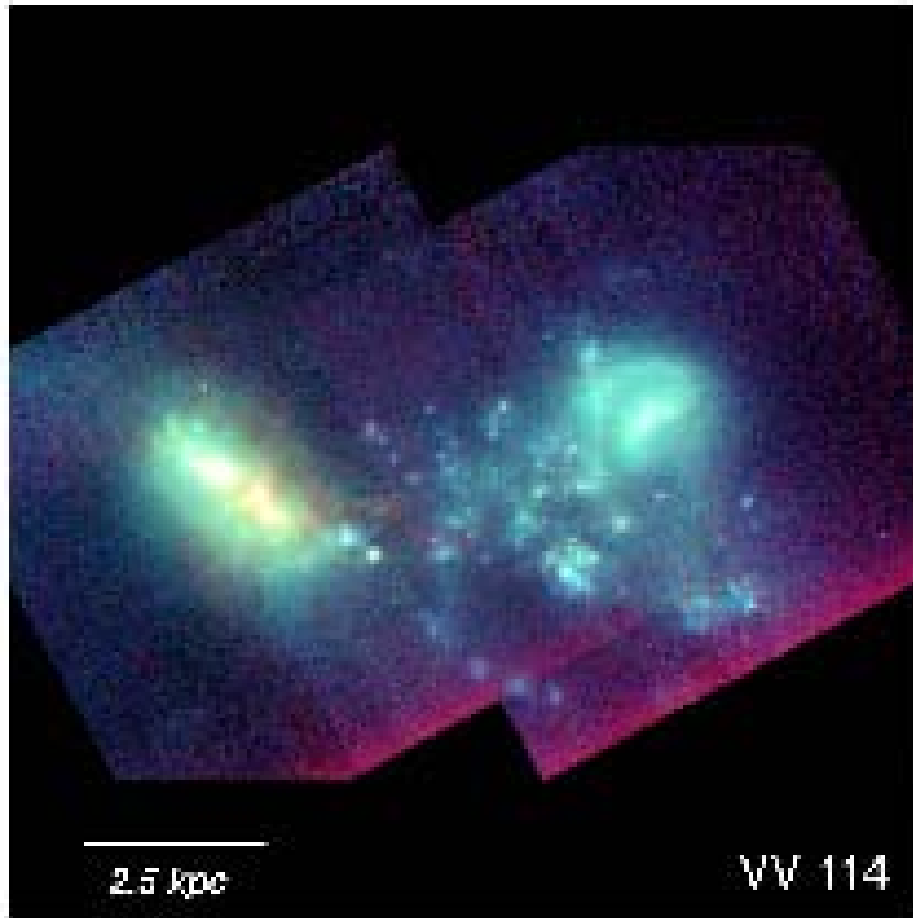
HST NICMOS Observations of Infrared Luminous Galaxies

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Acknowledgements: NICMOS GTO Team

Caltech Infrared Army

Motivation



- ID of Imbedded Sources
- Distribution/Location of Near-Infrared light
- Near-Infrared Profiles

Sample

(Scoville et al. 2000)

- Nine Luminous Infrared Galaxies (LIGs: $L_{\text{IR}} = 10^{11.00-11.99} L_{\text{Sun}}$)
- 15 Ultraluminous Infrared Galaxies (ULIGs: $L_{\text{IR}} > 10^{12} L_{\text{Sun}}$)
- 21/24 Have Redshifts in the Range 0.01-0.1
- 7 HIIs , 8 LINERs , and 7 Seyferts
- 8 Warm ($f_{25}/f_{60} > 0.2$), 16 Cool ($f_{25}/f_{60} < 0.2$)

NICMOS

- Near-Infrared Camera and Multi-Object Spectrometer
- Wavelength Range = 0.8 – 2.5 μm
- Three 256x256 pixel HgCdTe Arrays

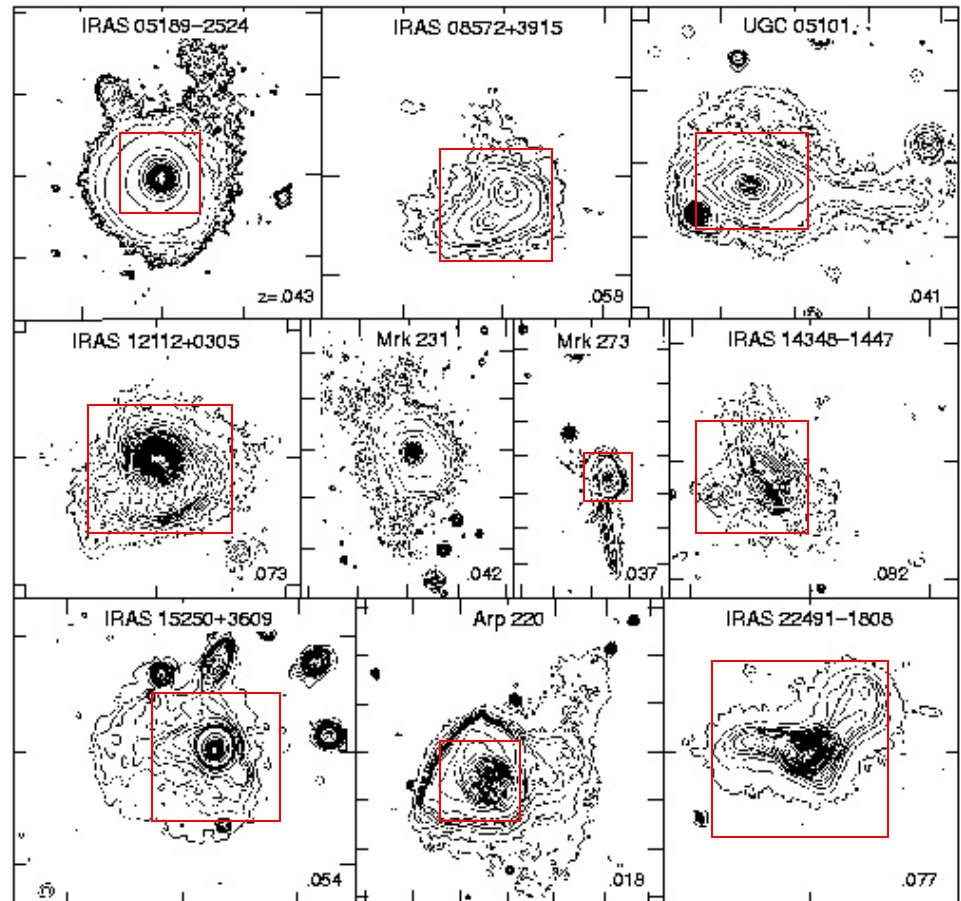
NIC1 – 0.04"/pixel, fov=11"x11"

NIC2 – 0.075"/pixel, fov=19"x19"

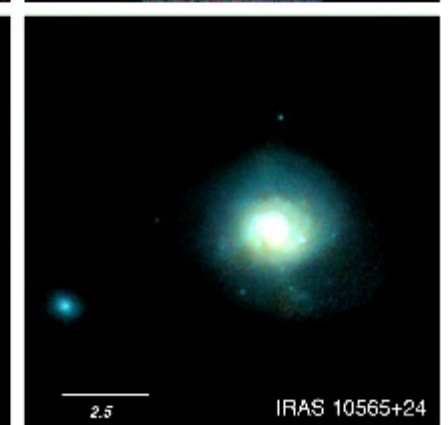
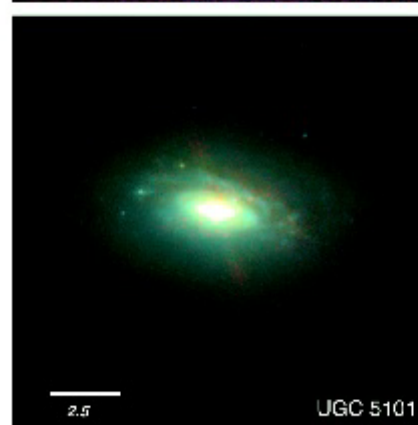
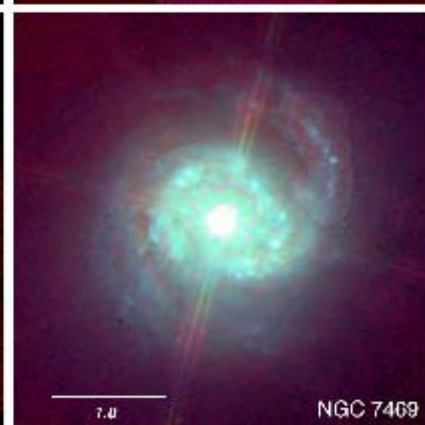
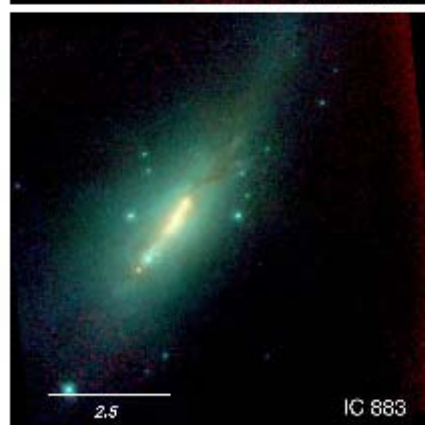
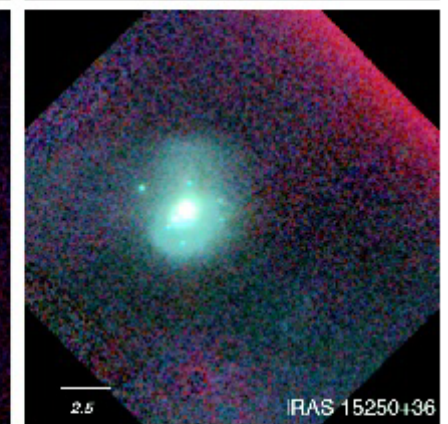
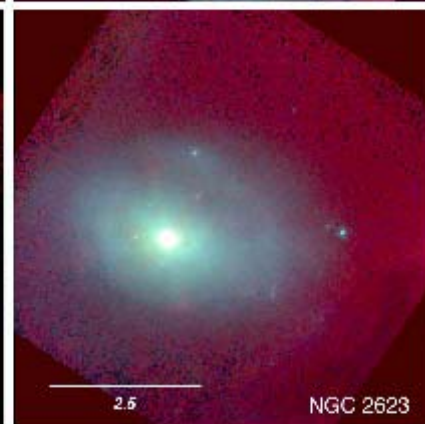
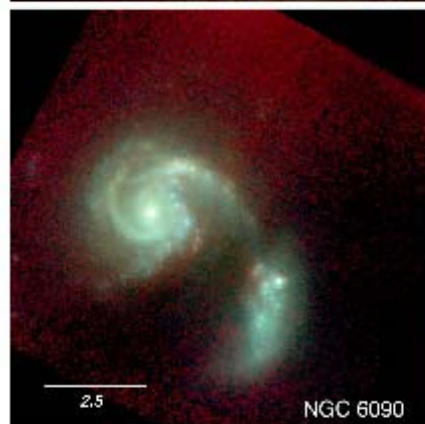
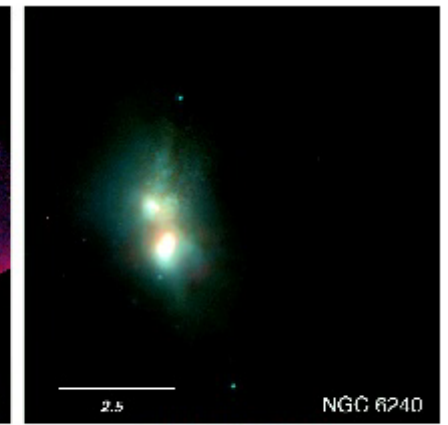
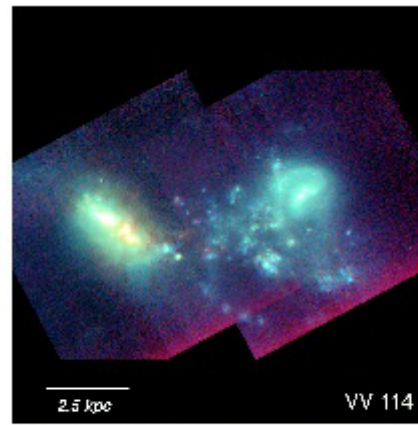
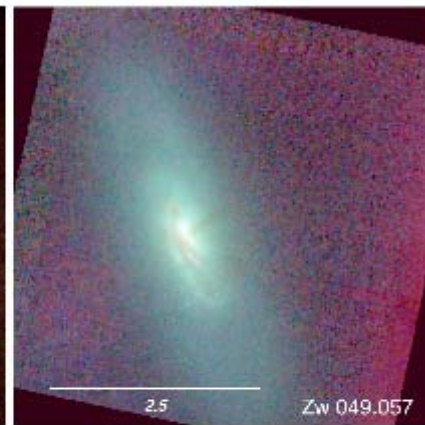
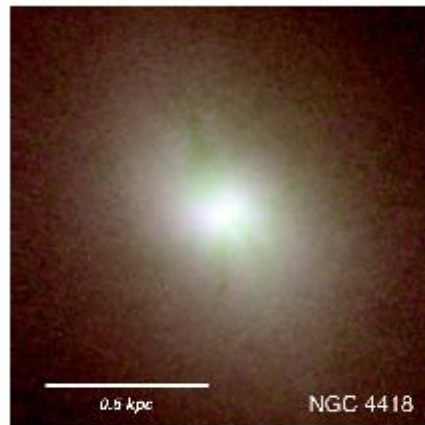
NIC3 – 0.2"/pixel, fov=51"x51"

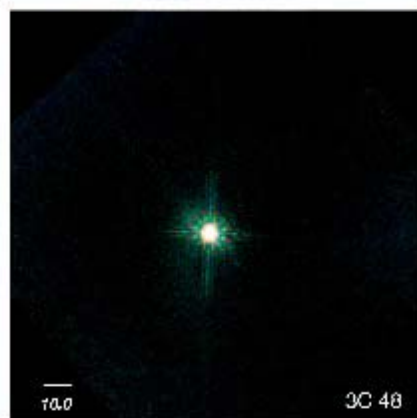
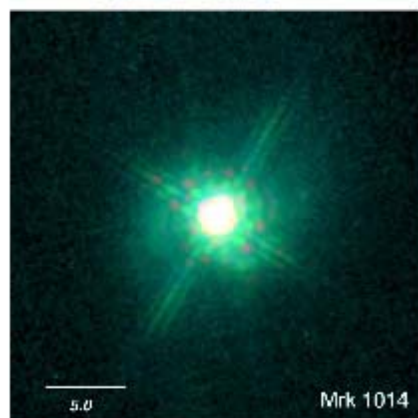
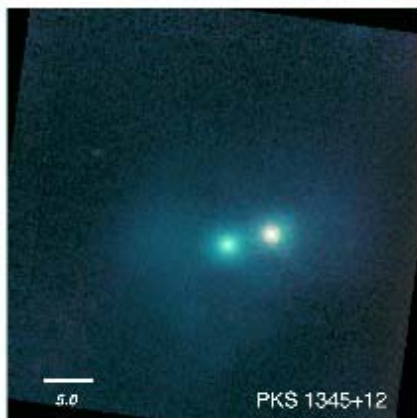
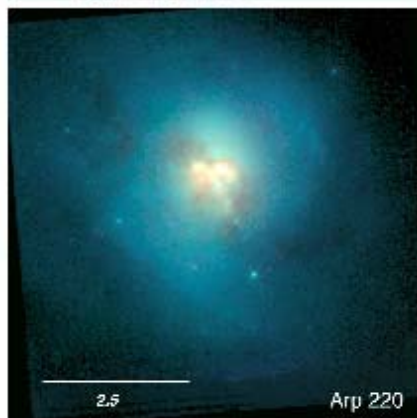
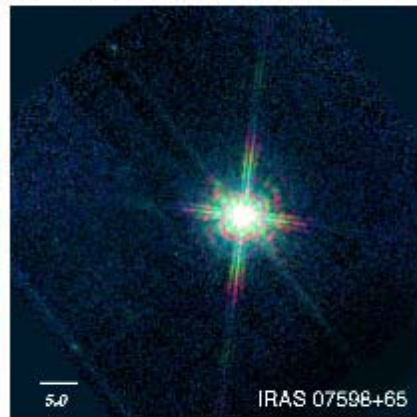
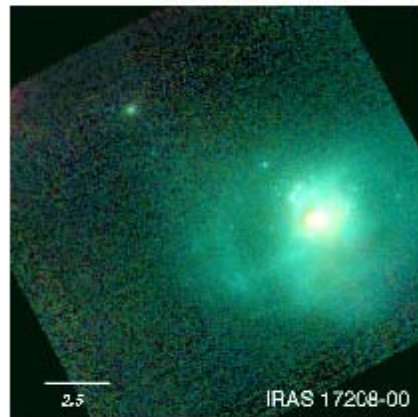
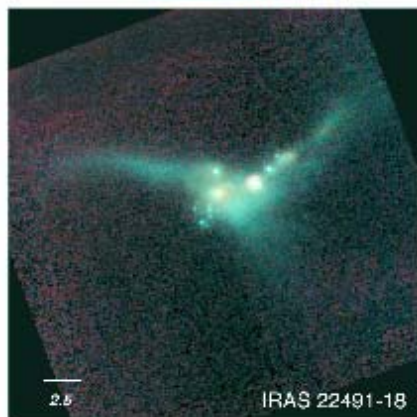
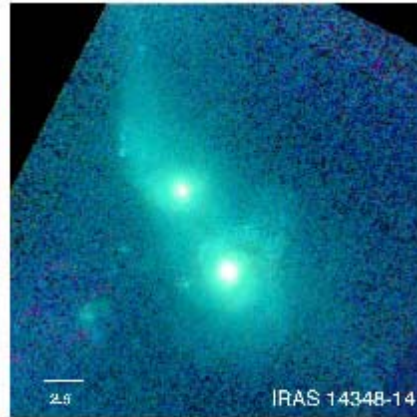
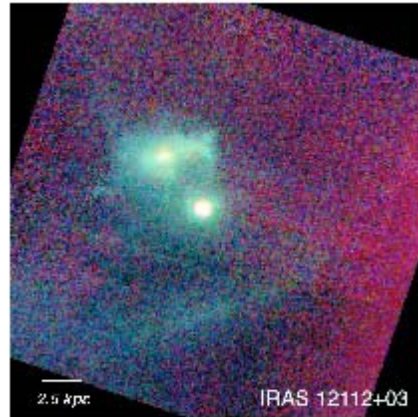
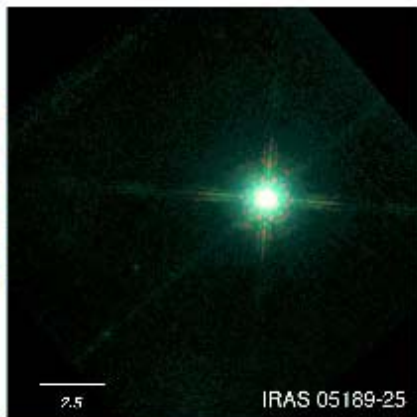
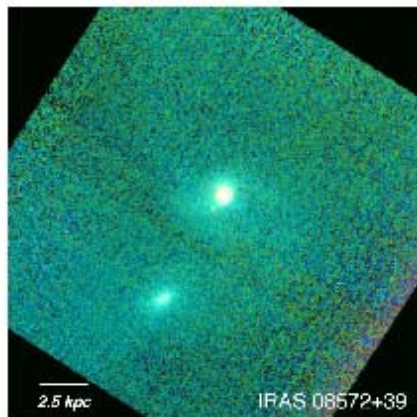
Observations

- NIC2
- 1.1, 1.6, 2.2 μm
- Res = 30-110 pc
- FOV = 4-13 kpc
- Total Orbits = 27



Sanders & Mirabel 1996

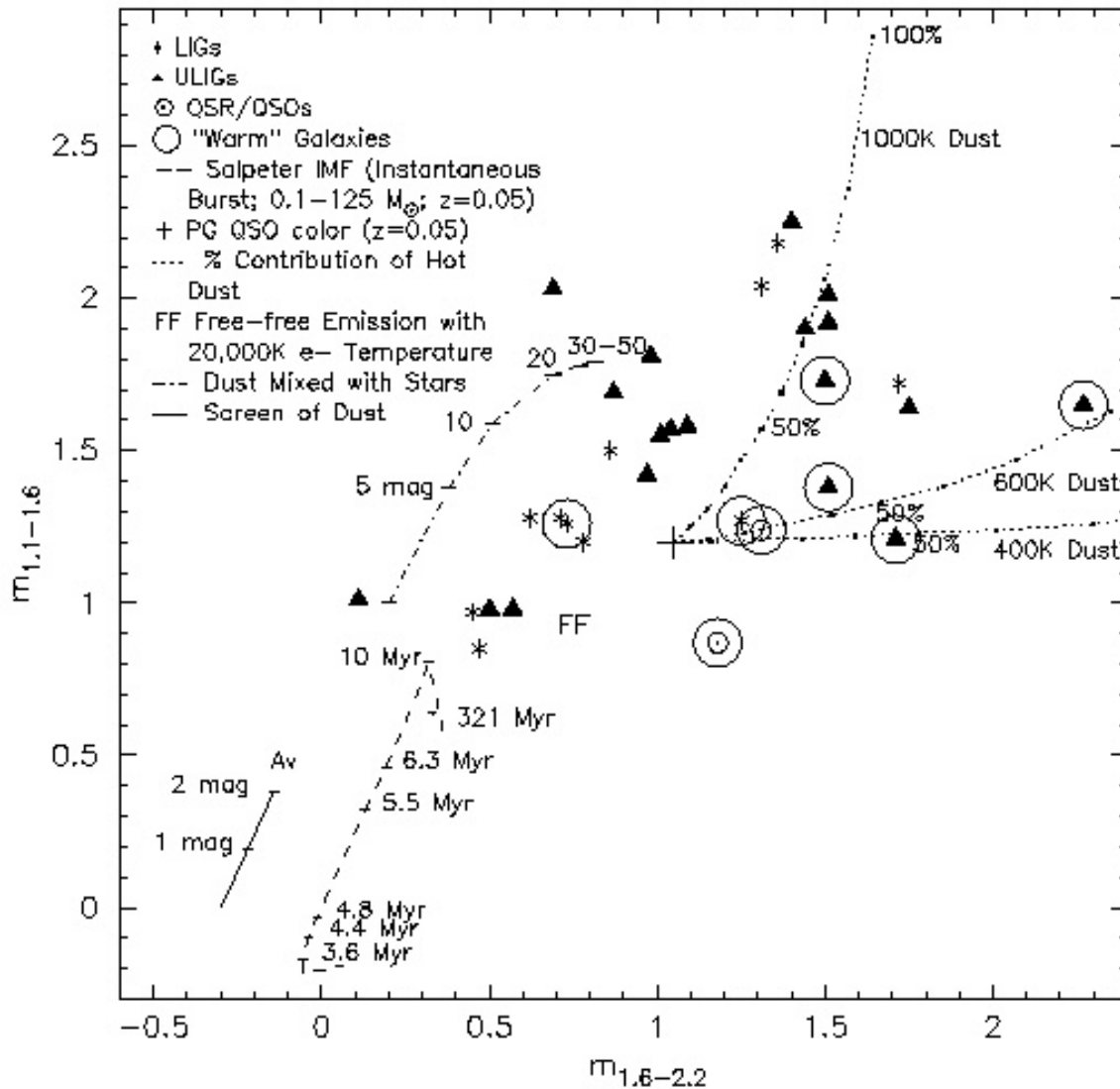




Summary of Images

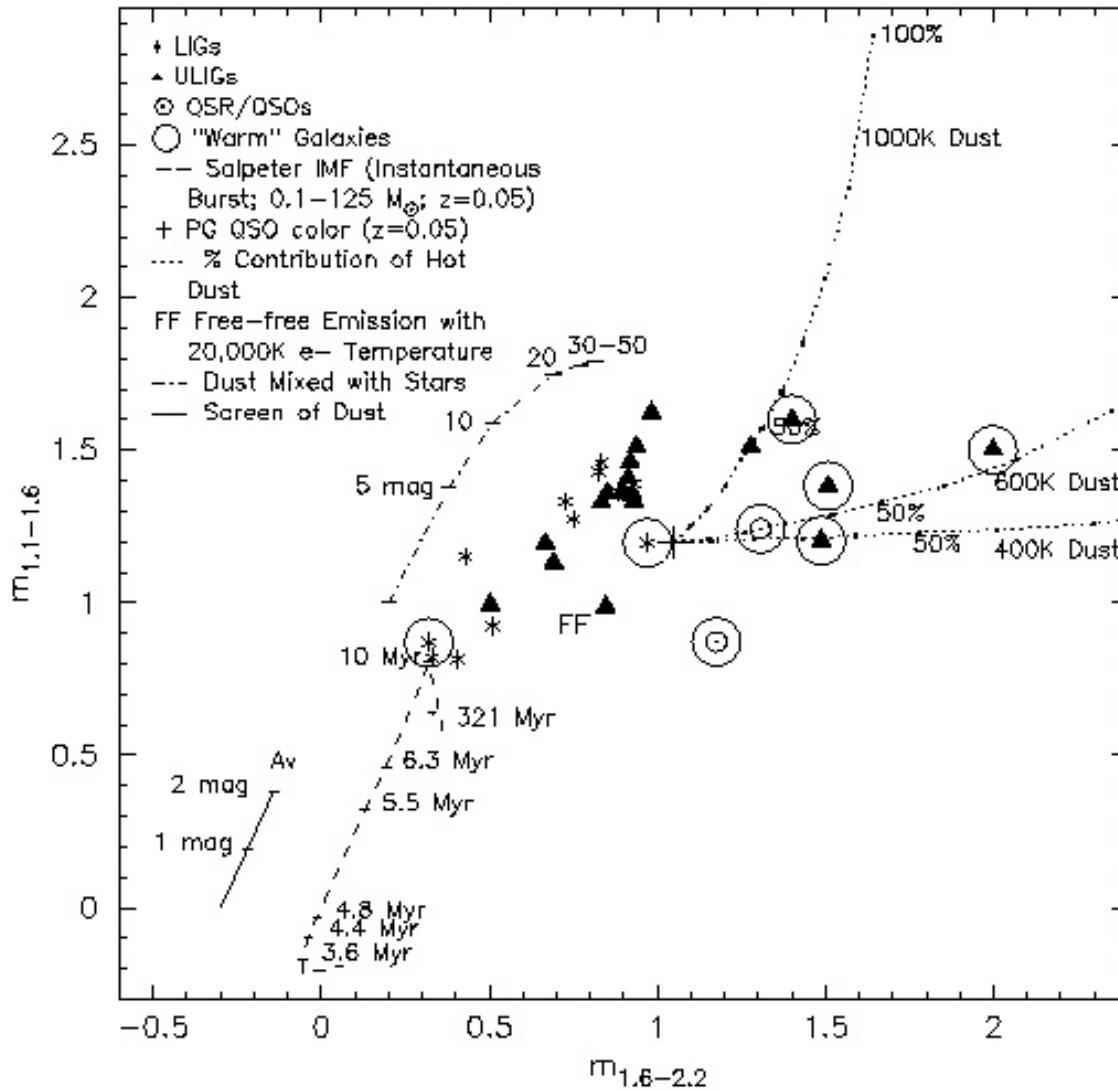
- There is evidence in a few galaxies of internal spiral structure on scale of 2.5 kpc.
- Many of the galaxies have star clusters. Most of the clusters are heavily extinguished, but a few are blue enough so that an age of < 100 Myr can be established.
- All but one of the ULIGs (I.e., IR 17208-0018) have compact (< 250 pc) nuclei.
- In many cases, there is extended near-infrared emission that surrounds these compact nuclei.

Infrared Nuclear Color Diagram



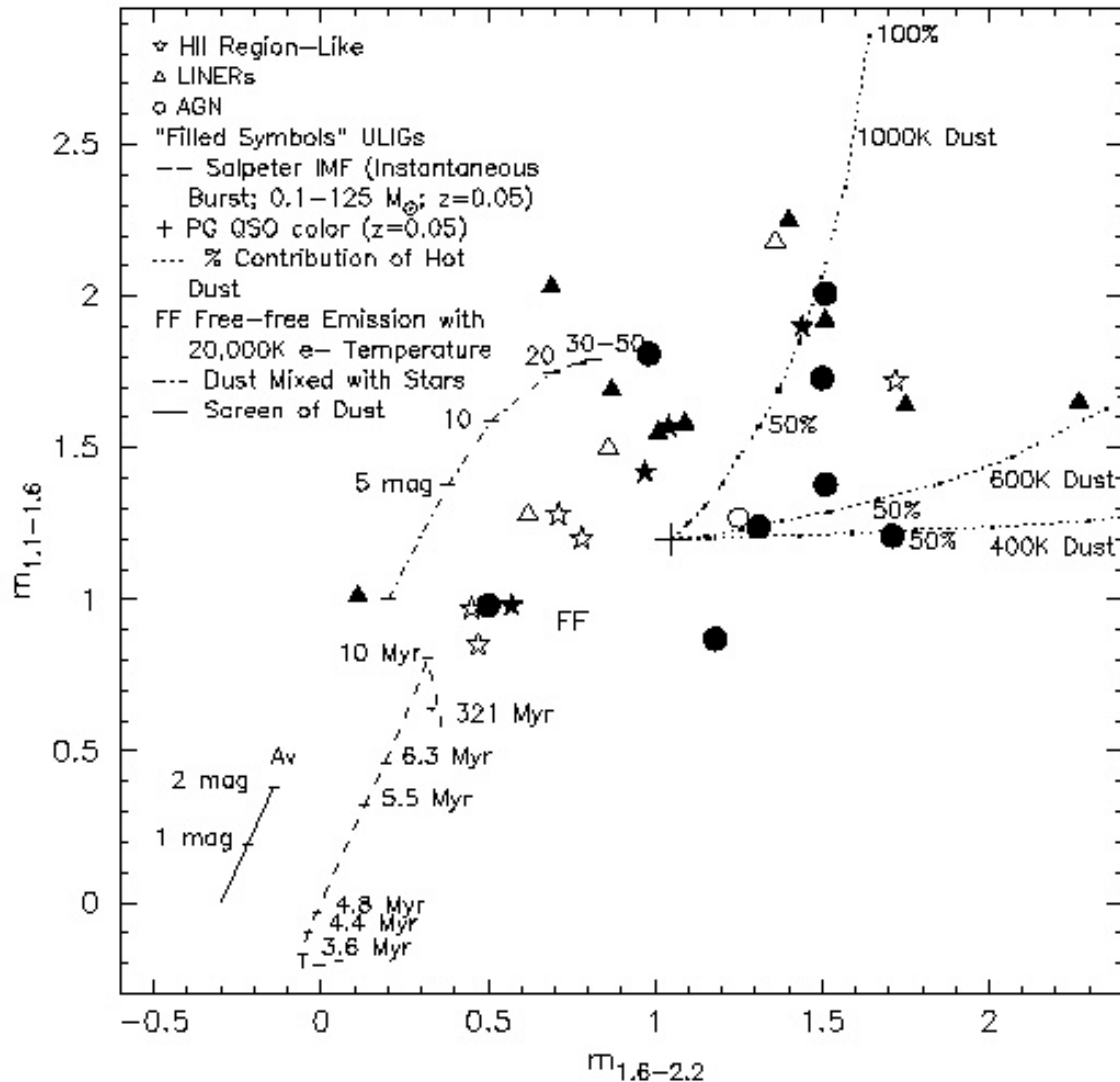
- Warm = Reddened QSOs
- Cool = Reddened Starlight

2 kpc Aperture Color Diagram



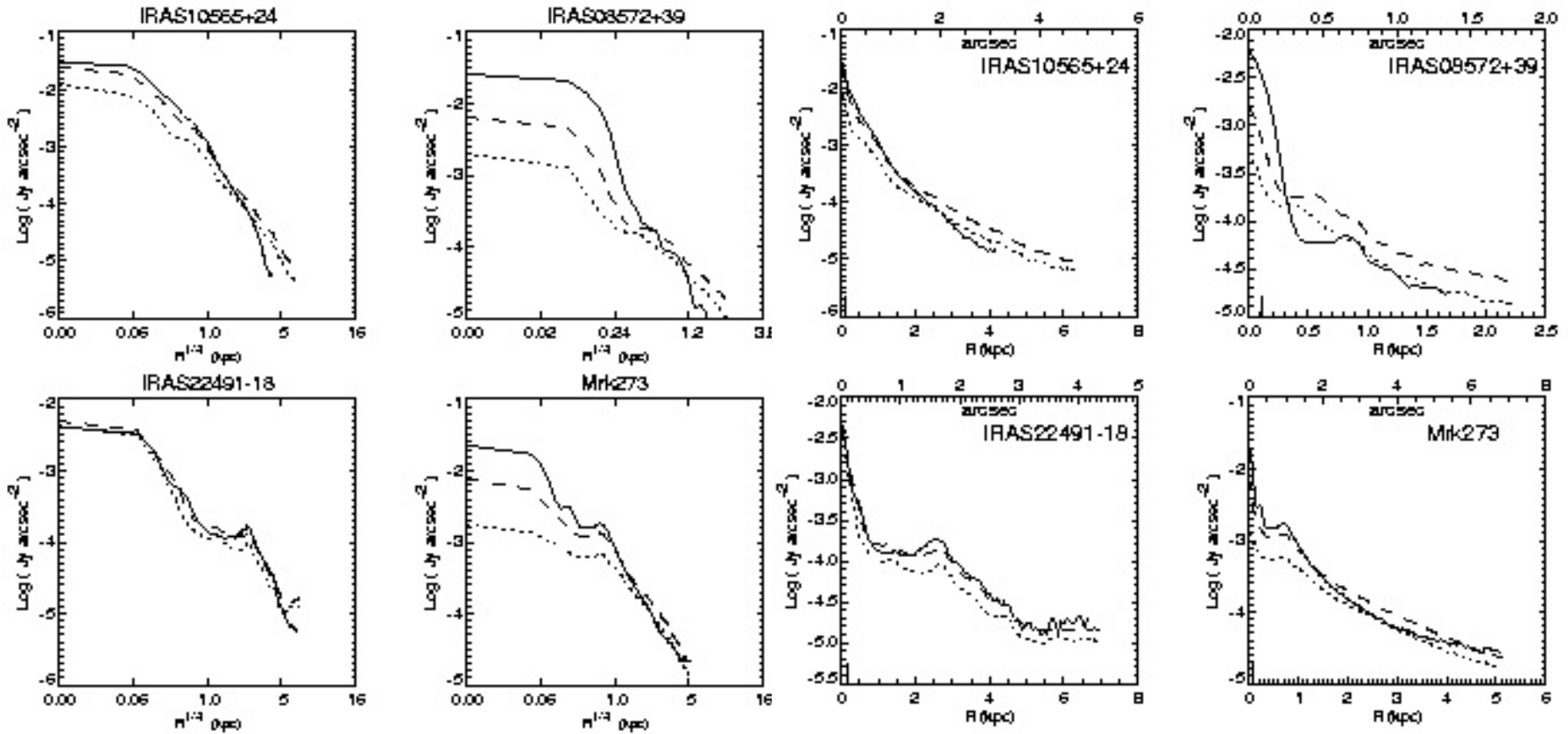
- Extended Near-infrared emission is starlight

Emission-Line Spectrum-Color Diagram



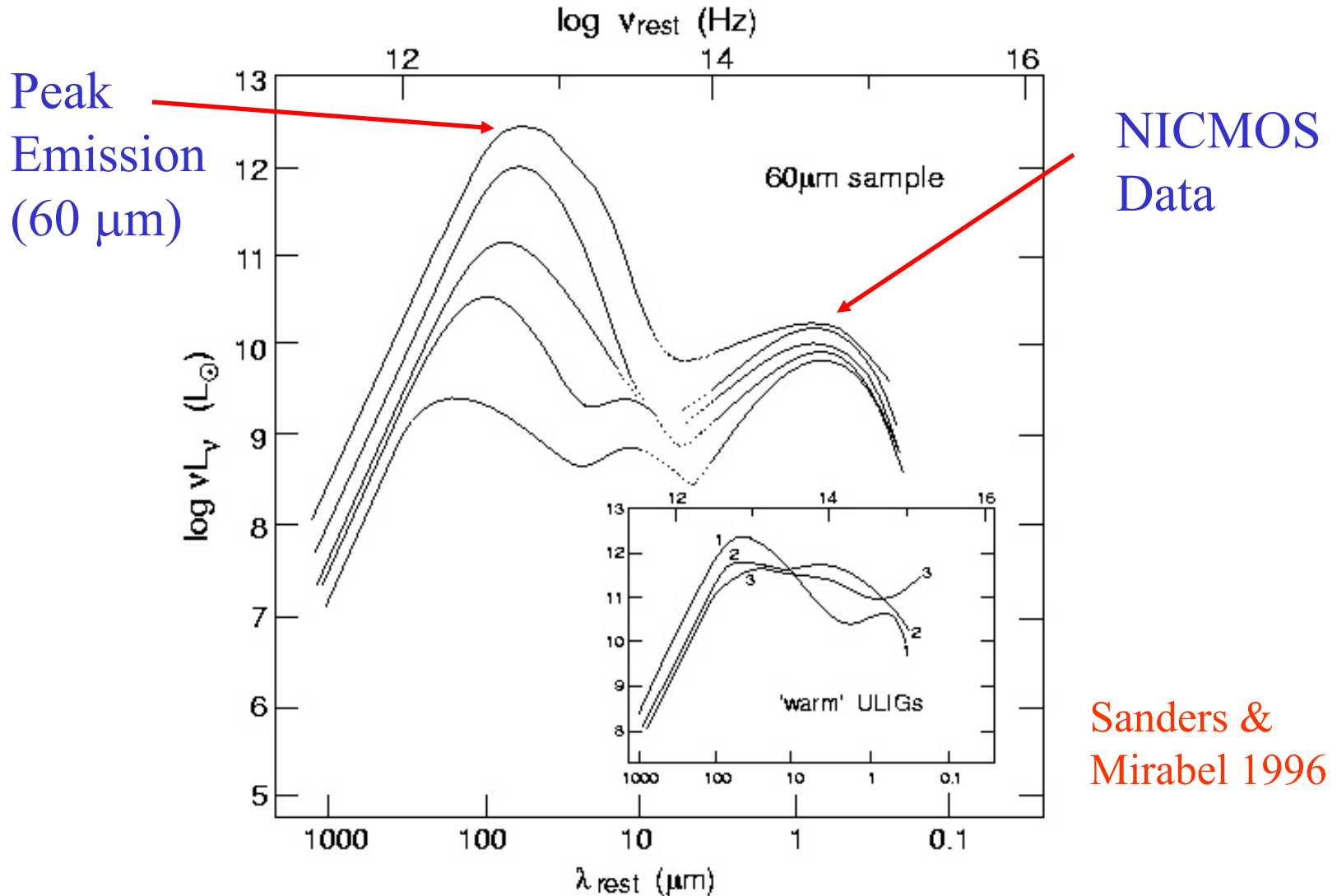
- No Correlation with Optical Emission Line Type

Near-Infrared Profiles



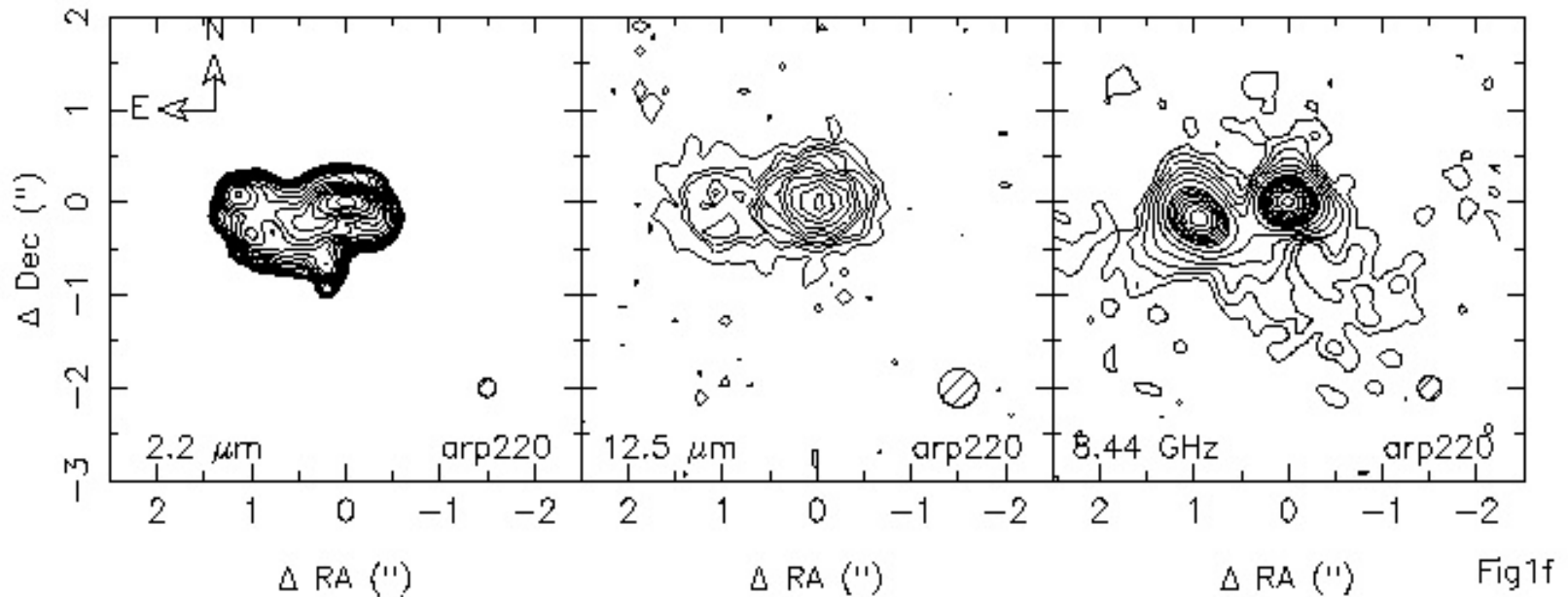
- Nine out of 24 are Well Fitted at $1.6 \mu\text{m}$ by $R^{1/4}$ Profile out to Scale Lengths of 0.7-4 kpc

Spectral Energy Distribution of Galaxies



Sanders &
Mirabel 1996

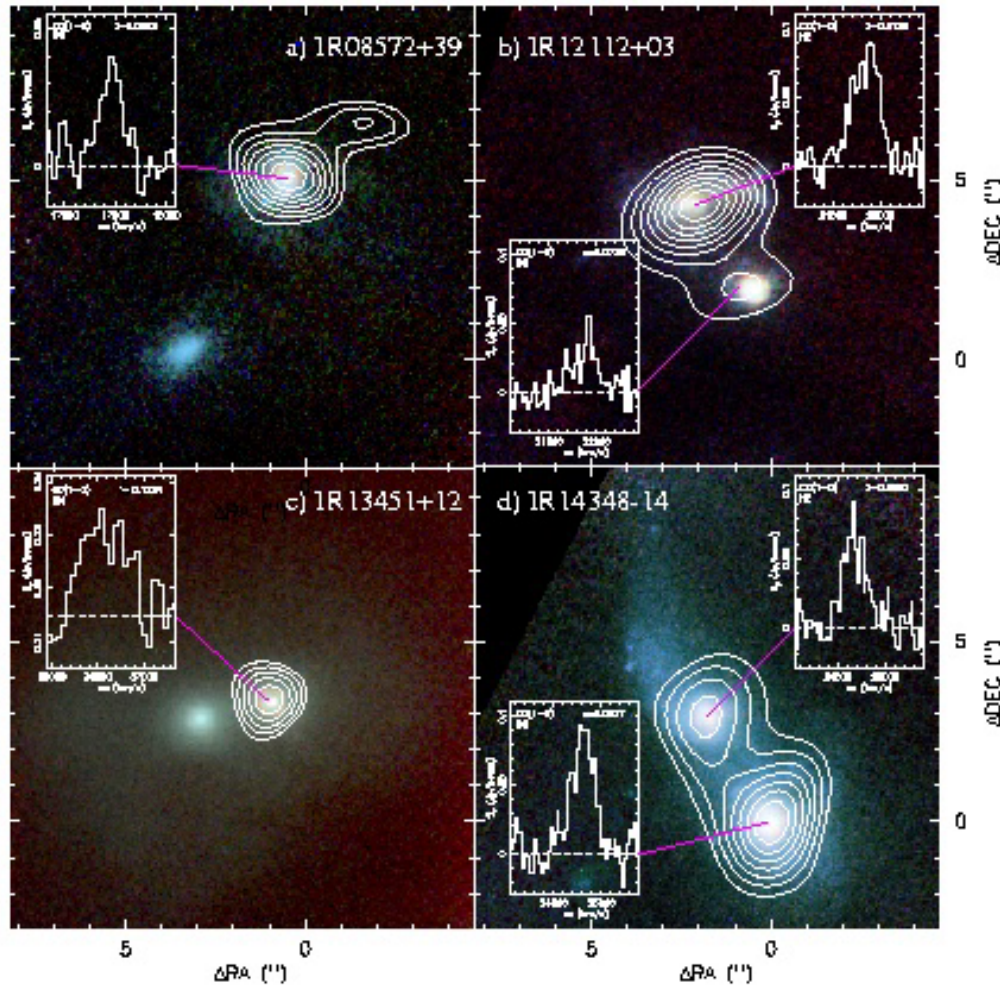
Comparison with Other Wavelengths



Scoville et al. 1998; Soifer et al. 2000

- Mid-Infrared and Radio Emission have Similar Distributions to Near-Infrared Emission
- Only the Compact Nuclei Contribute Significantly to the Overall Energy Output of ULIGs.

Comparison with Molecular Gas



- I.e., the Fuel Source for Star Formation and AGN Activity
- In ULIGs, Gas is Associated with Nuclei Visible in Near-Infrared
- Gas is Between Nuclei in Some Double-Nucleus LIGs

Evans et al. 2001