Subaru and Gemini high-spatial-resolution 20um imaging of nearby LIRGs

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NAOJ (Subaru Telescope)

Subaru

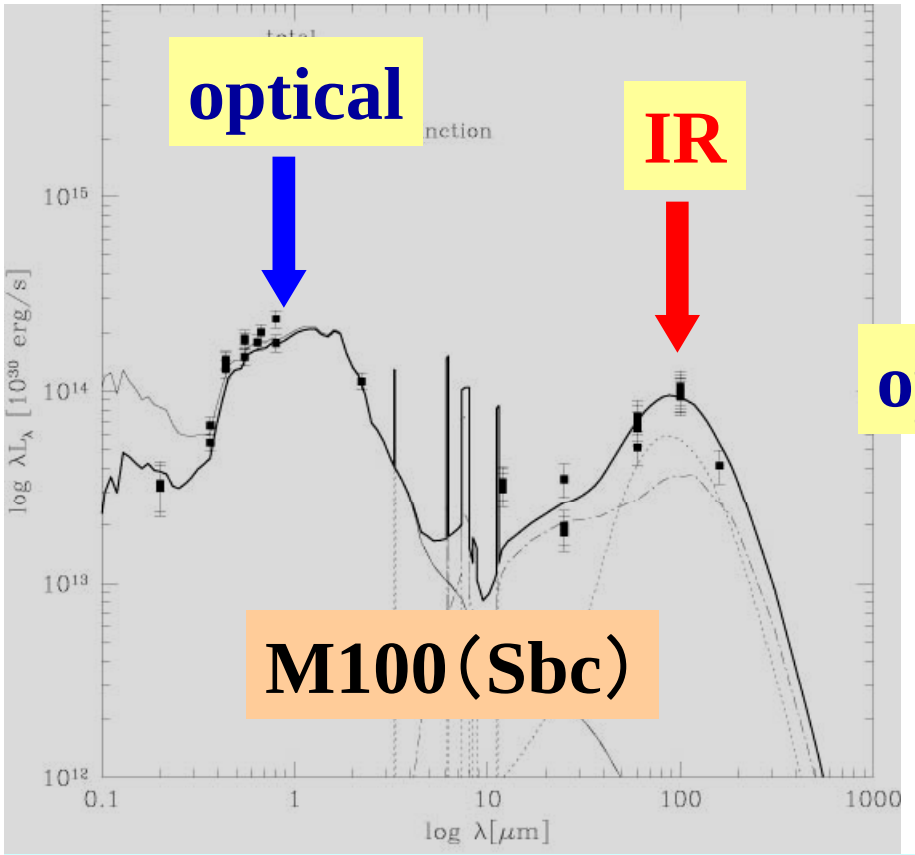
Gemini-S

Luminous infrared galaxies（LIRGs）

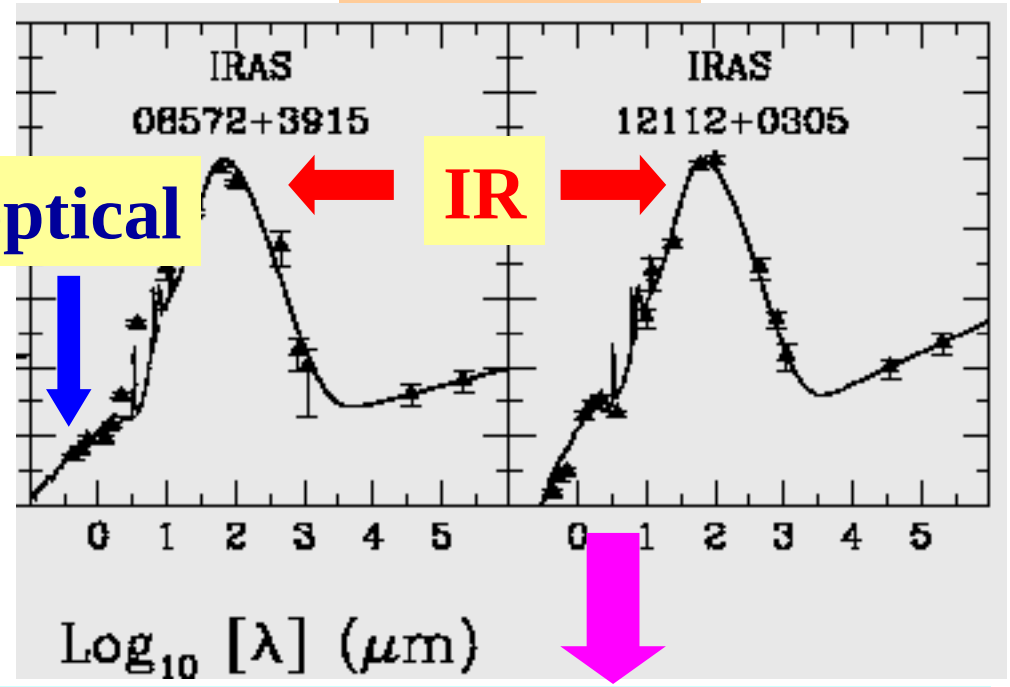
L(IR) > 10^{11} Lo

ULIRGs:>10^{12}Lo

(Normal spiral ~ 10^{10} Lo)



(U)LIRGs



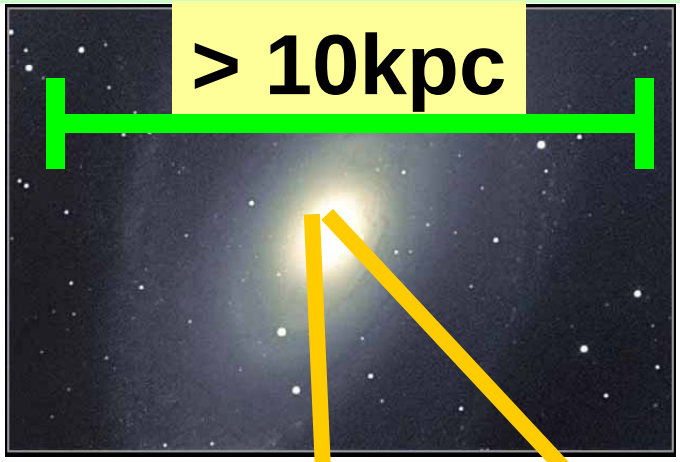
Luminous energy source is hidden behind dust

(U)LIRGs

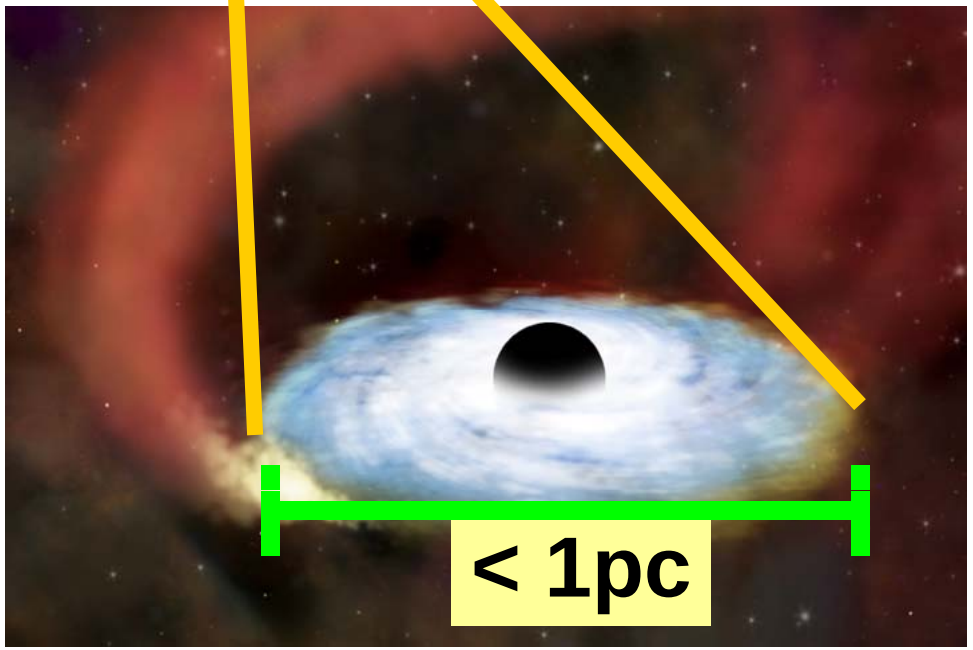
L(IR) > 10^{11}Lo

Luminous energy sources behind dust

Starburst



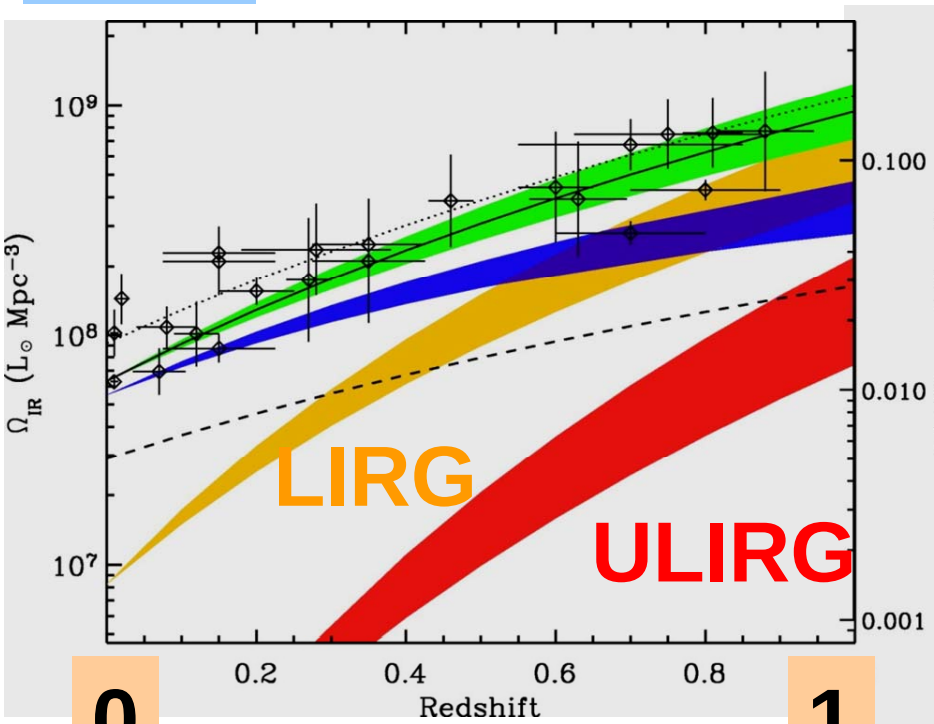
AGN



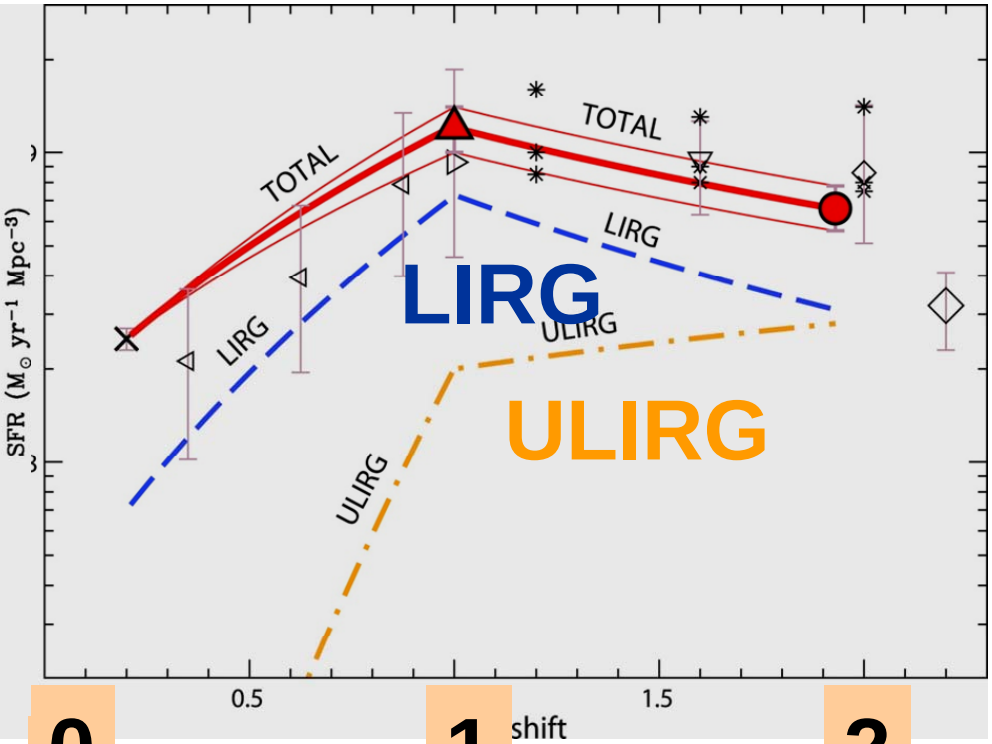
Mass accretion onto supermassive blackholes（>10^6 Mo）

(U)LIRGs: important at high-z

L(IR)



0 1

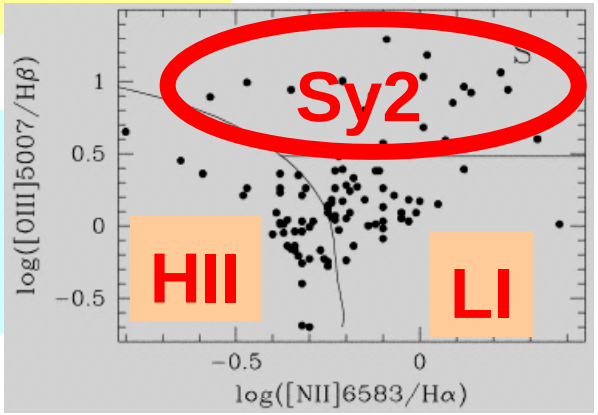


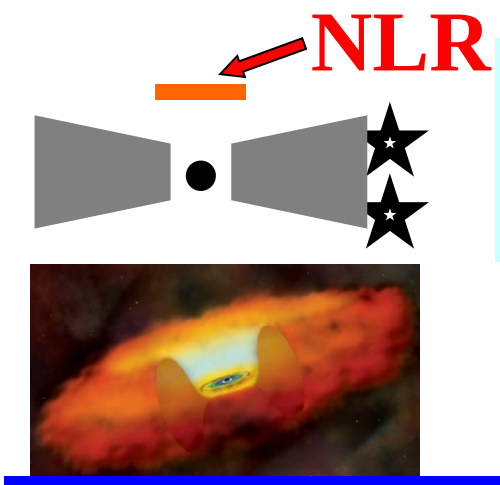
0 1 2

Le Floc'h et al. 2005 **Caputi et al. 2007**

AGNs in (U)LIRGs are buried

Veilleux+99

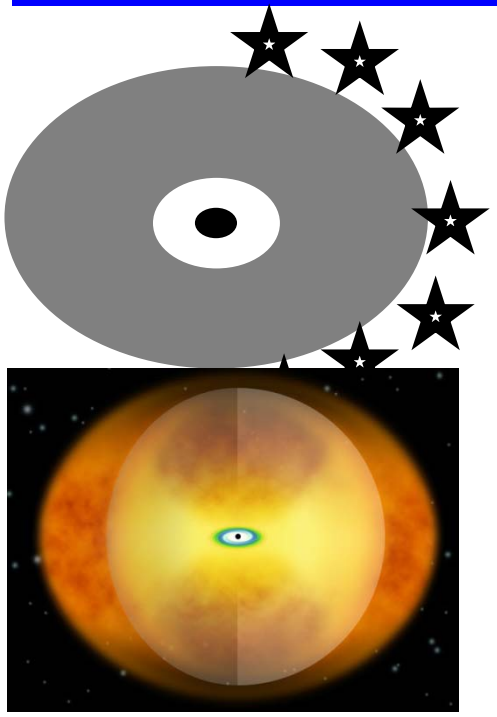




AGNs obscured by torus-shaped dust

Sy2

Detectable via optical spectroscopy



(U)LIRGs have a large amount of nuclear gas and dust

Buried AGNs are elusive

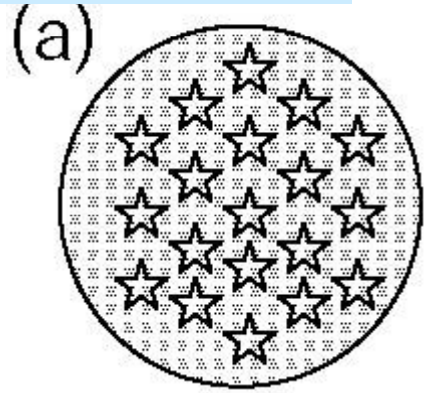
>70% (U)LIRGs = non-Sy

Veilleux+99;Yuan+10

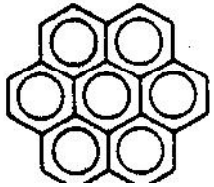
IR spectroscopy

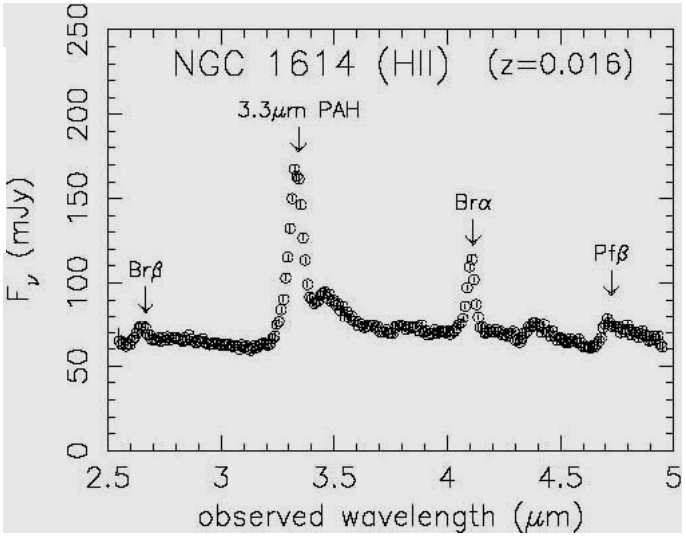
AKARI 2.5-5um

Normal SB

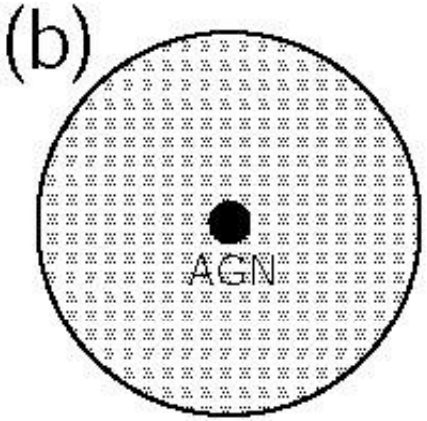


PAH

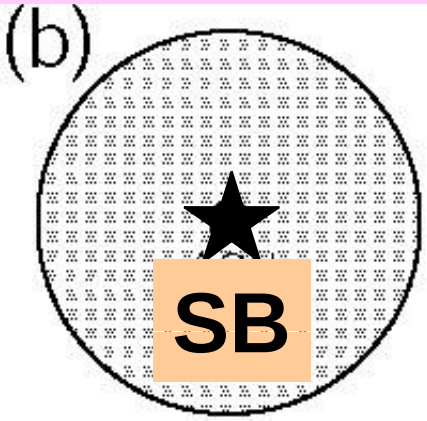


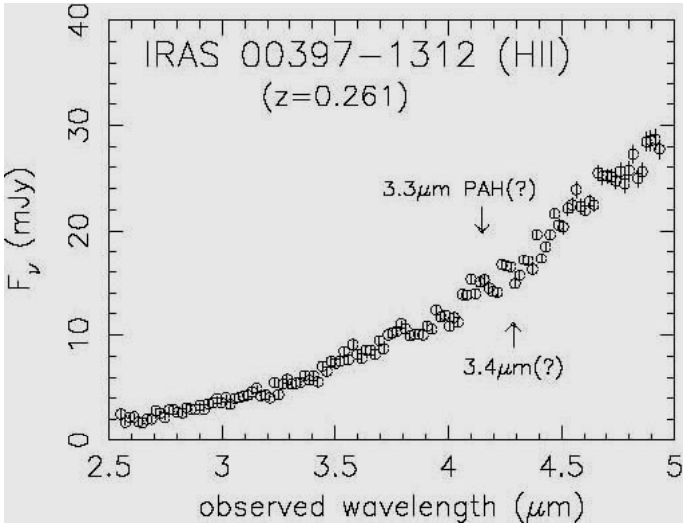


Buried AGN



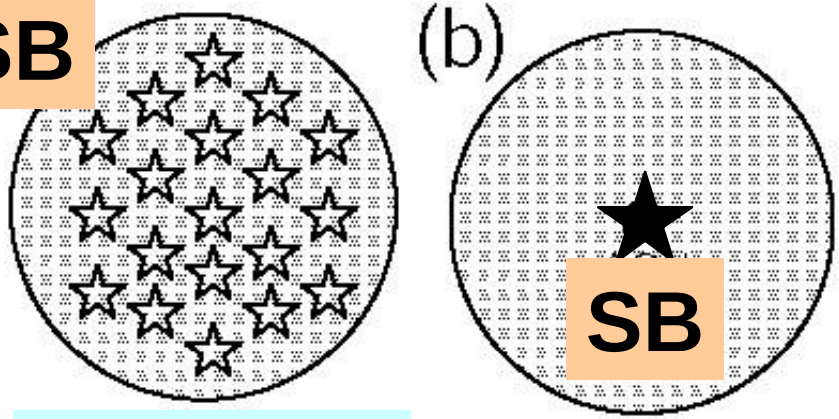
Extreme SB (?)



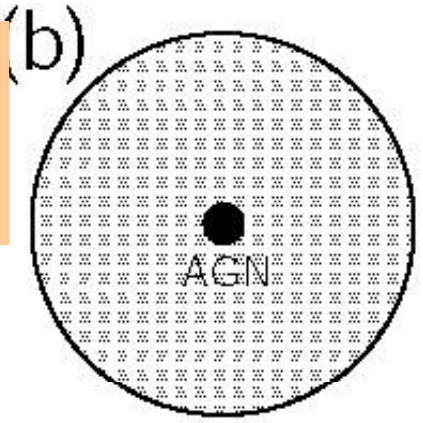


Emission surface brightness

SB



Buried AGN



$E = 0.5\% Mc^2$

$E = 6\text{-}40\% Mc^2$

$>>10^{13}$ Lo / kpc^2

10^{11} Lo / kpc^2

SB

$<10^{13}$ Lo / kpc^2

HII-region core

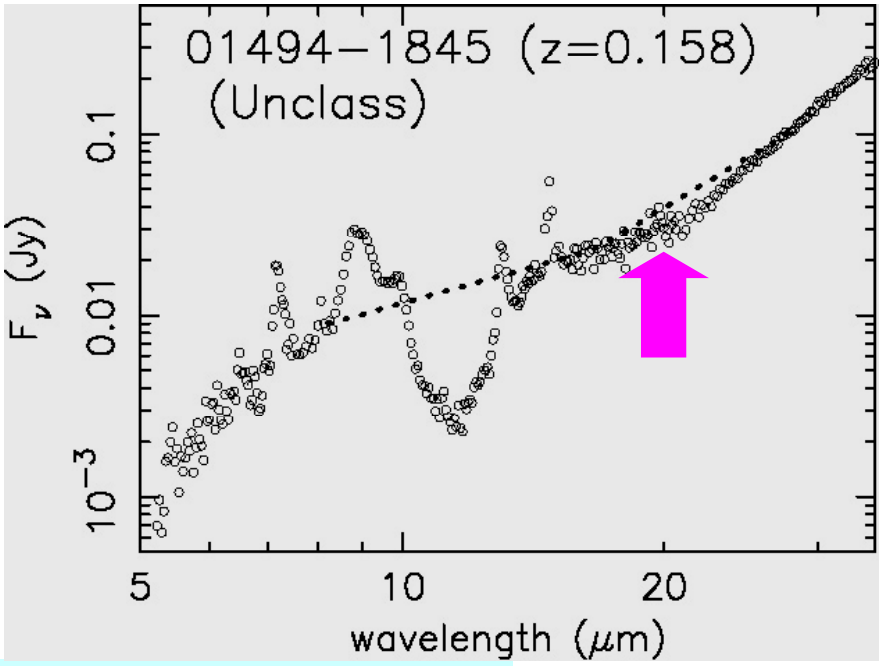
Supported by Eddington-limited SB theory

Thompson+05

If >>10^{13} Lo / kpc^2, then buried AGN

Ground-based large 8-10m telescope
is better than space satellites (0.7-0.85m)

Why 20um?



PAH contamination small

Diffraction-limited image achieved

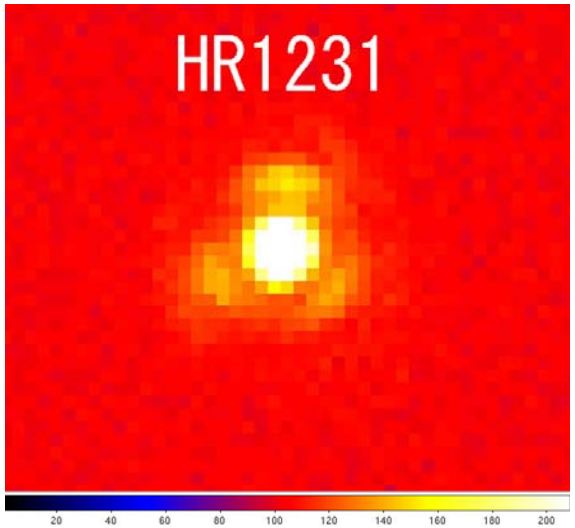
↳ **Stable PSF**

Subaru COMICS

20um

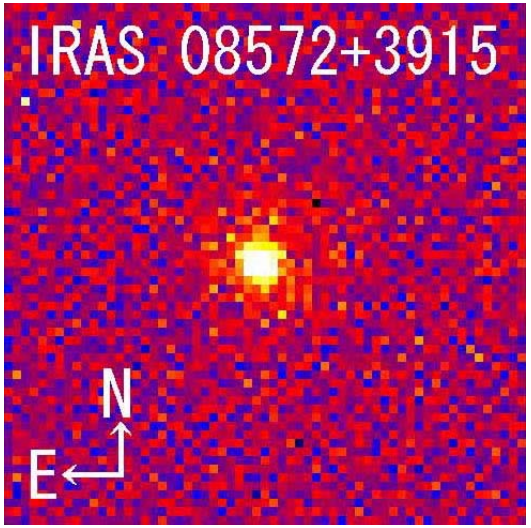
Diffraction-limited images are usually achieved

Standard star



Mitsubishi-pattern

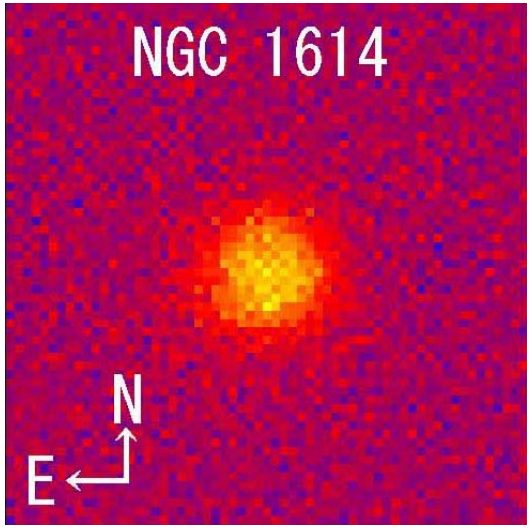
compact



size<0.2”

>3*10^{13} Lo / kpc^2

extended



10^{12} Lo / kpc^2

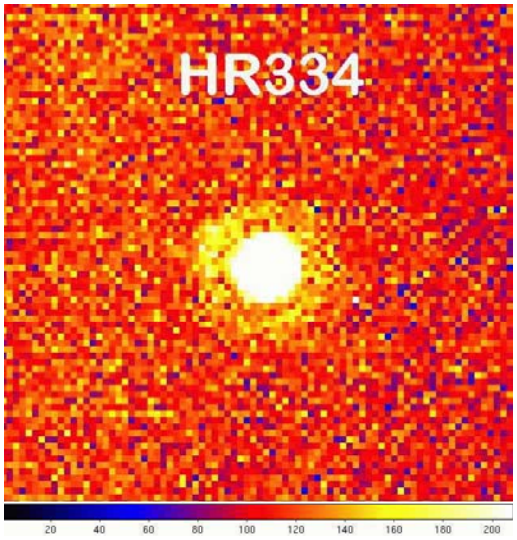
Imanishi+11

Gemini-S/T-ReCS

20um

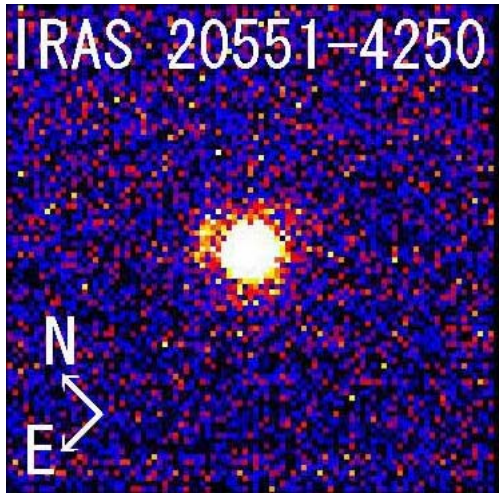
Diffraction-limited images are usually achieved

Standard star



Diffraction ring

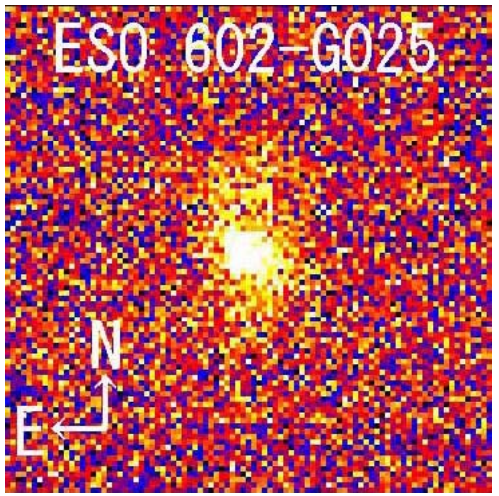
compact



size<0.25”

>2*10^{13} Lo / kpc^2

extended



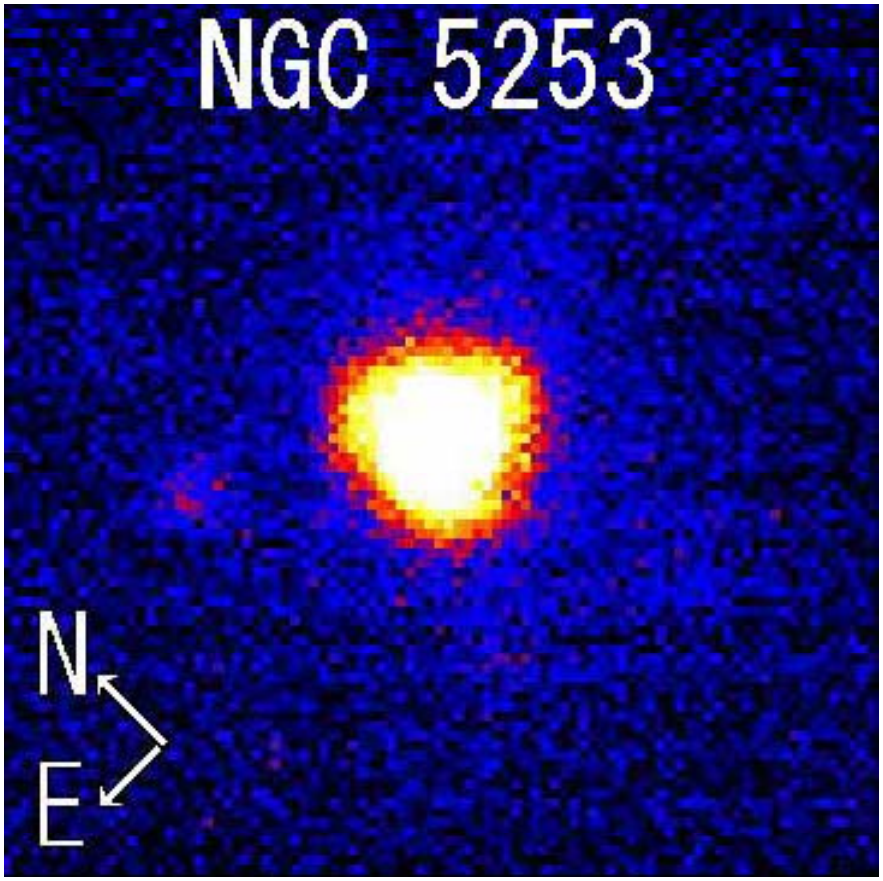
<10^{12} Lo / kpc^2

Imanishi+11

Super star cluster

NGC 5253
(d=4Mpc)

20um

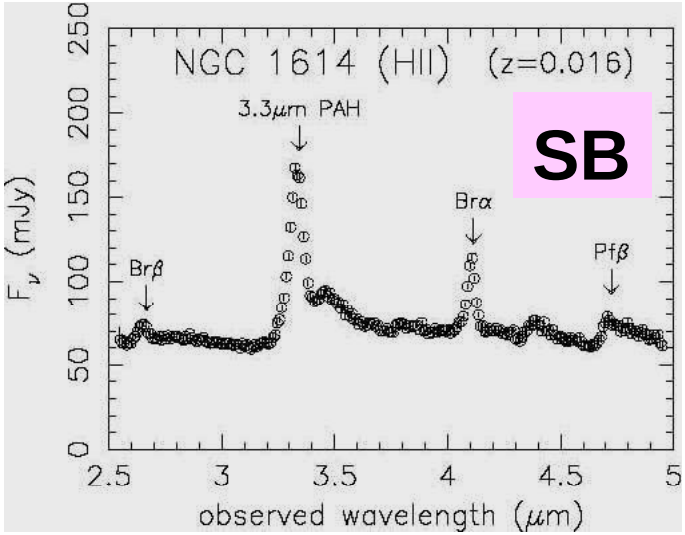


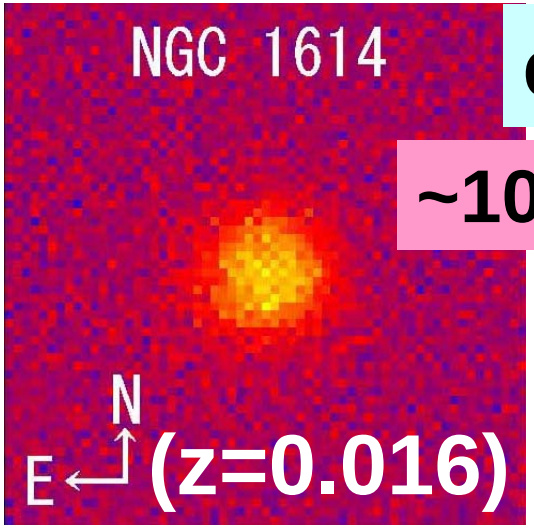
Gemini-S
T-ReCS

~10^{13} Lo / kpc^2

Imanishi+11 submitted

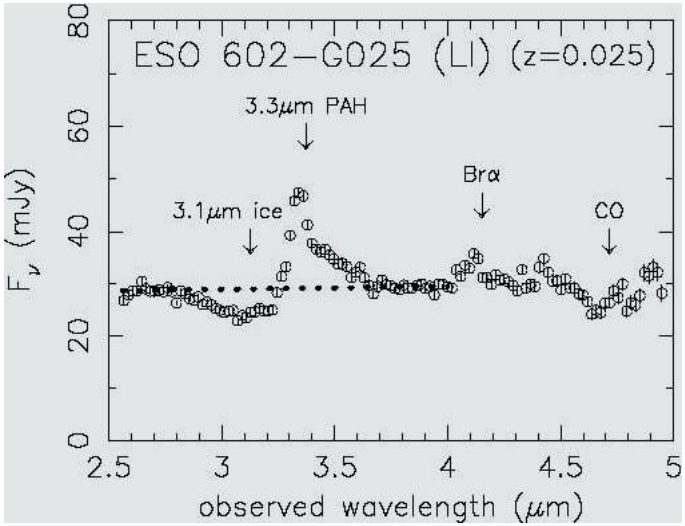
IR spectroscopy vs imaging (I)

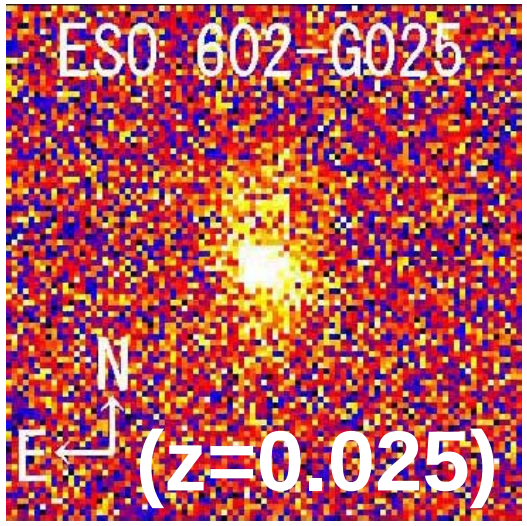




extended

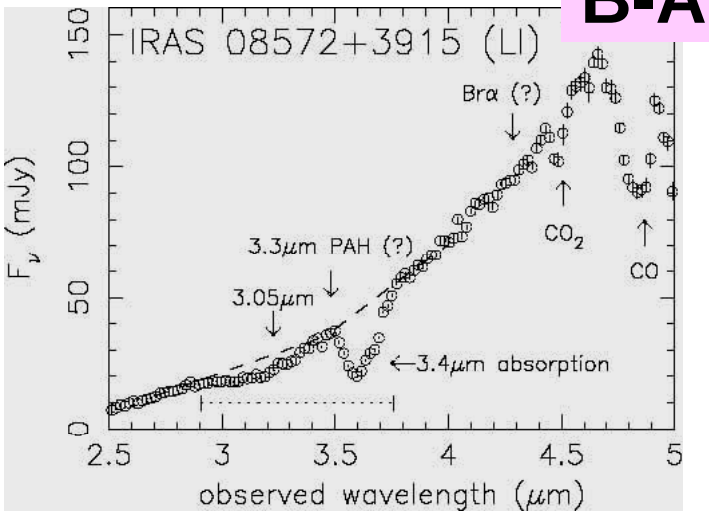
~10^{12} Lo / kpc^2

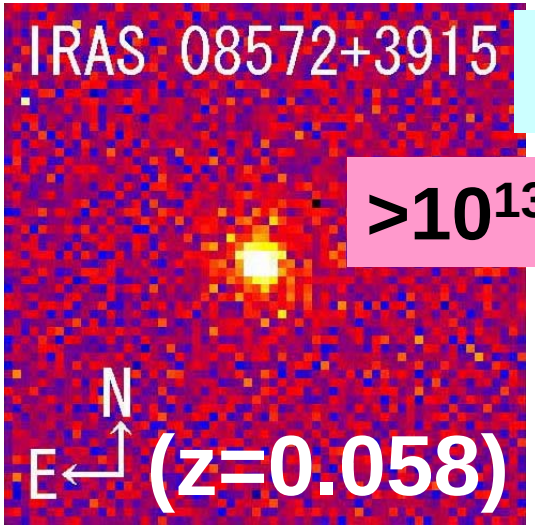




IR spectroscopy vs imaging (II)

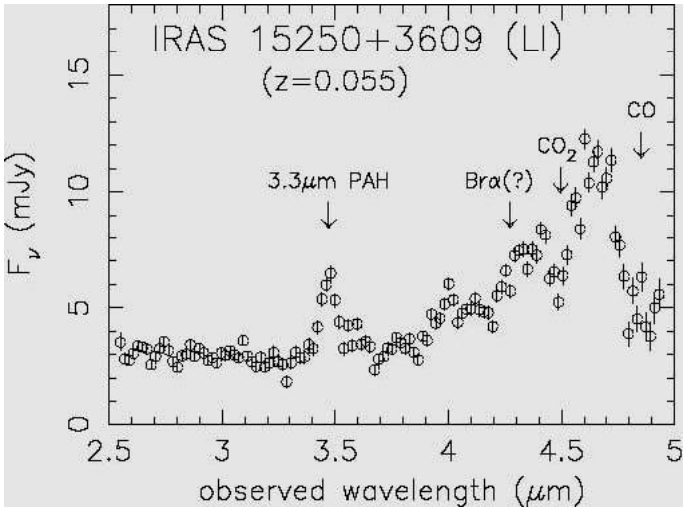
B-AGN

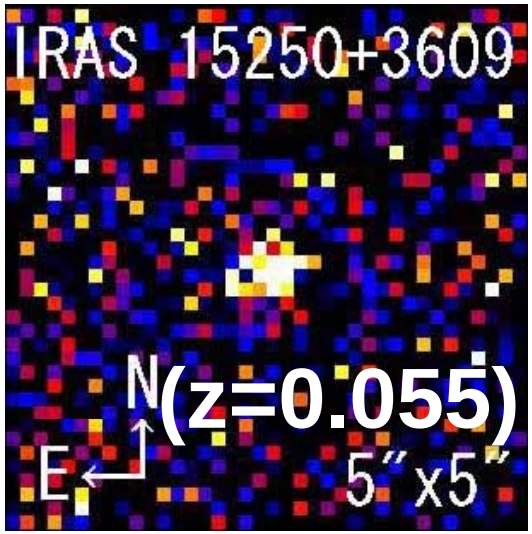




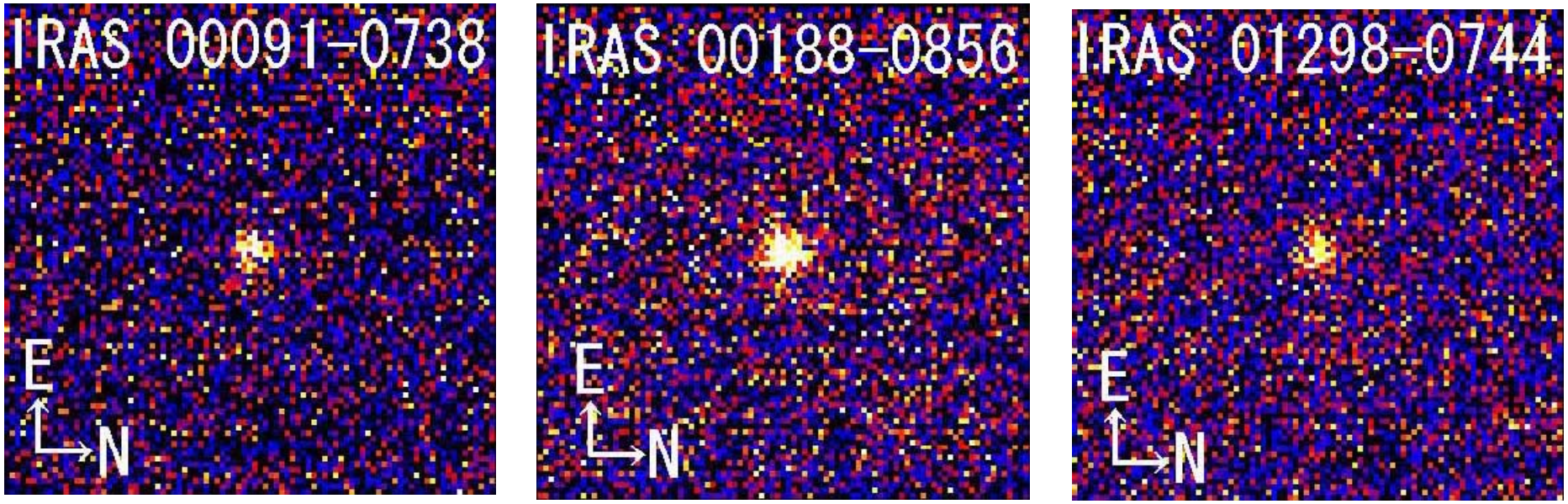
compact

>10^{13} Lo / kpc^2





Distant ULIRGs (z>0.1)



>0.5*10^{13} Lo/kpc^{2}

Need higher-spatial-resolution of TMT/MICHI

Summary

B-AGN and SB are distinguishable, based on 20um emission surface brightness, if z < 0.06

Generally agree with IR spectroscopic energy diagnostic method

Imanishi+11 submitted (accepted soon)

End