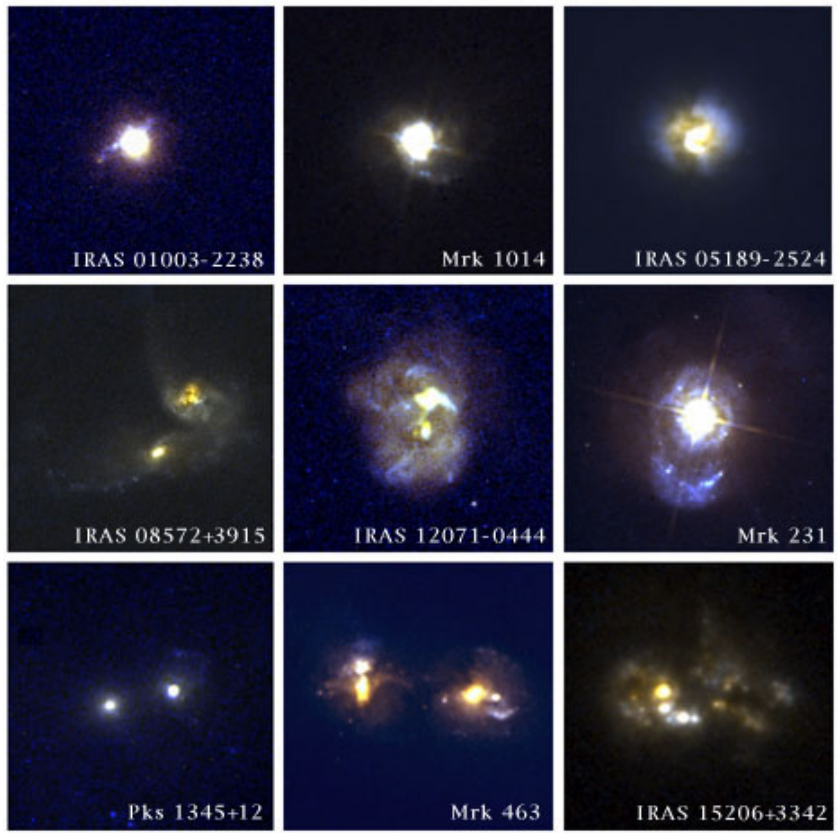
Buried AGNs in nearby ULIRGs

Masa Imanishi

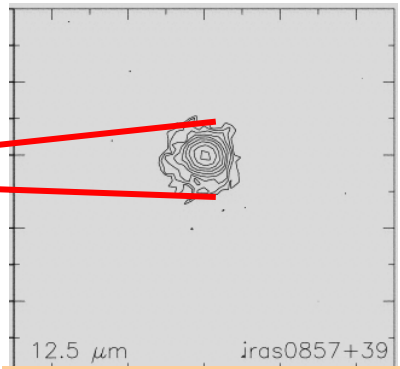
(National Astronomical Observatory of Japan)



Ultraluminous Infrared Galaxies（ULIRGs）

L(IR)>10^12Lsun → **Powerful energy source is hidden behind dust**

optical

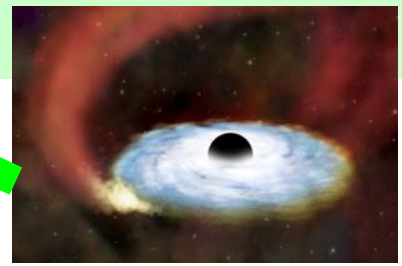


IR(12um)

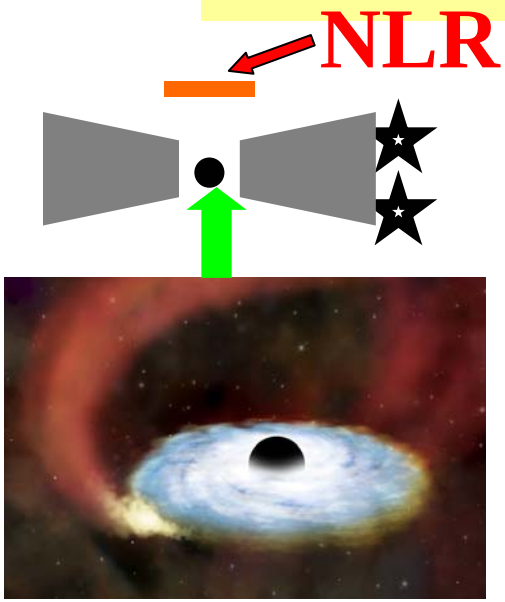
Soifer et al. 2000

Compact cores (<500pc) are dominant

Very compact starburst or AGN ?



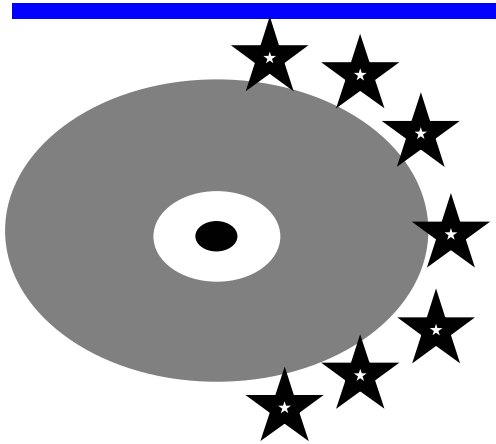
AGNs in ULIRGs are buried



AGNs obscured by torus-shaped dust

Sy2

Detectable via optical spectroscopy



ULIRGs have a large amount of nuclear gas and dust

Buried AGNs are elusive

Infrared 3-4 um spectroscopy

IRCS on Subaru 8.2m telescope

Optically non-Seyfert ULIRGs
(LINER,HII-region type)

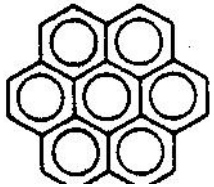
Methods:

1. Spectral shape (PAH vs dust absorption)

2. Geometry of energy sources and dust

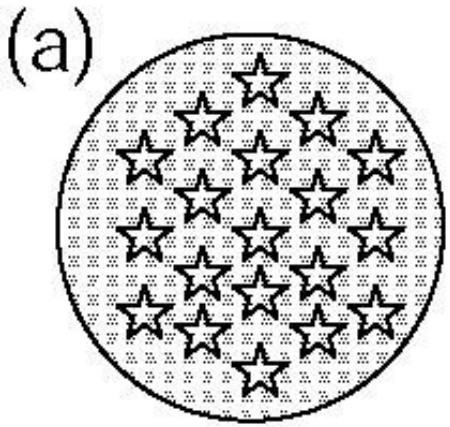
1. 3-4 um spectral shape

PAH

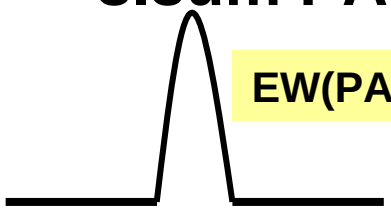


PAHs are excited in starburst PDRs but destroyed near an AGN

starburst

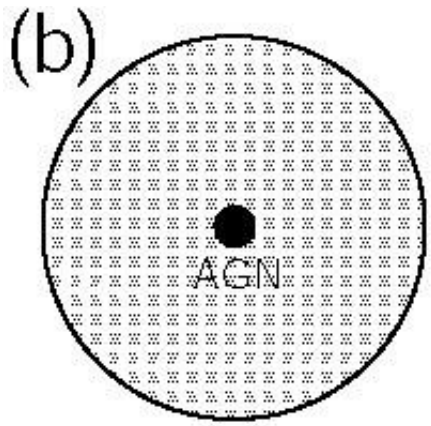


3.3um PAH

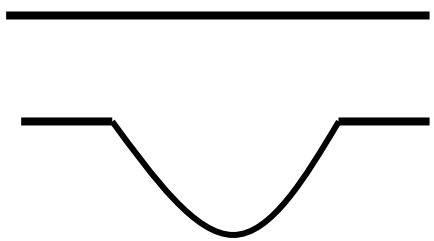


EW(PAH)~100nm

Buried AGN

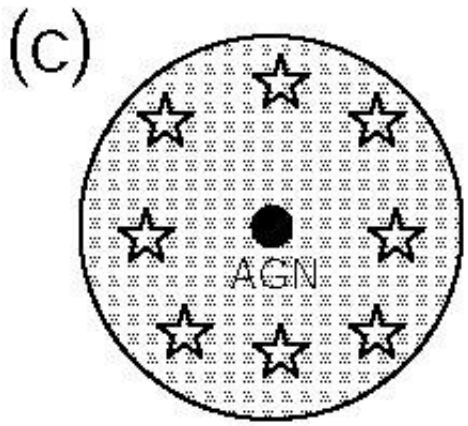


featureless

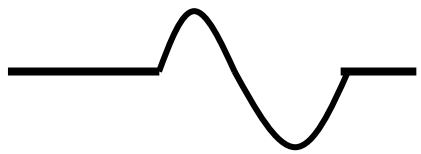


3.4um/3.1um

composite



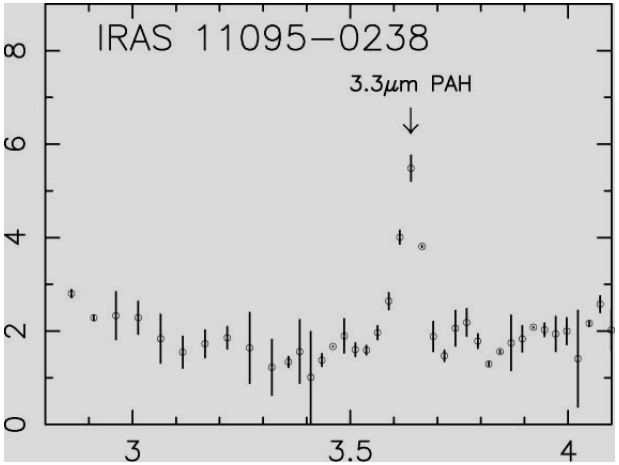
EW(PAH)<<100nm

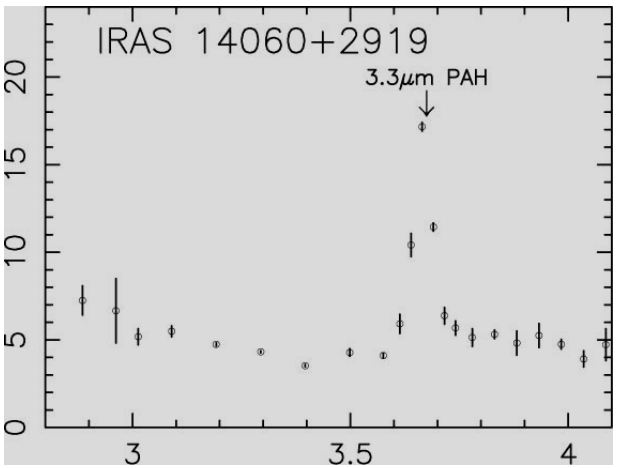


3-4 um

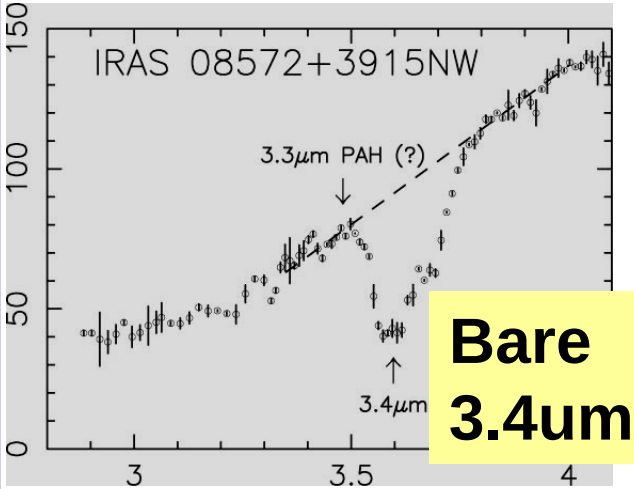
Subaru

starburst

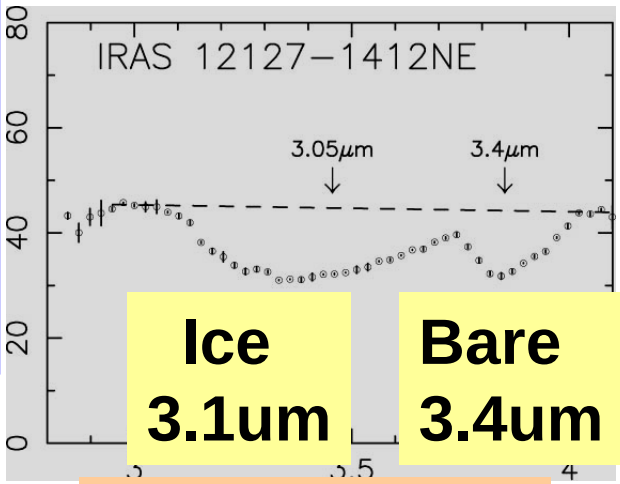




Buried AGN



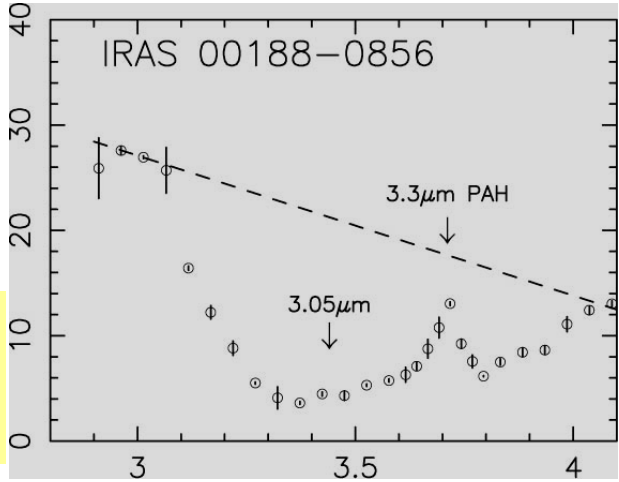
Bare 3.4um

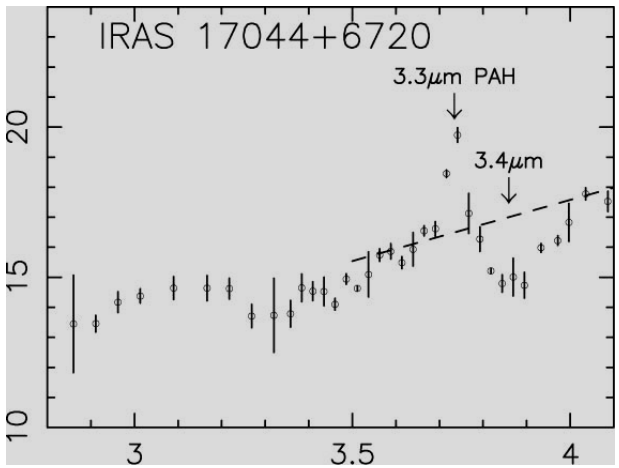


Ice 3.1um

Bare 3.4um

AGN/SB composite





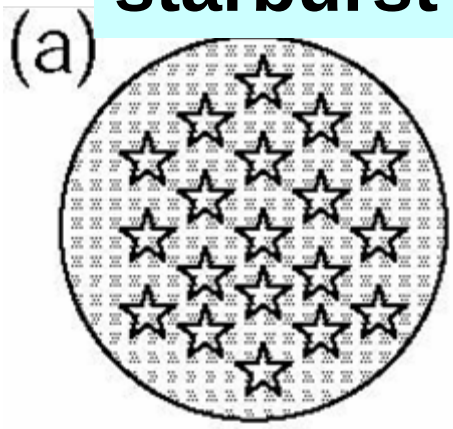
Strong PAH

Abs. feature

Low EW(PAH)

2. dust/energy-source geometry

starburst

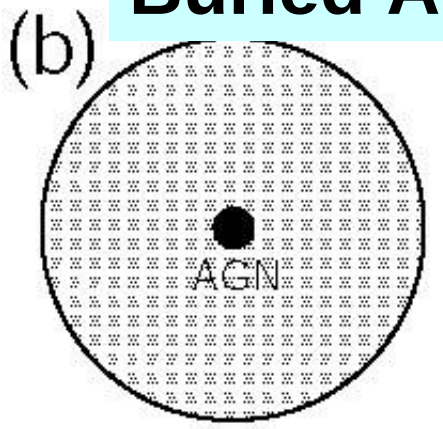


Mixed dust model

$$\frac{1-\exp(-\tau_\lambda)}{\tau_\lambda}$$

Dsut absorption feature: weak

Buried AGN



Foreground screen dust model

$$\exp(-\tau_\lambda)$$

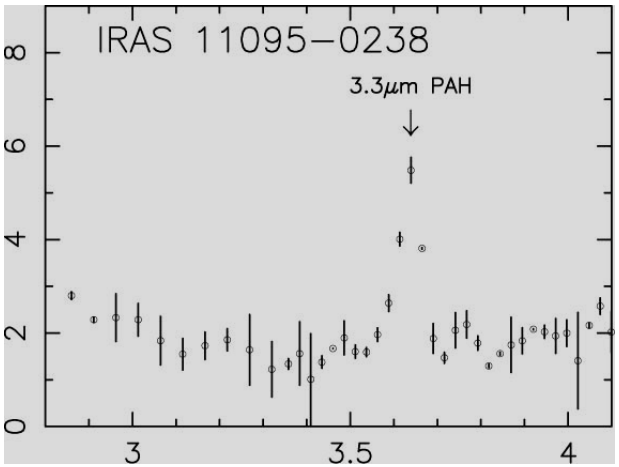
strong

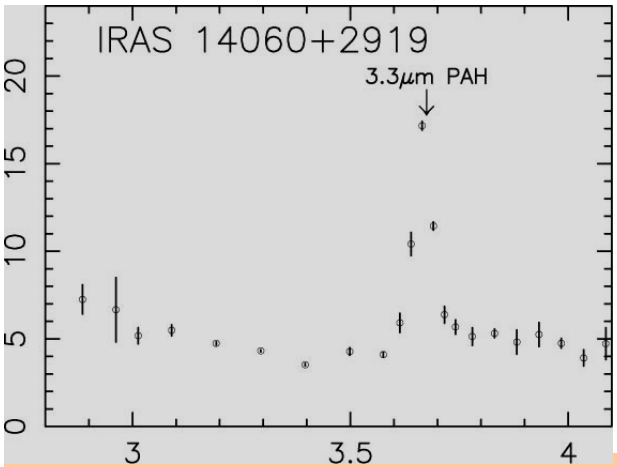
Tau(3.1) < 0.3

Tau(3.4) < 0.2 (Imanishi & Maloney 2003 ApJ 588 165)

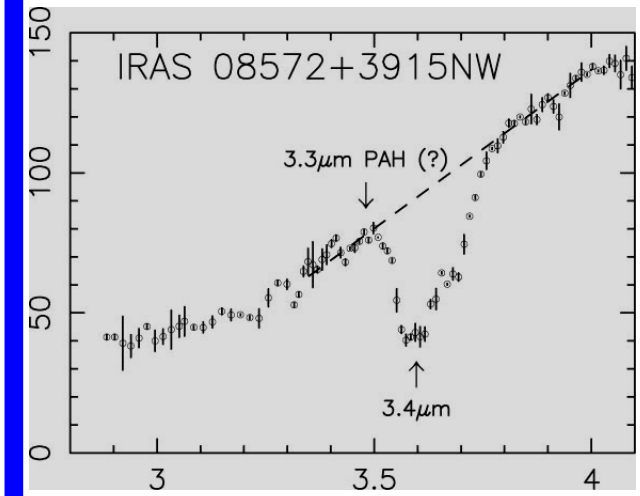
3-4 um

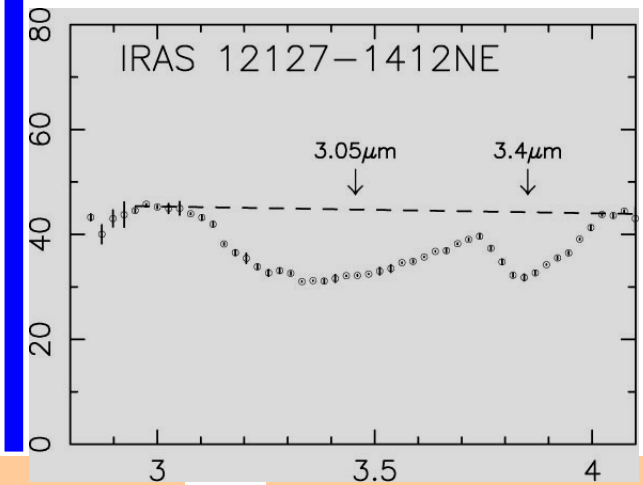
Starburst



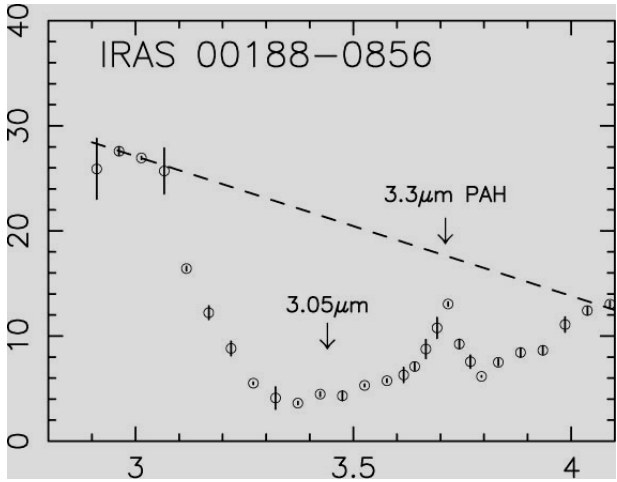


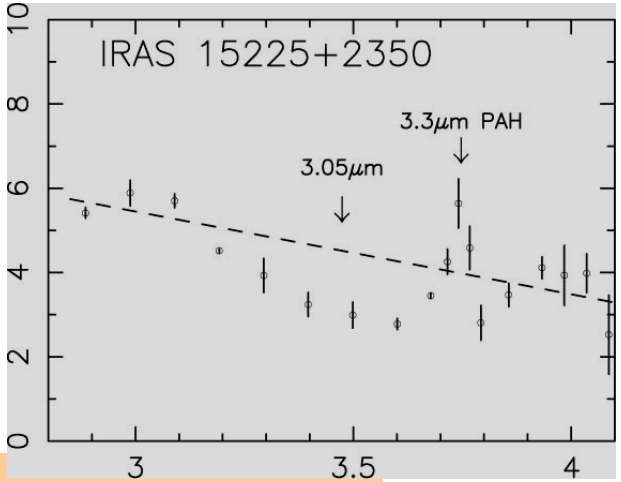
Buried AGN





composite

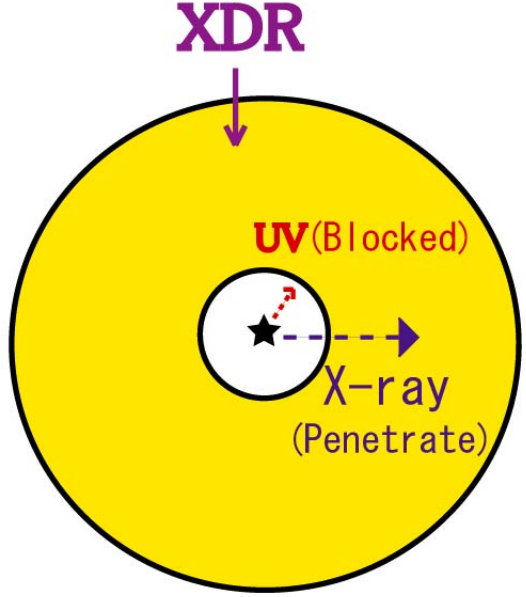




PAH strong (starburst): Dust absorption weak

PAH weak (AGN): Dust absorption strong

Results



Buried AGN signatures:

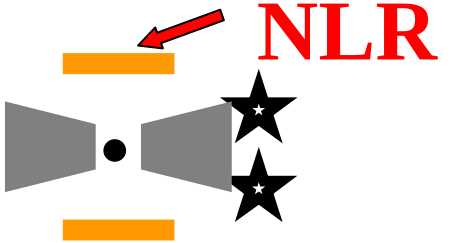
17/27 (63%) LINER ULIRGs
(statistically complete)

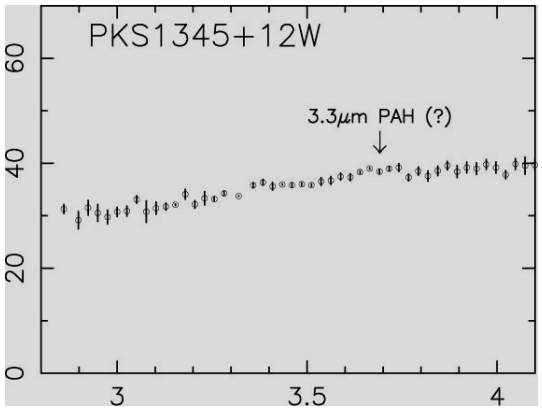
Pure buried AGNs
Show LINER spectra

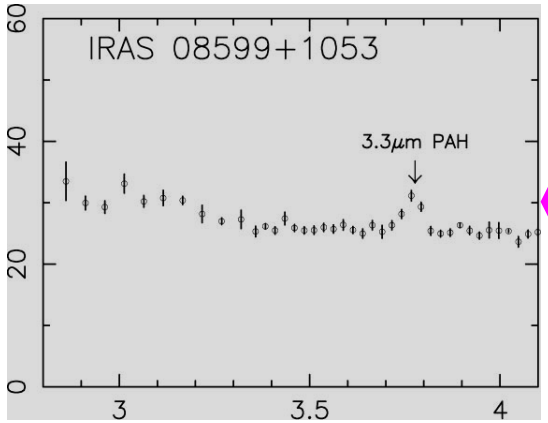
3/13 (23%) HII-region ULIRGs
(complete at RA=10-22hr)

Powerful buried AGN fraction: LINER > HII

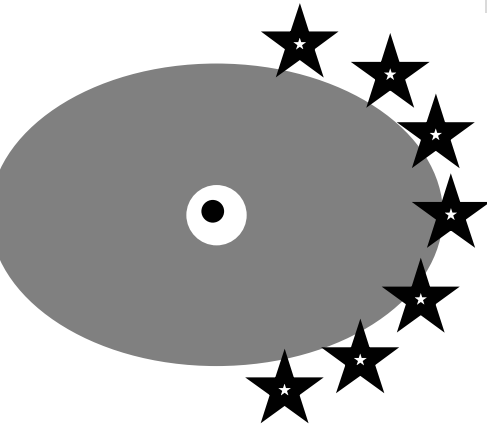
Our line-of-sight obscuration: Non-Sy >> Sy2

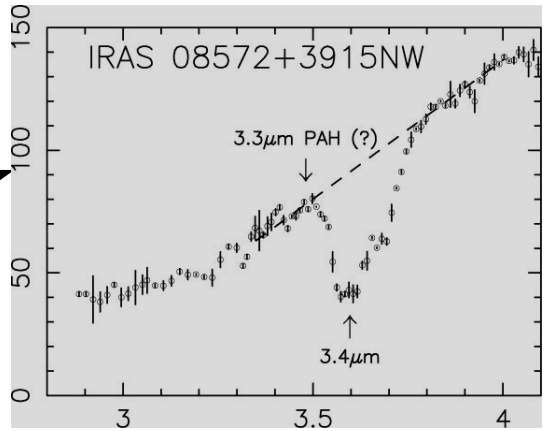


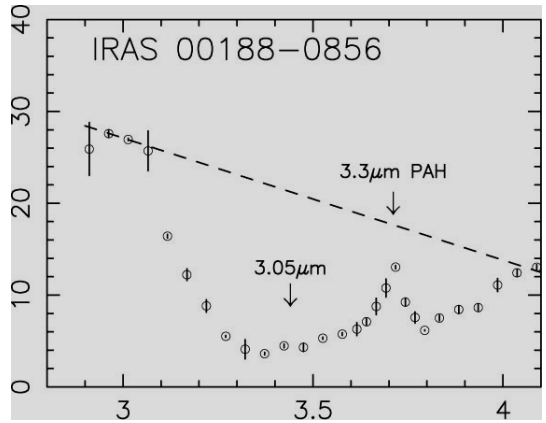




Sy2: Abs weak





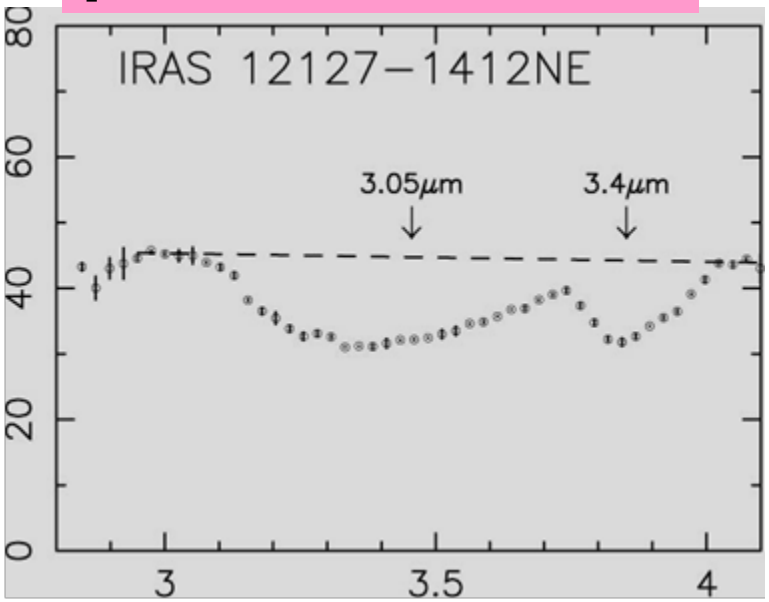


Non-Sy: strong

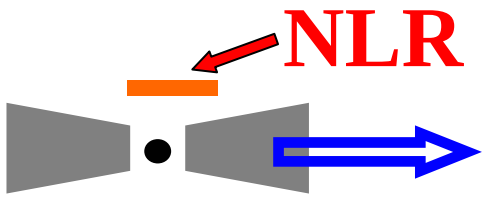
Amount of nuclear dust: Non-Sy >> Sy2

Buried AGNs: both warm/cool FIR colors

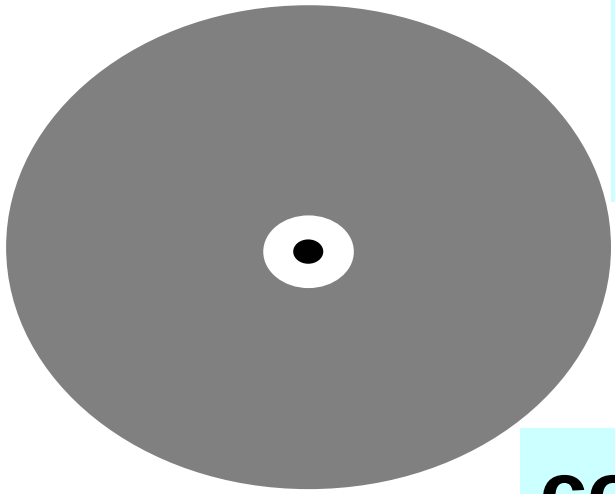
pure buried AGN



F25/F60=0.16(cool)



warm



larger dust column

cool FIR color

cool ≠ starburst

Summary

1. Buried AGNs fraction: LINER > HII-region

warm & cool

2. Nuclear dust amount:
non-Sy ULIRGs > Sy2 ULIRGs

→ **Optical Sy (non-)detectability depends on the amount of nuclear dust**

↓

It is important to understand optically-elusive buried AGNs in ULIRGs.

(Imanishi et al. 2005, astro-ph/0509861)
ApJ, in press