Multi-band AGN and Starburst signatures

Anna Feltre - IAP

in collaboration with

E. Hatziminaoglou - ESO, A. Hernán-Caballero - IFCA,

J. Fritz (ITM) - A. Franceschini (Univ. of Padova)

S. Charlot, J. Gutkin & NEOGAL group - IAP

credit to ESO/ M.Kornmesser

AGN11 - Where Black Hole and Galaxies Meet - 23-26 September - Trieste

AGN and SB co-exist in galaxies at all redshift

(e.g. Farrah et al. 2003, Alexander et al. 2005)

M-σ relation

(e.g. Magorrian et al. 1998, Ferrarese & Merritt 2000; Tremaine et al. 2002; Häring & Rix 2004; Gültekin et al. 2009)

quasar number density and SFH of the Universe

(e.g. Madau et al. 1998, Heavens et al. 2004, Boyle & Terlevich 1998; Heavens et al. 2004; Richards et al.2006 etc)

feedback from AGN in cosmological simulations and semi-analytical models (e.g. Blandford & Rees 1974; Zanni et al. 2005; Di Matteo et al. 2005; Bower et al. 2006; Croton et al. 2006; Booth & Shaye 2009; Wagner & Bicknell 2011)

Molecular outflows

(e.g. Sturm et al. 2011; Brusa et al. 2014)

AGN and SB co-exist in galaxies at all redshift

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What is an AGN- or SB- dominated system when both phenomena are present?

Does the presence of an AGN have an impact on the properties of the host galaxy?

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Does the presence of an AGN have an impact on the properties of the host galaxy?

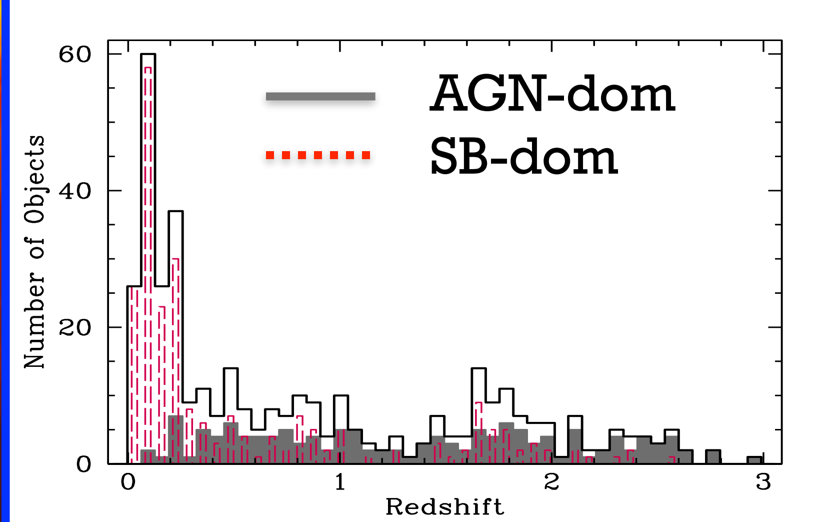
possible effects on the IR properties of the host galaxy

HerMES/IRS SAMPLE

375 sources

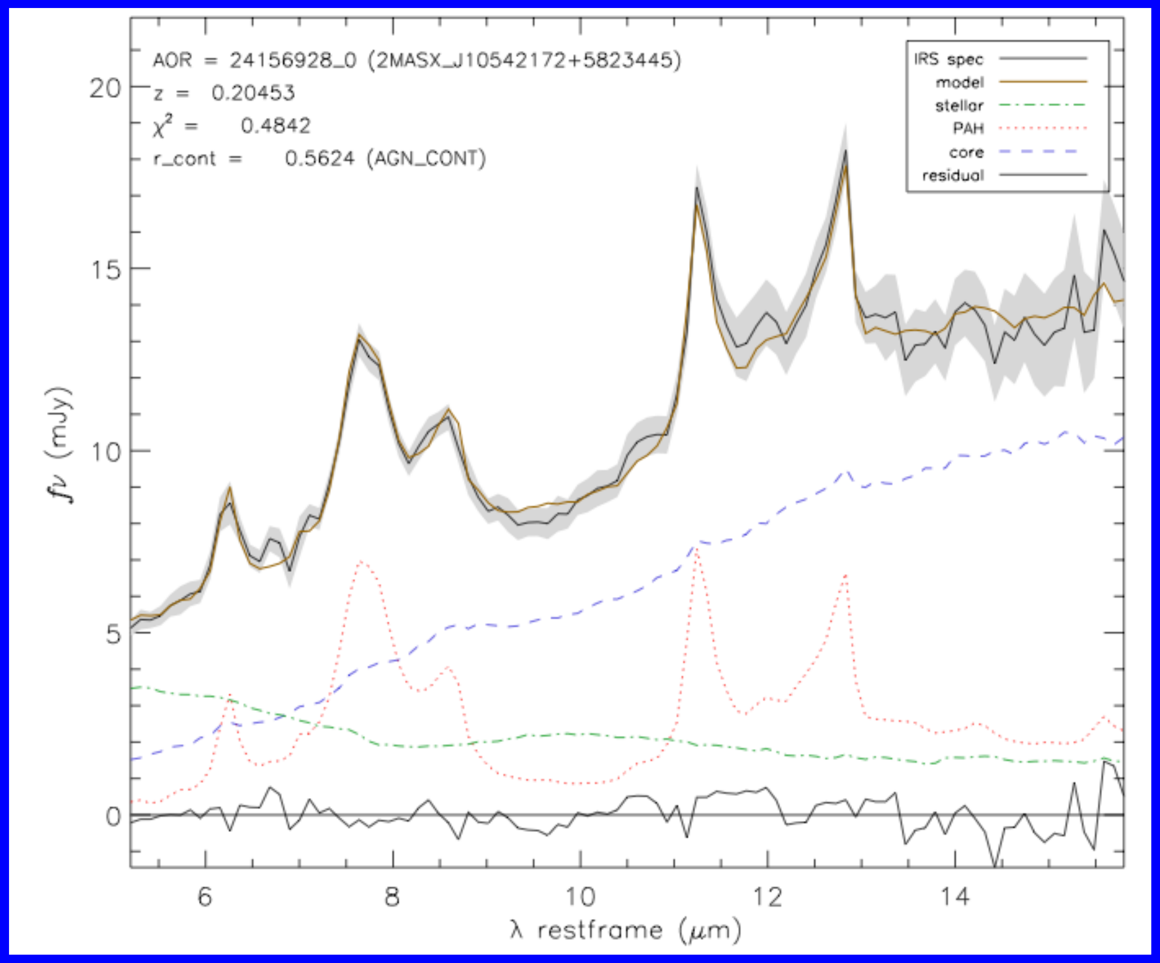
- detected >3σ at 250 μm
- in the northern HerMES fields (Bootes, FLS, Lockman, EN1)
- IRS spectra available
- reliable estimates of z (optical or IRS)

BAND	DETECTIONS
IRAC 3.6 &	100%
IRAC 5.8 &	90%
MIPS 70 nm/	77%/43%
SPIRE 350	98%(72%)
SPIRE 500	84%(35%)
SDSS ugriz	73%



Feltre et al. 2013
CASSIS http://cassis.astro.cornell.edu/atlas
HerMES http://hermes.sussex.ac.uk

IRS SPECTRA DECOMPOSITION



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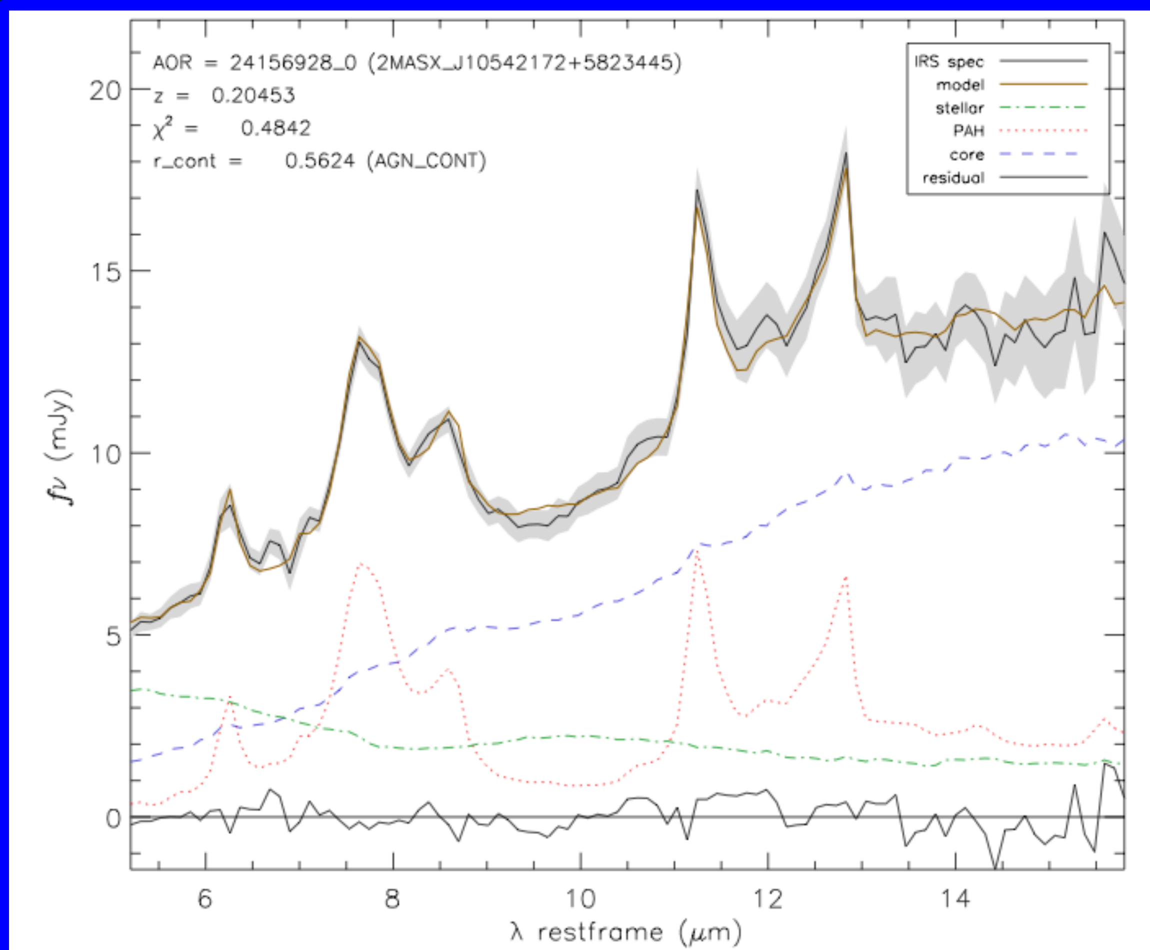

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* AGN and SB contribution to MIR (5-15μm)
* EW_{PAH} (6.2μm, 11.3μm)
* L_{PAH} ➡ SFR_{PAH}

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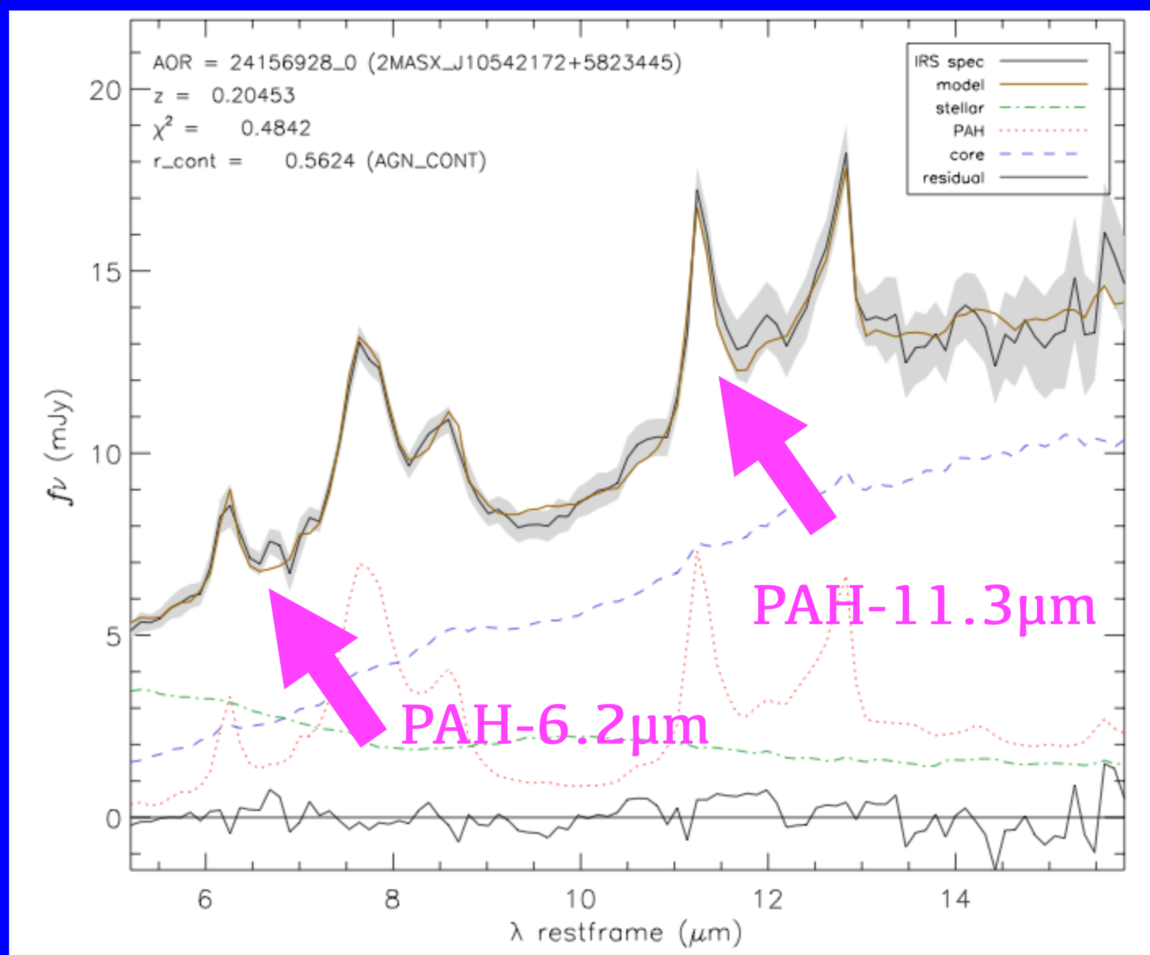

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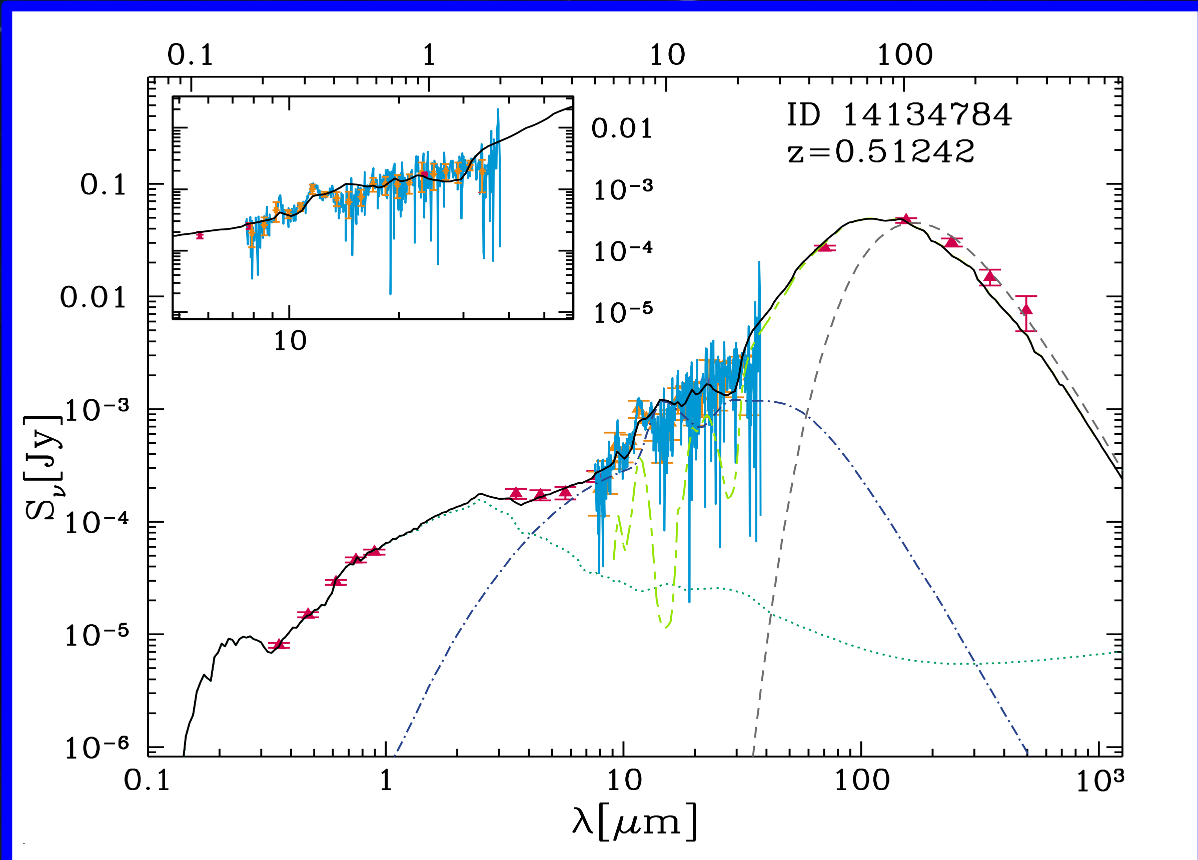

f_{AGN}, f_{SB} (L_{IR}[8-1000]μm)
L_{acc}, L_{IR}, L_{SB} ➡ SFR_{FIR}
M_{hot}, M_{cold}, T_{cold}

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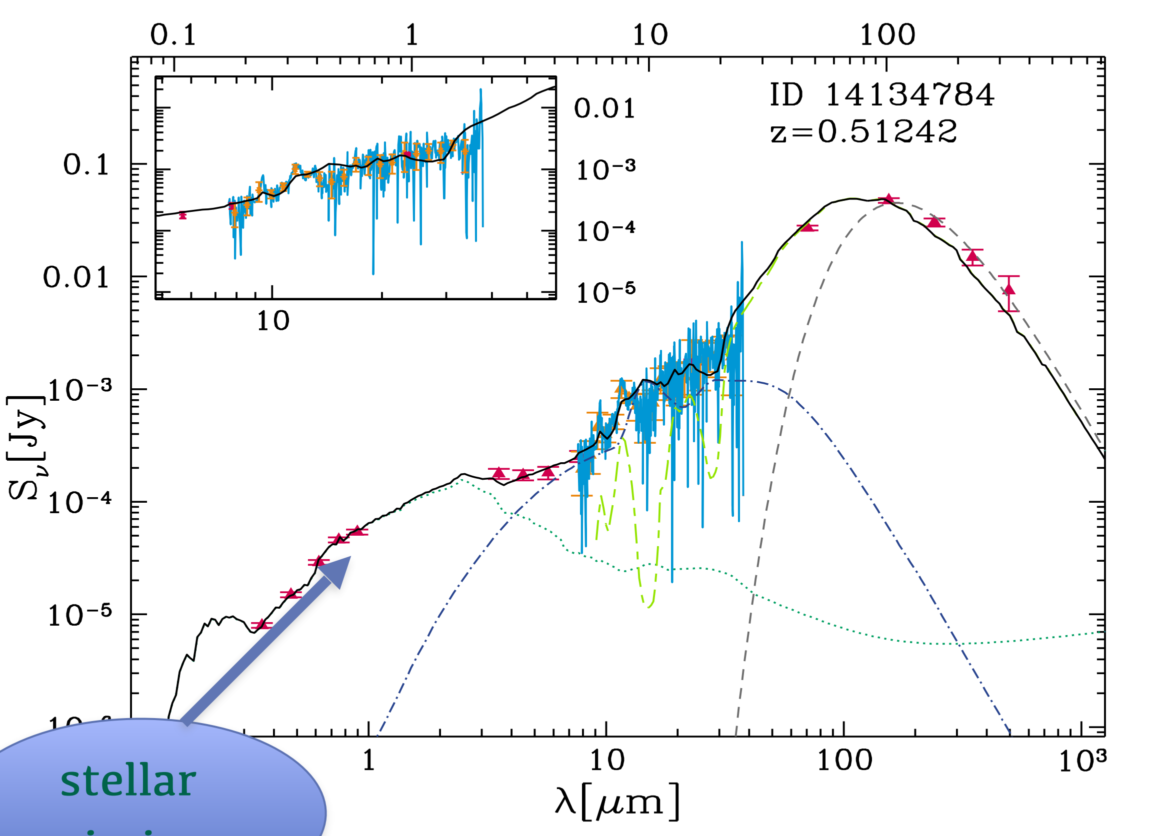

stellar emission

SSP models
Bertelli 1994

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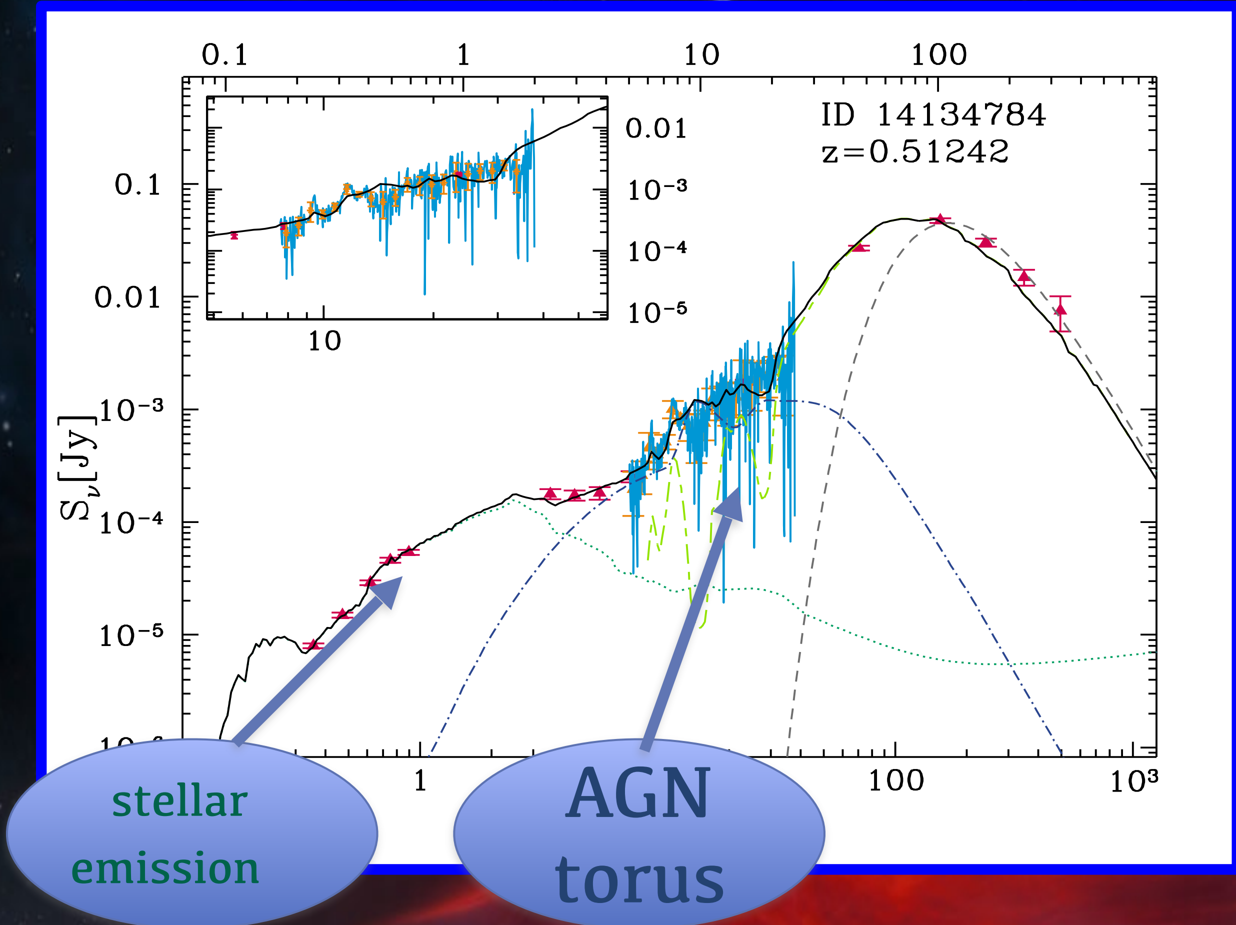

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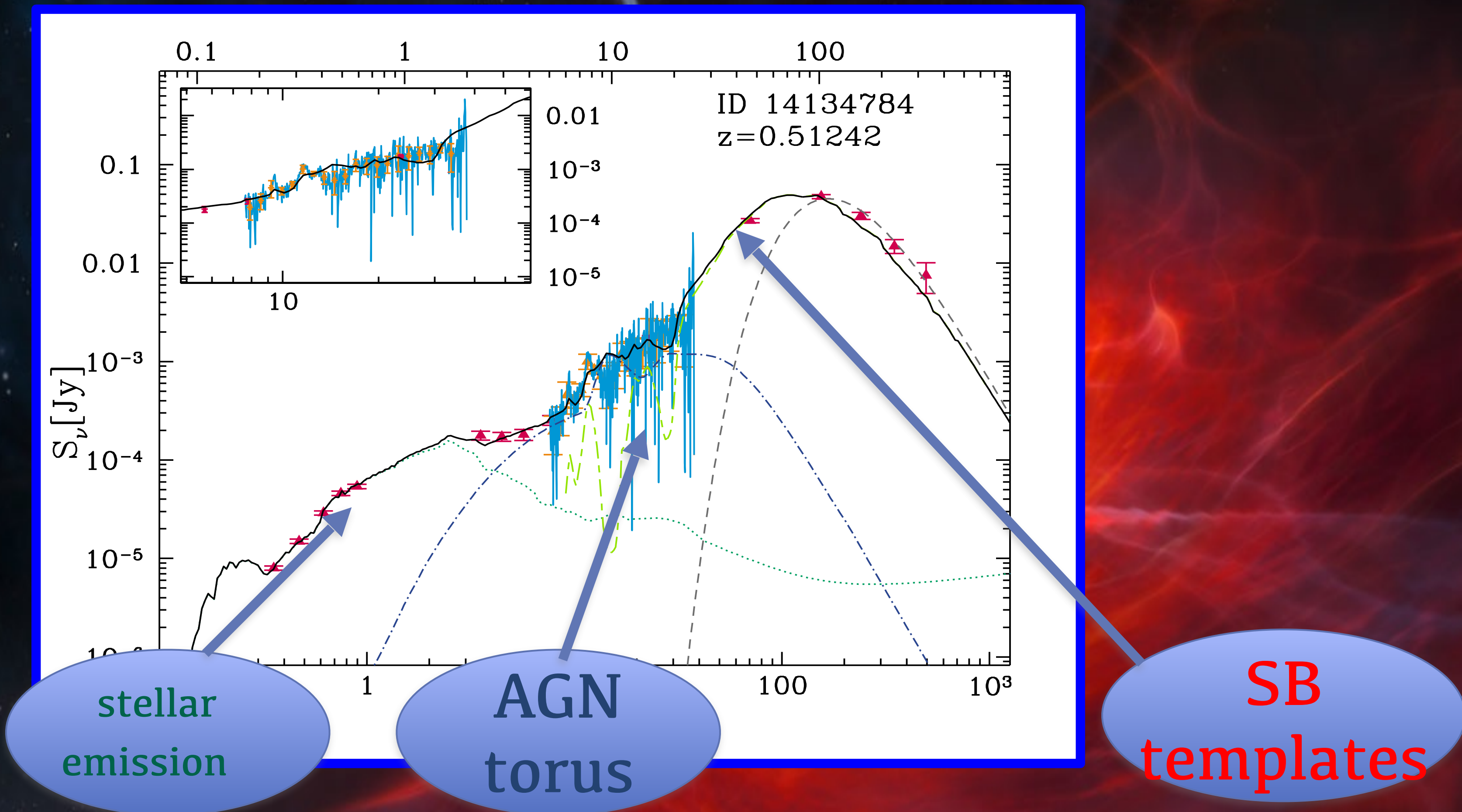

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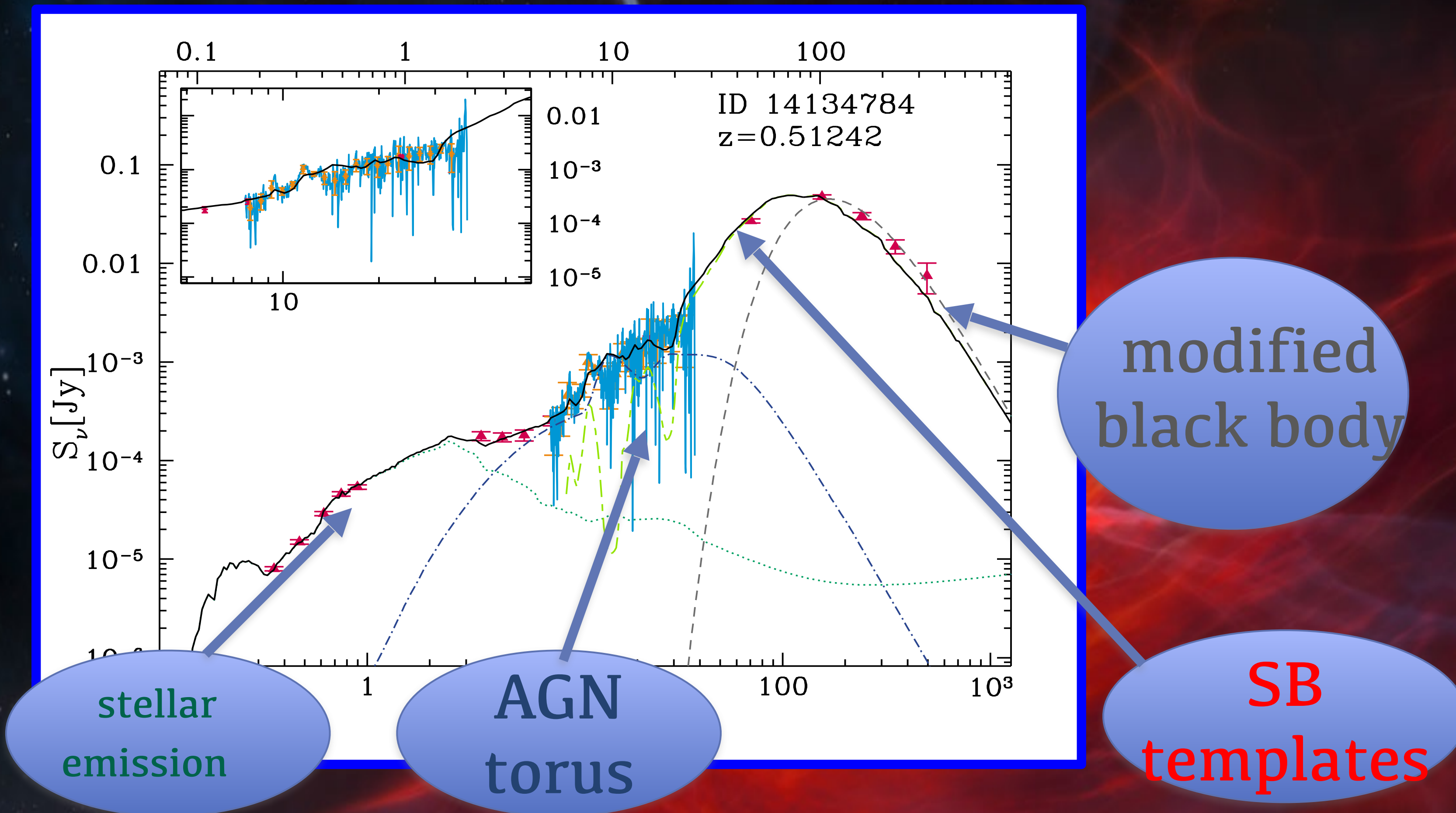

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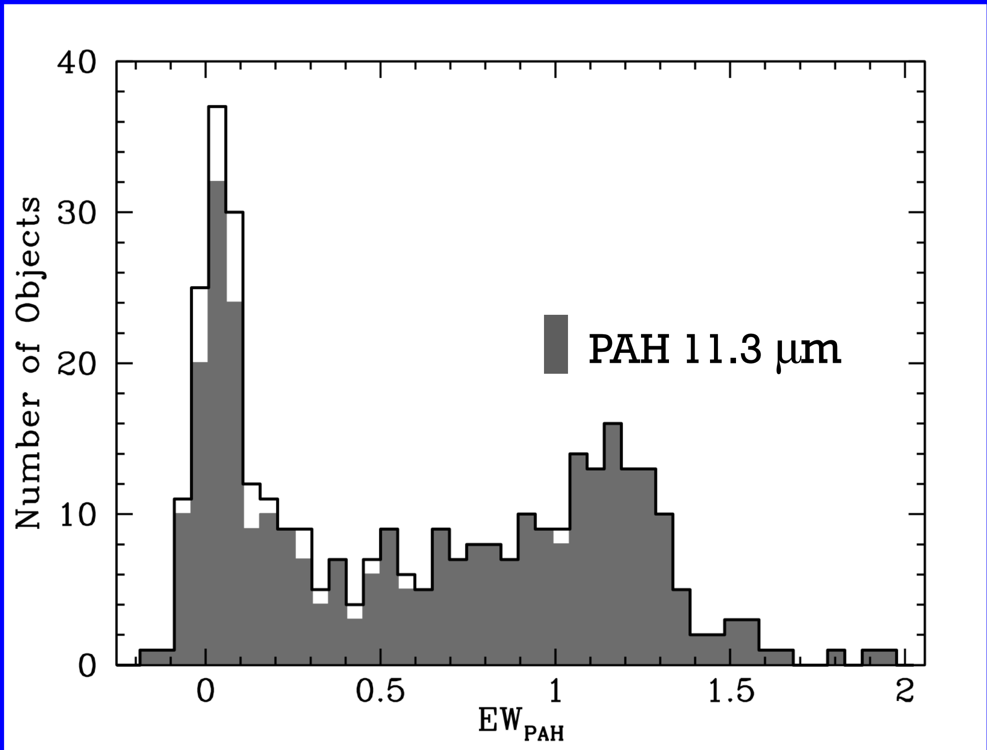
AGN and SF in mid-IR



$EW_{PAH\ (11.3|6.2\mu m)} = 0.2$

e.g. Spoon et al. 07, Smith et al. 2007,
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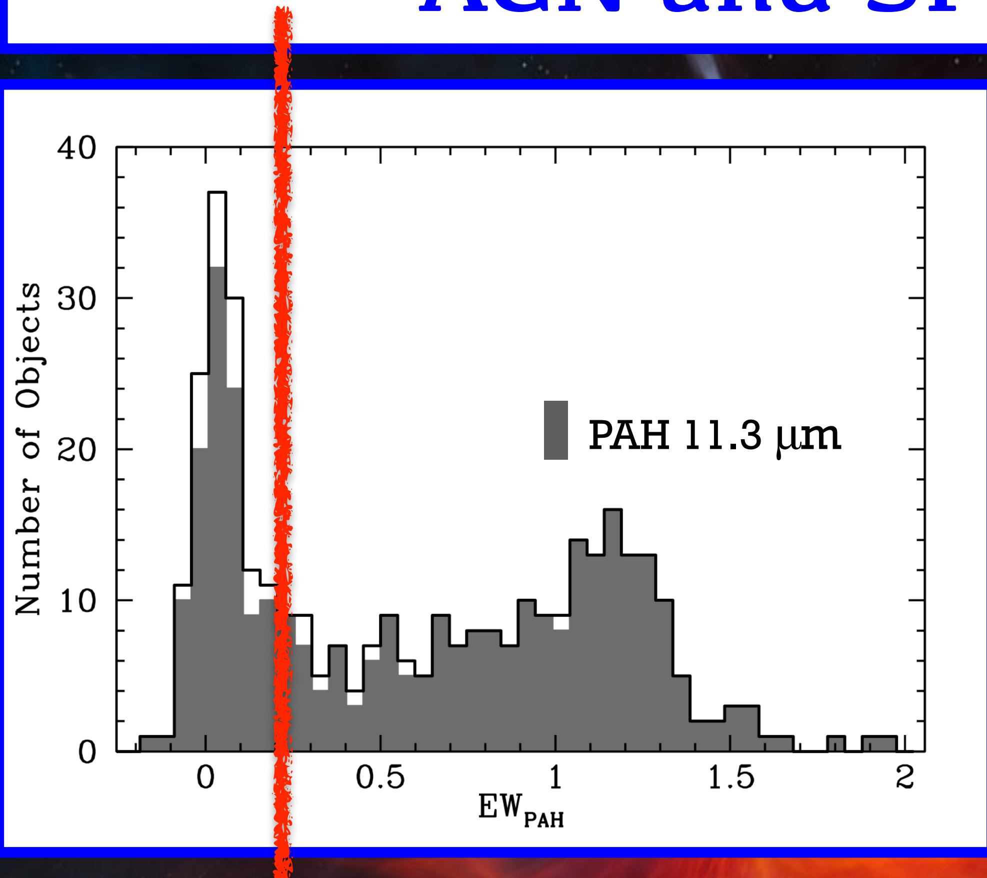

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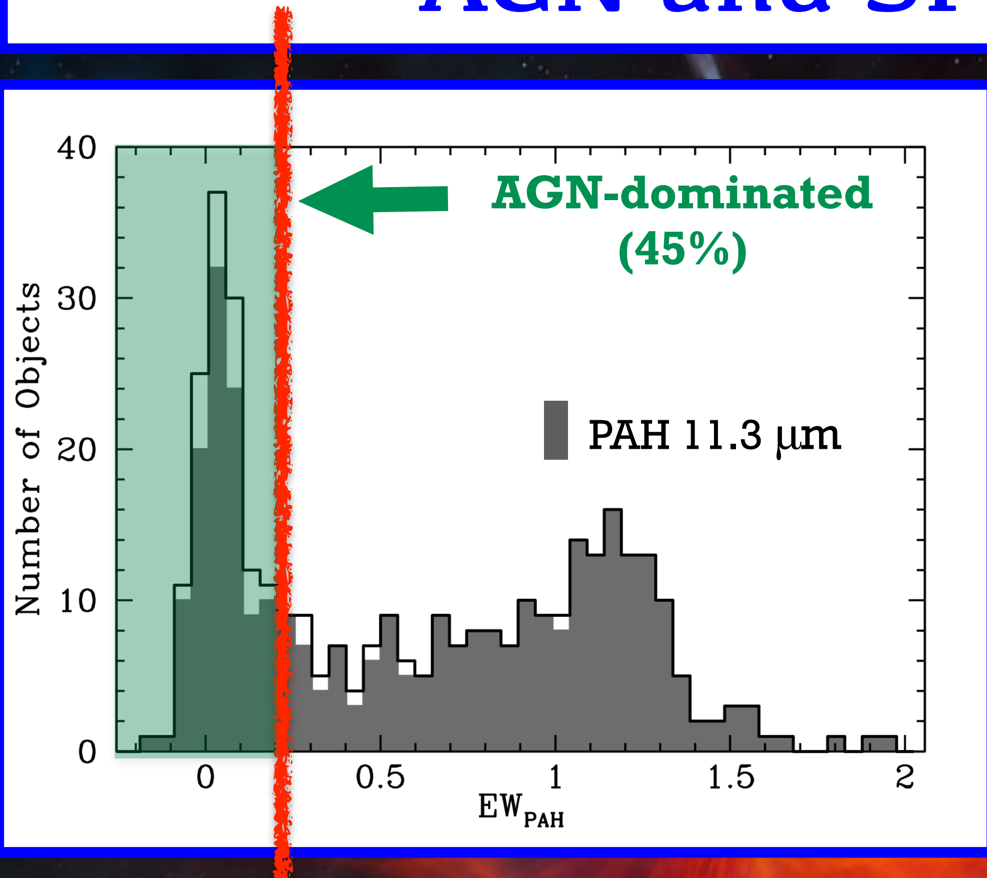

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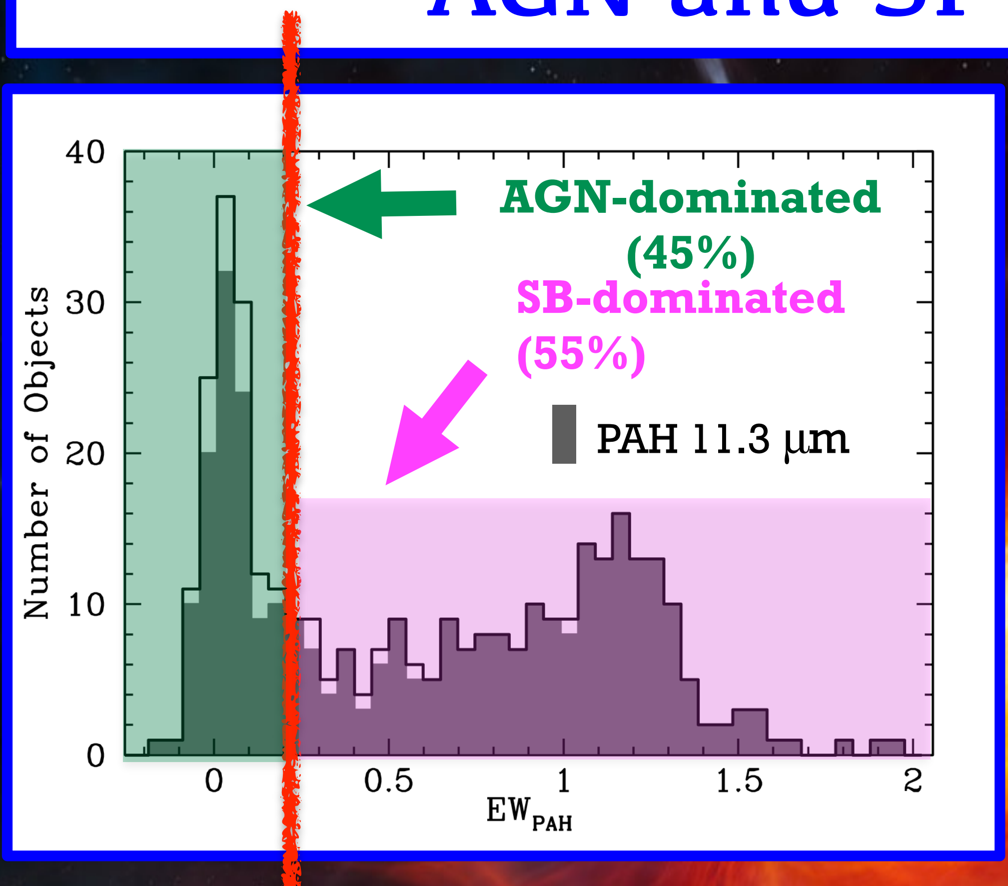

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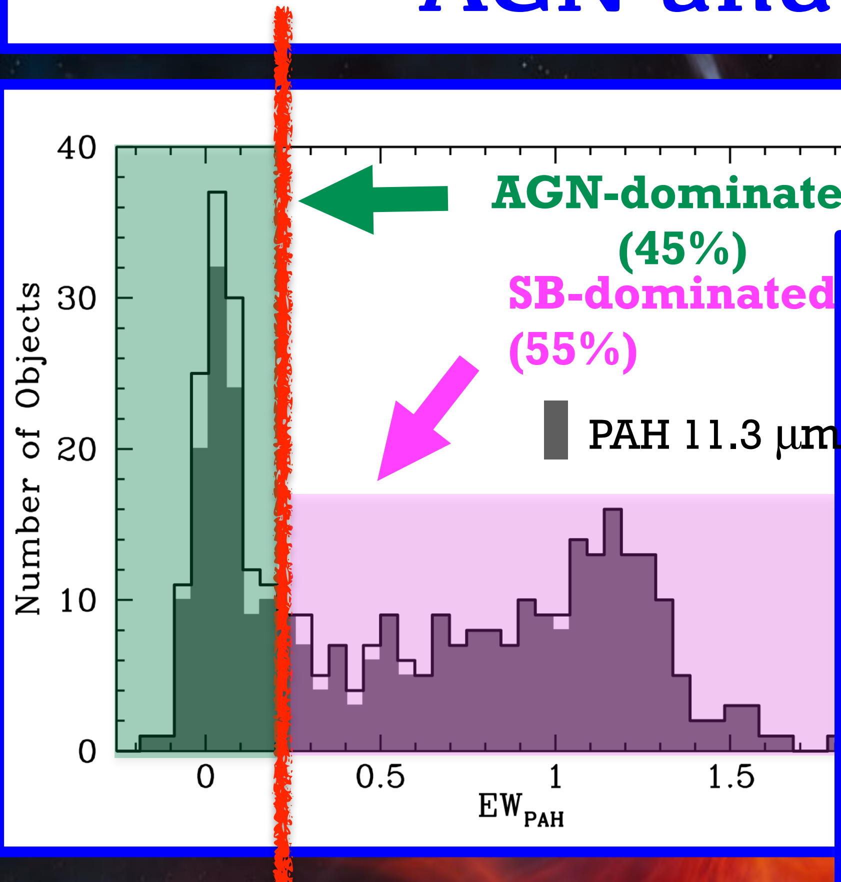

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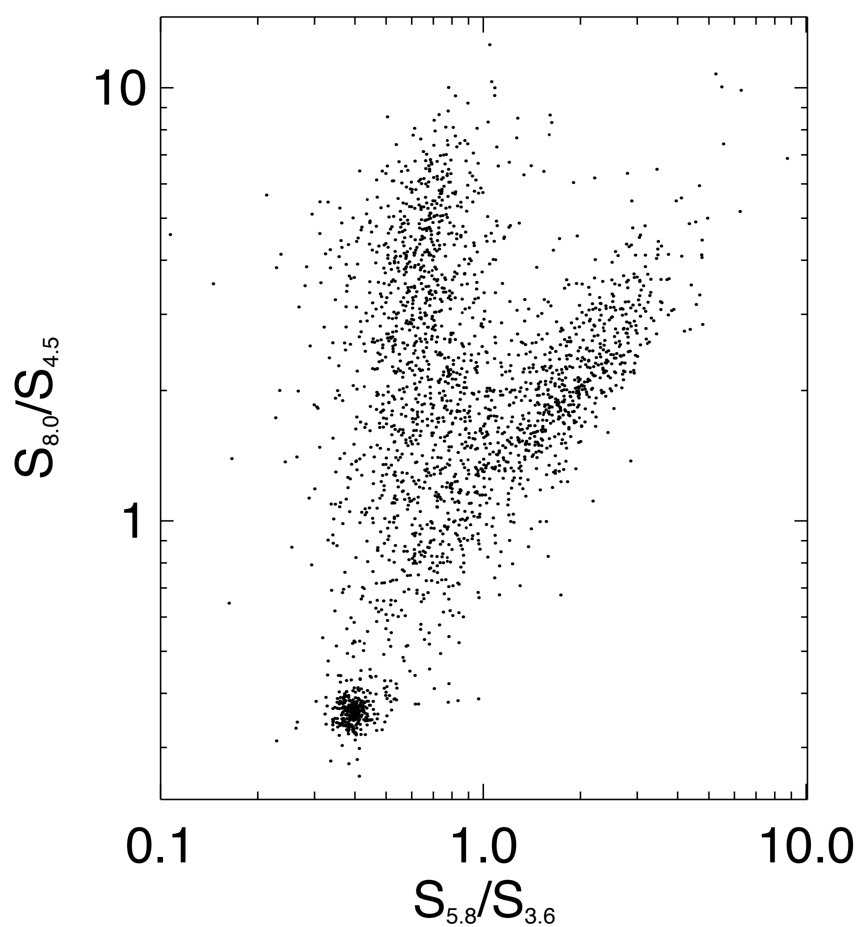

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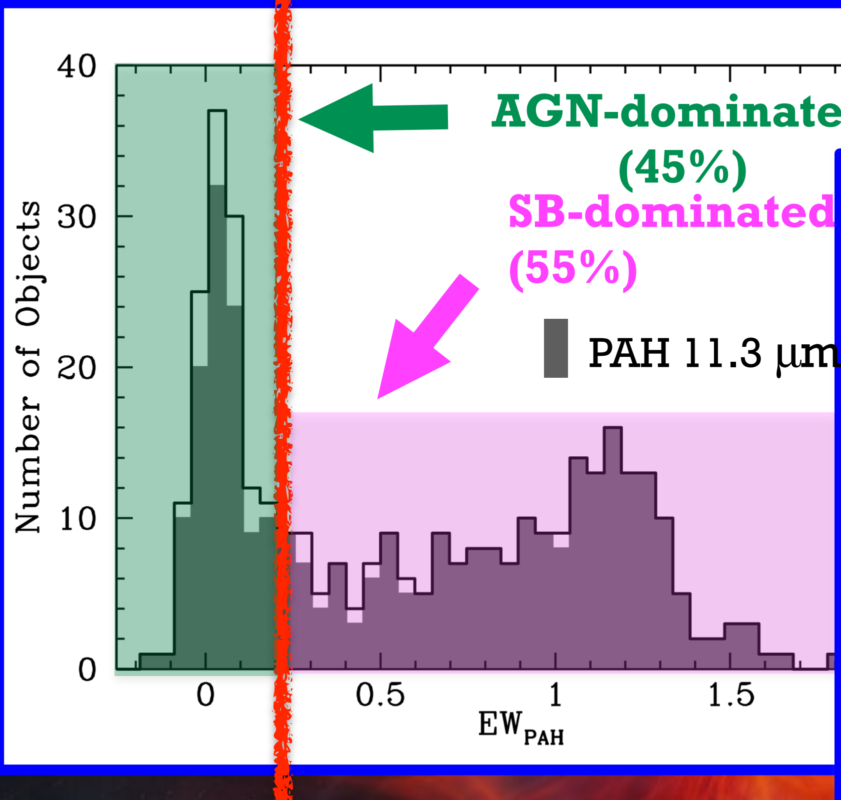

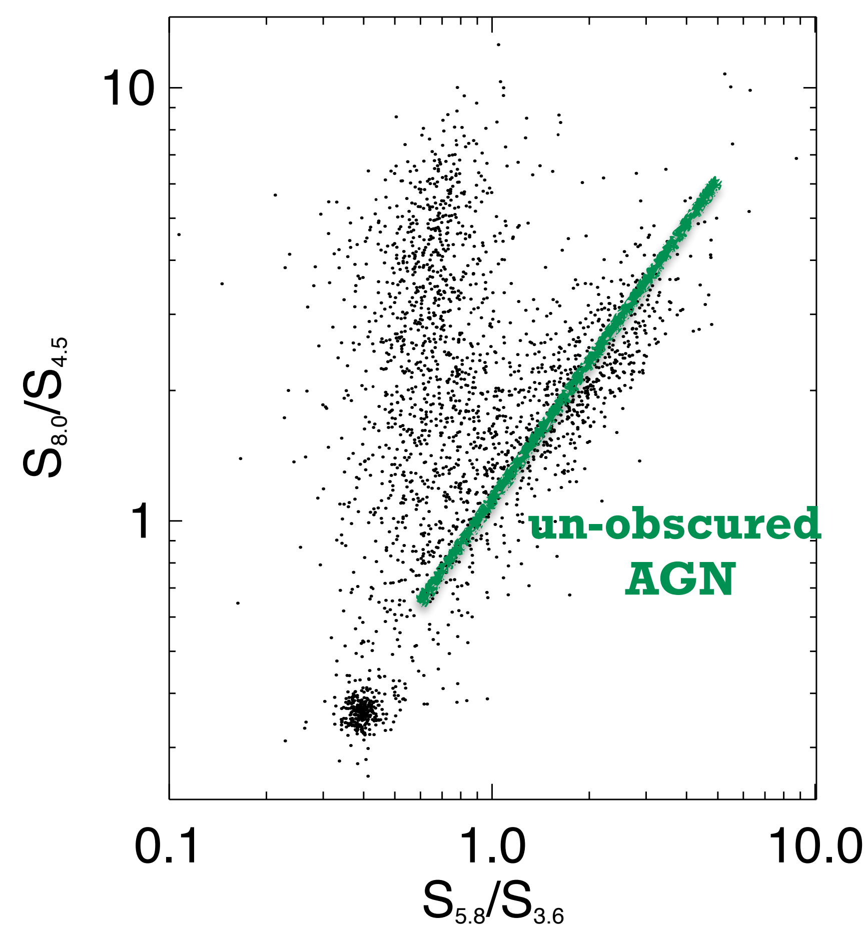

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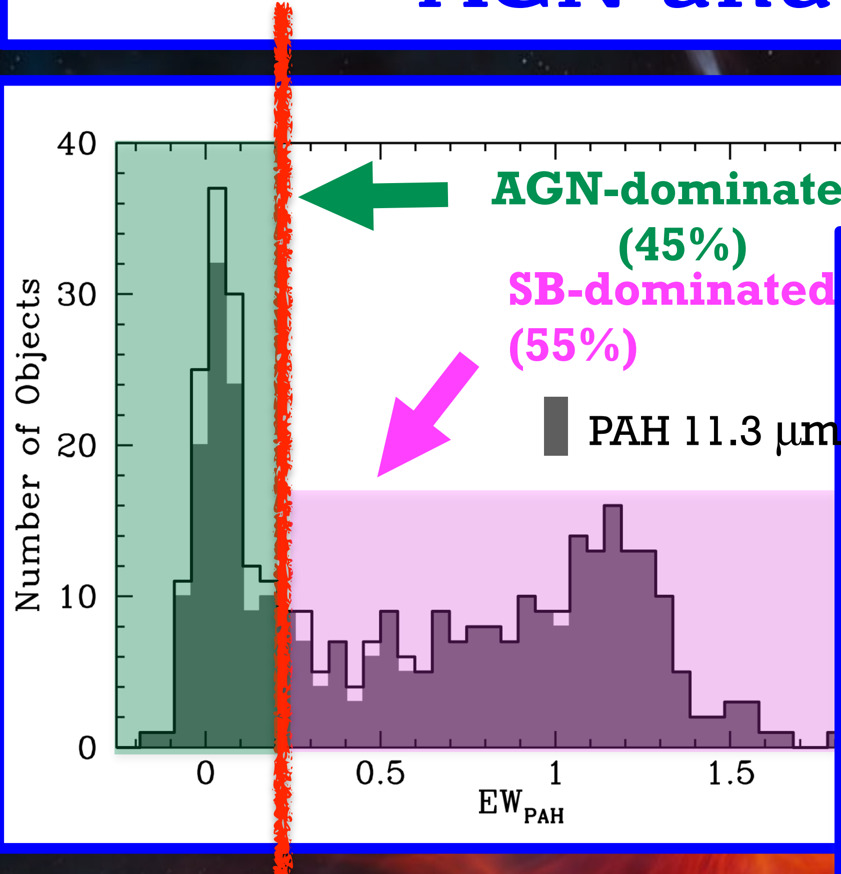

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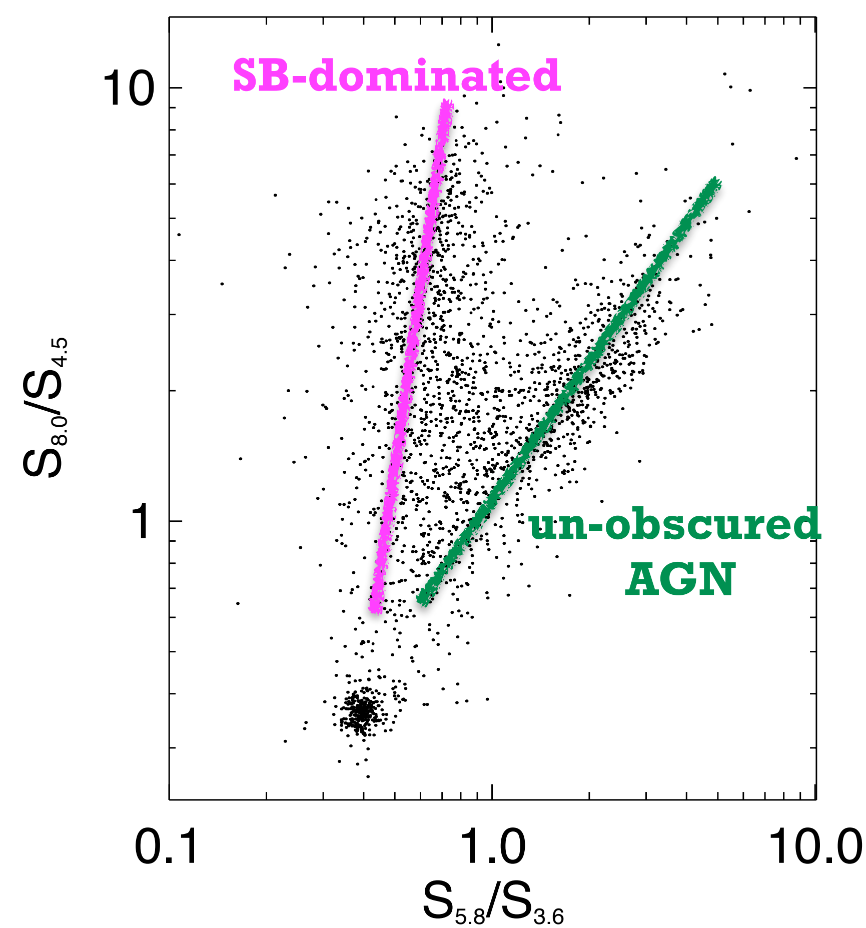

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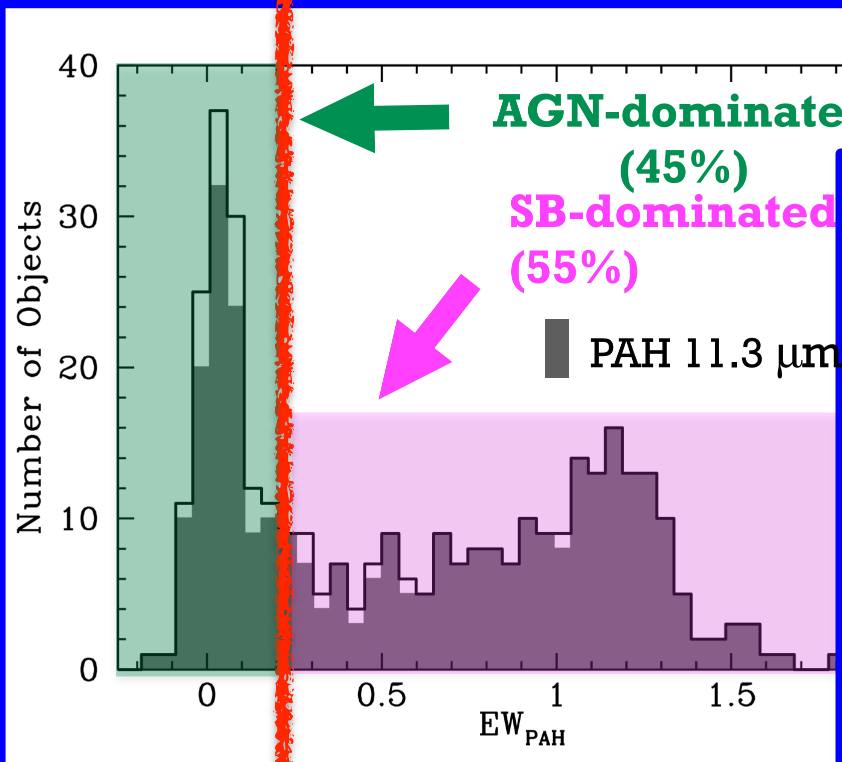

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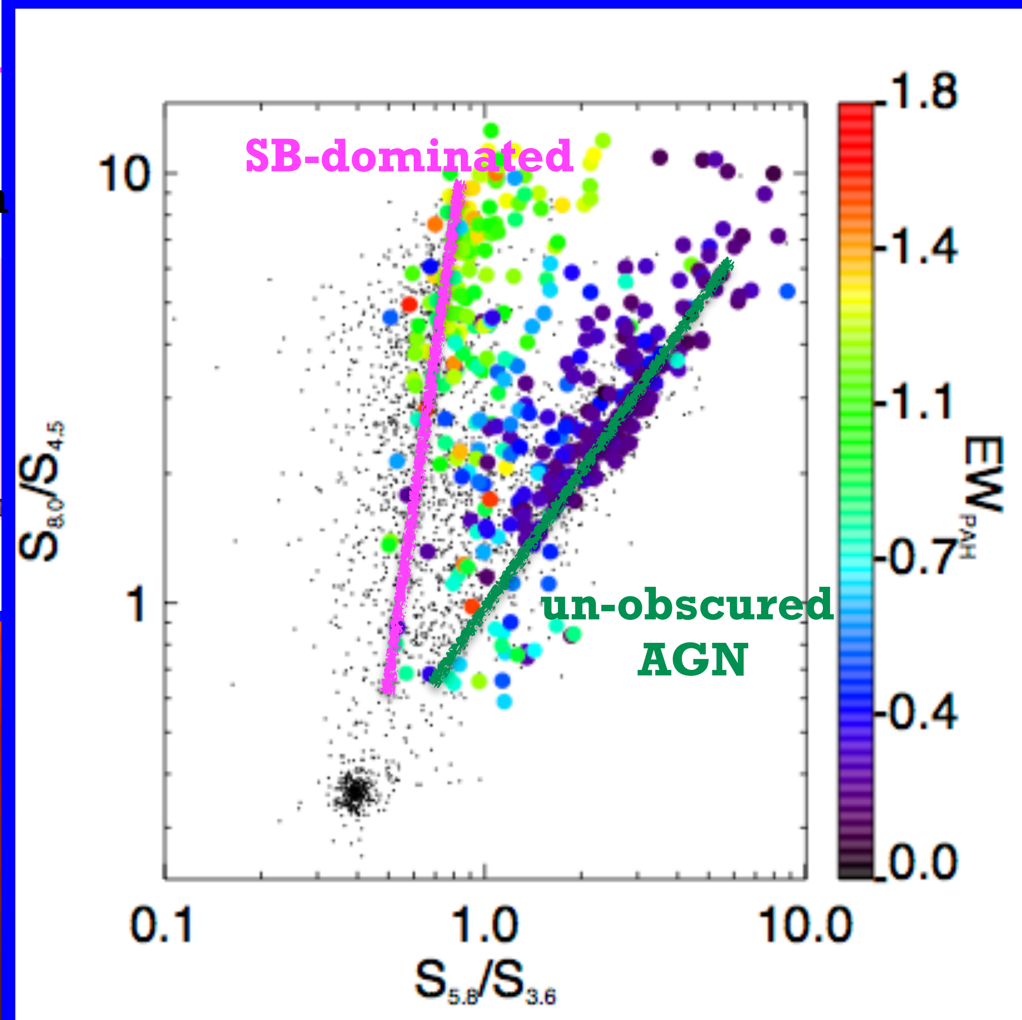

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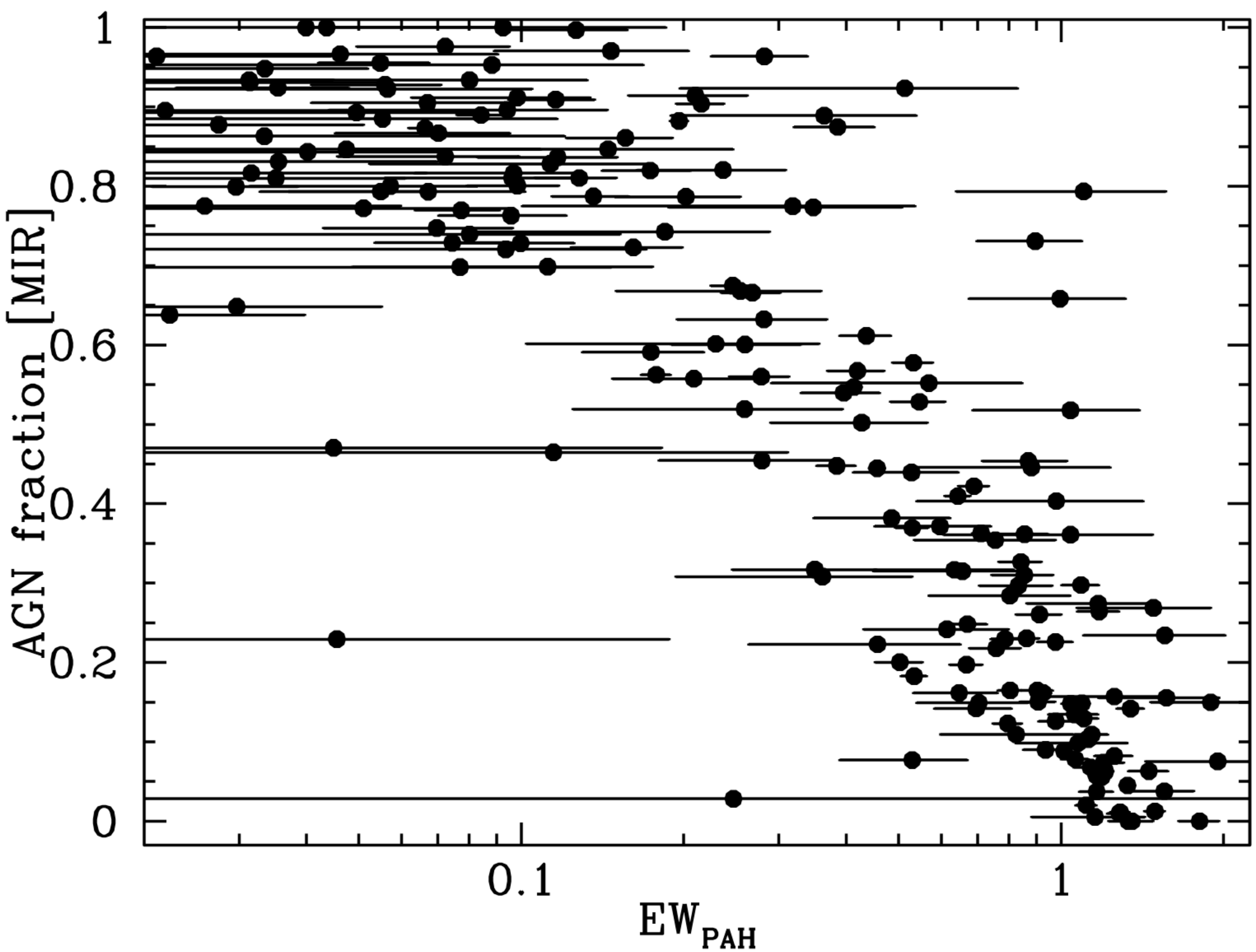

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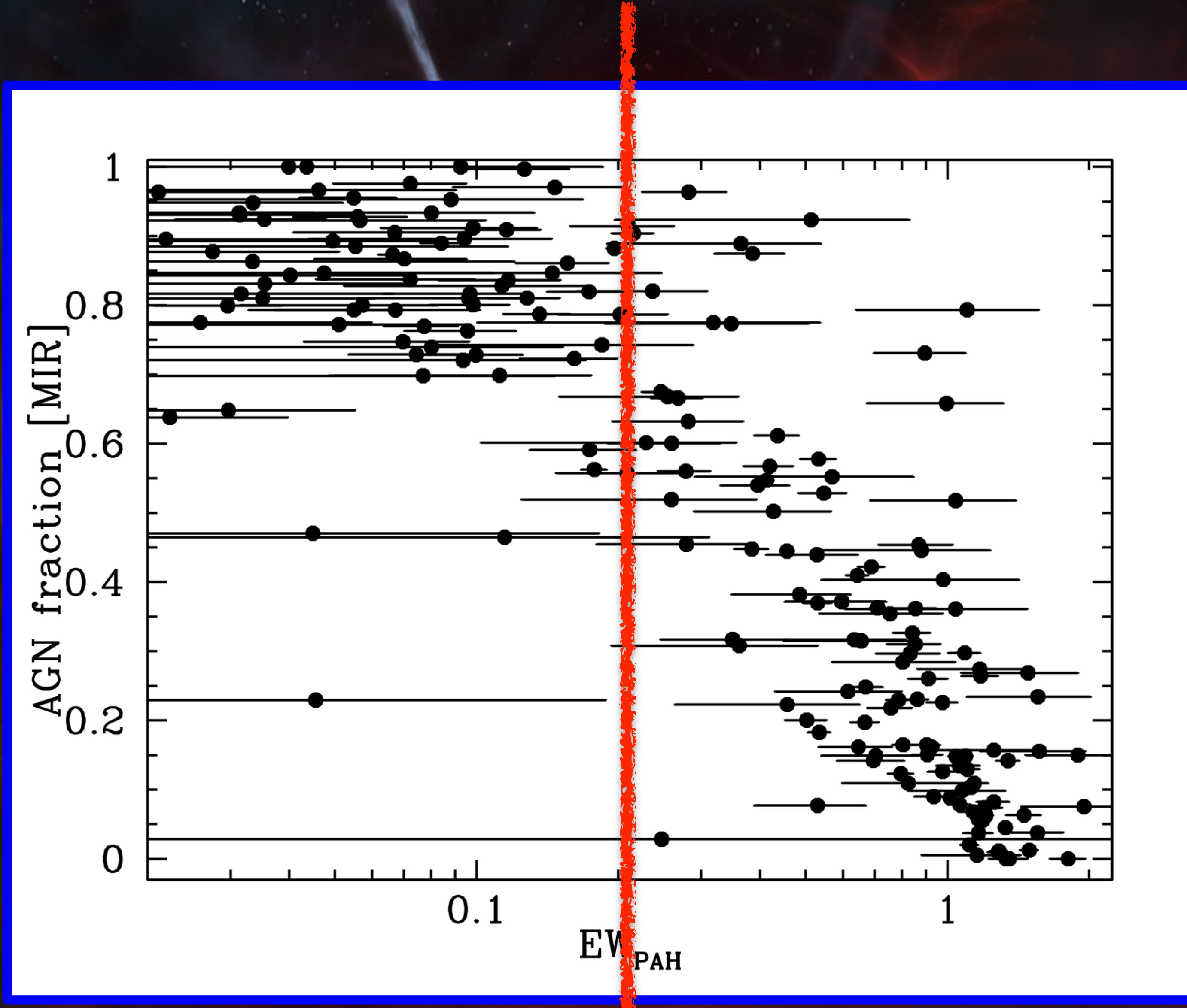

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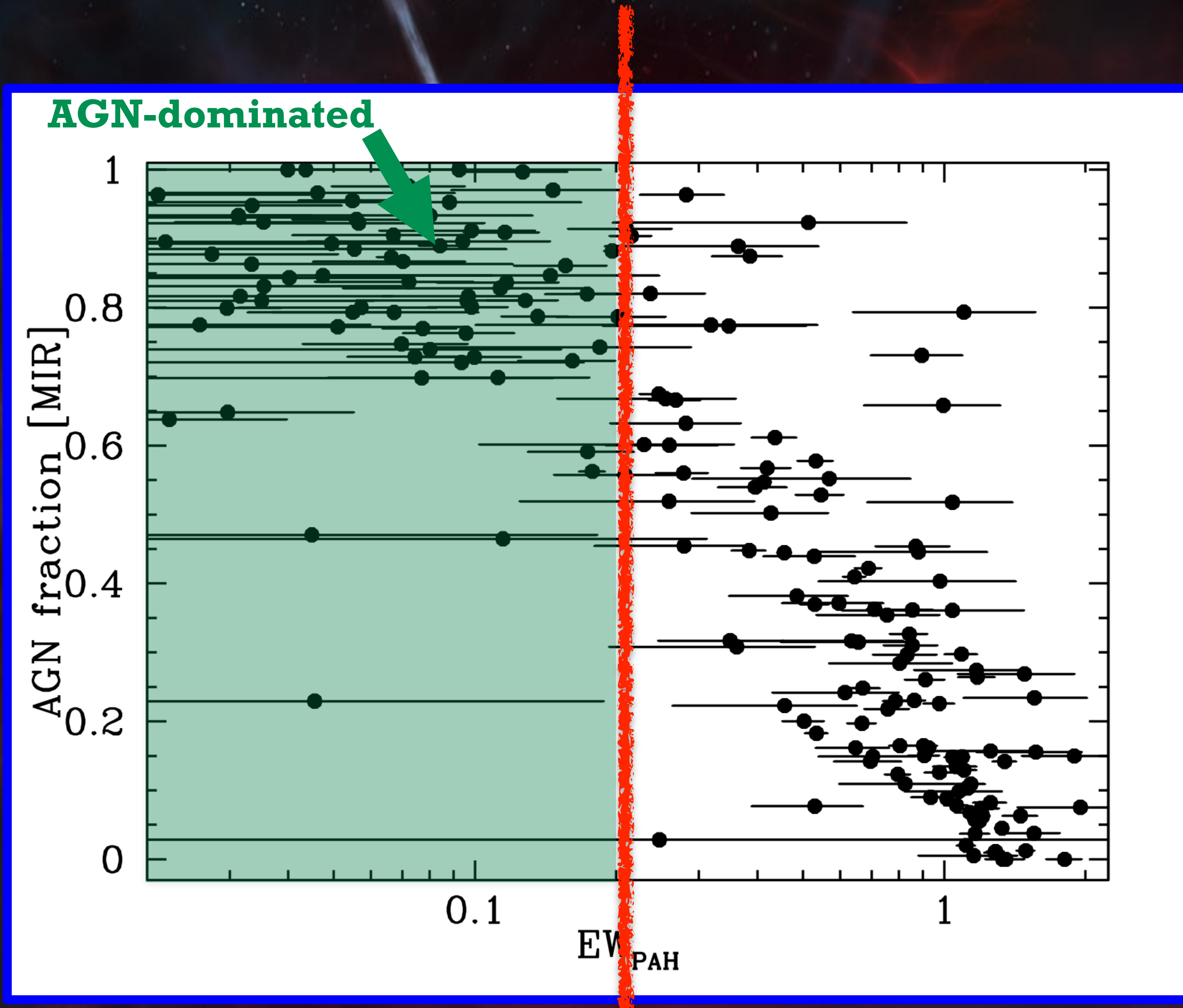

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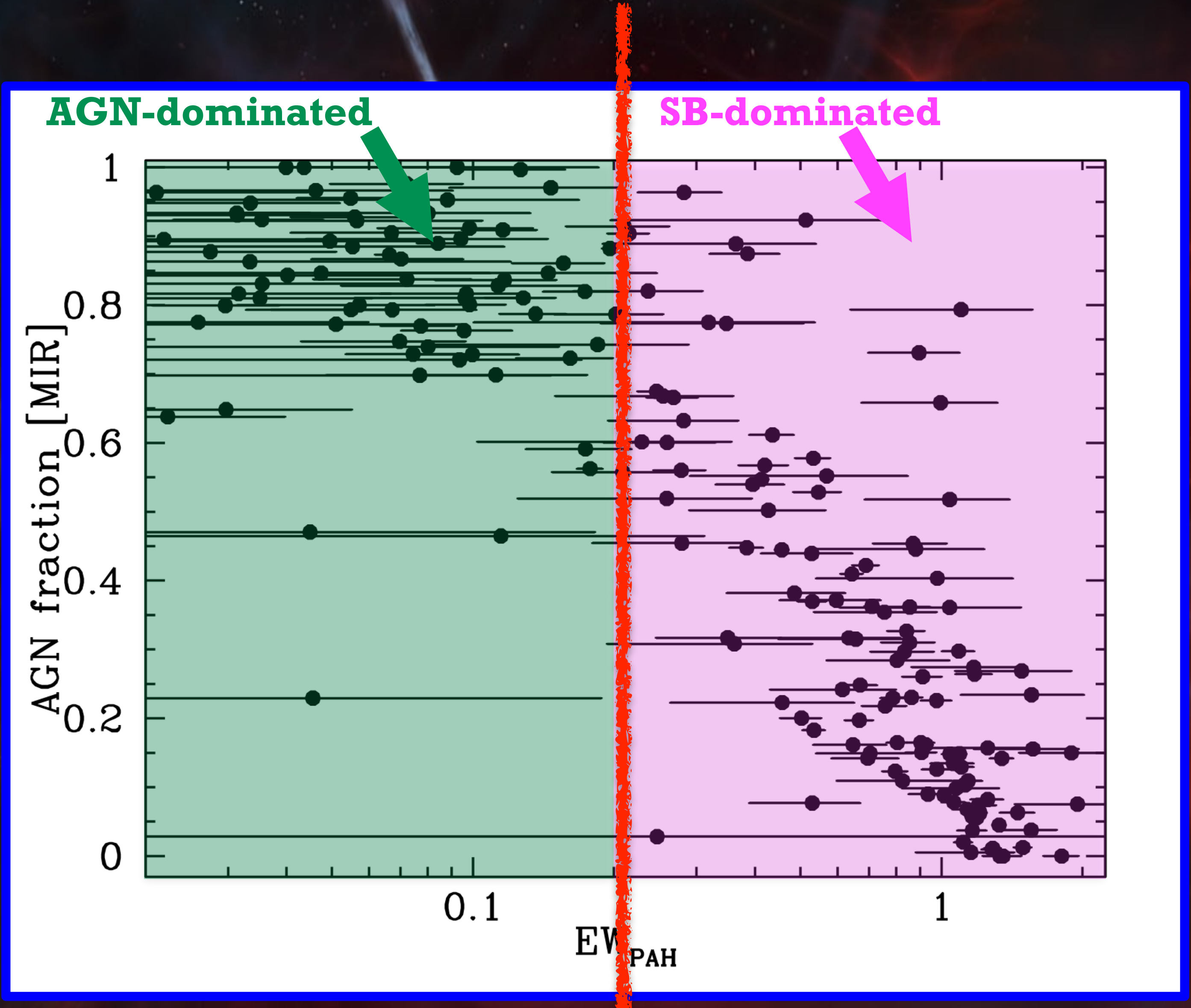

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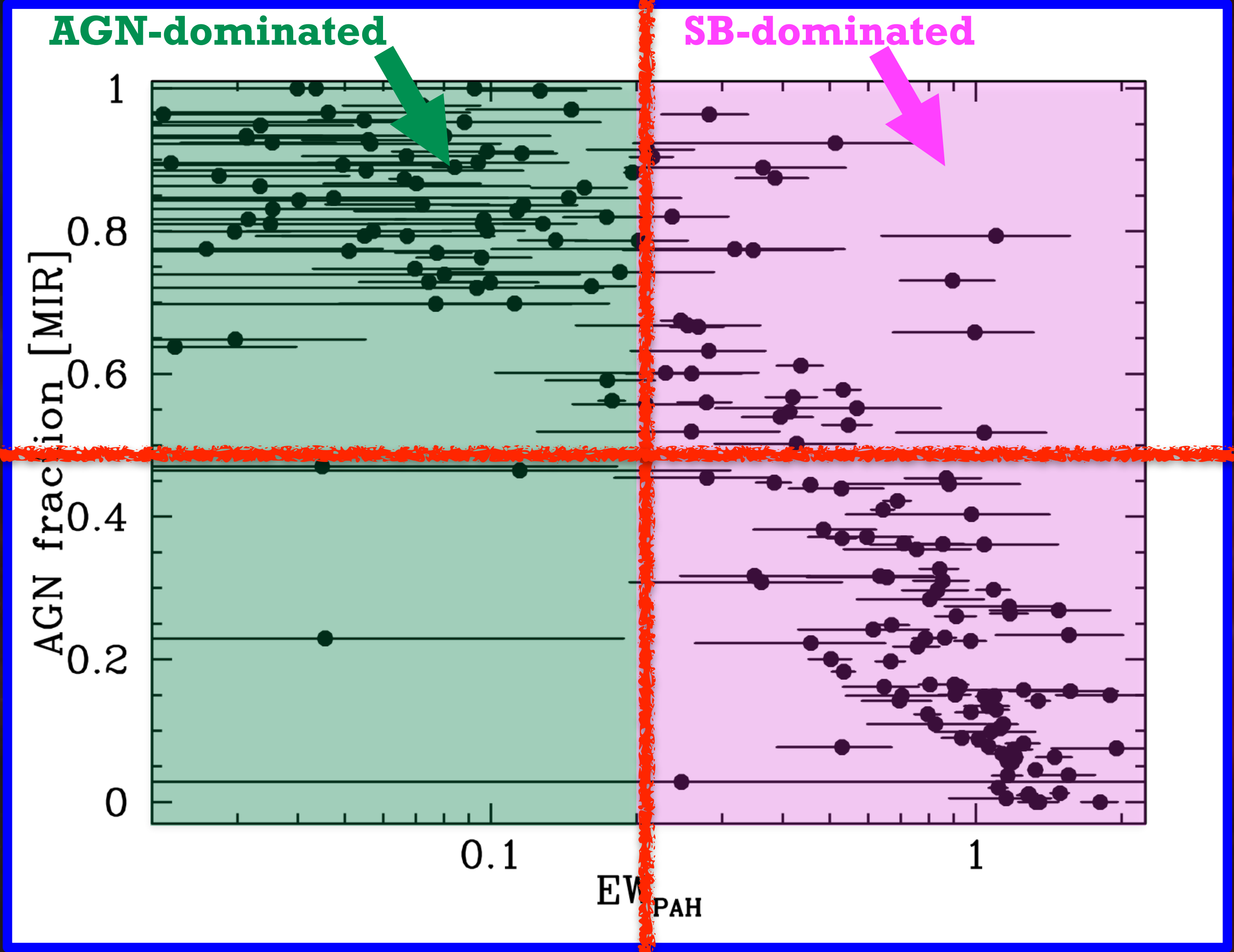

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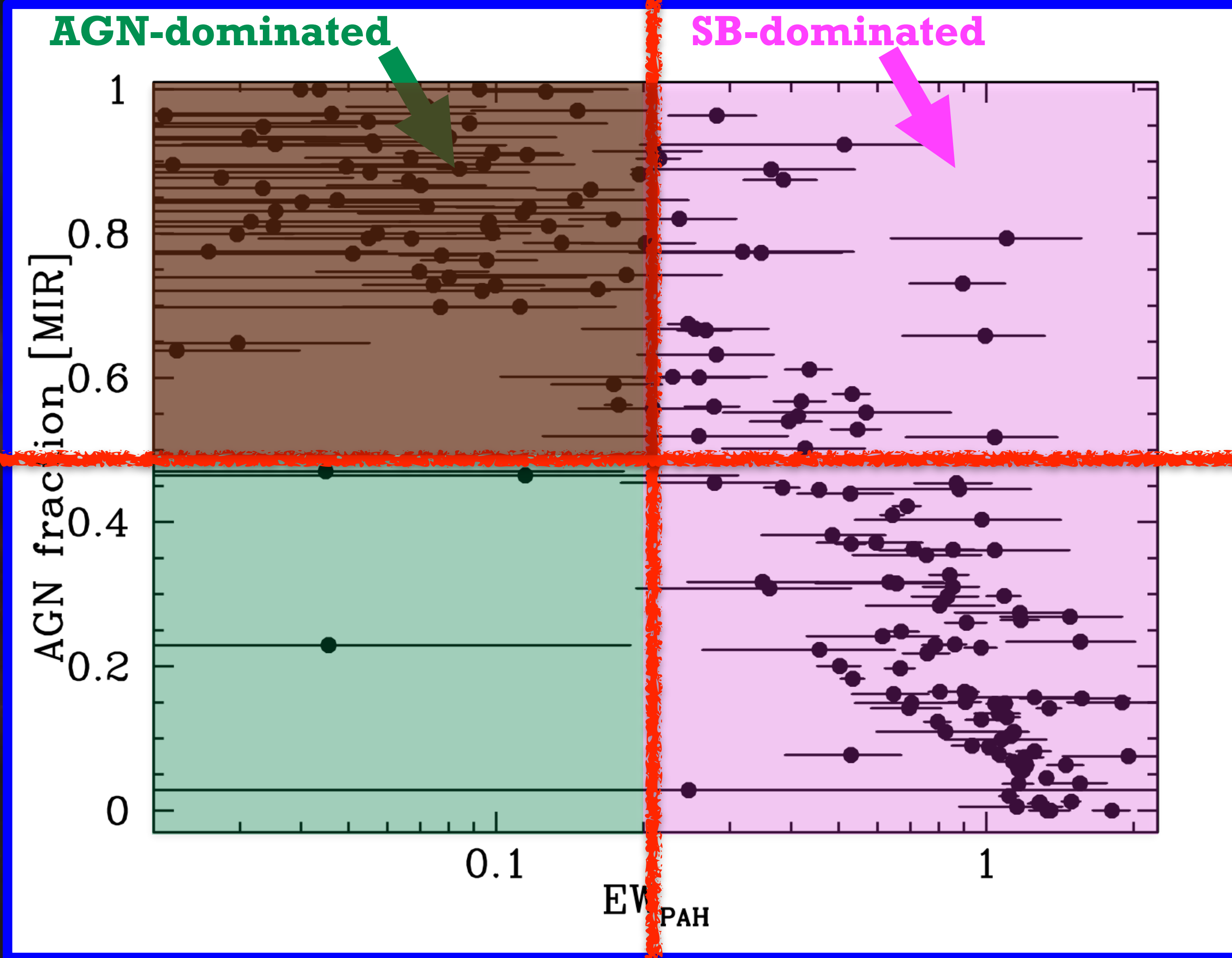

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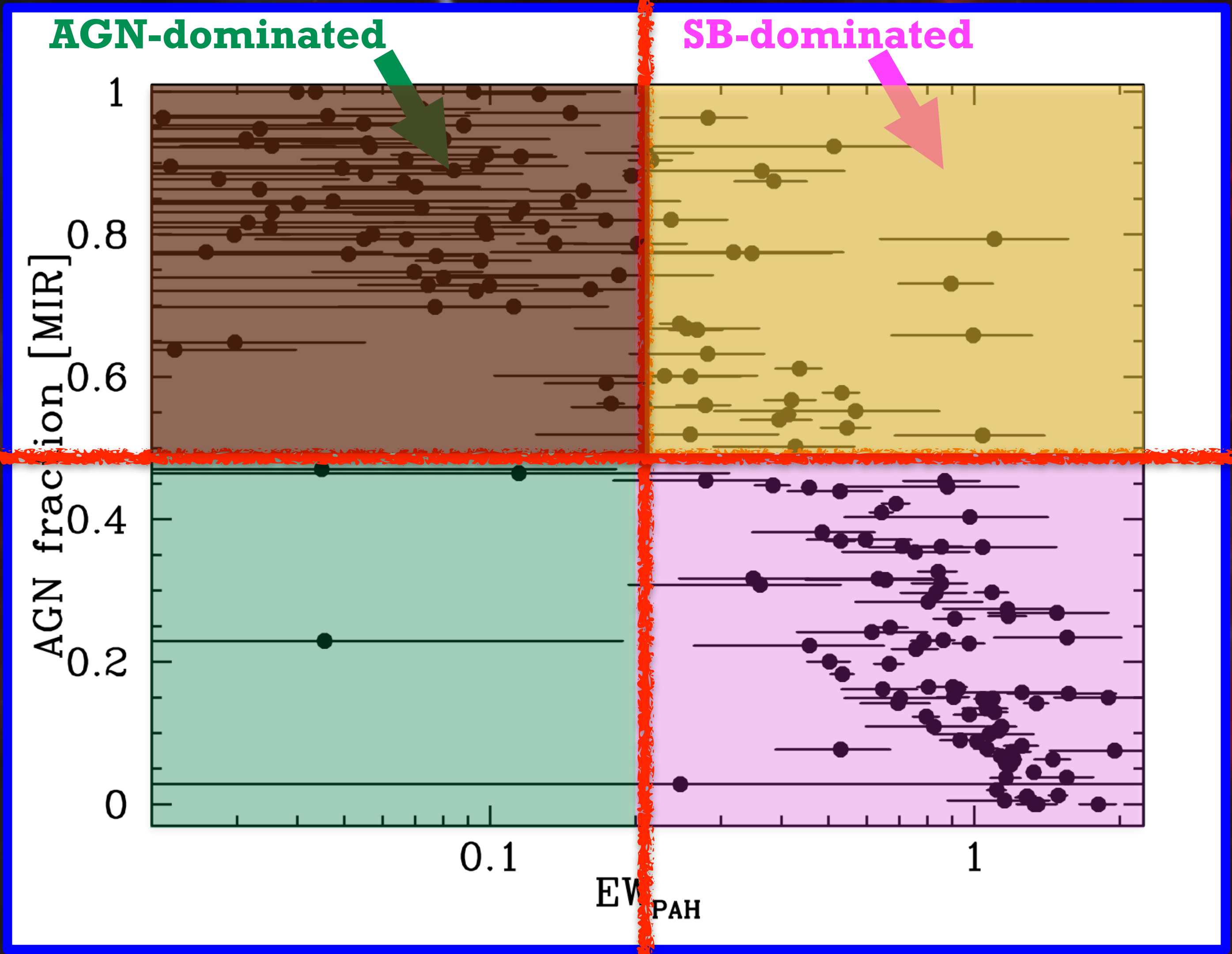
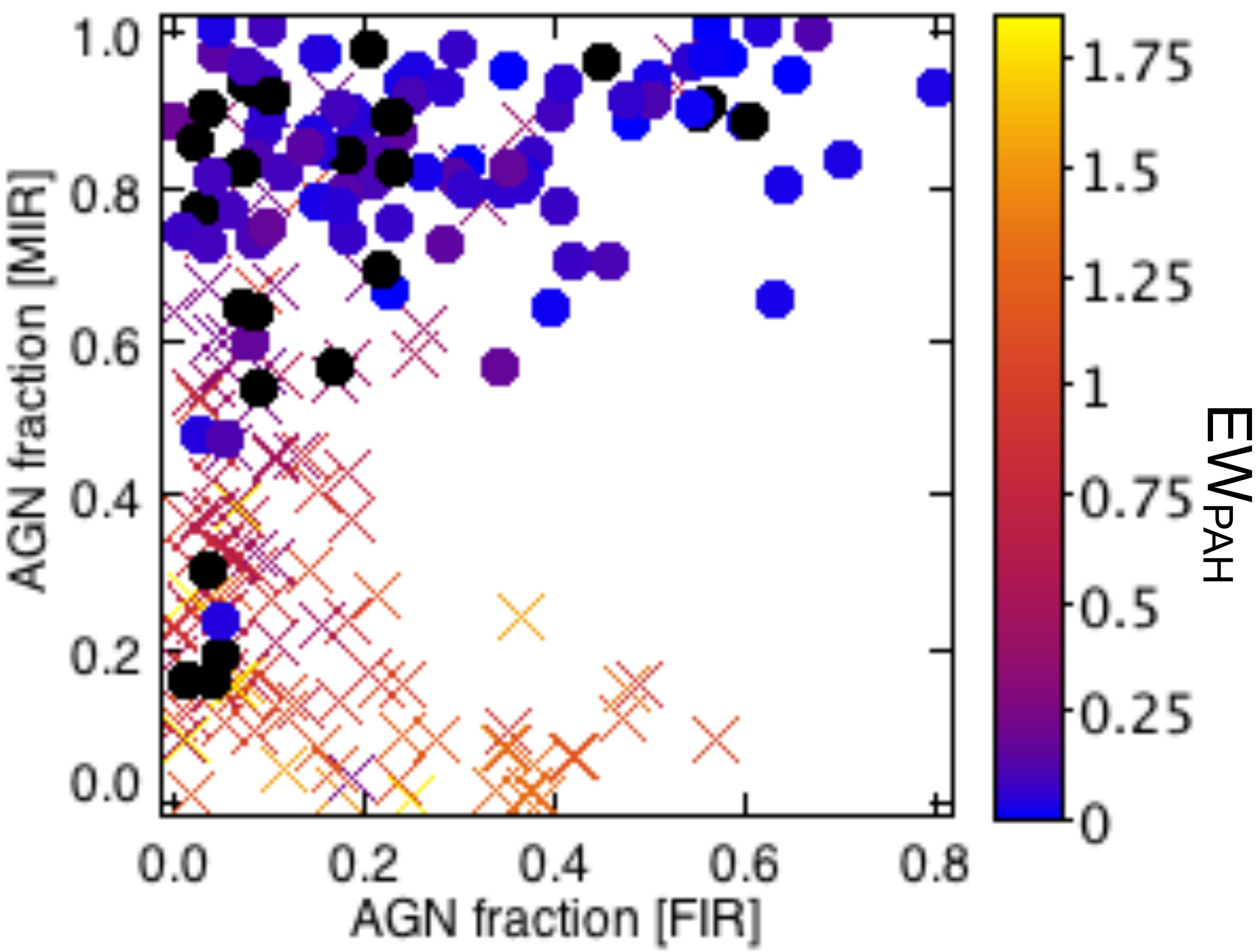


AGN and SF in mid- and far- IR



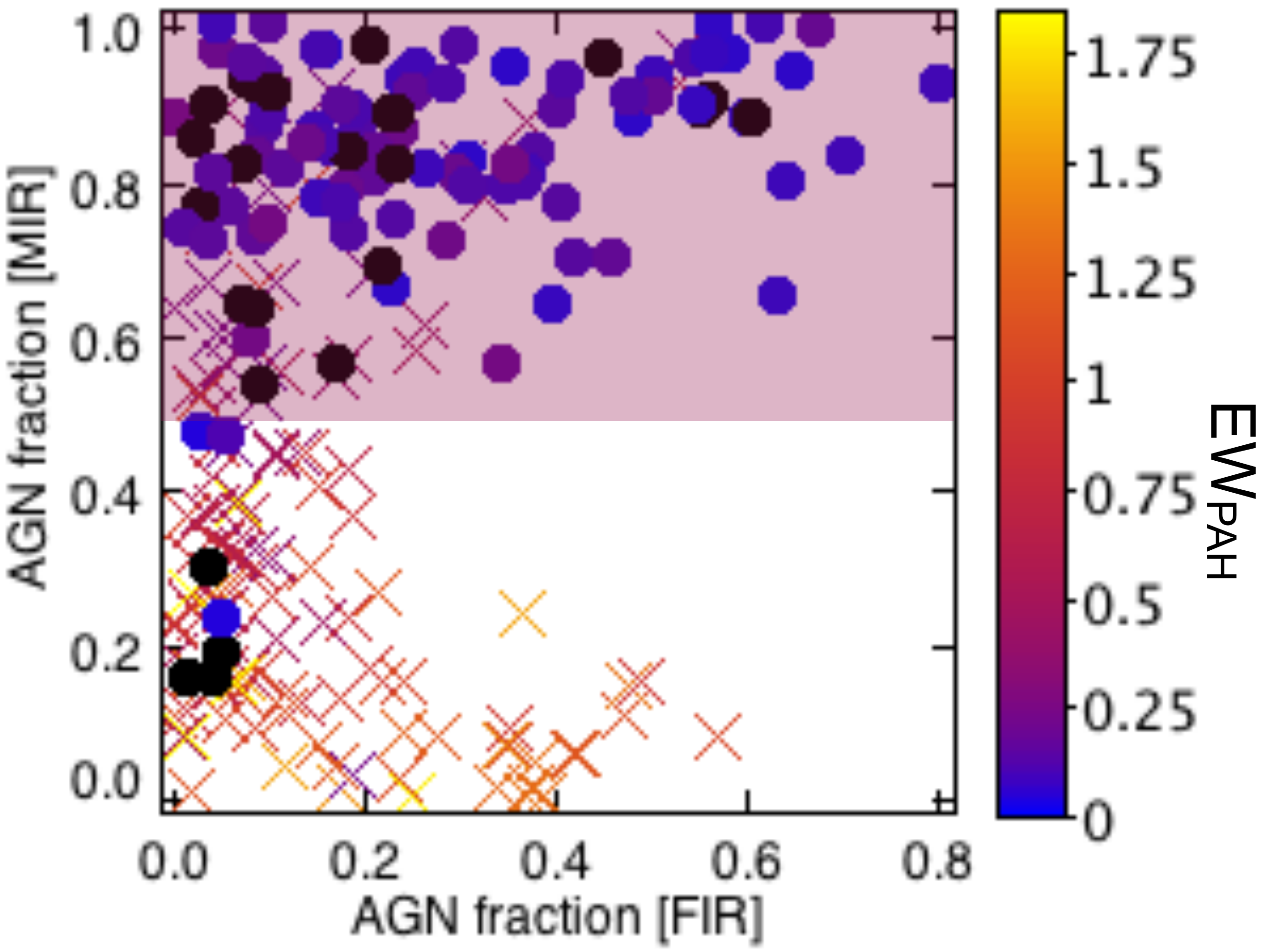
AGN-dom

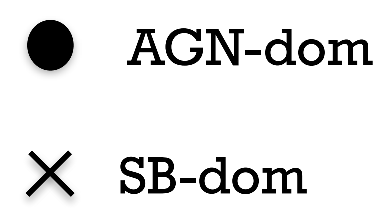
SB-dom

*SB component to account for FIR

*SB-dom. objects small contribution from AGN

AGN and SF in mid- and far- IR





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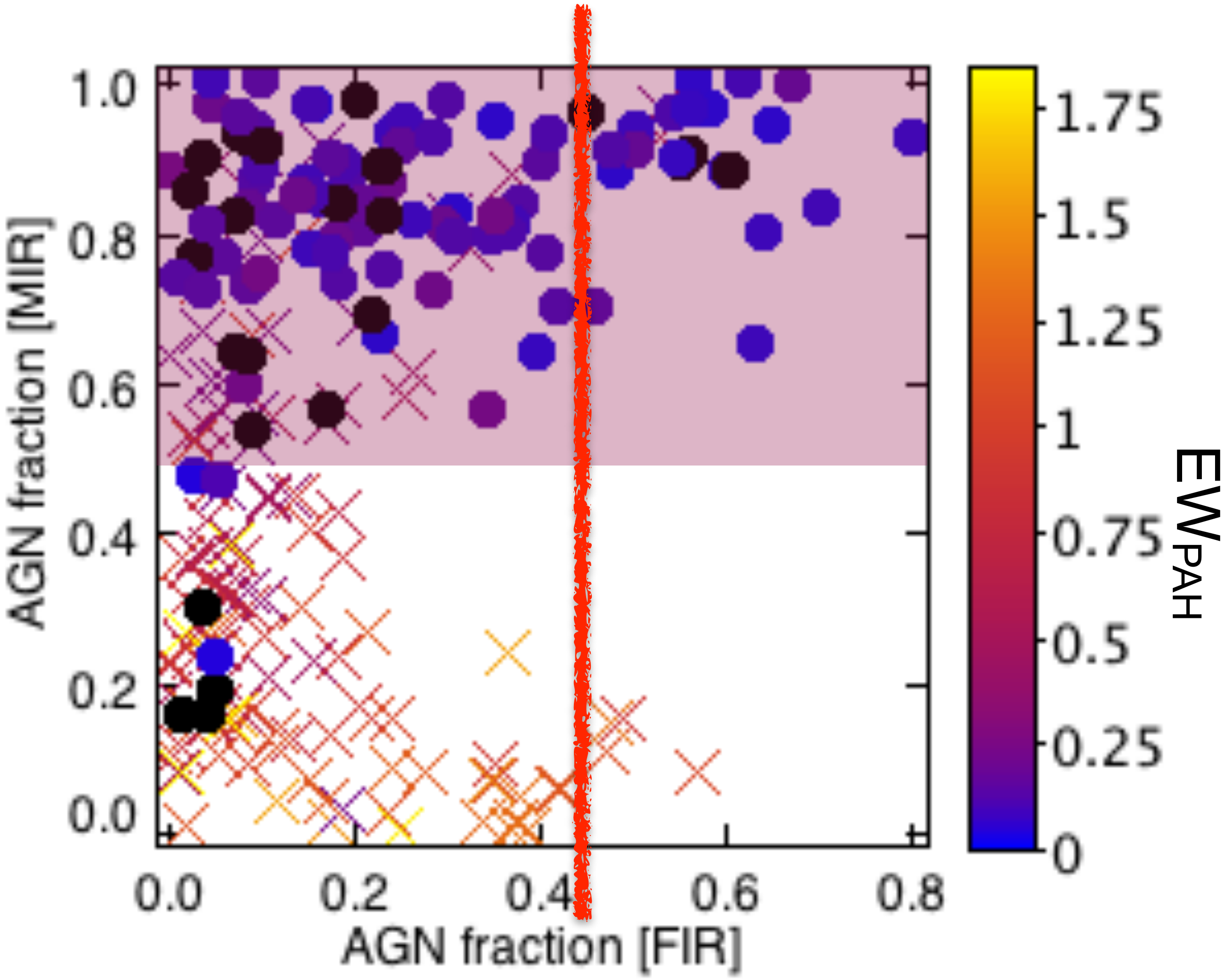

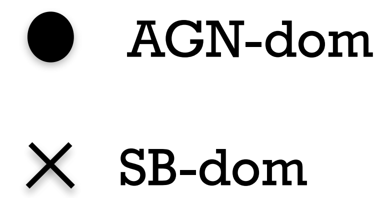

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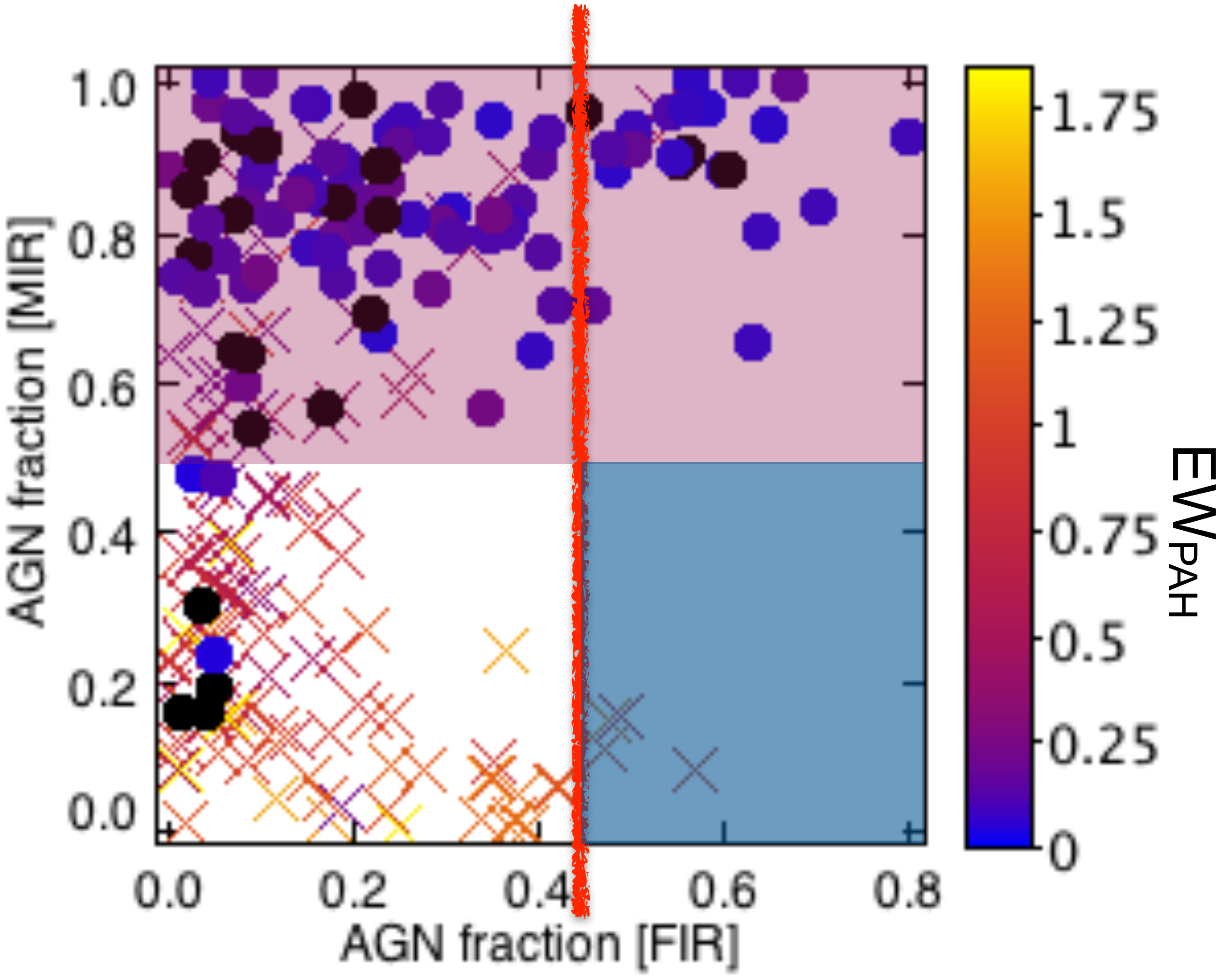

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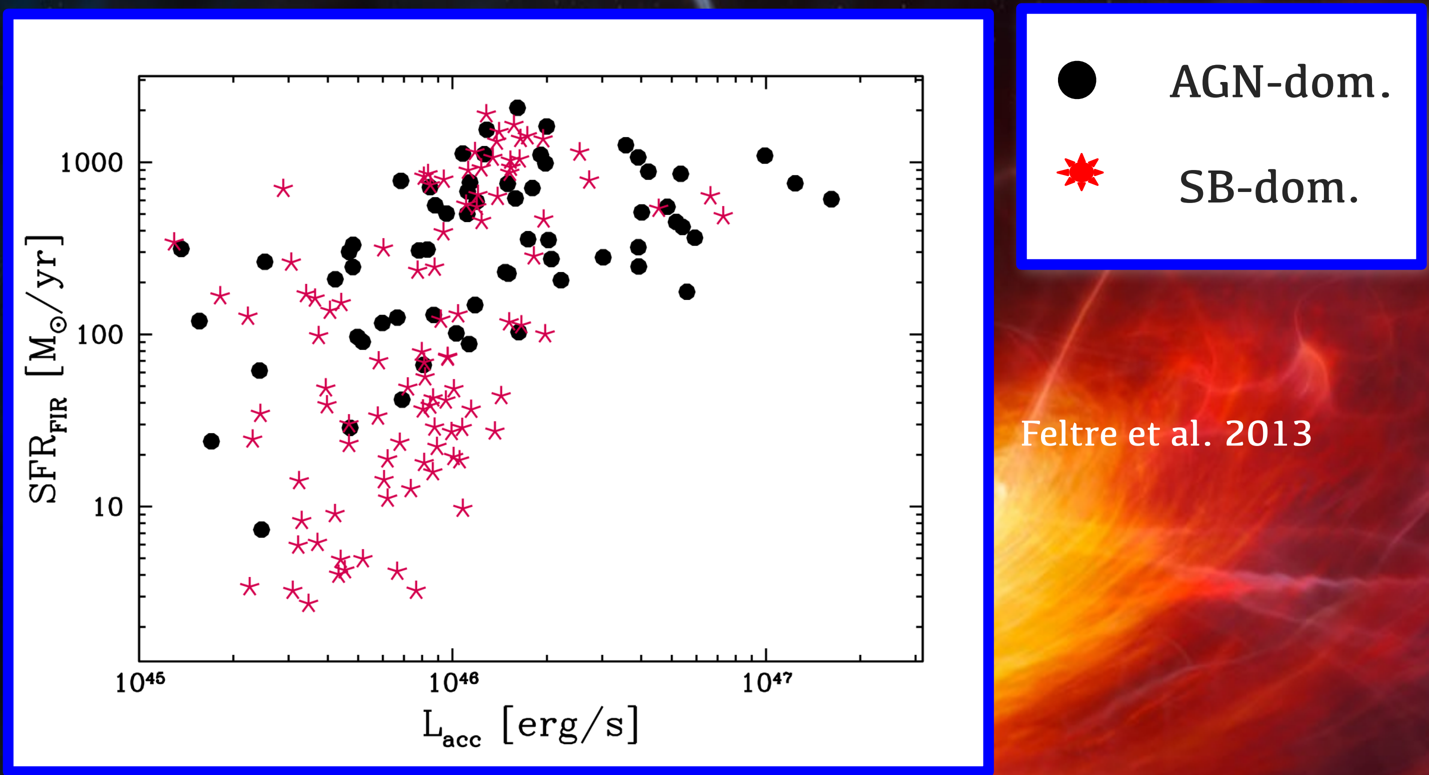

Feltre et al. 2013

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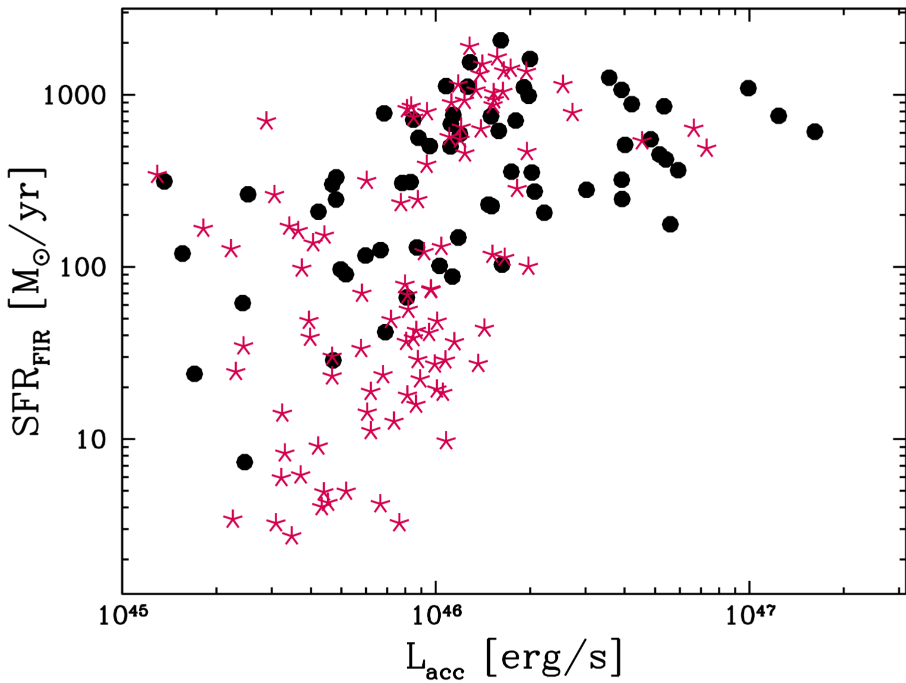

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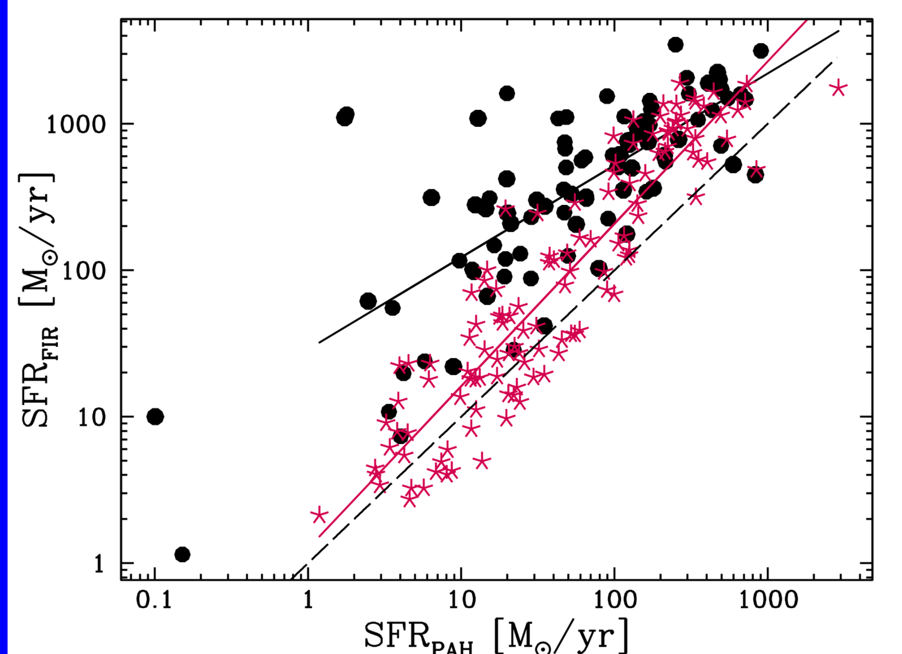

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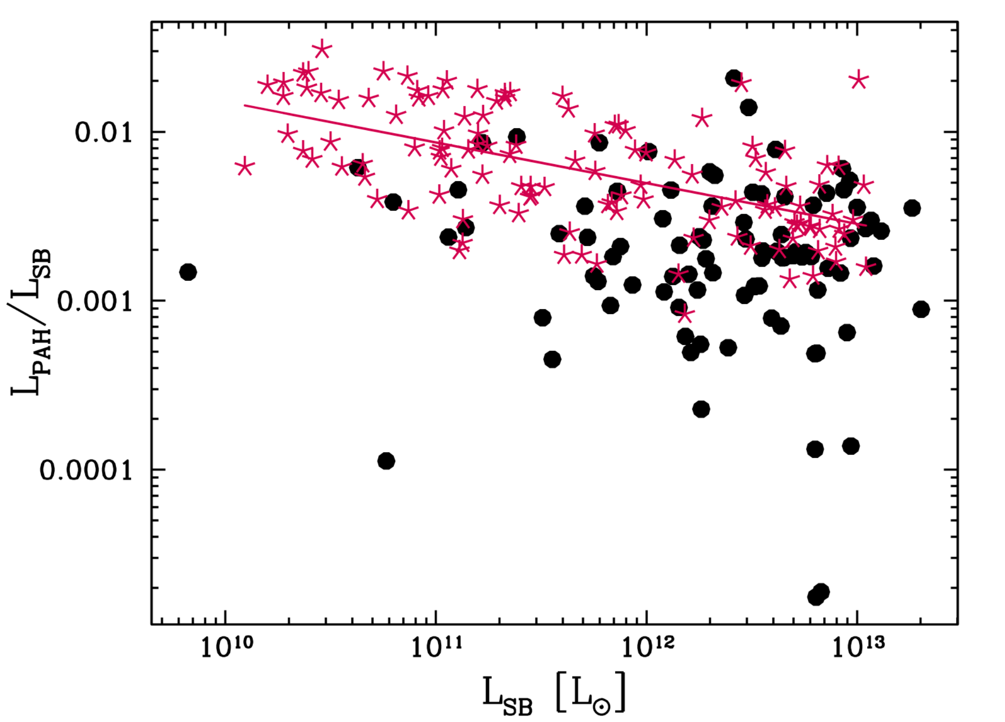
Schweitzer et al. 2006; Netzer et al. 2007; Lutz et al. 2008; Armus et al. 2007; Brandl et al. 2006; Smith et al. 2007; Pope et al. 2008; Fadda et al. 2010

AGN and SFR in mid- and far- IR



Feltre et al. 2013

Lutz et al. 2008 report a constant L_{PAH}/L_{SB} ratio over > 4 orders of magnitude in L_{SB} on a sample of local ULIRGs.

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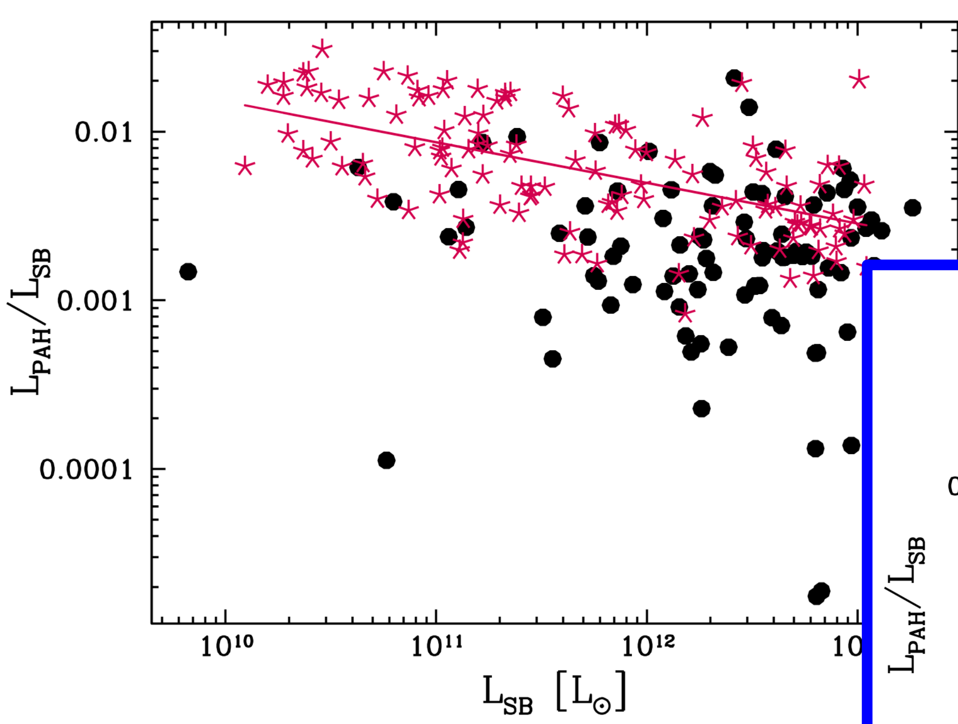

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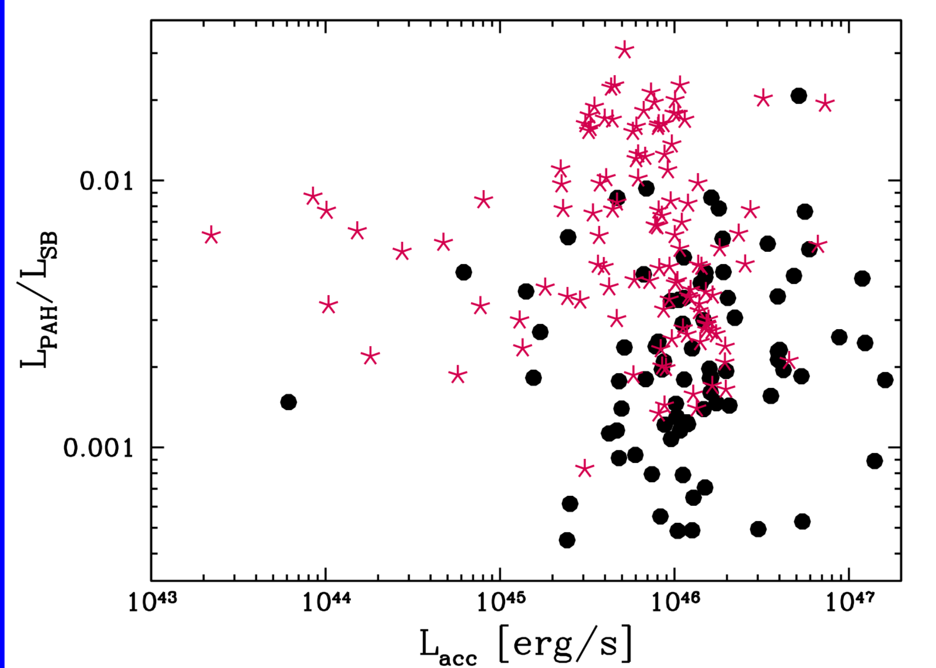
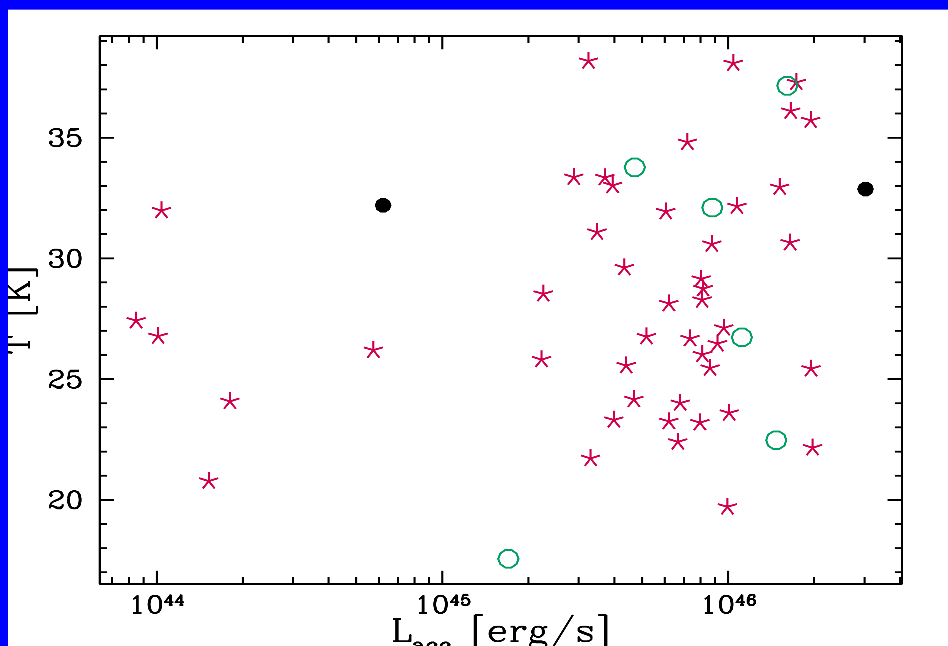


PAH features not affected by L_{acc}

Hot and Cold dust components

Lacc [erg/s]	<T> [K]
total	28.5
< 10^	27.1
10^	27.7
> 10^	30.9



Single-T modified BB (Fritz et al. 2012) but range of temperatures consistent with multi-T approach (e.g. Kirkpatrick et al. 2012)

T of the cold dust does not depend on L_{acc}

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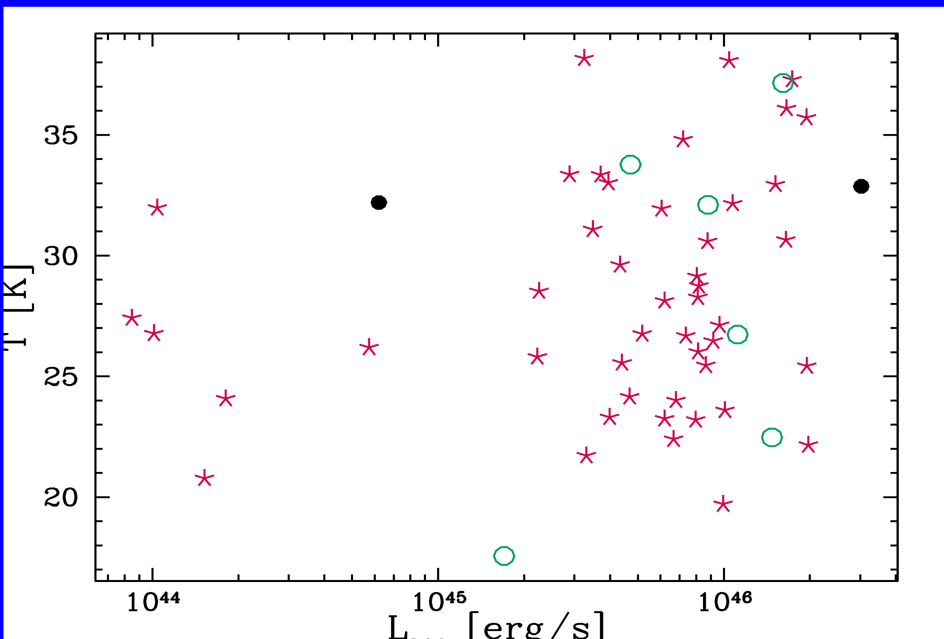

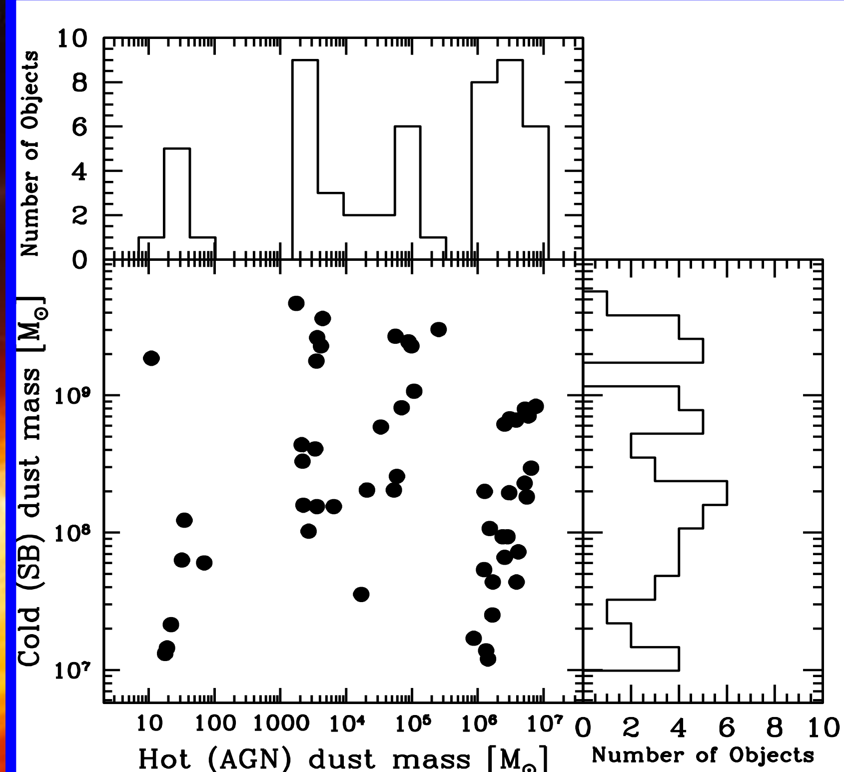

no correlation between the masses of hot and cold dust

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T of the cold dust does not depend on L_{acc}

CONCLUSIONS

- ✦ Definition of AGN (SB)-dominated system is method and wavelength dependent
- ✦ AGN rarely contribute >50% to L_{IR}
- ✦ Lacc does not affect SFR estimates
- ✦ SFR_{FIR} and SFR_{PAH} correlate differently for AGN- and SB- dom. sources
- ✦ L_{PAH}/L_{SB} not constant for SB-dominated objects
- ✦ No robust evidence that the temperature of the cold dust is affected by the AGN
- ✦ non-constant fraction of gas driven by the gravitational effects to the AGN while the starburst is ongoing

NO EVIDENCE THAT THE PRESENCE OF AN AGN AFFECTS THE STAR FORMATION PROCESS

TWO PHENOMENA OCCUR SIMULTANEOUSLY OVER A WIDE RANGE OF LUMINOSITIES

NEOGAL

NEw frOntiers in GALaxy spectral modeling

Members

Stéphane Charlot (PI)
Aida Wofford, Jacopo Chevallard, Julia Gutkin, Alba Vidal,
Anna Feltre, Michaela Hirschmann

GOAL

explore the early star formation and chemical evolution of galaxies through the development and exploitation of innovative spectral models and spectral analysis tools

NEOGAL

NEw frOntiers in GALaxy spectral modeling

- modeling emission lines from AGN using photoionisation code CLOUDY
- looking for diagnostics through comparison with emission lines models of galaxies (Gutkin et al., in prep) (e.g. calibrating the models starting from the BPT diagram and exploring other emission lines)
- to create grids of models in preparation for NIRspec-JWST high quality observations of the early Universe

THANKS FOR THE ATTENTION

TAKE AWAY POINTS

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