Mapping coeval star formation and supermassive black hole growth with PRIMA

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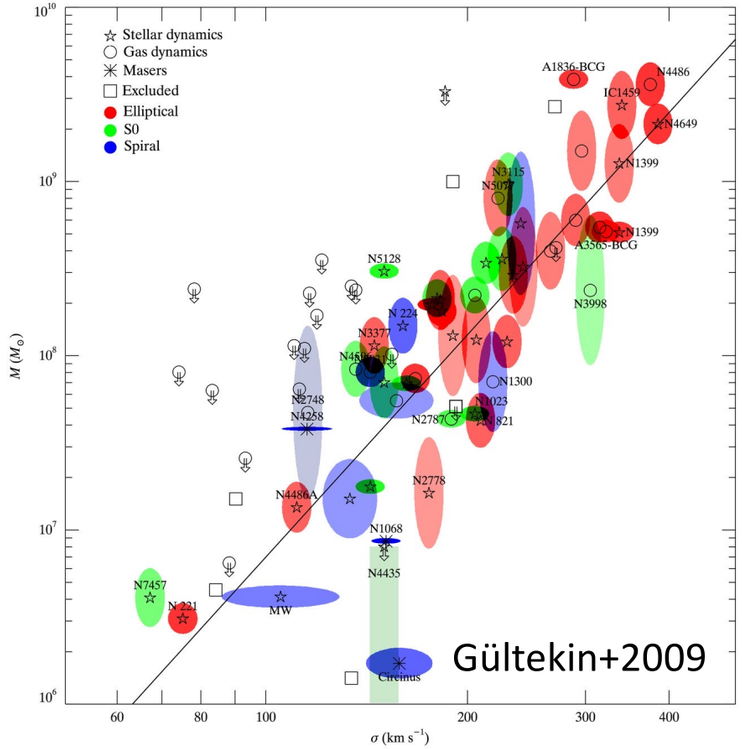
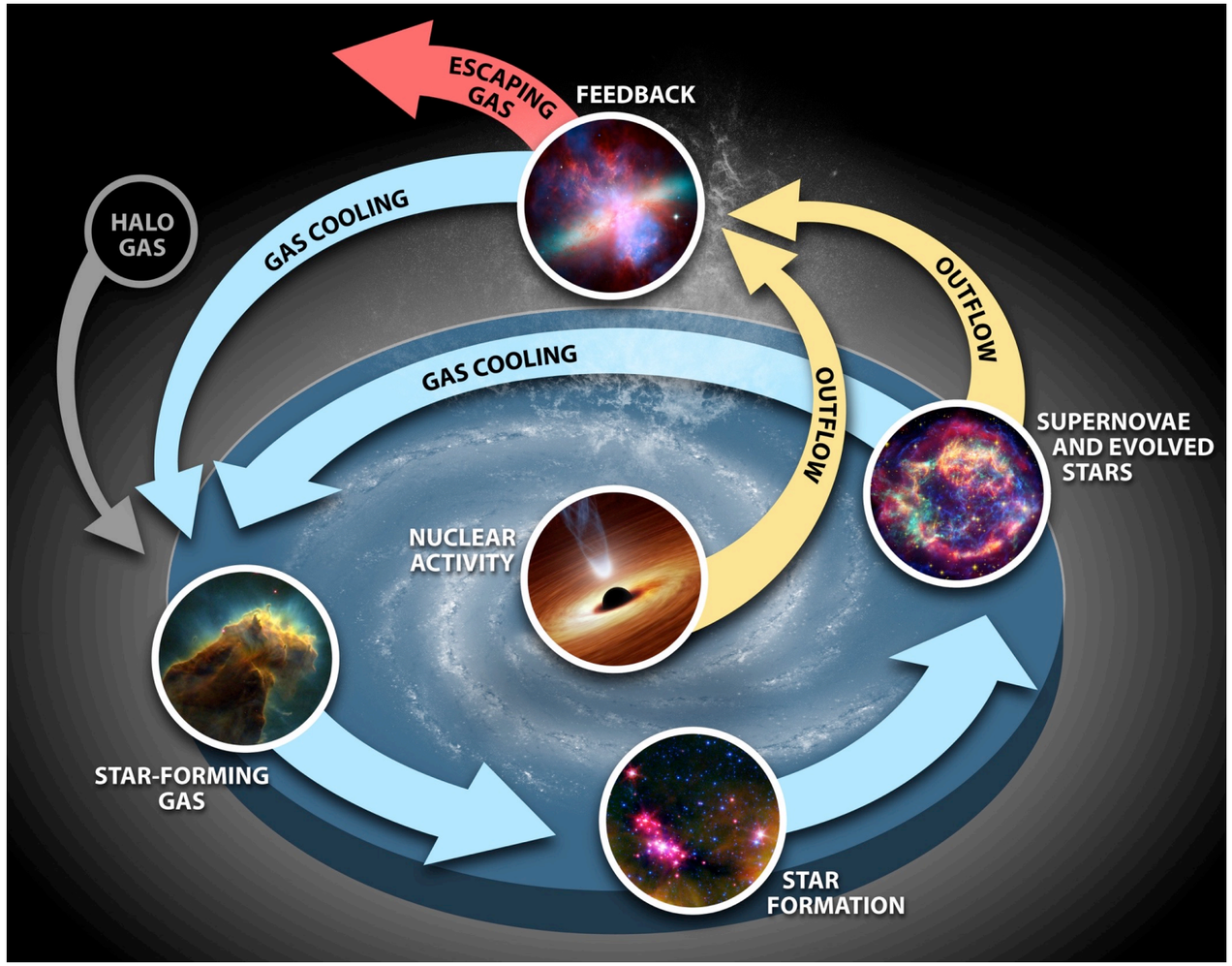
https://prima.ipac.caltech.edu/



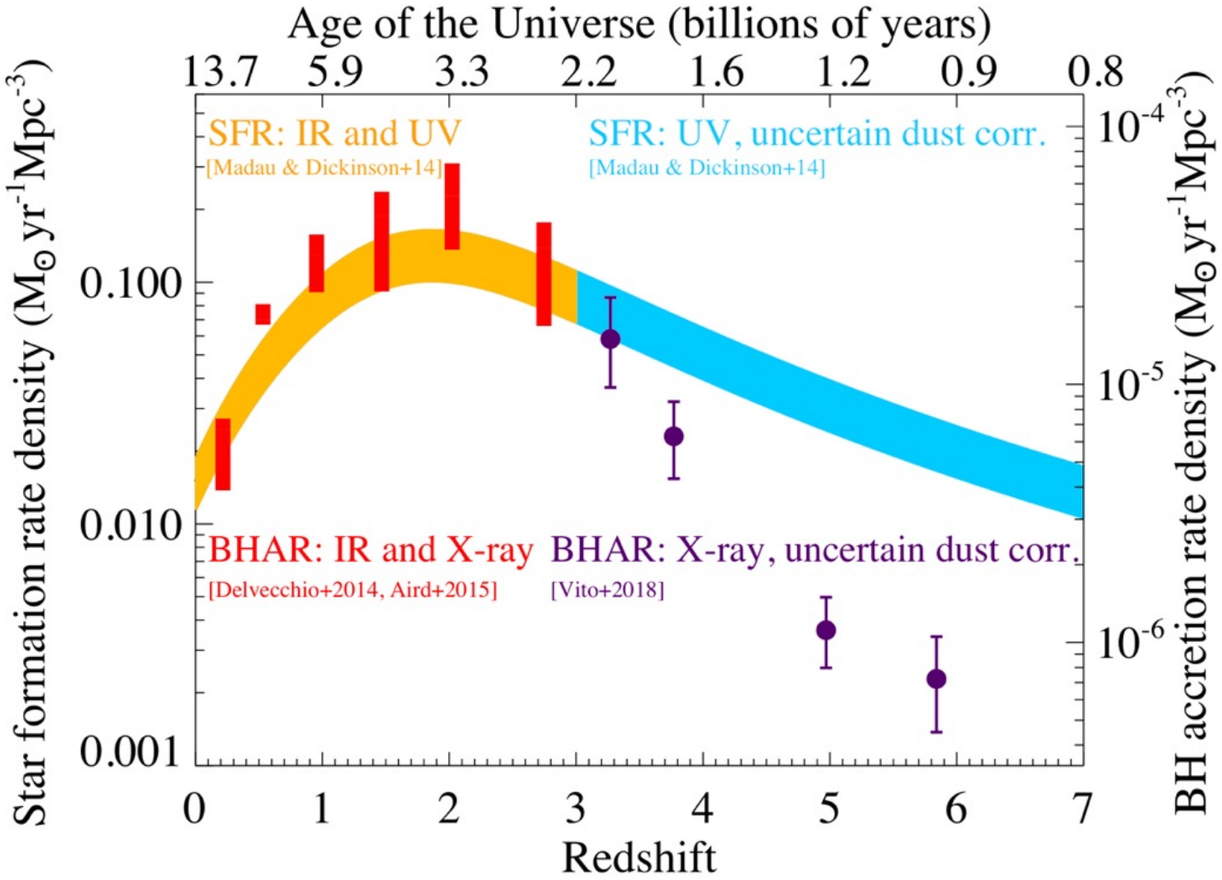
How do supermassive black holes and their host galaxies coevolve?

These processes are linked through the ISM and can be simultaneously measured in the infrared

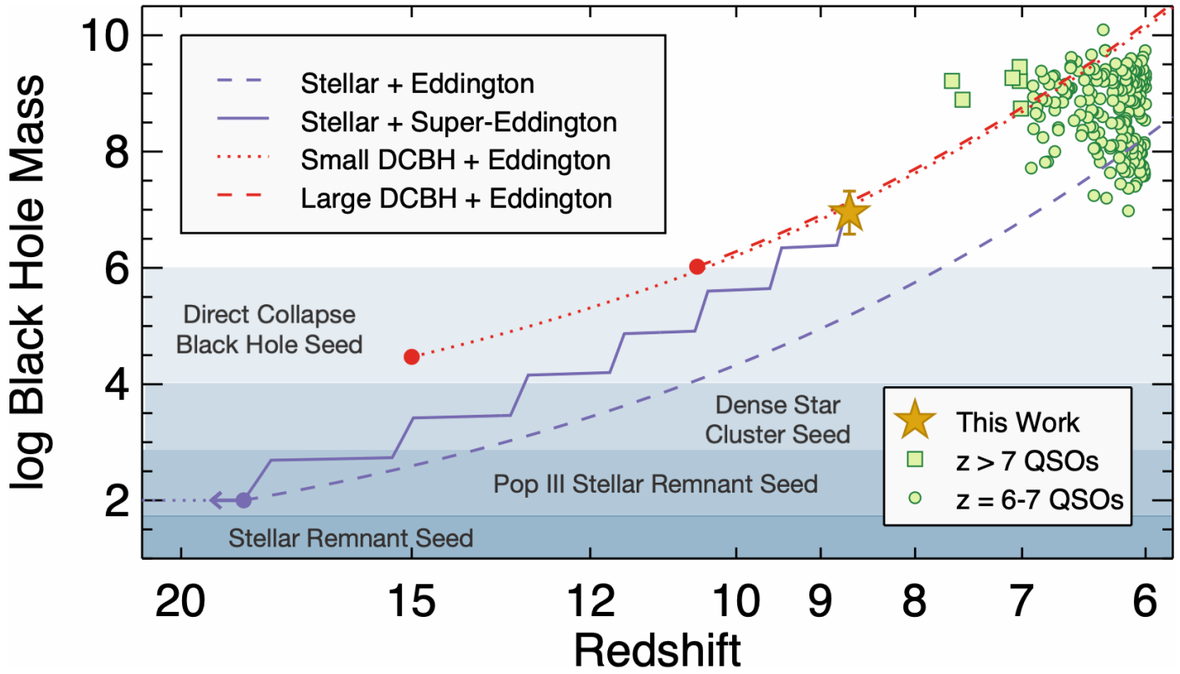


Origins Space Telescope mission concept study report, 2019

The growth of supermassive black holes peaked with the stars at z~2 … but there are accreting SMBHs lurking in the very early Universe!

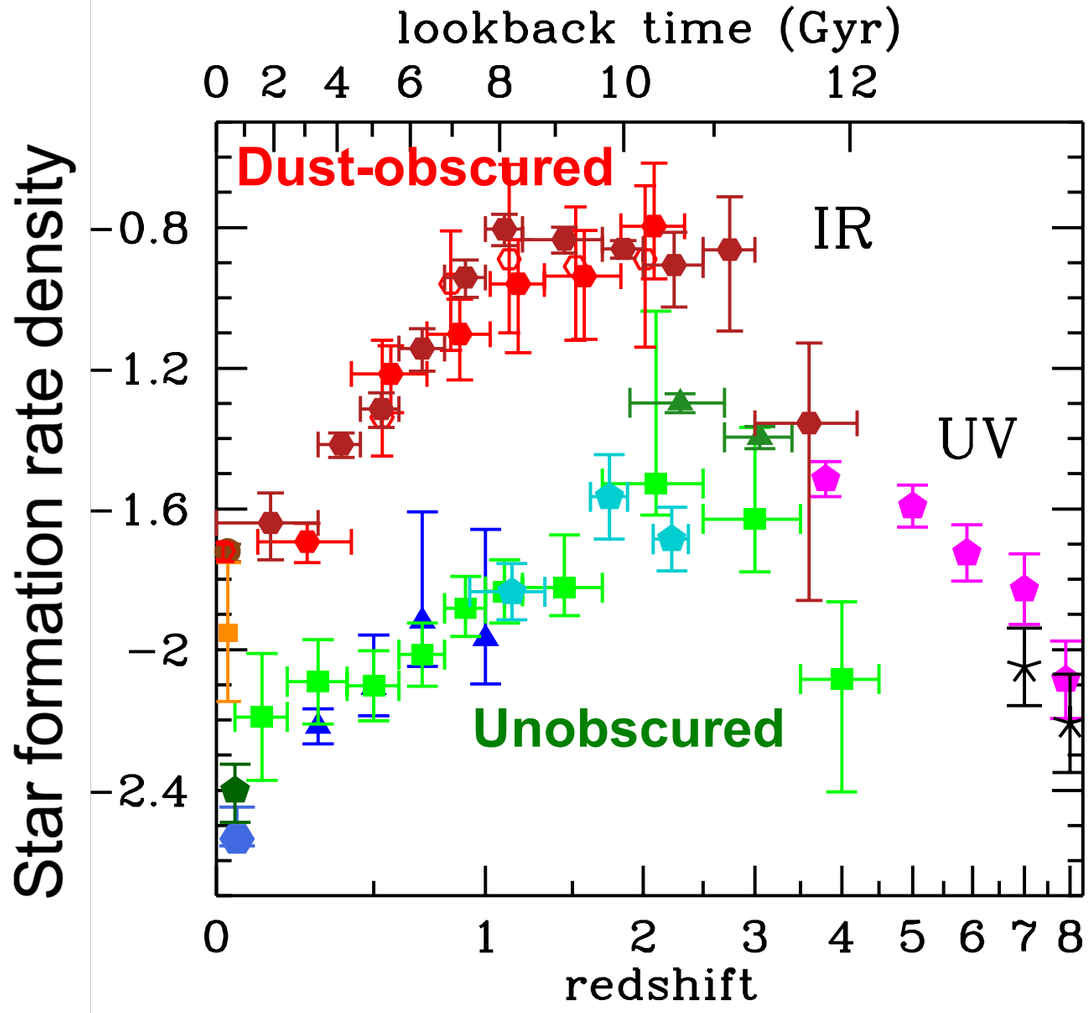


Pope et al. 2019

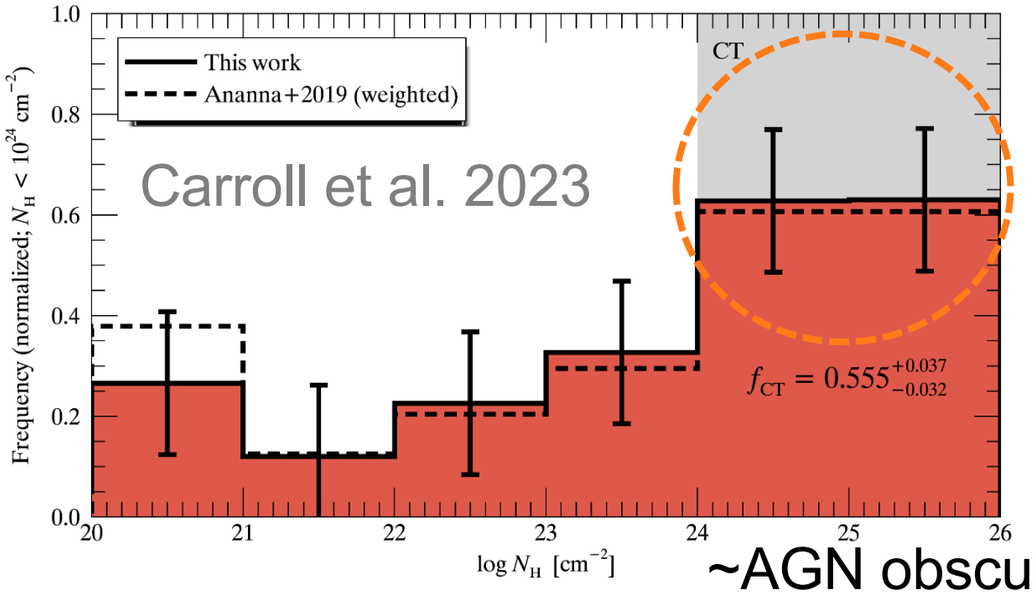


Larson et al. 2023

The majority of cosmic star formation and black hole growth is hidden behind dust

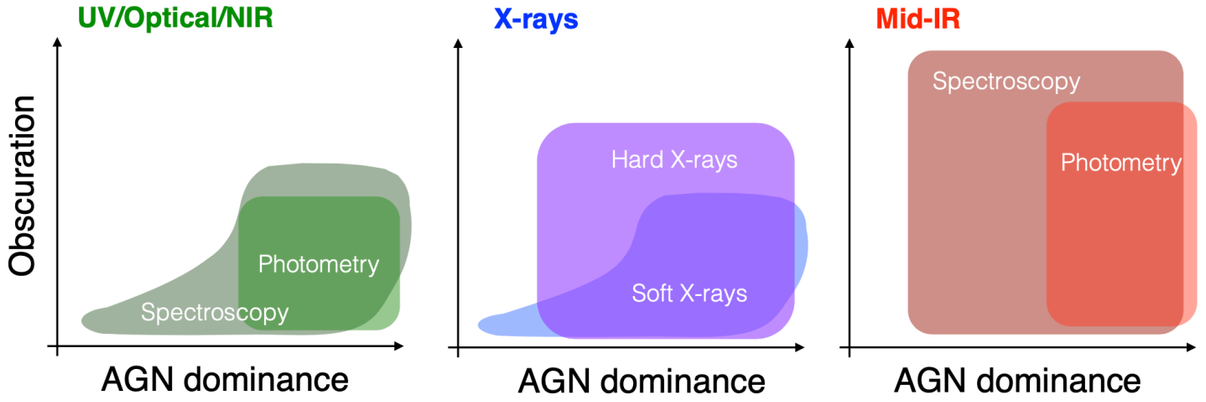


Madau & Dickinson 2014



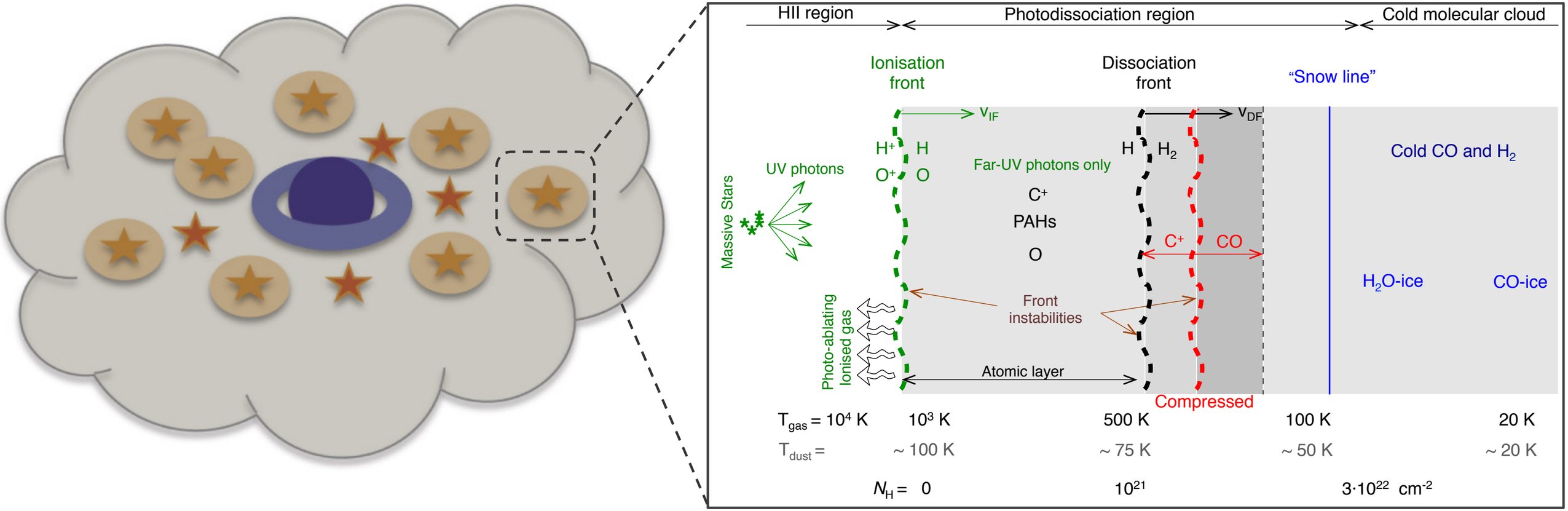
Most AGN are highly obscured (z<0.8)

~AGN obscuration



Hickox & Alexander 2018

Measuring SFRs and BHARs in the mid-IR



Figures adapted from Roebuck et al. 2016 and Goicoechea et al. 2016

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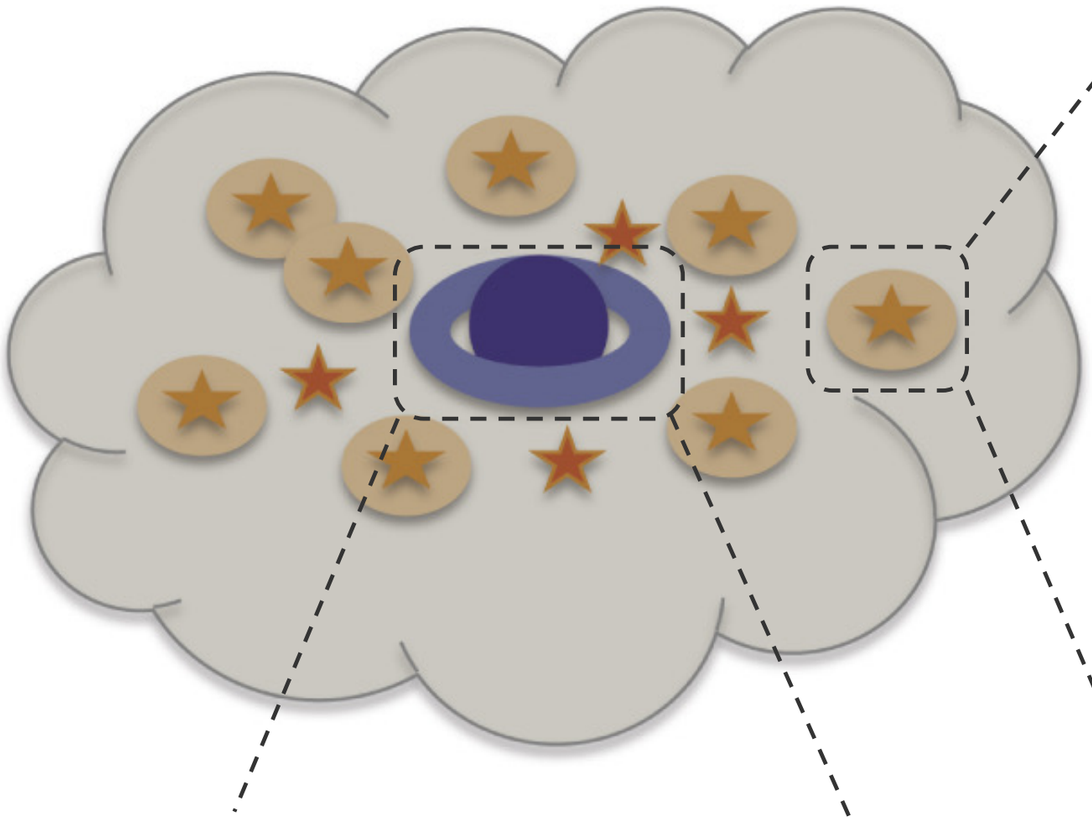
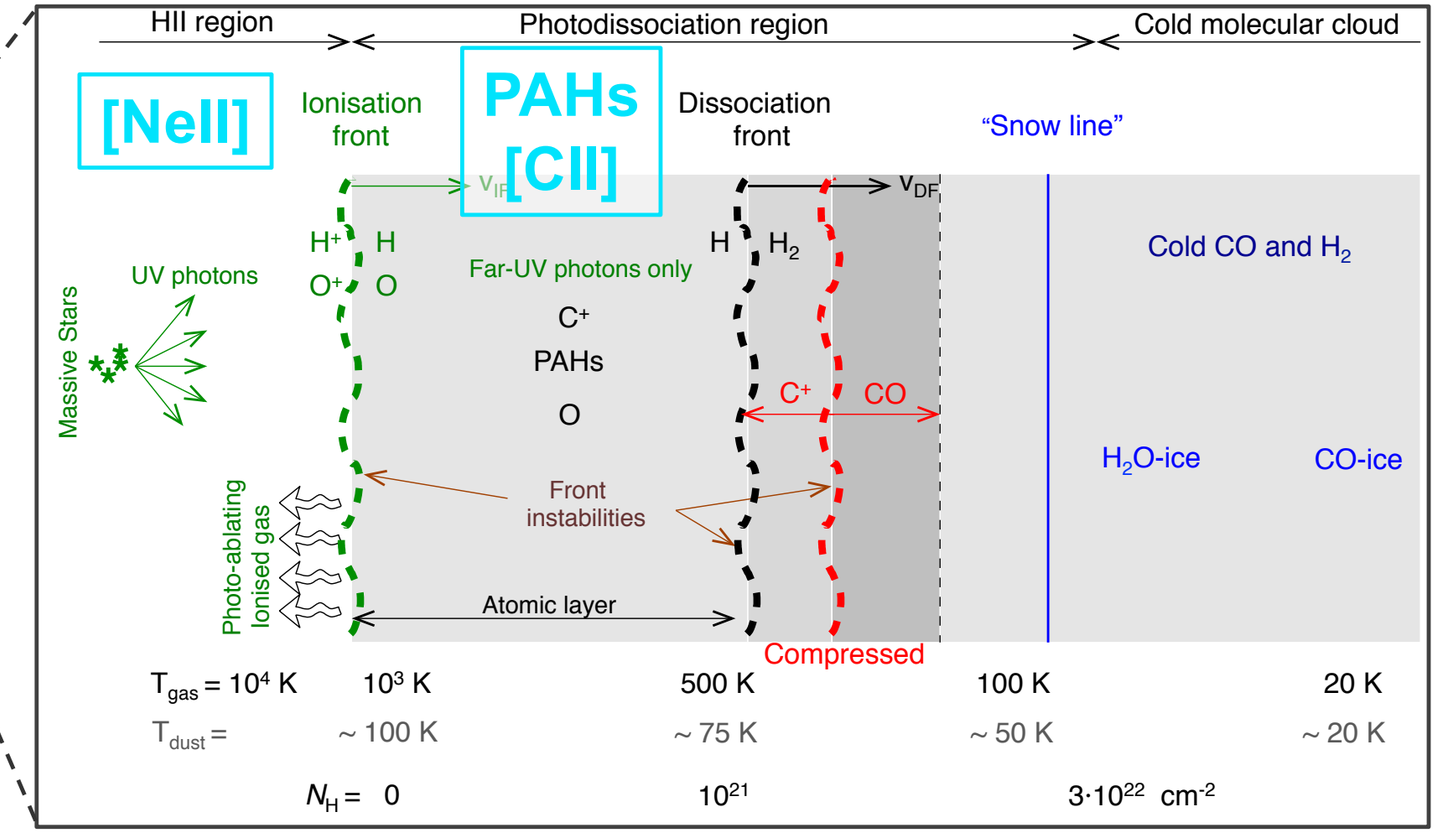


[NeVI], [NeV], [OIV], hot dust



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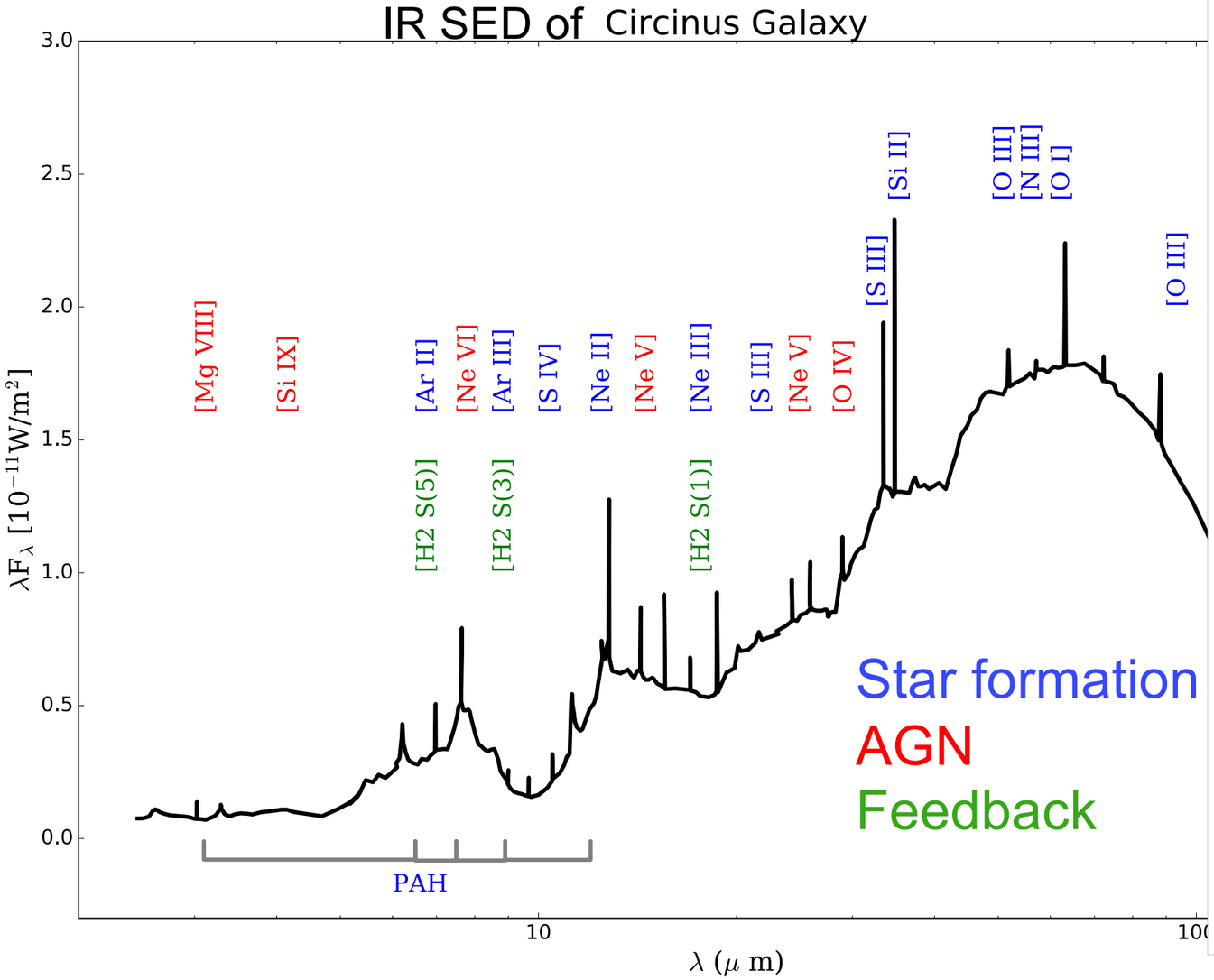
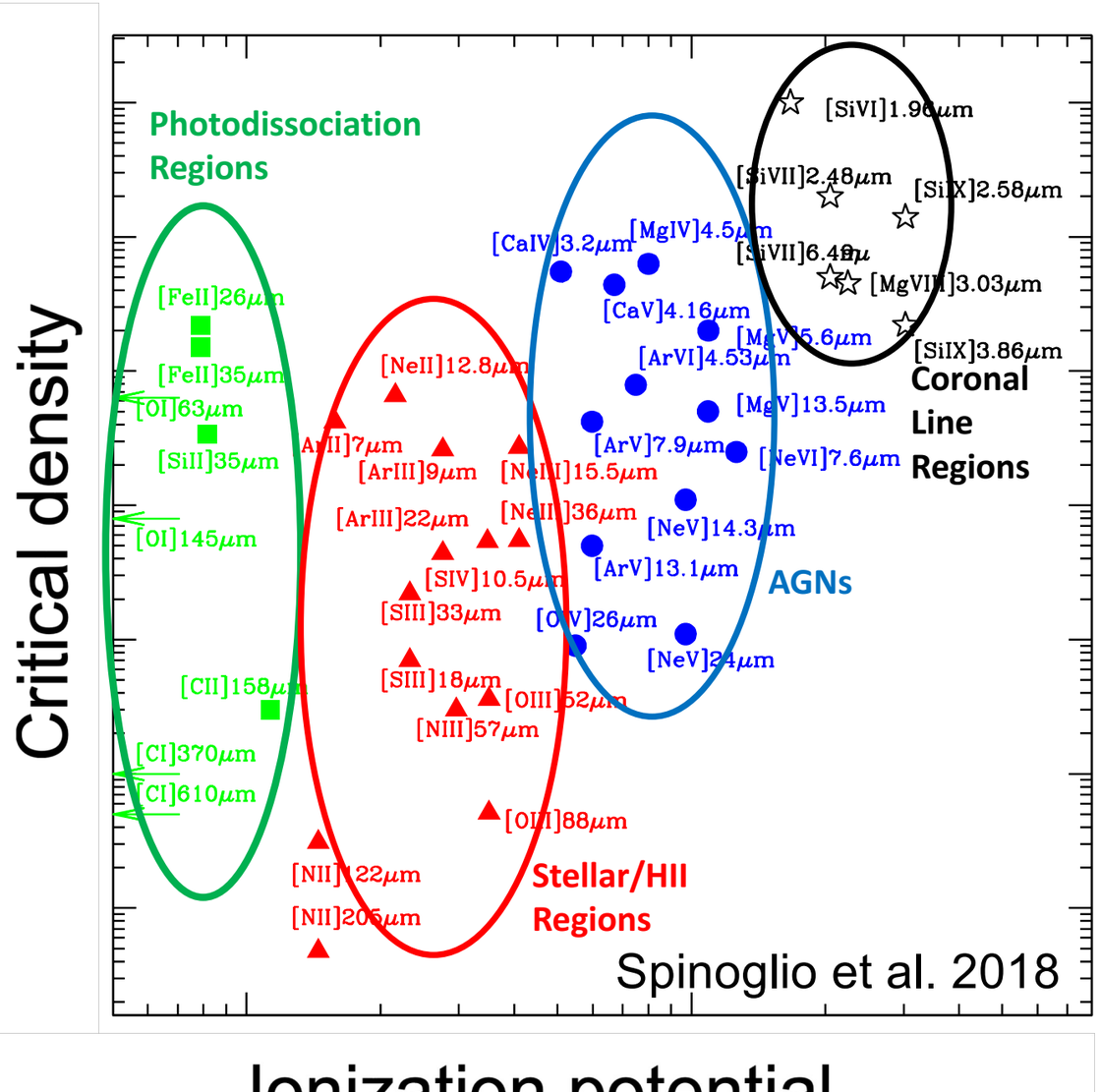
Measuring **SFRs** and **BHARs** in the mid-IR





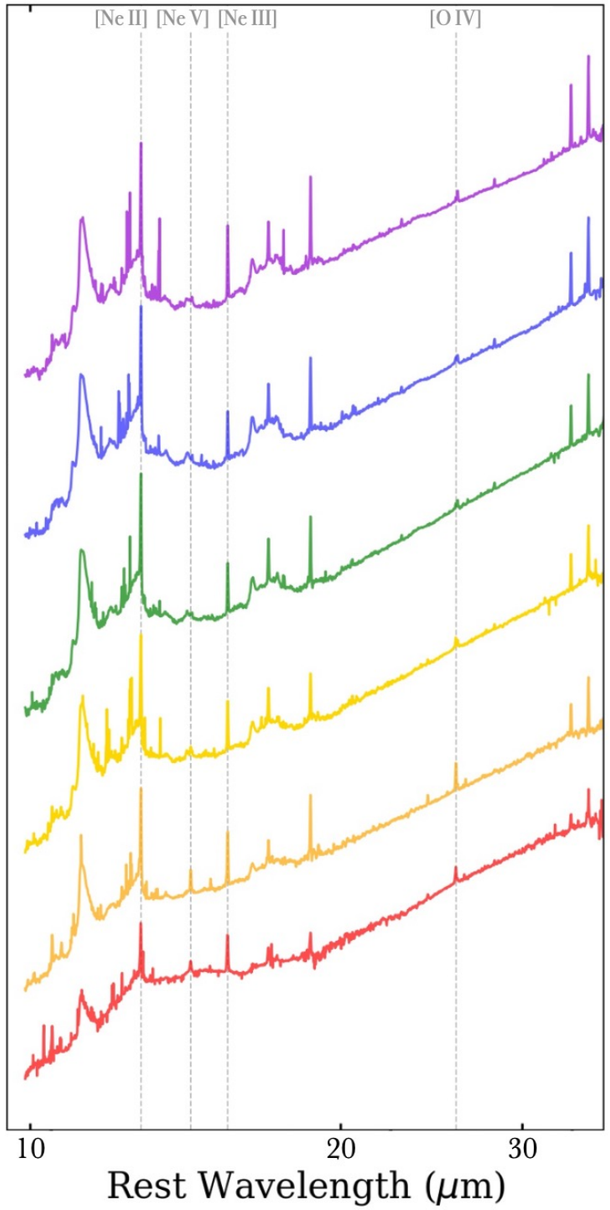
Origins Space Telescope report 2019

Measuring **SFRs** and **BHARs** in the mid-IR at z~0

SF dominated

MIR AGN fraction

AGN dominated



- 200 local IR luminous galaxies from GOALS
- Binned by MIR AGN fraction (PAH EW)
- Stack high res (R=600) MIR spectra

Stone, Pope, et al. 2022

Measuring **SFRs** and **BHARs** in the mid-IR at z~0

z~0

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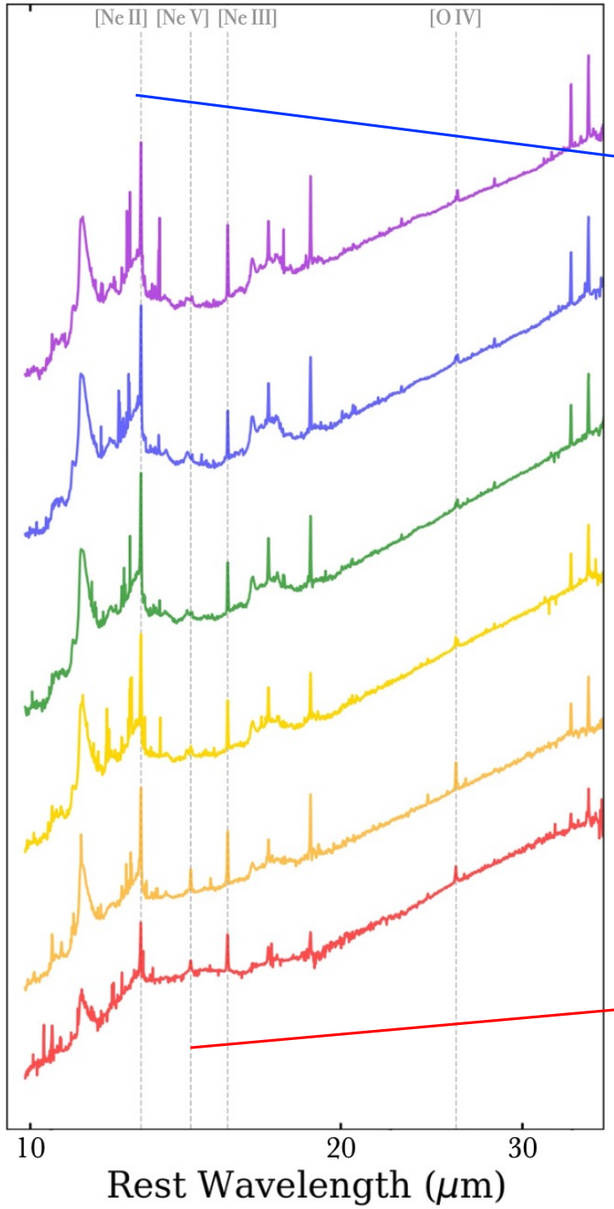

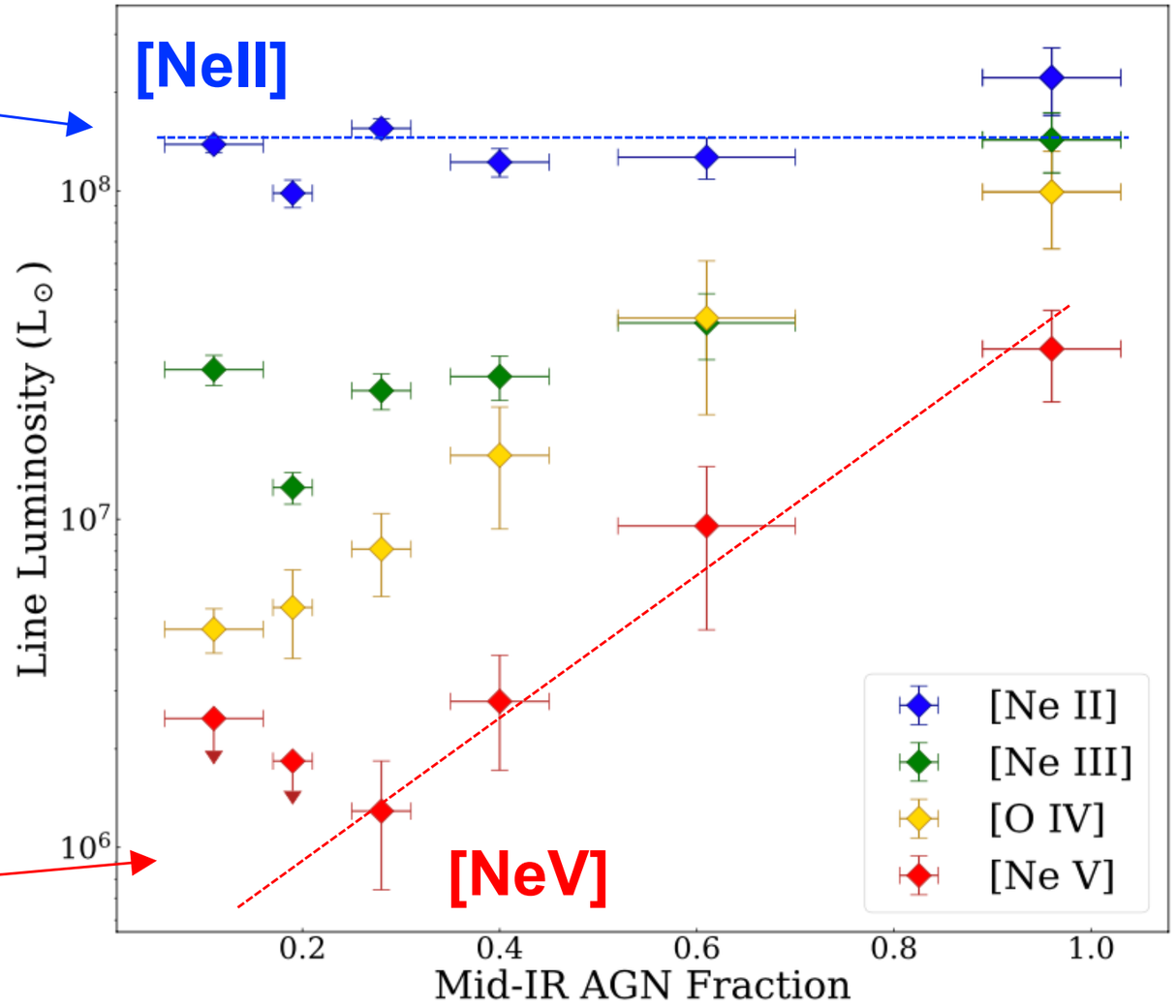

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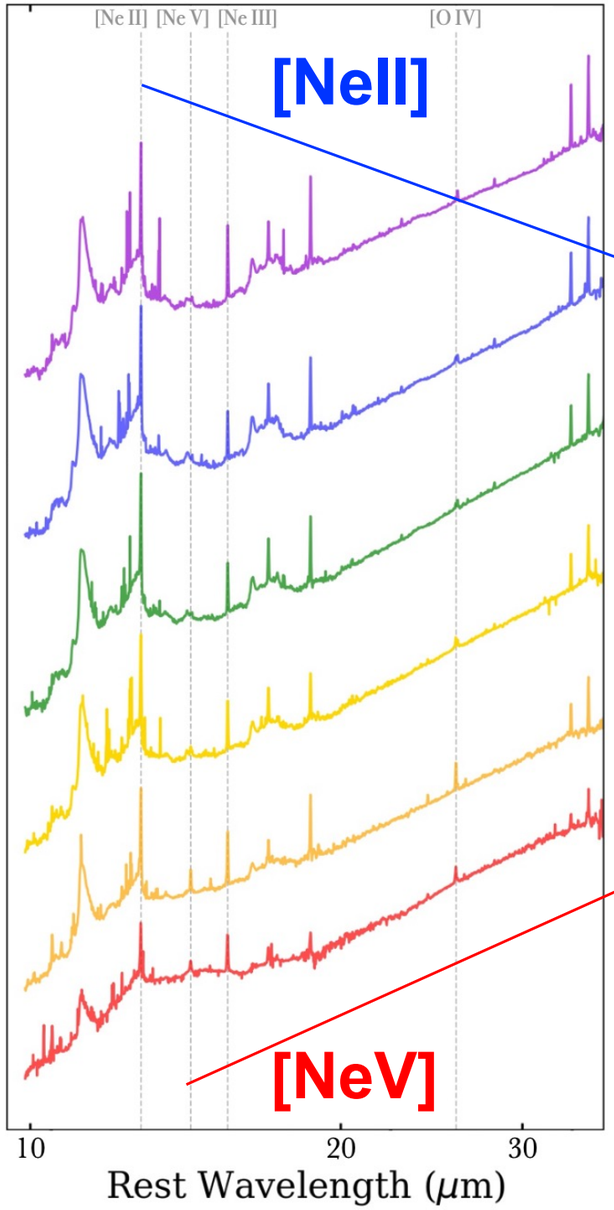
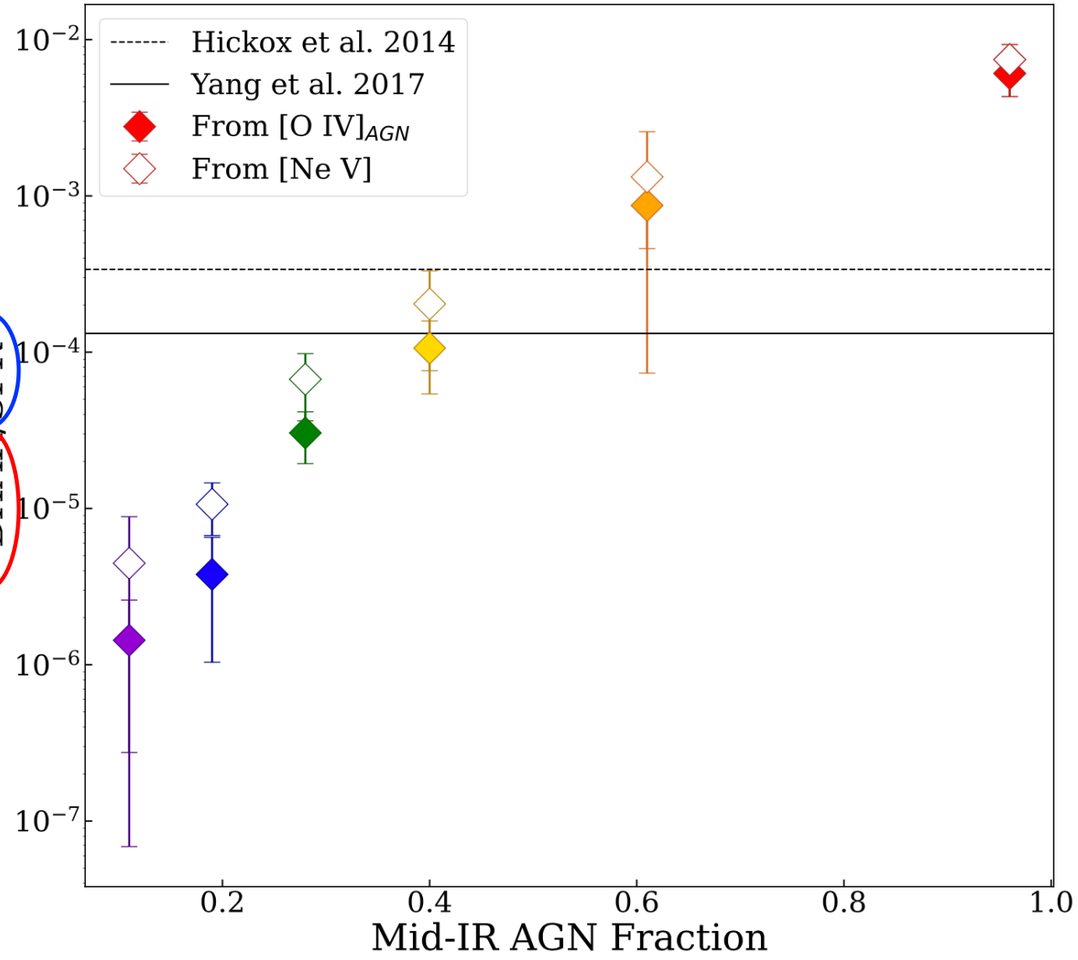
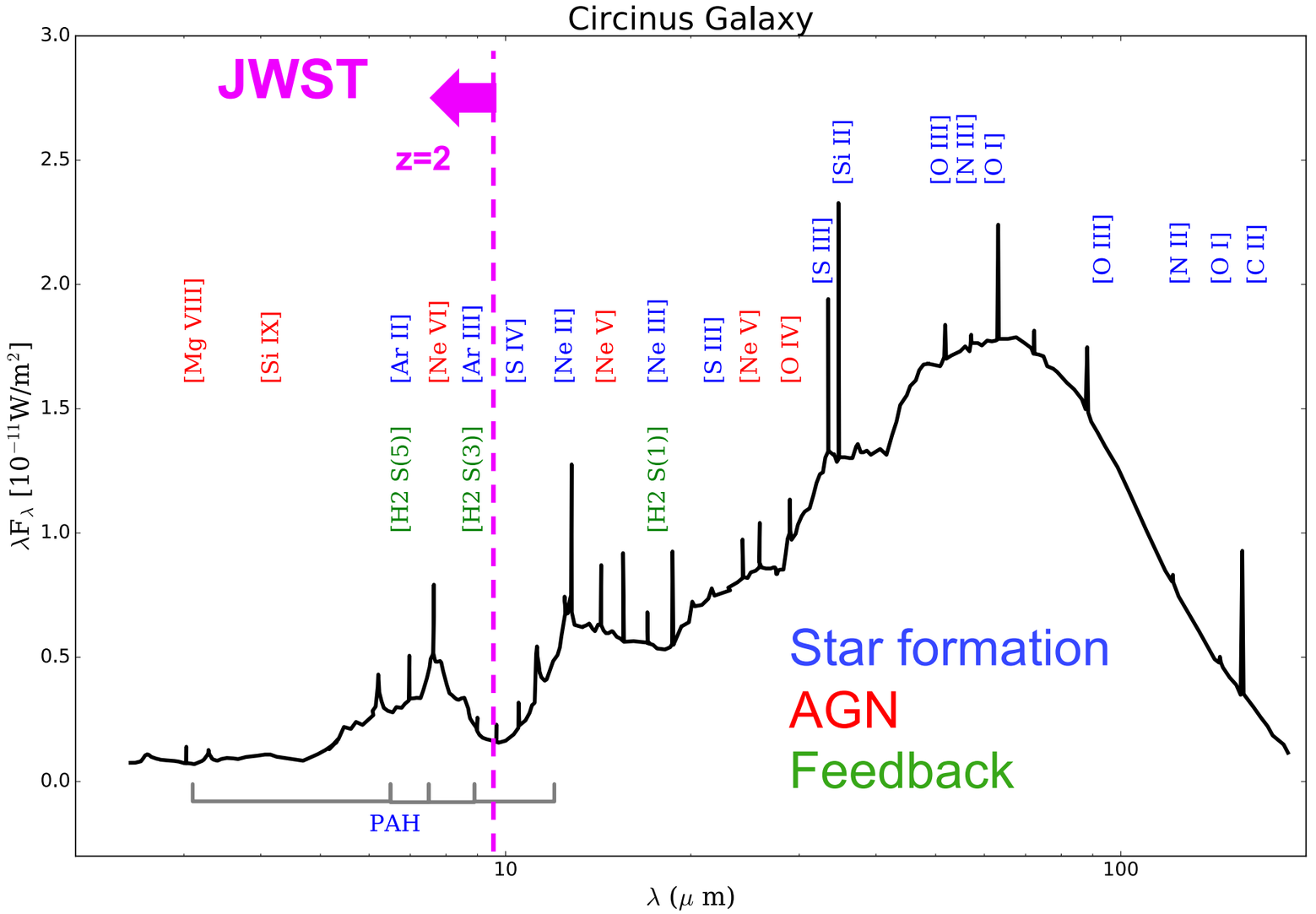


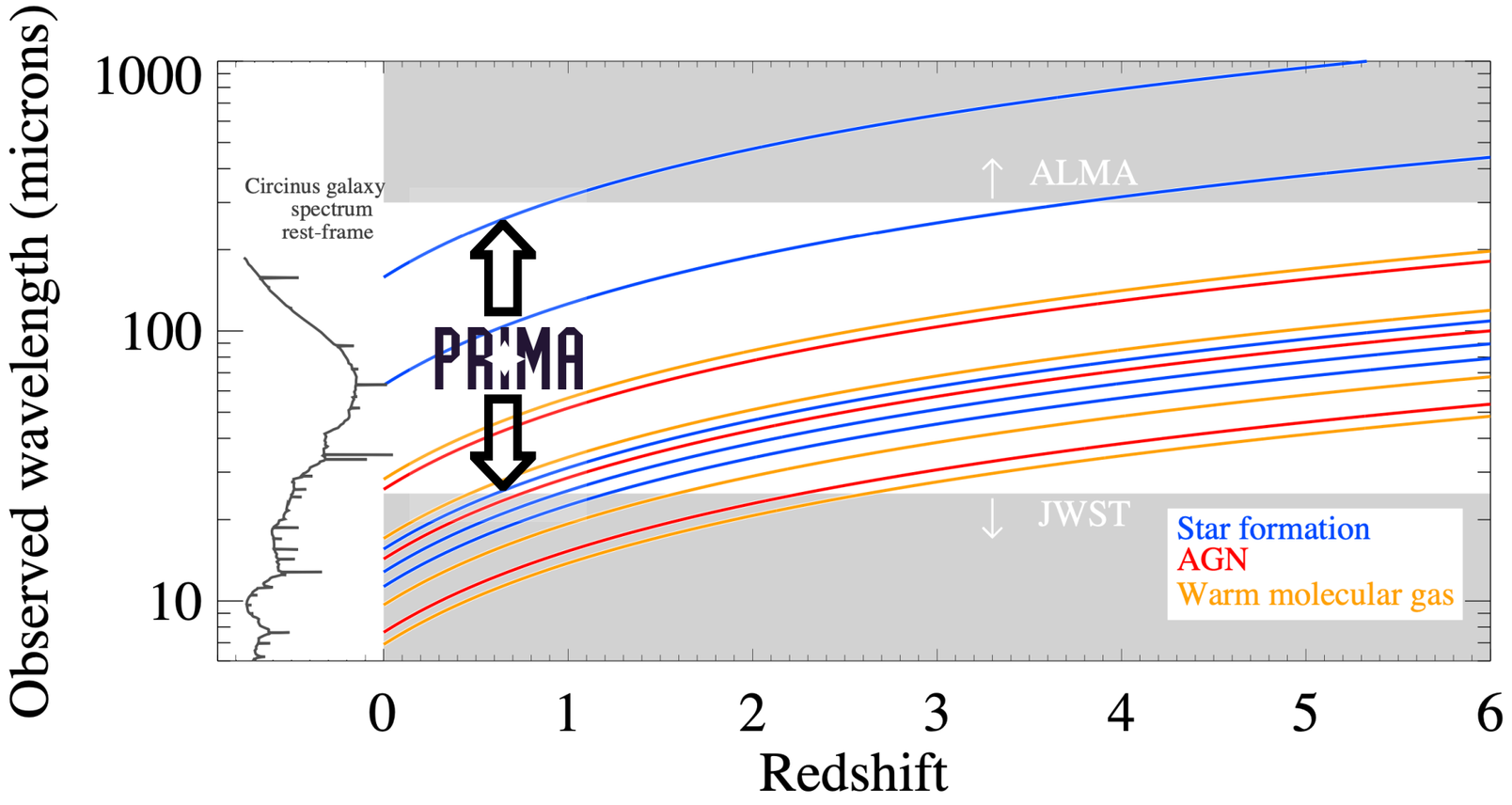
BHAR/SFR



Stone, Pope, et al. 2022

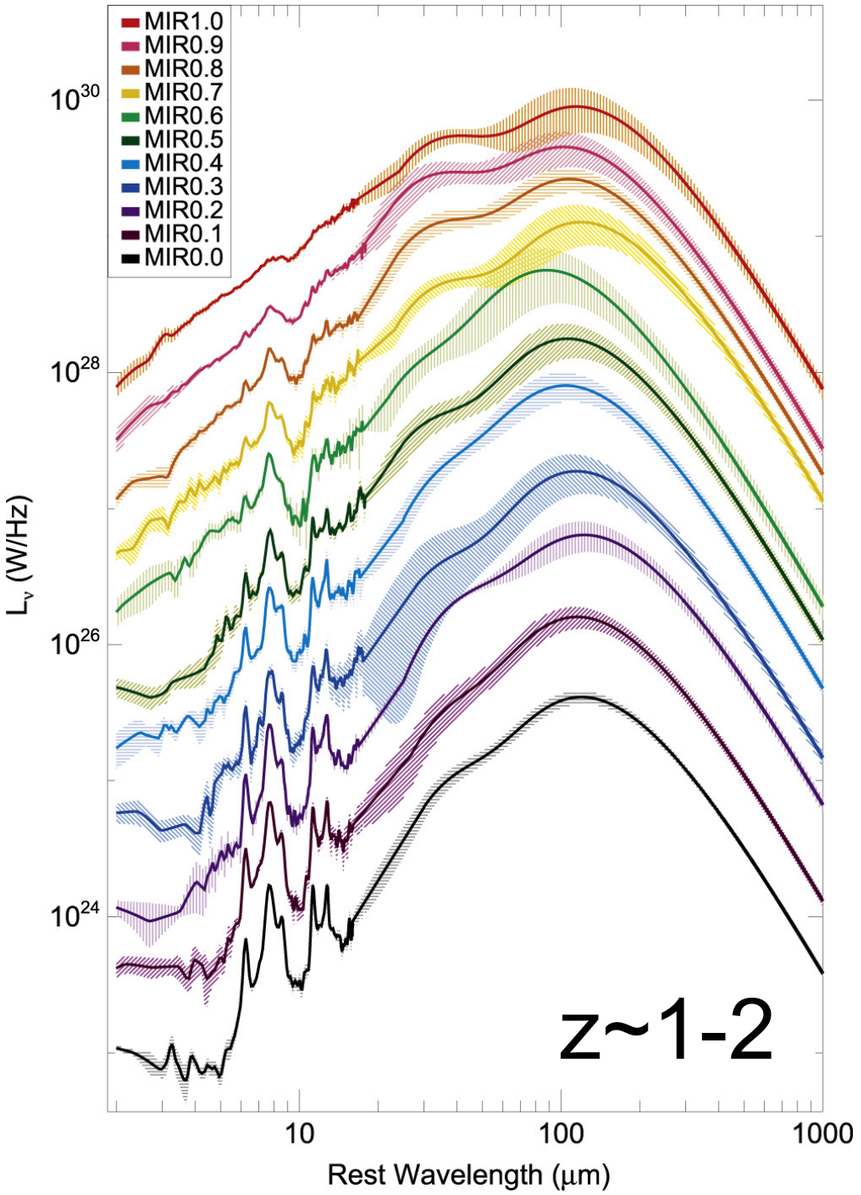
JWST can observe powerful MIR diagnostics out to cosmic noon



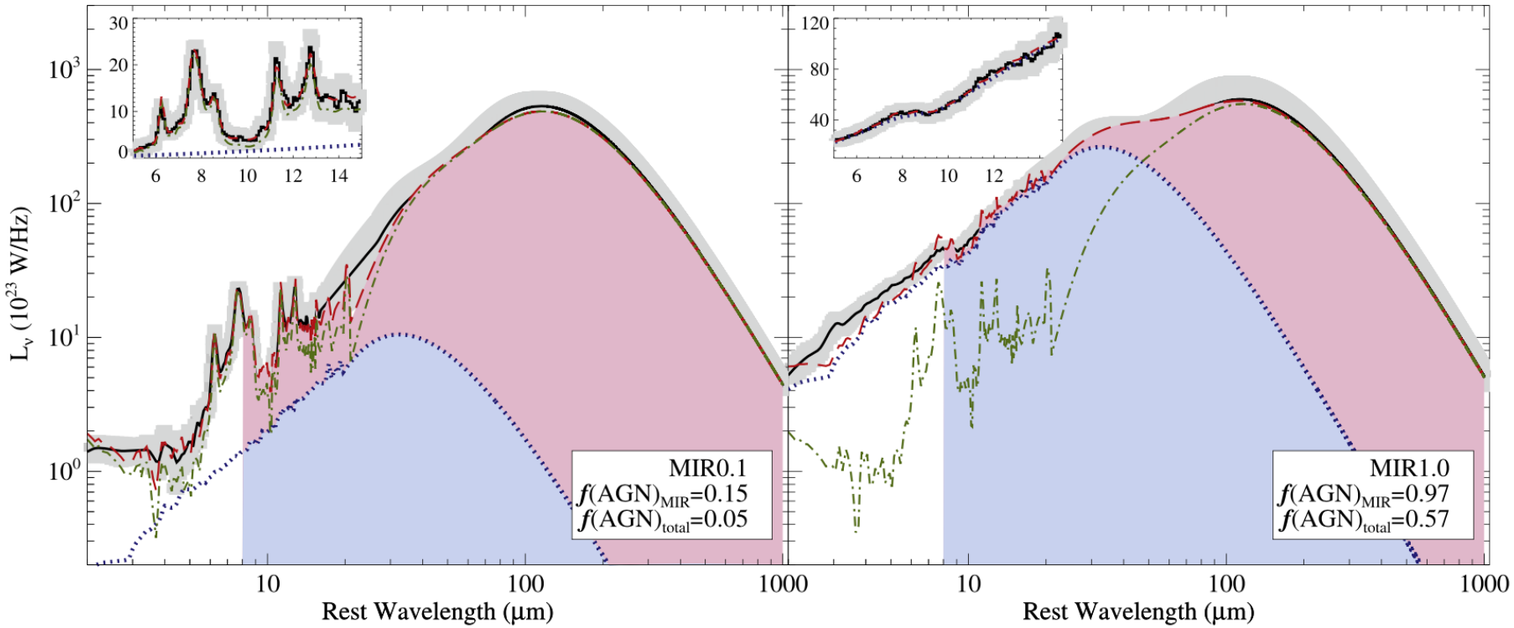


PRIMA fills the decade in wavelength between JWST and ALMA that is rich is spectral features sensitive to AGN, star formation and other tracers of the multiphase interstellar medium in galaxies.

Both star formation and AGN impact the SED: Excite lines and heat the dust

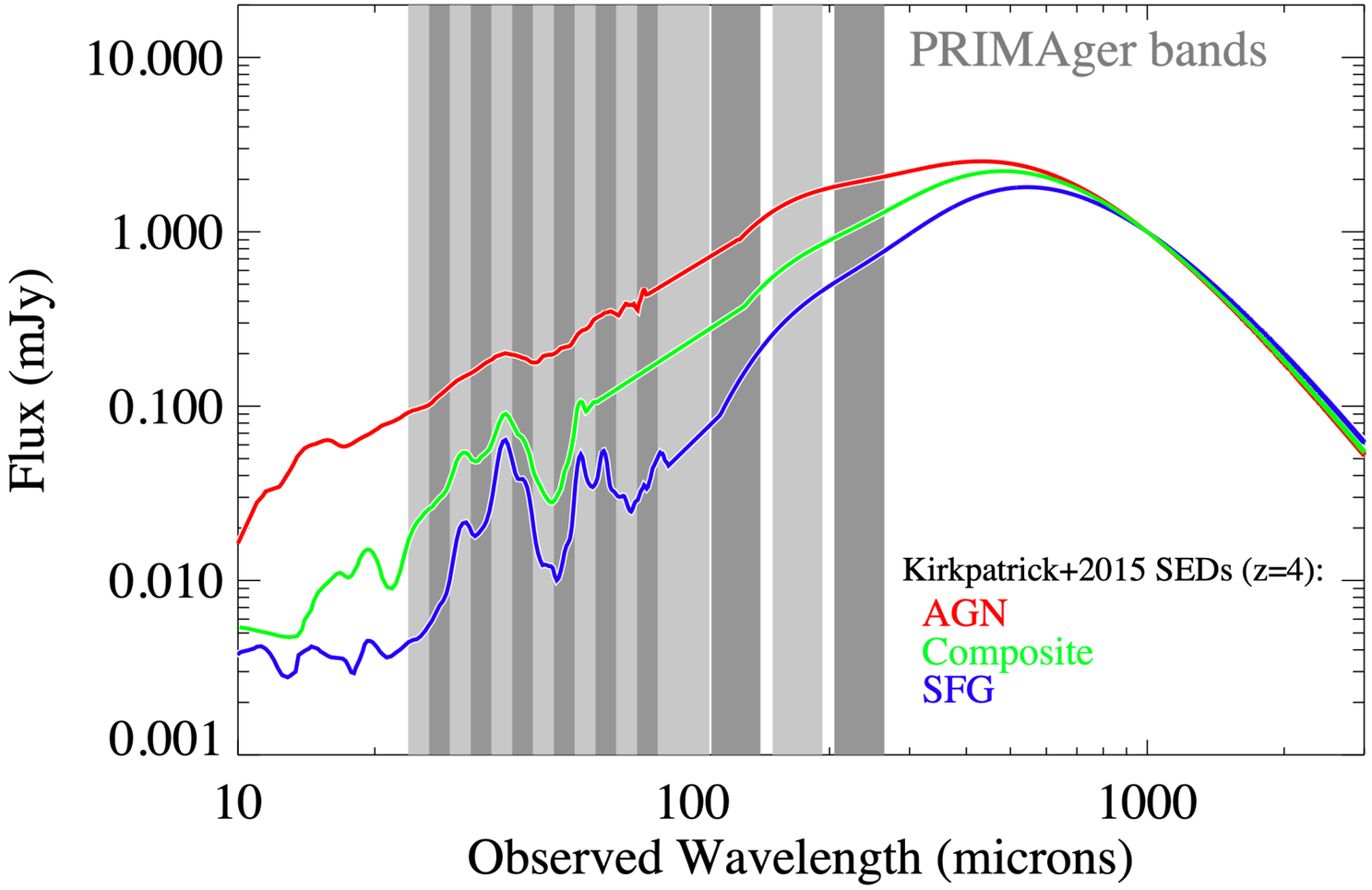


MIR AGN fraction



Kirkpatrick et al. 2015, see also Gruppioni et al. 2016

Taking a cosmic census of AGN with PRIMAger



The unique narrow bands in the PRIMA imager, PRIMAger, can be used to select AGN, and composite galaxies, over wide survey areas.

SED decomposition provides the relative luminosity from the AGN and star formation.

Example PRIMA programs to study coeval star formation and supermassive black hole growth

Spectroscopic surveys

- Blank field surveys to provide unbiased census of AGN
- Surveys of overdense fields to determine environmental impact
- Targeted surveys to quantify BHARs of certain populations (e.g. selected from PRIMAger, Roman, lensed sources, etc.)

Imaging surveys

- Blank field surveys to identify statistical samples of AGN and composite galaxies
- Surveys of overdense fields to determine environmental impact

By combining imaging and spectroscopic surveys, PRIMA can take census and quantify AGN over all cosmic time!