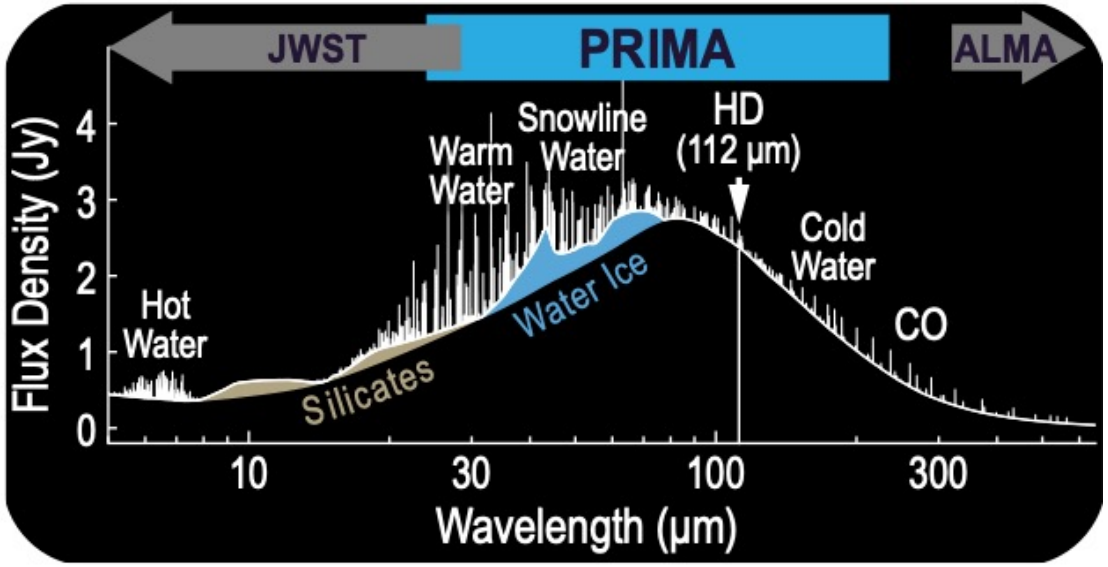
PI Theme 1: Origin of Planetary Atmospheres

Which protoplanetary disks can form planets, how and where?

The role of far-IR observations:

- fundamental HD line (112 μm)
- hundreds of water lines and features (ice/gas)
- Samples cold/warm water in disks



PRIMA PI survey

- Deep high-res FIRESS spectra of 200 disks (R=3500 @112 um)
- Targets in 5 regions within 200 pc
- Target selection: 3 stellar mass bins between 0.2-2M⊙; two age bins (separated at 2 Myr).

→

- Elemental abundances: C/H, O/H
- H_2 and dust masses
- Water vapor content

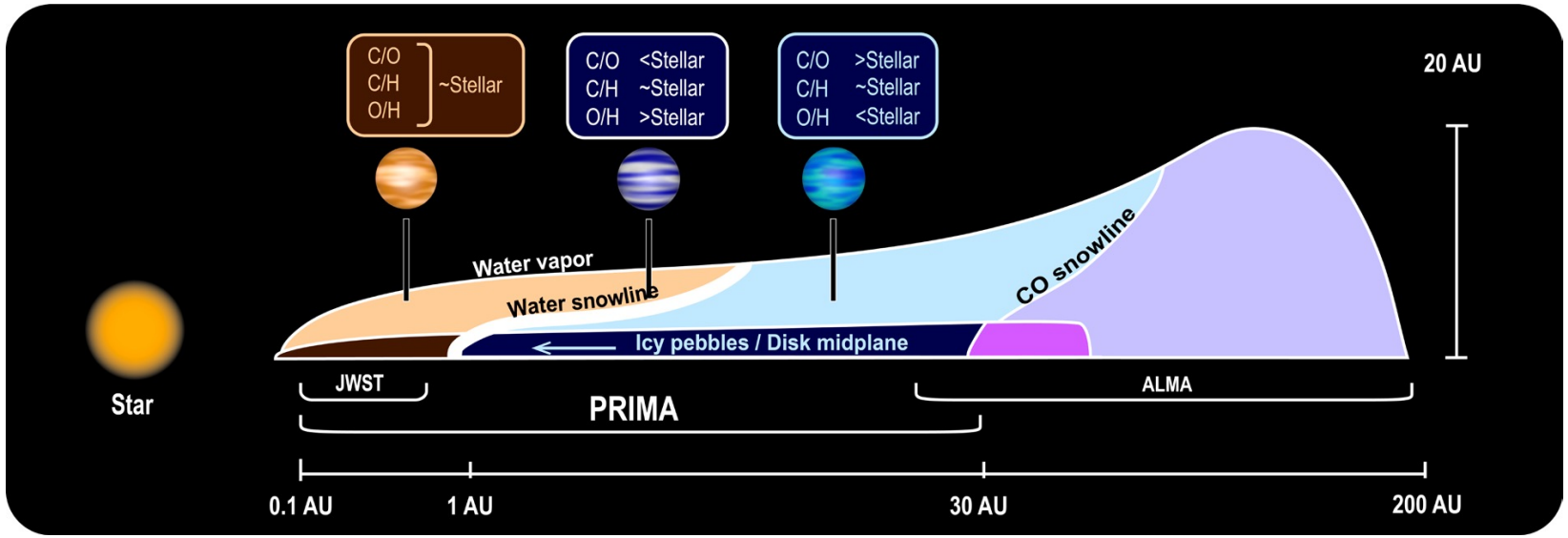
PRIMA PI Science will use the PI survey to:

- Determine if there is enough mass in water to drive the formation of planetesimals and giant planet cores near the water snowline

- Determine if protoplanetary disks in the regions where most planets likely form (<10–20 AU) have non-solar carbon and oxygen compositions

GI science ideas:

- measure the total ice–rock mass ratio
- uncover the primary molecular carrier of nitrogen (Bergner et al., 2023

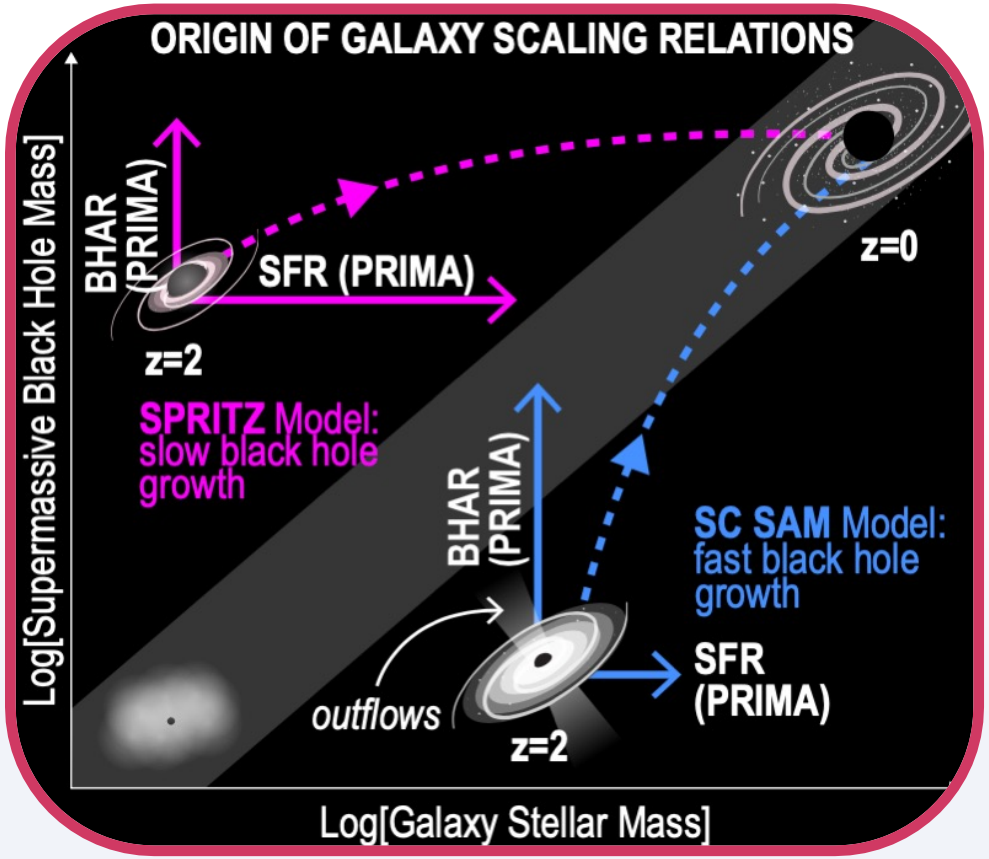


PI Theme 2: Evolution of Galactic Ecosystems

How do supermassive black holes and their host galaxies coevolve?

The role of far-IR observations

- [OIV] -> black hole accretion rate (BHAR) –
- [NeII] -> star formation rate (SFR)
- Mid-IR SEDs: -> BHAR and SFR



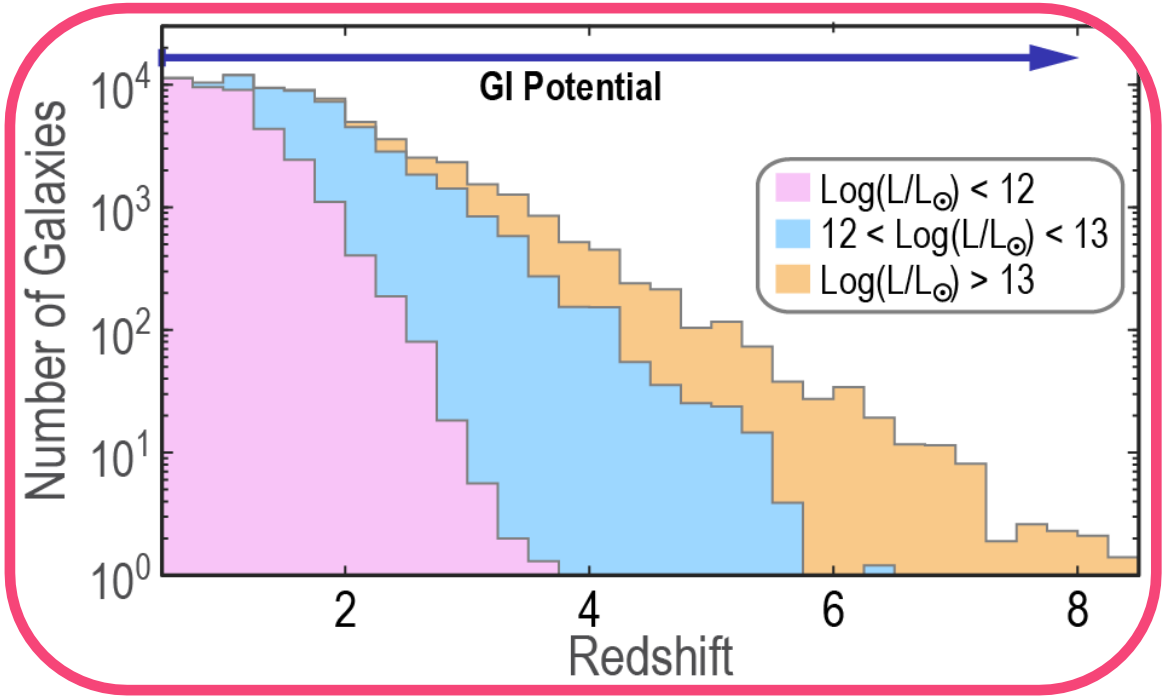
PRIMA PI surveys

1) **PRIMAger blind survey, two-tiered**:
- wide (10 sq deg, detects L* galaxy at z=1)
- deep (1 sq deg, detects L* galaxy at z=2) in Roman/Euclid extragalactic fields

-> redshifts, BHAR, SFR on ~50,000 galaxies at z 0.5-2.5

2) **FIRESS follow up spectroscopic survey**:

- 160 galaxies low res: independent BHAR, SFR measurements
- 50 galaxies high res: outflow and cool galactic winds out to z~2.5.



PRIMA PI Science will use the PI survey to:

- Determine the scaling between black-hole accretion rate and star-formation rate in luminous galaxies since the peak epoch of galaxy evolution (z=0.5-2.5).

- Determine if winds in luminous galaxies (z=1–2.5) quench star formation by characterizing the wind's cool component.

GI science ideas:

- relation between SFR tracers at high redshift (z>6)
- population studies below confusion limit (Clements et al., 2023)
- fraction of obscured AGNs

PI Theme 3: Buildup of dust and metals

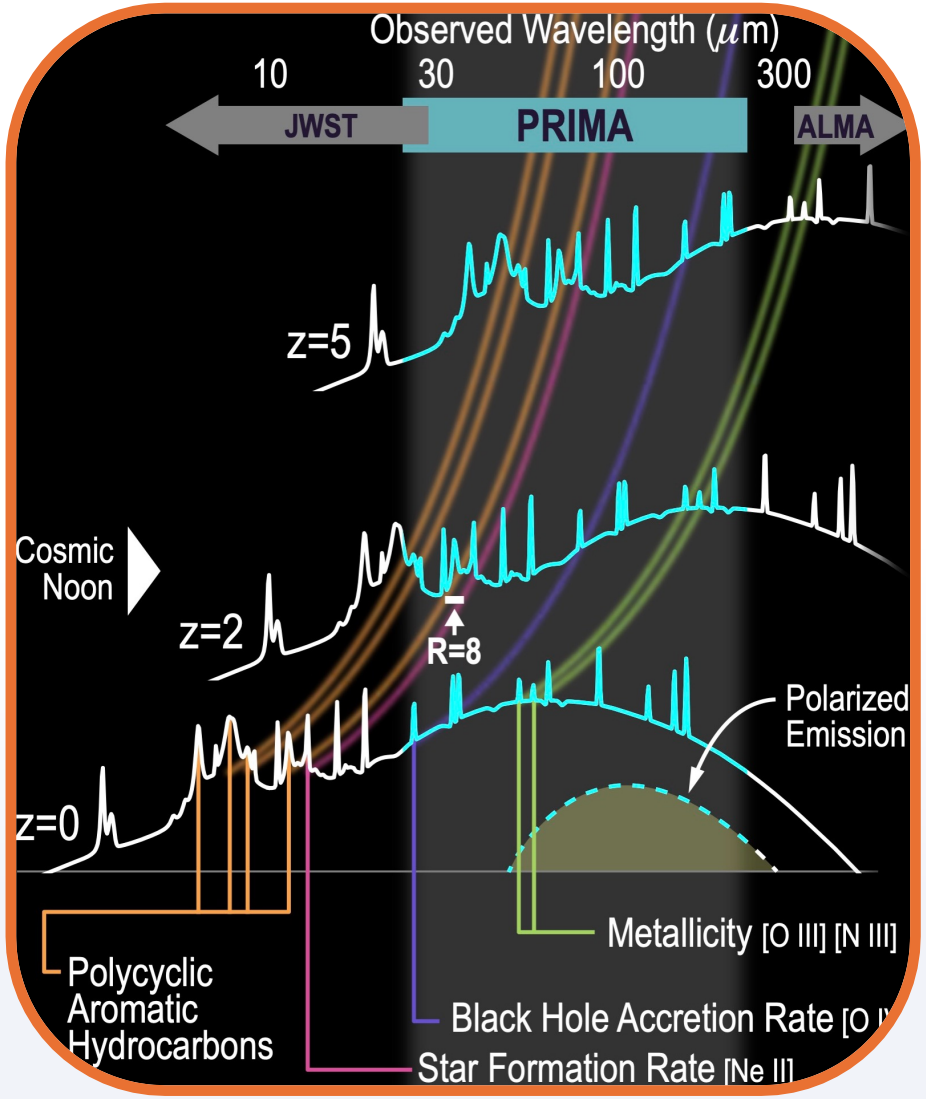
How do interstellar dust and metals form and build up in galaxies over cosmic time?

The role of far-IR observations:

- dust properties (polarized emission)
- metallicity (FIR fine structure lines and PAHs)

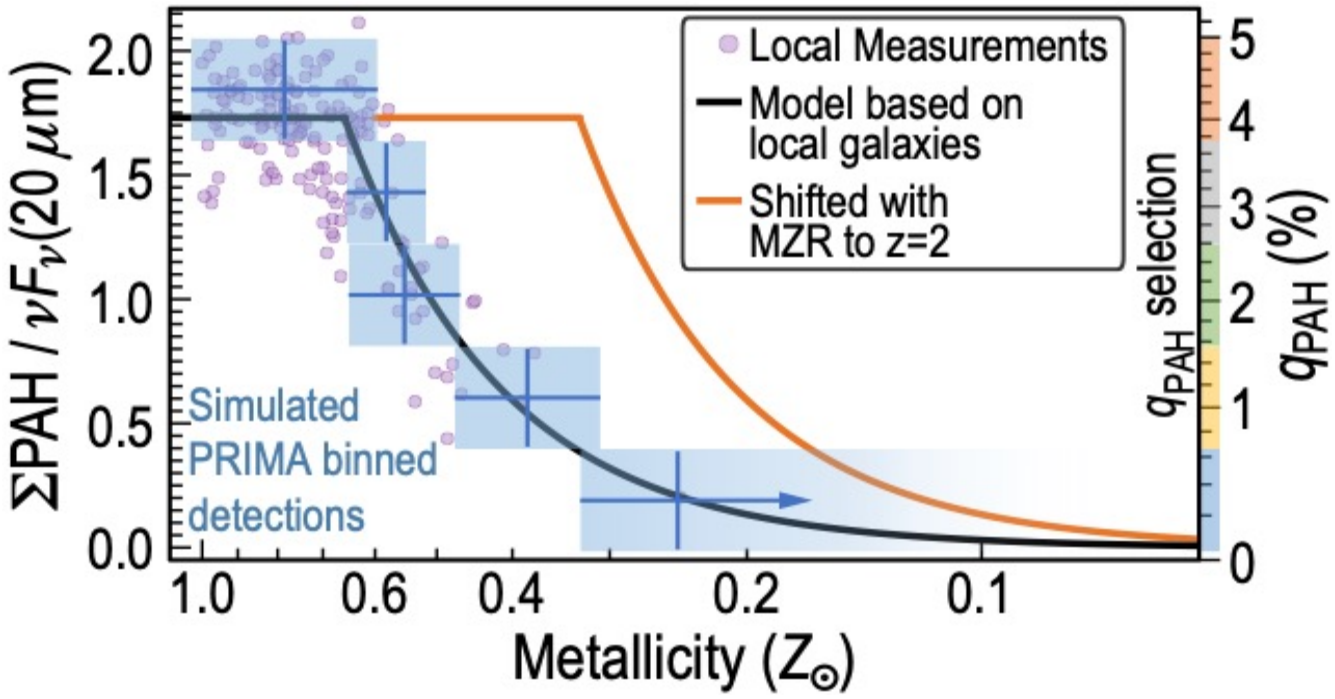
PI surveys

1) **PRIMAger Metallicity survey:**
- ~100 galaxies at z~2
- Gas-phase abundances of O and N via [O III], [NIII]
- q_{PAH} from rest-frame 11.3 and 12.7 μm bands



2) PRIMAGer Polarimetry survey

- 30 nearby galaxies
- Polarization Vs wavelength indicates distribution of ISM-mixed dust Vs carbon and silicate star dust



PRIMA PI Science will use the PI survey to:

- Determine if the relationship between PAHs and metals has evolved since cosmic noon
- Distinguish how the structure of interstellar dust grains changes across environments in the local universe

GI science ideas:

- dust properties as function of z and luminosity) in z>2.25 galaxies (e.g., Donnelly et al. 2023)
- role of mag. fields in the formation of giant molecular clouds and star formation in local galaxies (e.g., Lopez-Rodriguez et al. , 2023)