Seeking the hidden active galactic nucleus by powerful JWST

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Where are they ? JWST will tell us.

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1. About active galactic nucleus

Active galactic nucleus (AGN) is an ultra-luminous region which is at the center of its host galaxy. It has been widely believed that its central engine is driven by the supermassive black hole (SMBH).

Why is AGN important ?

The evolution of galaxy is a crucial part in search of galaxy history. However, the interaction between galaxy and its SMBH remains unsolved problem.

To investigate the co-evolution of galaxy and its center SMBH, it is crucial to search for the properties of AGN and obtain a census on AGN !

How to seek ? Use mid-infrared !

A troublesome problem is that many AGNs are often obscured by dust and gas cloud, missed in UV/optical observations.

Fortunately, the obscured lights are re-emitted in the mid infrared region (Mid-IR). It supplies us a strong, powerful way to find out those obscured AGNs.

Just like playing hide-and-seek with galaxies !
But they are all good gamers…

2. JWST, the game changer

JWST provides us a clear mid-IR observation, which can help us capture AGNs undetected in previous works because of its unprecedented high sensitivity !
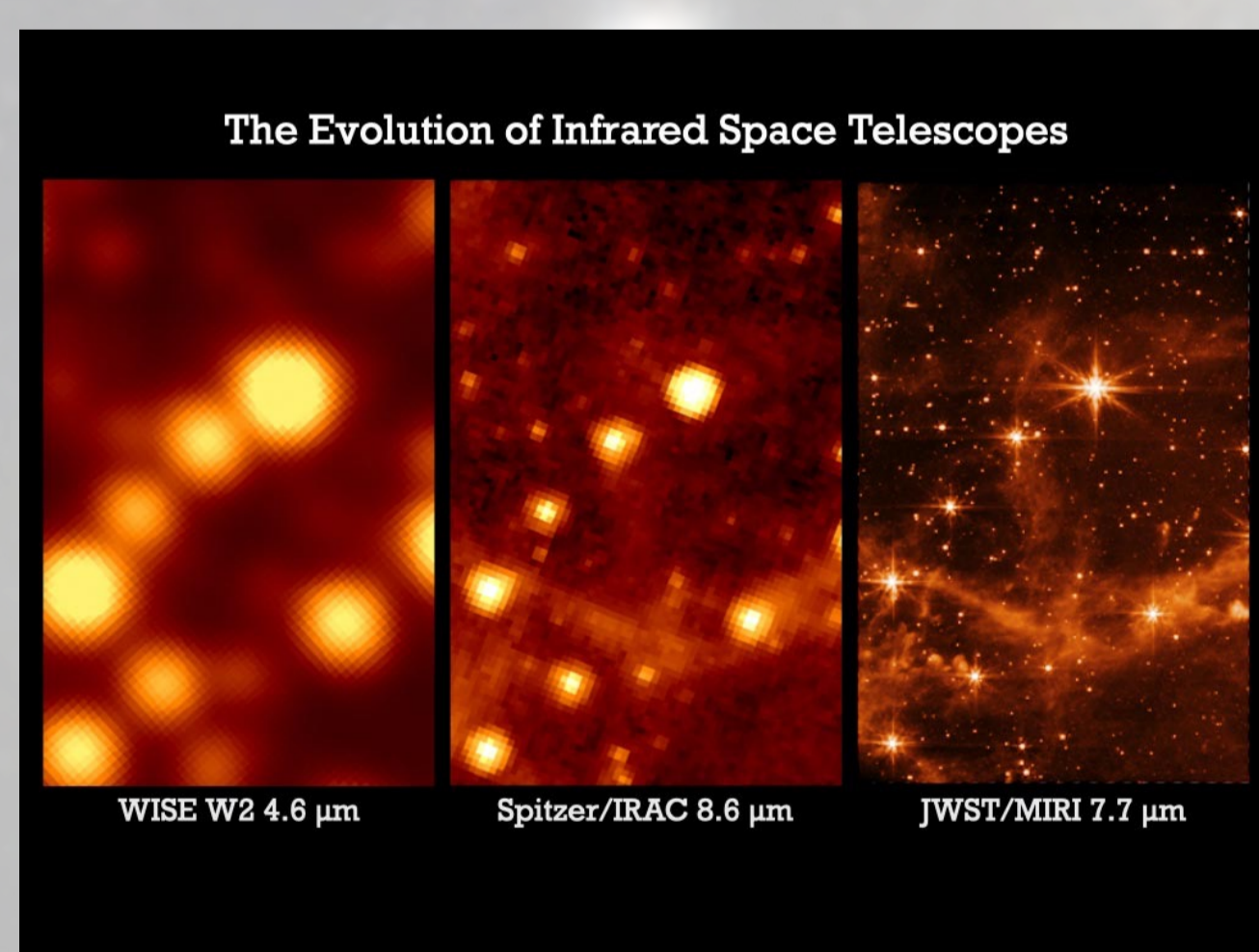

Fig.1 Quick comparison of JWST with others.
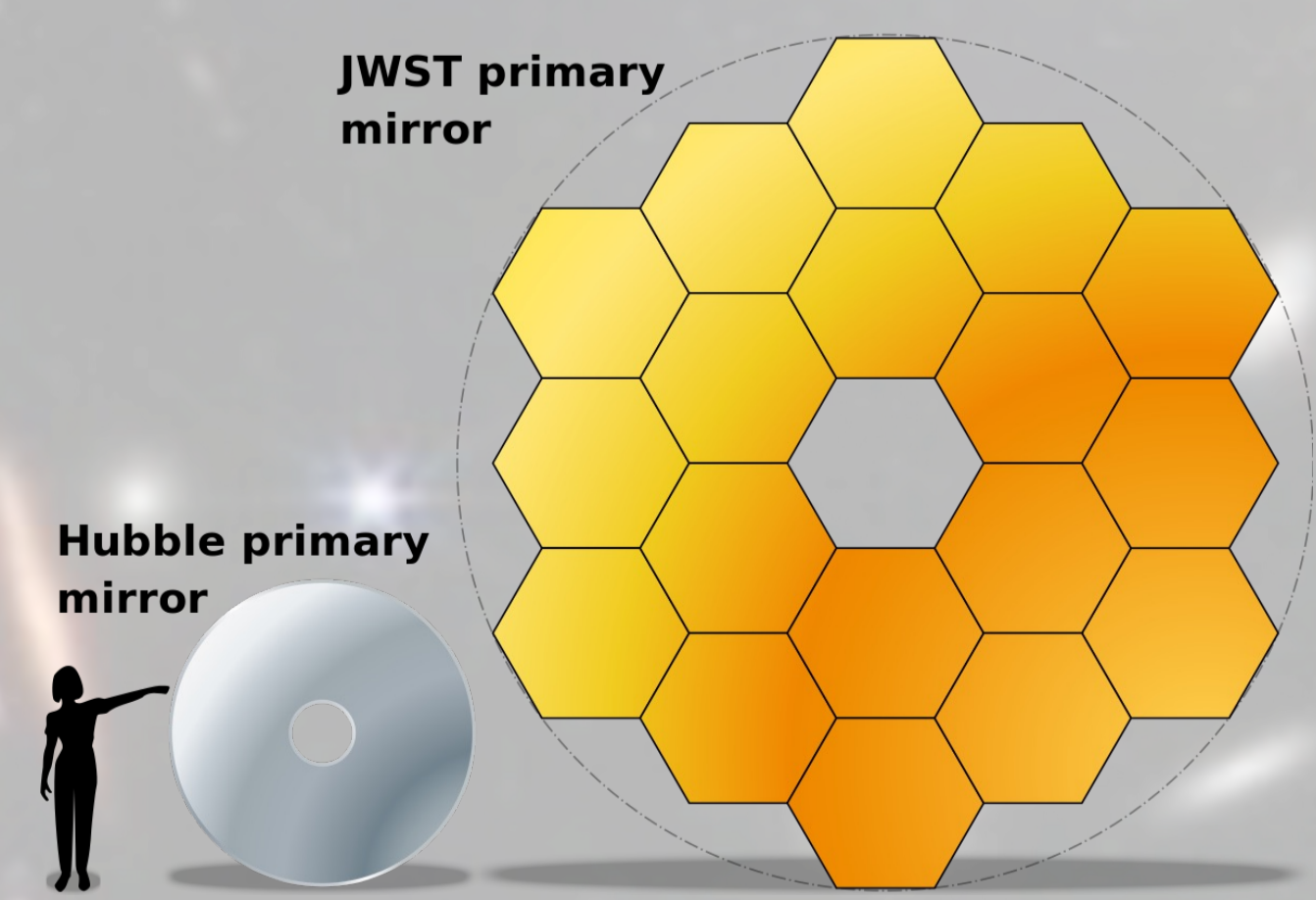Source: https://scitechdaily.com/comparing-the-incredible-webb-space-telescope-images-to-other-infrared-observatories/

Fig.2 JWST comparison with HST
Source: https://zh.wikipedia.org/zh-tw/File:JWST-HST-primary-mirrors.svg

With comparison, we can clearly realize that JWST has powerful ability to converge more light ! Fig.1 is a strong evidence to prove its ability !

We construct a HST-and-JWST-MIRI-based catalog and focus on the 6-bands of JWST-MIRI $(7.7, 10, 12.8, 15, 18, 21 \ \mu m)$ to investigate the AGNs.

3. SFG and AGN, a challenge for census

However, there are some obstacles in our investigation. Star-forming galaxies (SFGs), which have polycyclic aromatic hydrocarbon (PAH) emission in mid-IR region as well.

To successfully complete our AGN census, the separation of AGNs and SFGs is of importance. In this work, we classify our objects into three different galaxies,

1. SFGs ➢ excluded from our census.
2. Composites (SFGs + AGNs) ➢ having possibility to be picked up as our candidates of AGNs in this work.
3. AGNs ➢ our targets in this work.

SED fitting ➢ CIGALE

To determine our galaxies clearly, we compare the observed spectral energy distribution (SED) with CIGALE SED models. A example of the CIGALE SED model is shown on right-hand side. With its helps, we can quickly distinguish the major difference between AGNs vs SFGs.
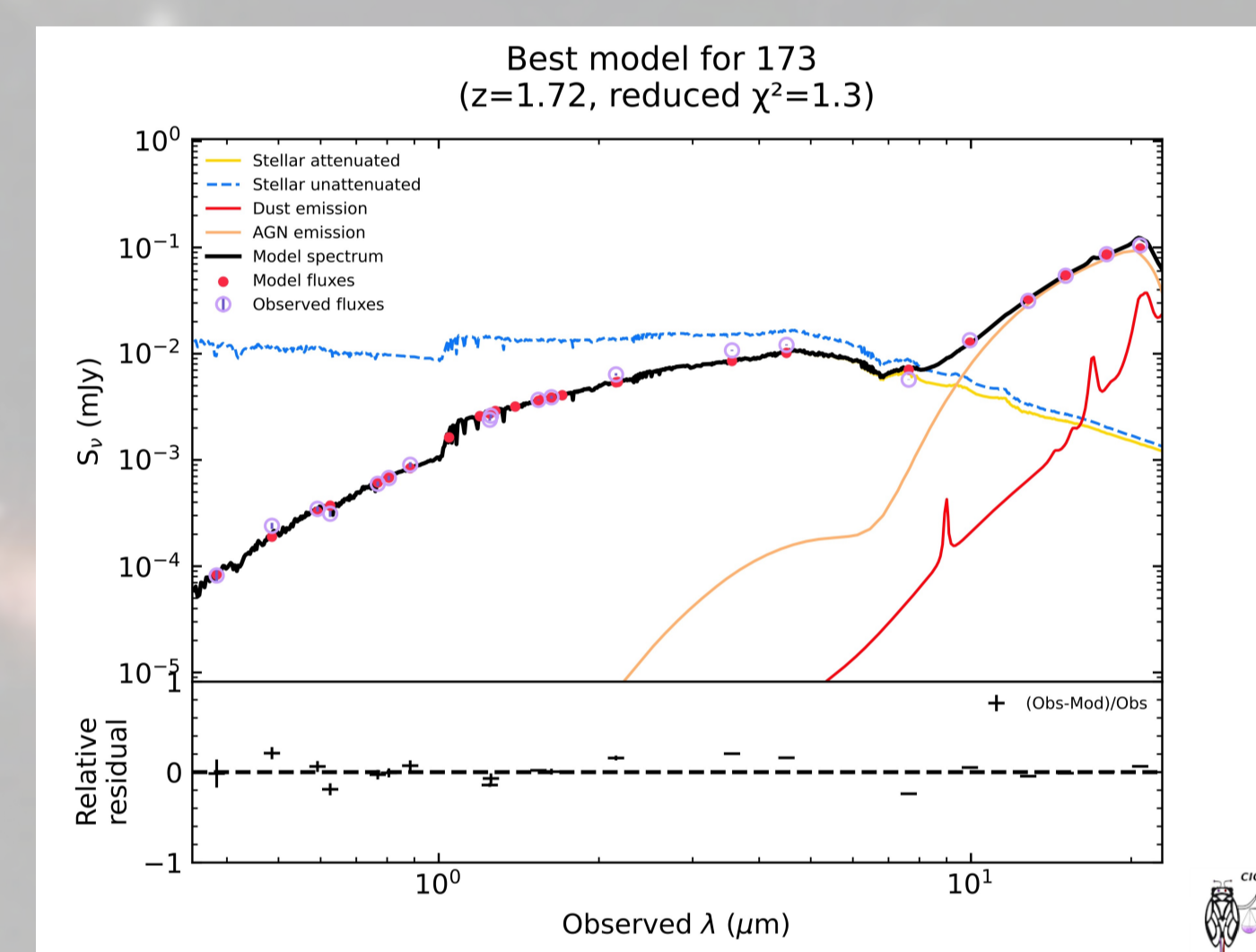

Fig.3 A example of SED fitting for AGN.

4. Results

Fig.4 Distribution of our sources

We found the trend that luminosity contributed by AGN (called AGN fraction or AGN contribution) may become larger as redshift increases (shown in Fig.5), which may infer that AGNs are more active in the high-z Universe !
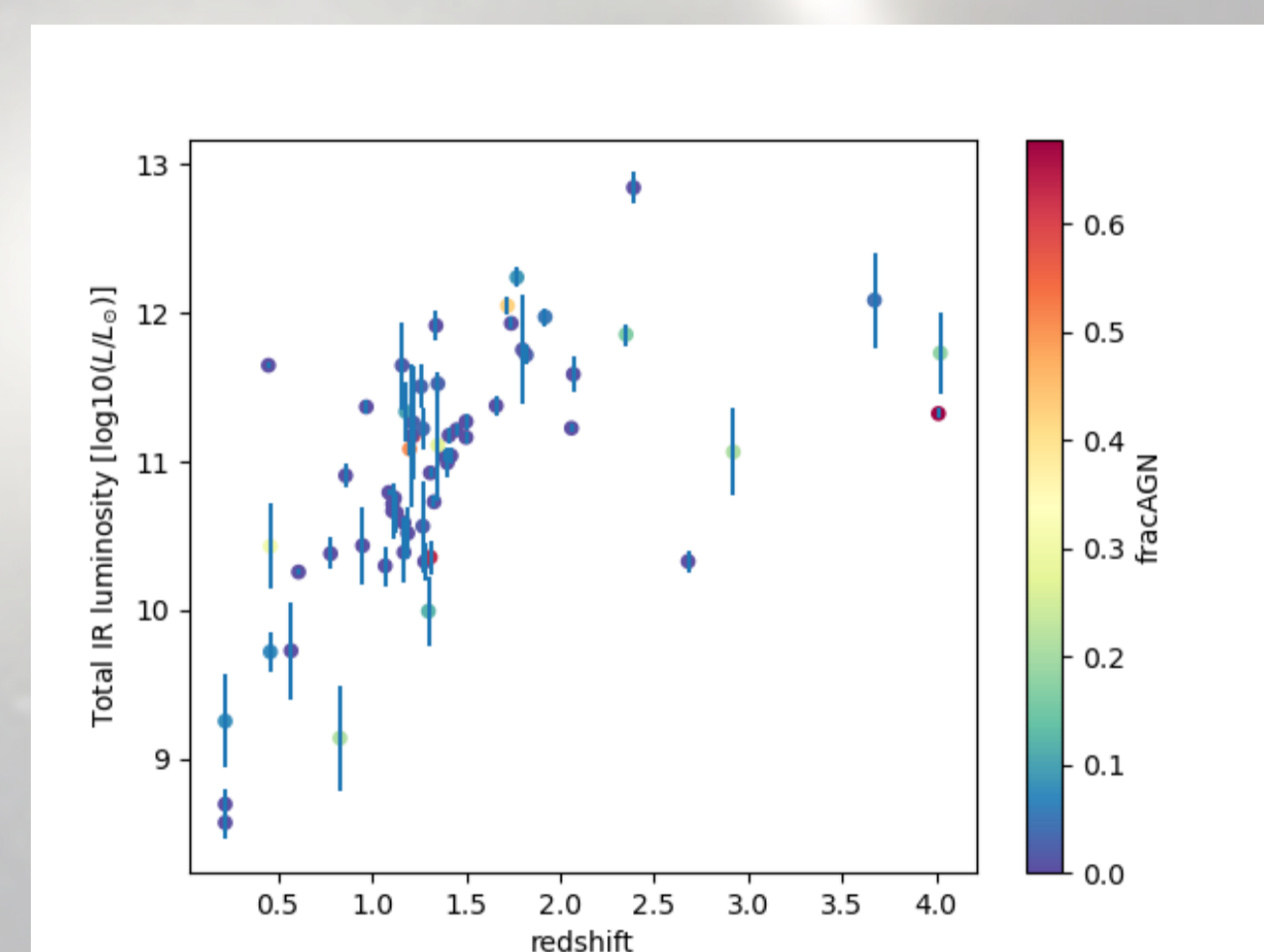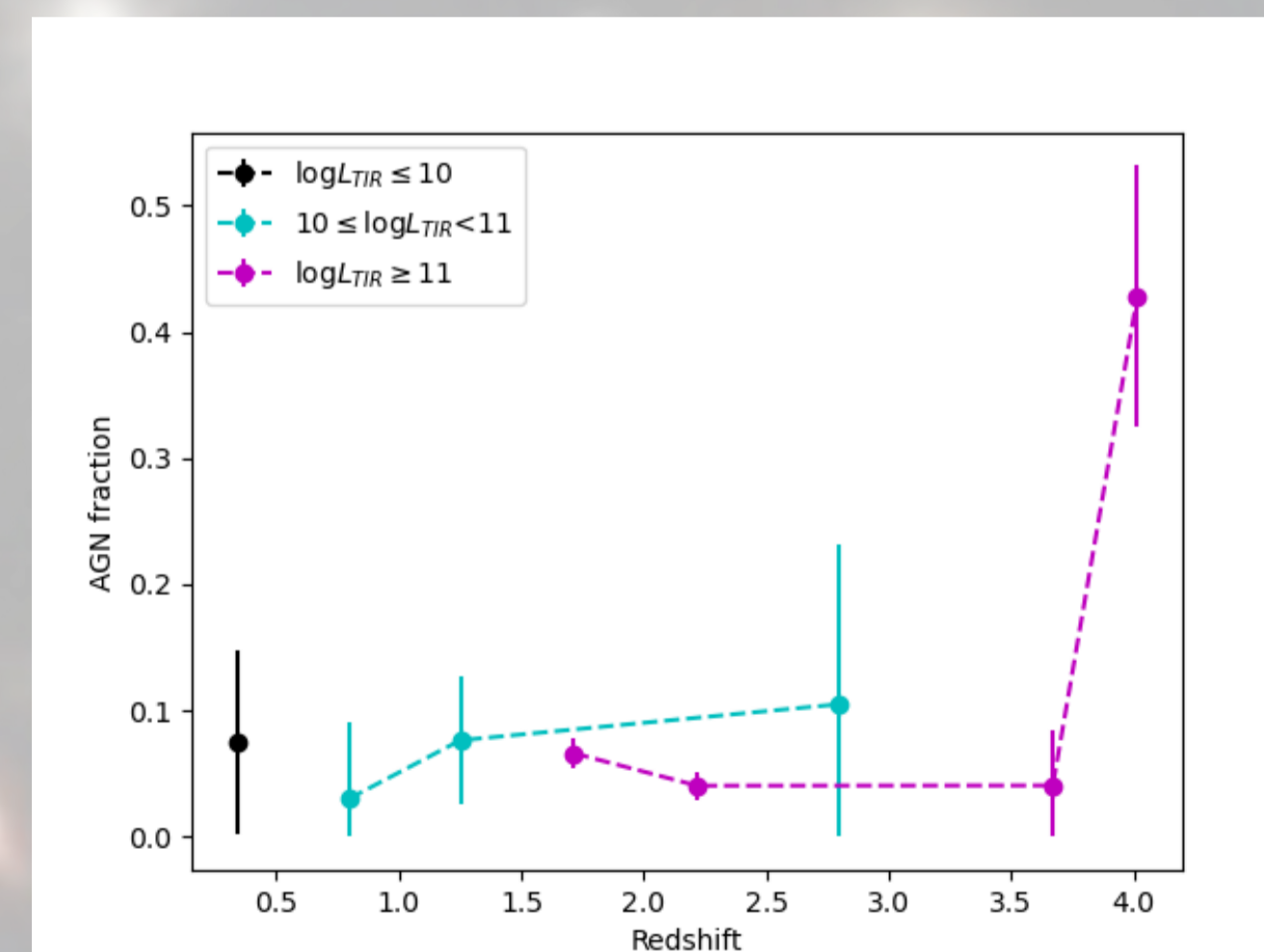

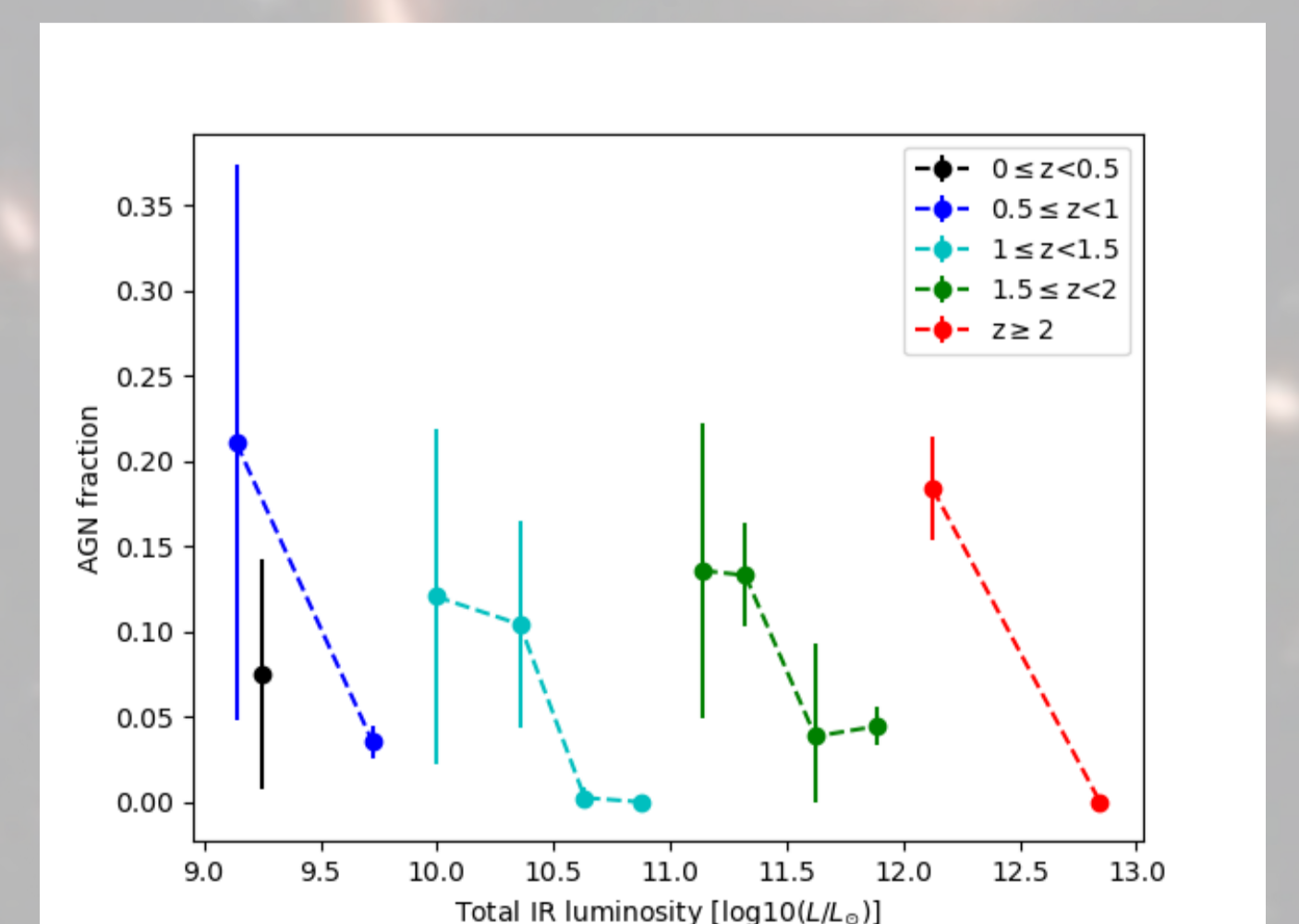Fig.5 AGN contribution as function of redshift

Fig.6 AGN fraction as function of TIR

Conclusions

◆ High-AGN-contribution galaxies locate at higher redshift region in large part with high luminosity. They may be the crucial constraints to search galaxy evolution and AGN properties.

◆ With more JWST data published in future to come, more AGN sources will be able to be captured to extent our AGN census.