Source counts at 7.7 to 21 μm in CEERS field with James Webb Space Telescope

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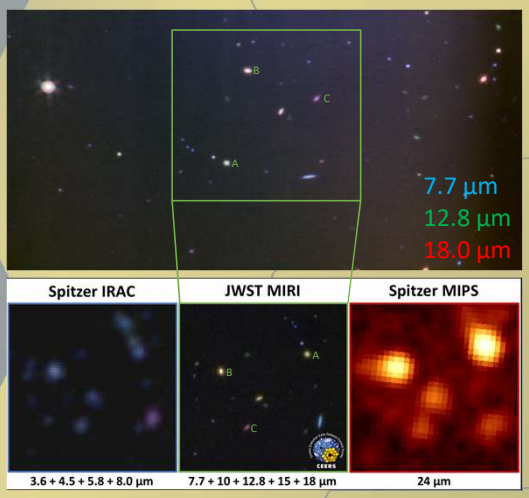
Introduction

Source count --- the number density of sources as a function of flux density --- is one of the most fundamental statistics of imaging observations. One of the advantages is its simplicity, i.e., compared with more complicated and advanced analyses such as luminosity/mass functions, there is little room for analysis errors to distort results, yet the source counts still carry important information on galaxy formation and evolution.



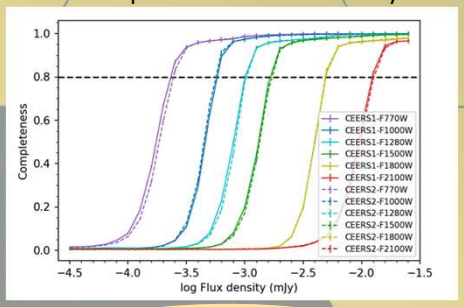
↙ Fig.1 The composite false-color image of CEERS with the JWST Mid-Infrared Instrument.
Credit: CEERS team

Analysis

We extract/count sources and measure their flux with SourceExtractor. To accurately measure the source counts, it is important to correct them for completeness of source detection at each band. Therefore, we estimated completeness as a function of flux density. The final source count has been corrected for the completeness of our source extraction.

Fig.2→ Source completeness of the CEERS field The black dashed line shows our criterion of the 80% completeness. We only present the result above this criterion.

Completeness vs. Flux density



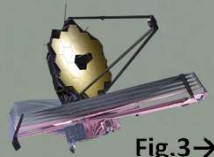
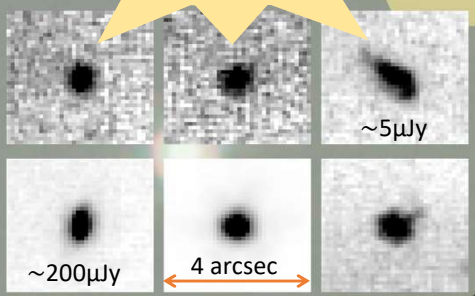


Fig.3→ The example sources at 15 μm in the CEERS field. We measure the flux depends on their size

First seen by JWST!!



Results & Future works

We show the resulting number counts in Fig. 5, the prediction from the dark matter simulation combined with the SED models appears in a range with reasonable agreements in almost all the observational measurements. Nonetheless, in the 7.7μm (Fig.4), the model shows a good agreement with the data in 0.01-0.05 mJy. However, at a fainter flux of <0.01 Jy, the model *over-predicts* IR sources by a factor of ~ 2, while the slope is still consistent.

In the near future, we will be able to use photometric or spectroscopic redshifts and more advanced SED-fitting techniques with brand-new template libraries to unwrap/improve these parameters or models.

7.7μm Source Count Function

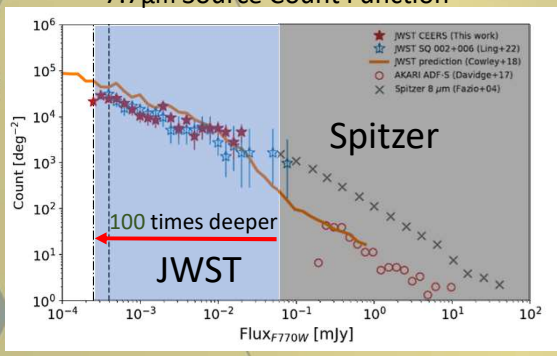


Fig.4 ↑ 7.7μm source count as a function of flux. The observed datapoints (★) are only about the half from the model prediction (╱). We may need to slightly modified the model.

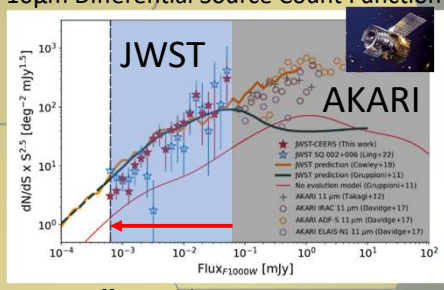
Fig.5 → 10μm Differential Source Count Function

★ : JWST CEERS data in this work.

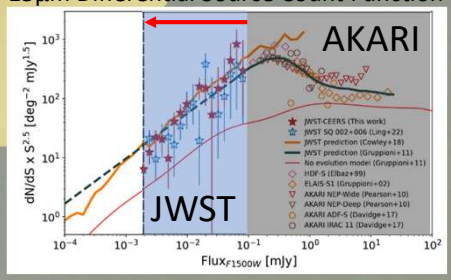
☆ : JWST Stephen's Quintet data in our previous work.

╱╱ : Prediction from current galaxy formation models.

The Source count function is the number density of sources as a function of flux density. For better comparison with previous studies, we also plot the differential source count function. The deviation between observed data points and no-evolution model (soild red line) implied the certain evolutionary path of different populations of galaxies in our Universe.



15μm Differential Source Count Function



18μm Differential Source Count Function