

Dust Evolution at Low Metallicity: A JWST study of NGC 6822

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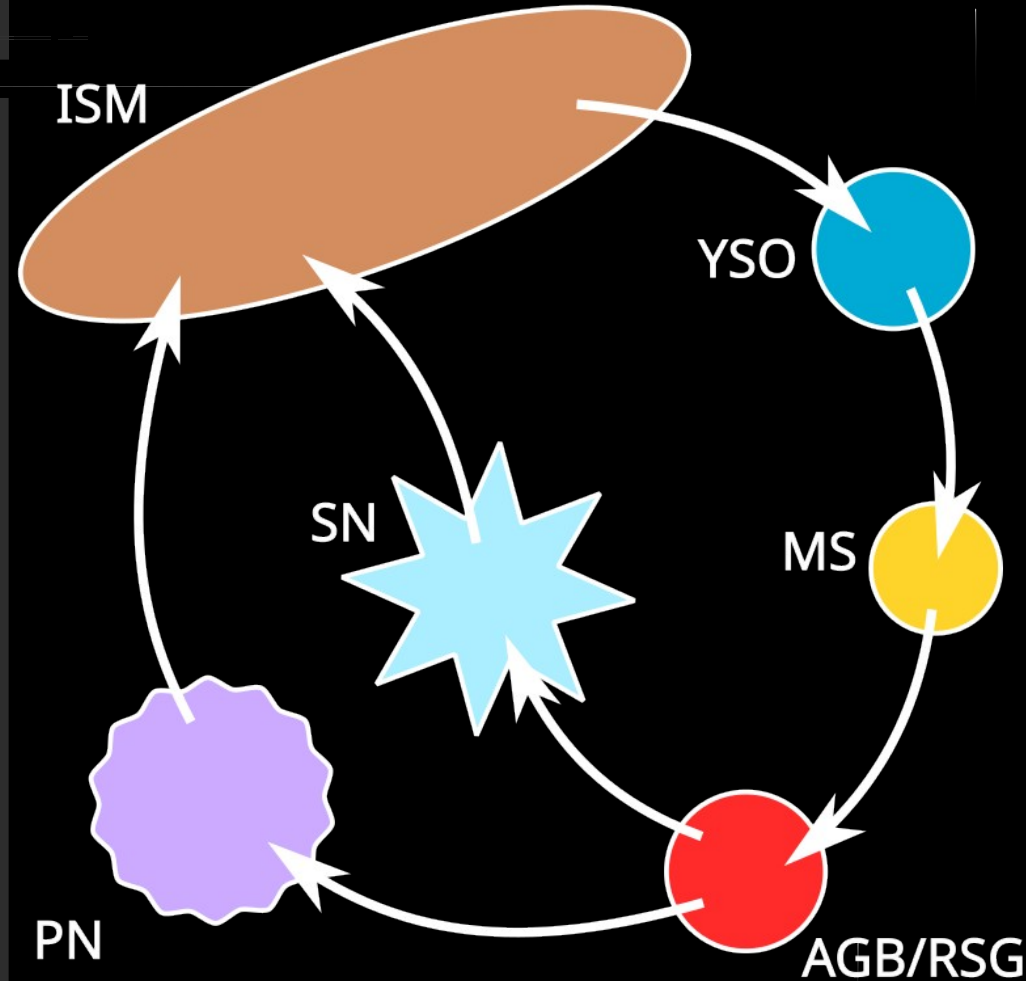
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Dust Life Cycle

- Chemical evolution of a galaxy centres around the dust in the interstellar medium
- We need to understand all the dust creation and destruction mechanisms in the full range of metallicity scenarios.
- Resolved stellar studies are the tool used to build models on Local Group objects and applied to the early universe
- Understanding dust evolution is a key component to galactic evolution



Previous Work

- SAGE-LMC Meixner et al. (2006)
- SAGE-SMC Gordon et al. (2011)
- DUSTINGS Boyer et al. (2017)
- Spitzer sensitivity and resolution limited the study to within $\sim 1\text{Mpc}$

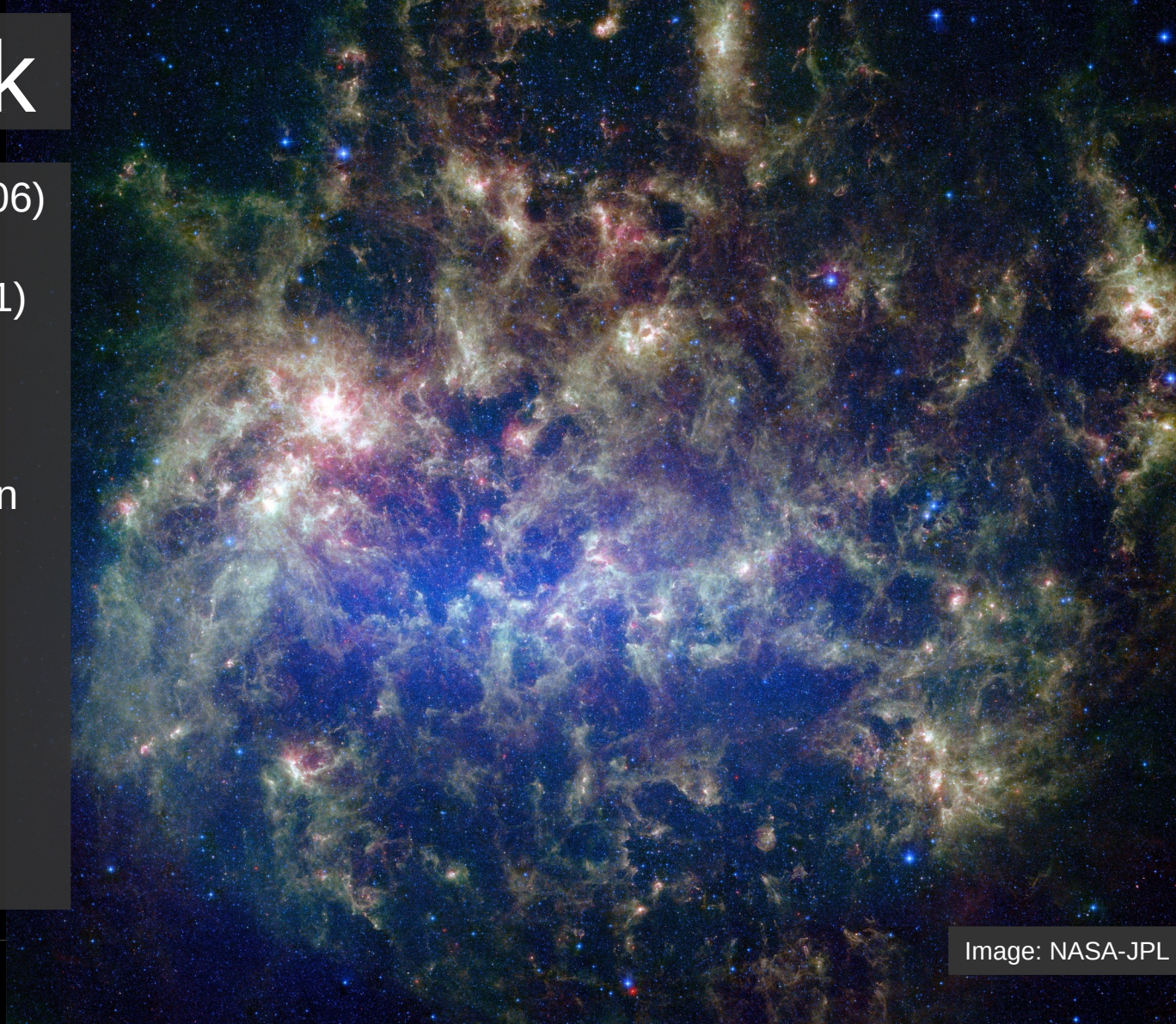


Image: NASA-JPL

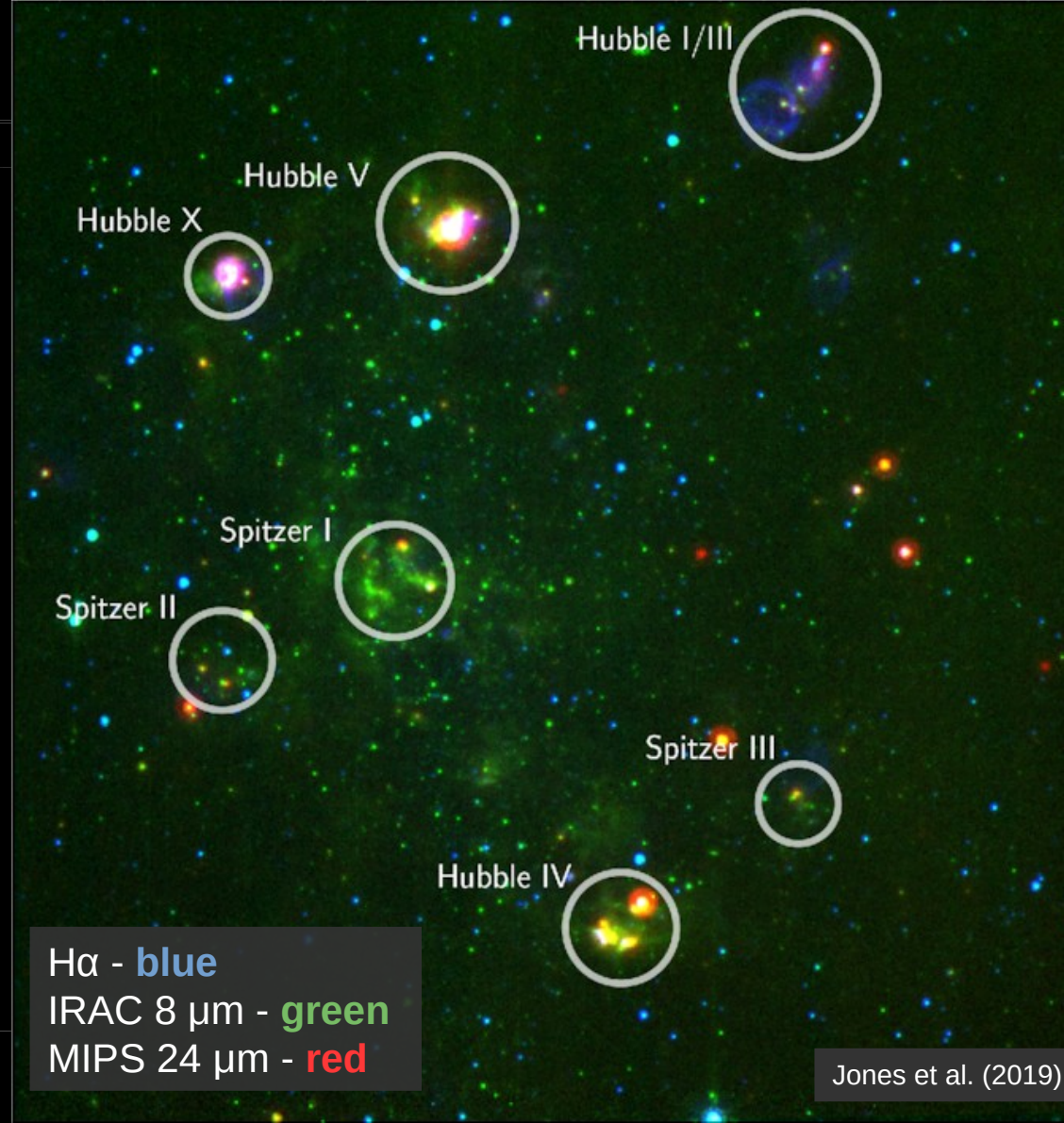
NGC 6822

- Barred irregular galaxy in the Local Group
- Nearby: $\sim 500\text{kpc}$
- Metal Poor: $Z \sim 0.25Z_{\odot}$
- Analogous star forming systems at epoch of peak star formation $z=2$
- Similar structure and composition as Small Magellanic Cloud
- Tidally isolated
- Unusual HI distribution and bright HII regions



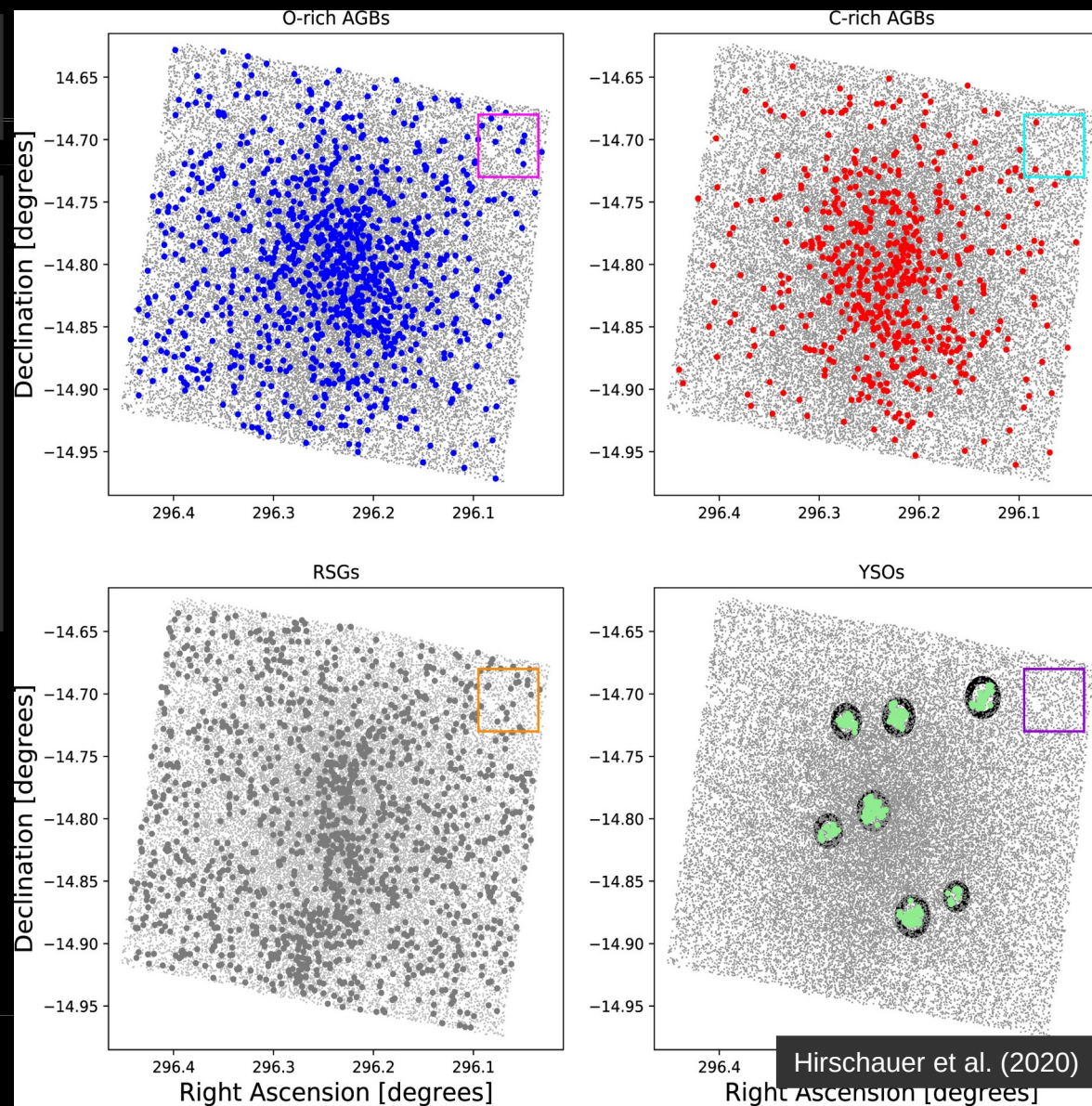
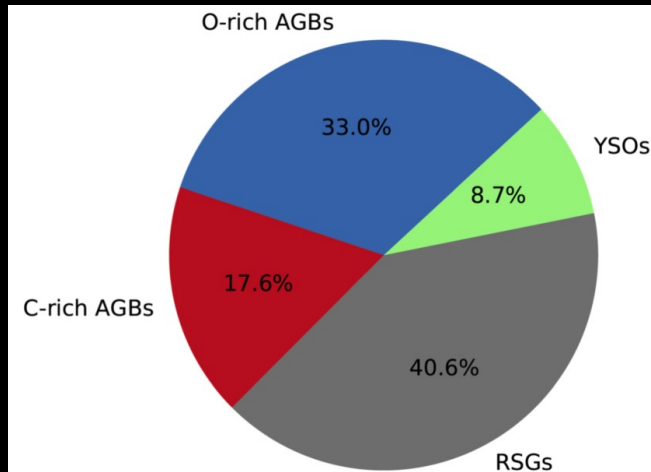
Young Population

- Home to several, bright, well known massive star-formation Hubble regions
- Spitzer archival data revealed three deeply embedded star forming regions
- Spitzer I has more young objects than any Hubble region
- Discovery changed the focus of this GTO program



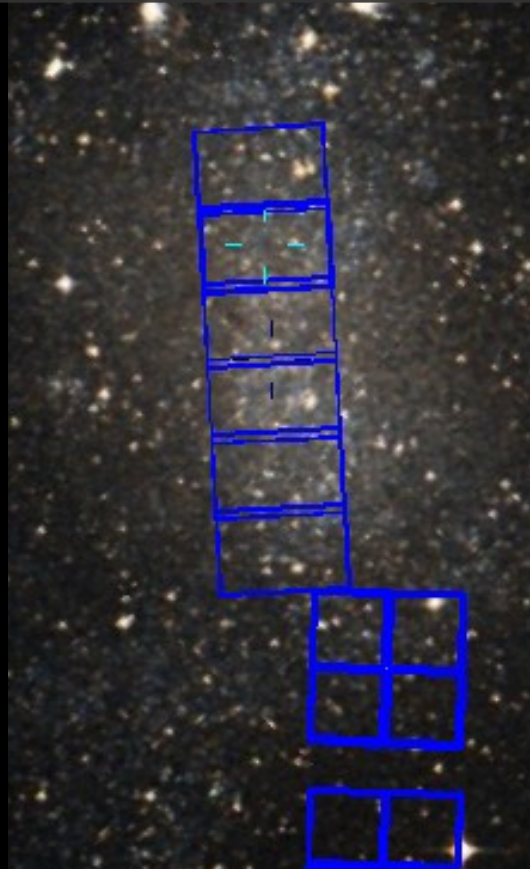
IR Population

- TRGB $K=17.4$; $N>3500$ AGBs
- Sibbons et al. 2012 (JKH) found even distribution of evolved stars
- Hirschauer et al. 2020 folded in Spitzer data and employed a statistical method to separate populations

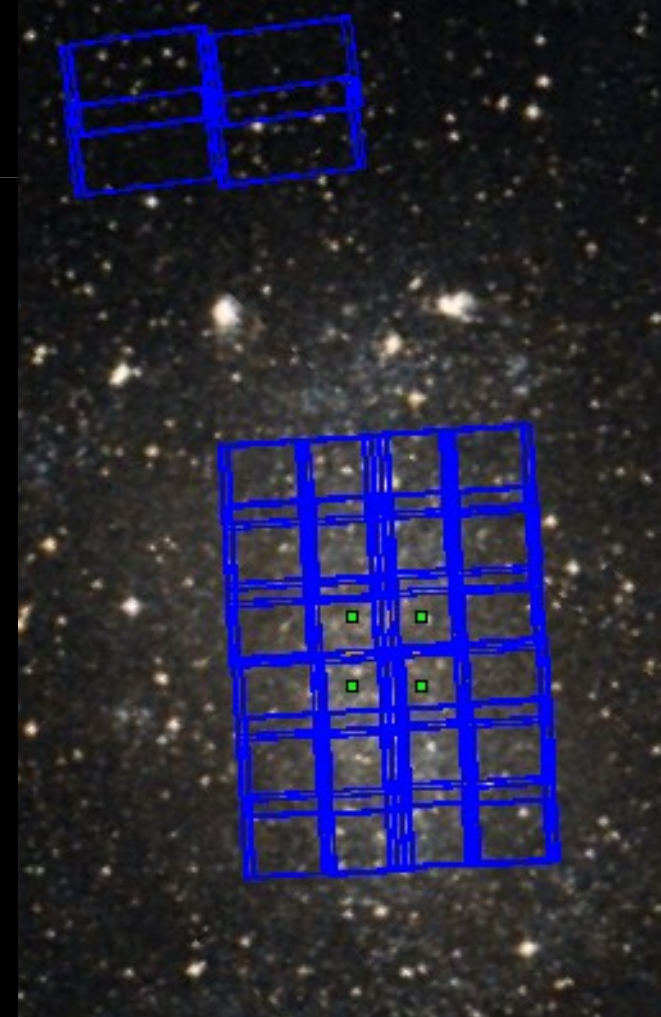


JWST Study of NGC 6822

- 17 Hours total integration time in 4 NIRCam filters and 4 MIRI filters
- Filters selected based on stellar models and Spitzer Spectra in the Magellanic clouds (Jones et al 2017)
- Star formation down to $2 M_{\odot}$
- Detecting several magnitudes below RC, entire IR population
- Embedded sources will be ideal spectroscopic follow up targets



MIRI: F770W F1000W
F1500W F2100W



NIRCam: F115W
F200W F356W F444W

Starbug II



- PSF fitting using python PHOTUTILS
- JWST Pipeline includes aperture photometry but for our purposes, PSF photometry is necessary
- Designed to accommodate large numbers of filters
- Ensemble of background subtractions to build a construct source list prior to fitting
- It will be able to recover saturated sources from earlier stages in JWST output pipeline



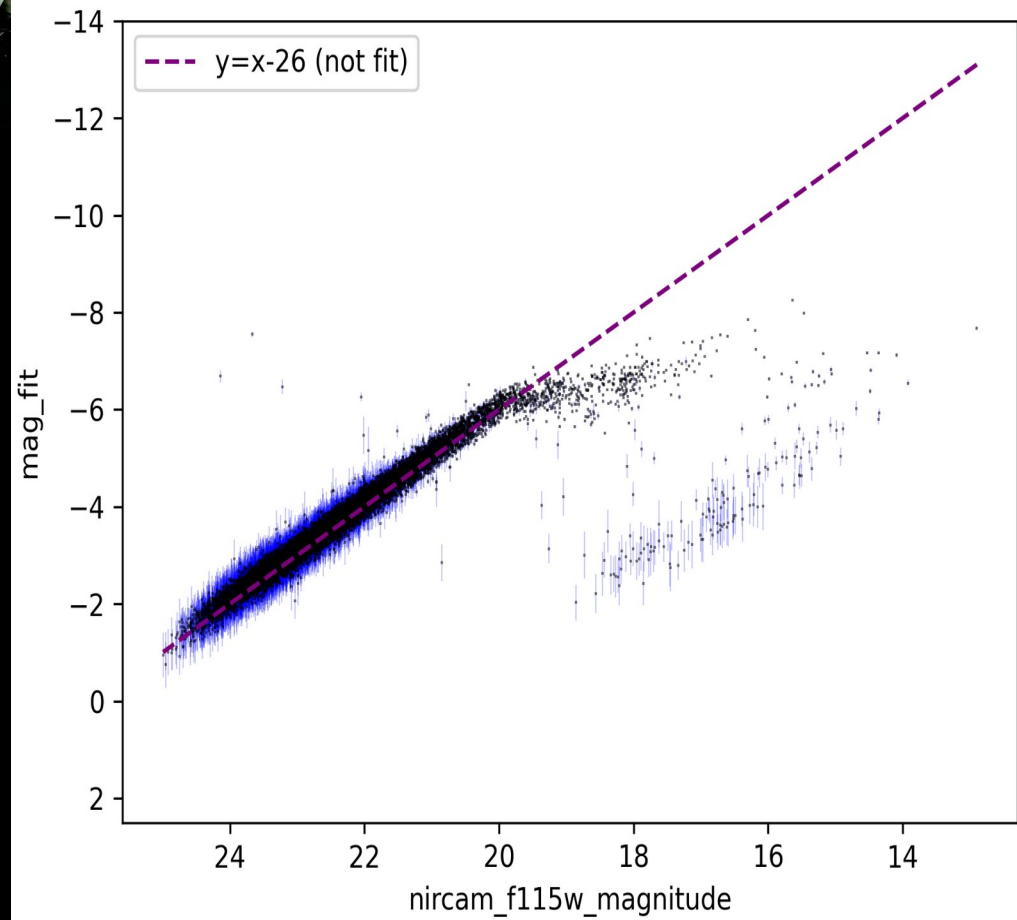
Image:NASA,ESA,CSA,STSci

WEBB MIRI 7.7 μ

Starbug II



- Tested on MIRAGE NGC 346 simulation
- After cutting contaminants Starbug recovers simulated fluxes well
- Saturation effects demonstrate necessity to integrate with JWST pipeline
- Aim to have it publicly available after some real data testing following data release on the 12th
- <https://github.com/conornally/starbug2>



Summary

- Dust cycle is a core mechanism of galactic evolution
- NGC 6822 is an ideal target for studying galaxies during peak star forming epoch: it has a significant population of evolved stars and several areas of very active star formation
- Our 17h JWST program using 8 NIRCam and MIRI filters is expected to reach the below the red clump and will detect embedded young stellar objects $M > 2M_{\odot}$
- Starbug II (Nally et al. in prep.) is a python PSF fitting tool that will be made public after robust testing is conducted following the first light release:

<https://github.com/conornally/starbug2>

