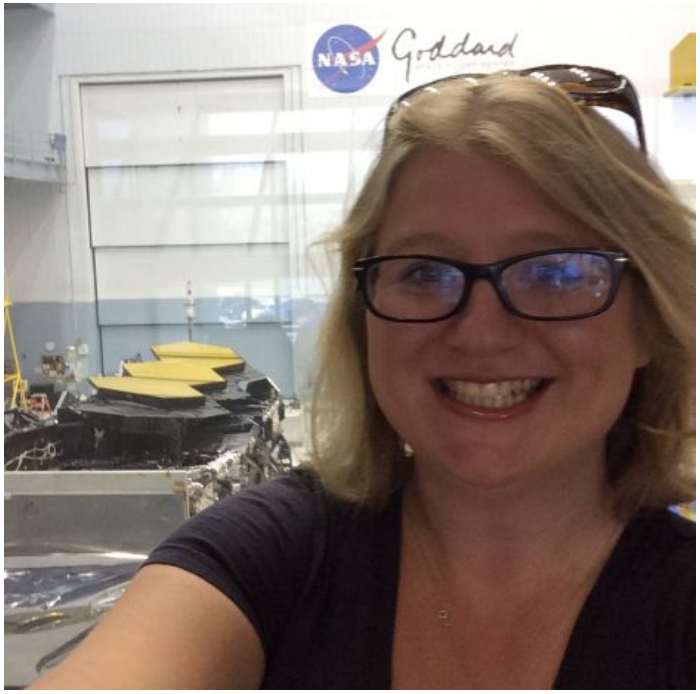
Galaxy Archaeology with Asymptotic Giant Branch Stars



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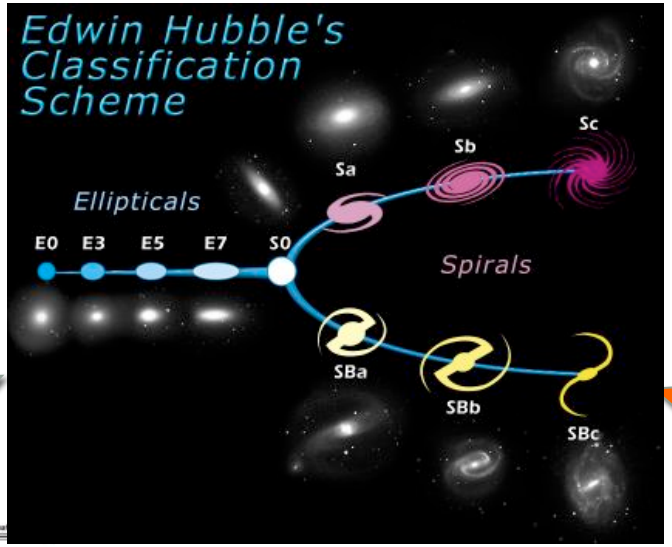
Different Approaches to Understanding Galaxy Evolution

Direct observations of young galaxies at high redshift shows how they looked **at a single snapshot** in time.



Observations of **old and intermediate-age stars** in local galaxies allows **entire past history to be reconstructed** indirectly.

LETTER

A galaxy rapidly forming stars 700 million years after the Big Bang at redshift 7.51

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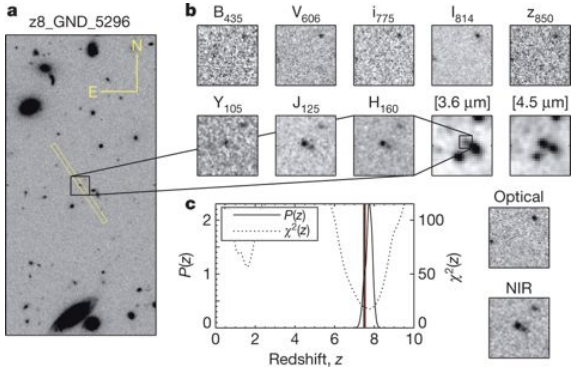
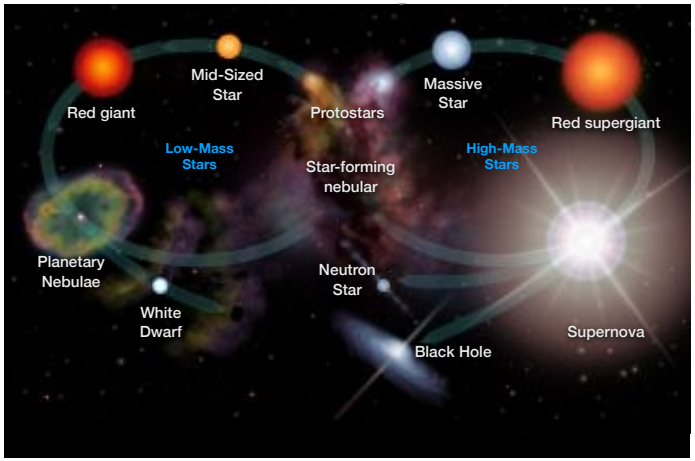
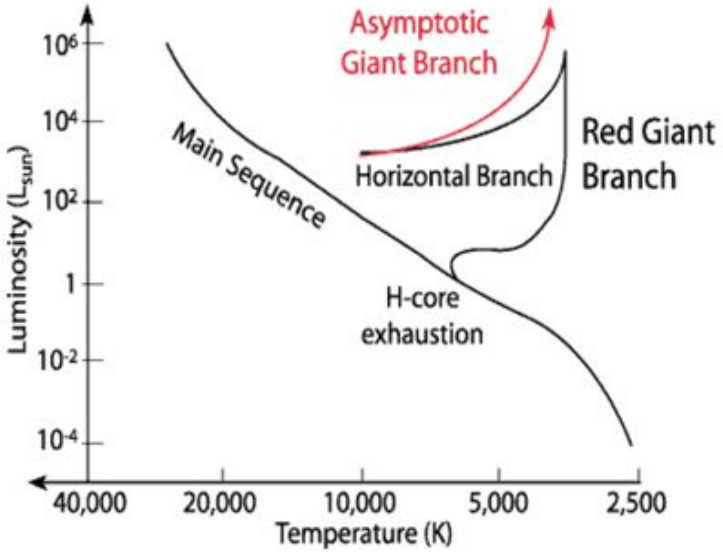


In this project, you will study galaxy evolution through deciphering the archaeological record in galaxies out to ~20 Mpc.

Asymptotic Giant Branch Stars as Archaeological Probes





AGB stars are **evolved low to intermediate mass stars** ($1 \leq M \leq 8\ M_{\odot}$).

Characterised by **high luminosities** and **high mass loss rates**, up to $10^{-4}\ M_{\odot}$ / yr.

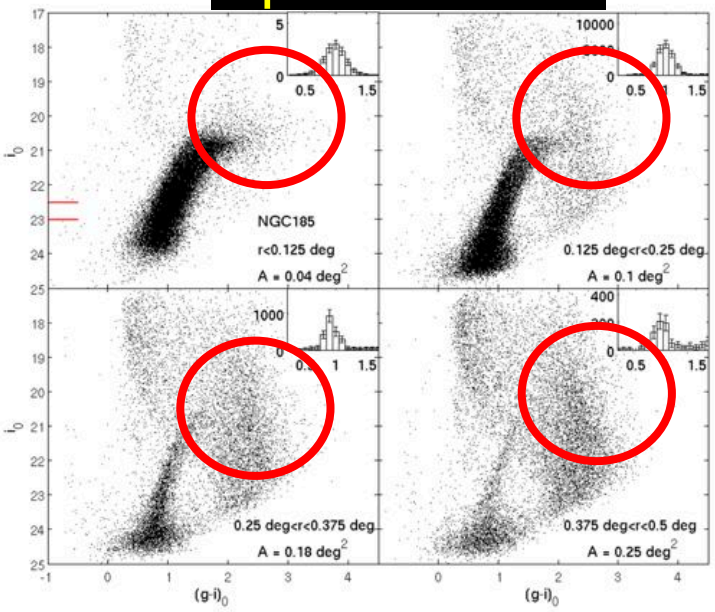
Thermally-pulsing AGB (TP-AGB) stars are particularly luminous in the near-IR/IR, where they sit above the tip of the red giant branch.

TP-AGB stars **trace epochs of star formation which occurred ~1-4 Gyr ago** (or at redshifts 0.1-0.5).

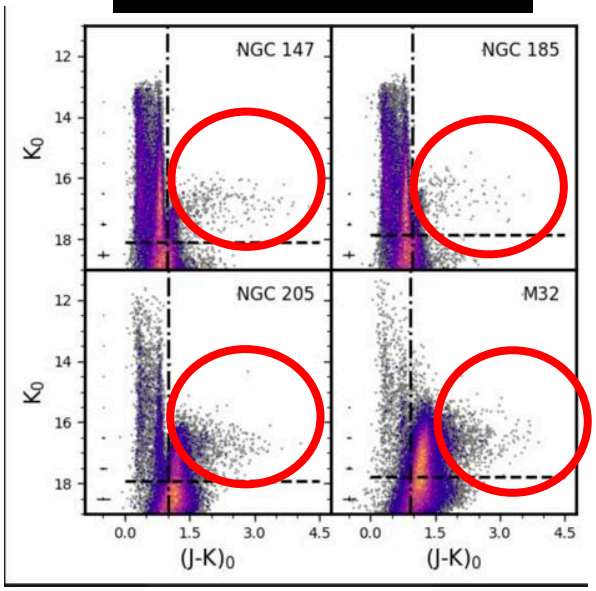
They can also be used to **probe dust production and chemical evolution**.

Asymptotic Giant Branch Stars as Archaeological Probes

Optical CMDs



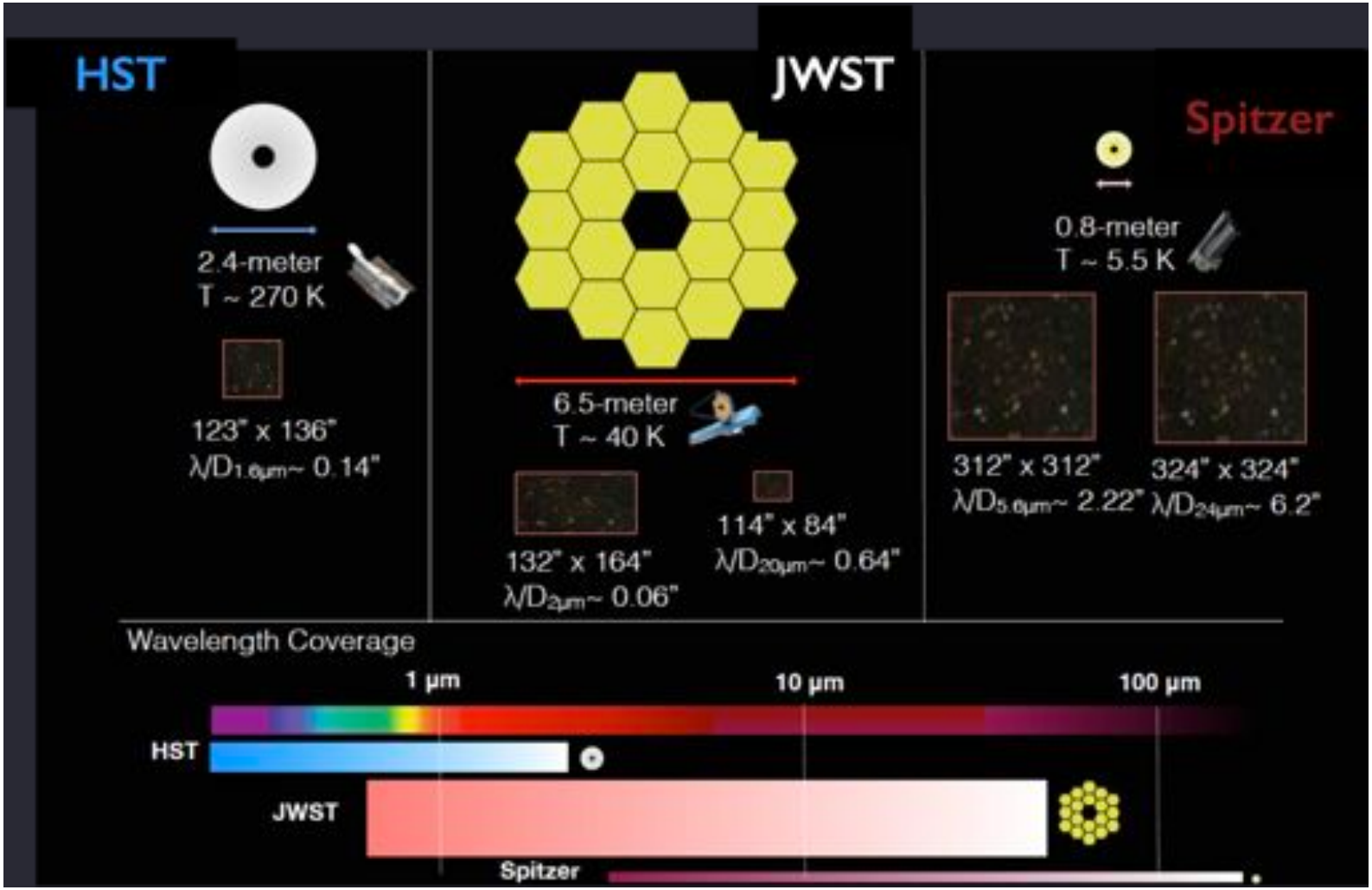
Near-IR CMDs



Extragalactic AGB stars are **much easier** to identify at near-IR/IR wavelengths, as they occupy a distinct region of colour-magnitude space and are well-separated from Milky Way foreground populations.

Ability to find and characterise AGB stars in a systematic way out to several Mpc distances **severely hindered by lack of facilities, until now…..**

Possible Directions for PhD Student: (1) First Science with JWST



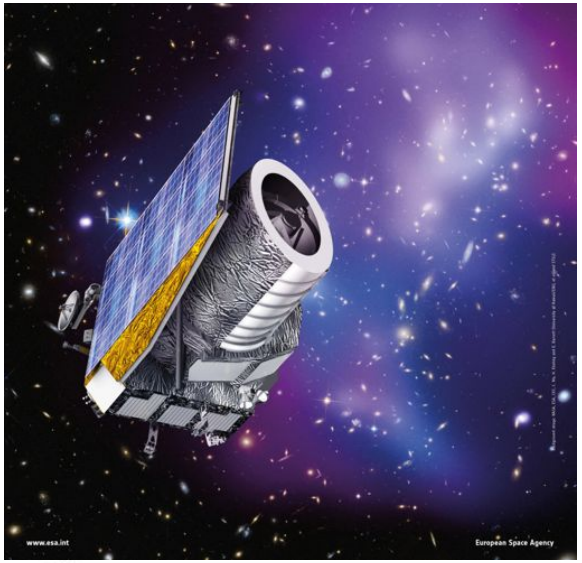
Possible Directions for PhD Student: (1) First Science with JWST

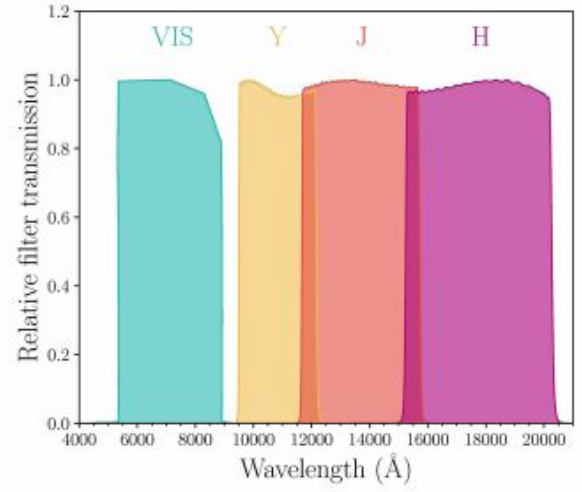
IZw18: An exceptional Blue Compact Dwarf and primeval galaxy analogue

NGC6822: An enigmatic dwarf irregular galaxy in the Local Group

With 23h of guaranteed JWST MIRI+NIRCam time (PI Jones), you would have the opportunity to study AGB stars and the ISM in IZw18 and NGC6822 – mapping the history of star formation and dust production at very low metallicities.

Possible Directions for PhD Student: (2) First Science with Euclid





Euclid is a 1.2m diameter wide-field near-IR satellite to be launched in 2022.

Will survey roughly 15,000 sq. degrees of the sky over 5 years to YJH of 24 mag with near HST resolution.

Primary science is cosmology but much legacy science to do with the ~10^9 detected sources – e.g. you could search for AGB stars out to large radii in several hundred nearby galaxies (Ferguson leads key science working group).

Summary

Exciting opportunity for PhD student to join our collaboration and take the lead in one or more studies of AGB stars in nearby galaxies using forthcoming state-of-the-art datasets.

The primary data for this project is guaranteed: expect JWST data in mid-2022 and Euclid data in mid-2023.

While waiting on the first data, your efforts may focus on (depending on your interests):

- software development/optimisation for JWST MIRI and NIRCam observations
- Analysis of AGB stars in Local Group galaxies using existing wide-field datasets from UKIRT/WFCAM
- Developing methodologies to extract quantitative star formation histories from AGB populations