

HOW CAN WE IDENTIFY GALAXIES THAT HAVE STOPPED FORMING STARS IN THE EARLY UNIVERSE?

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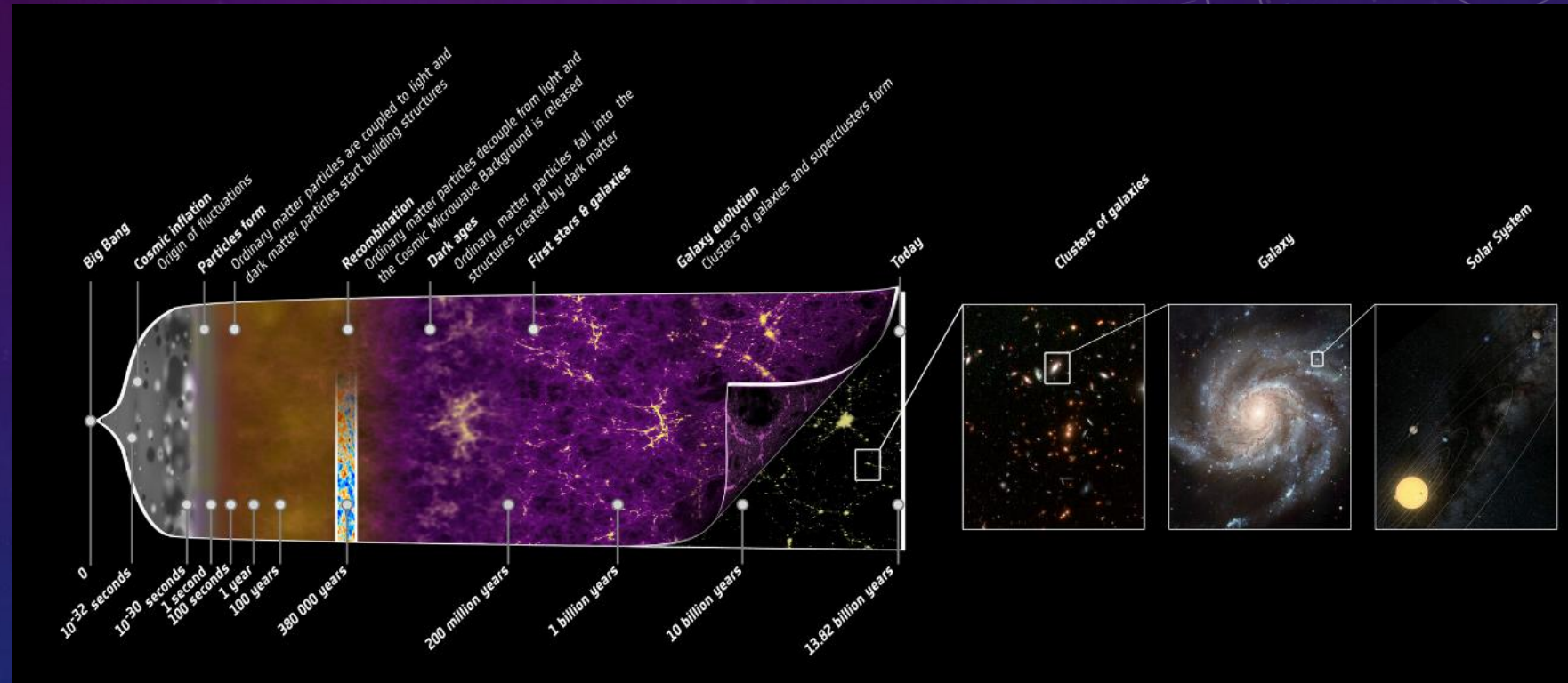
YOUNG ASTRONOMERS MEETING - 2026



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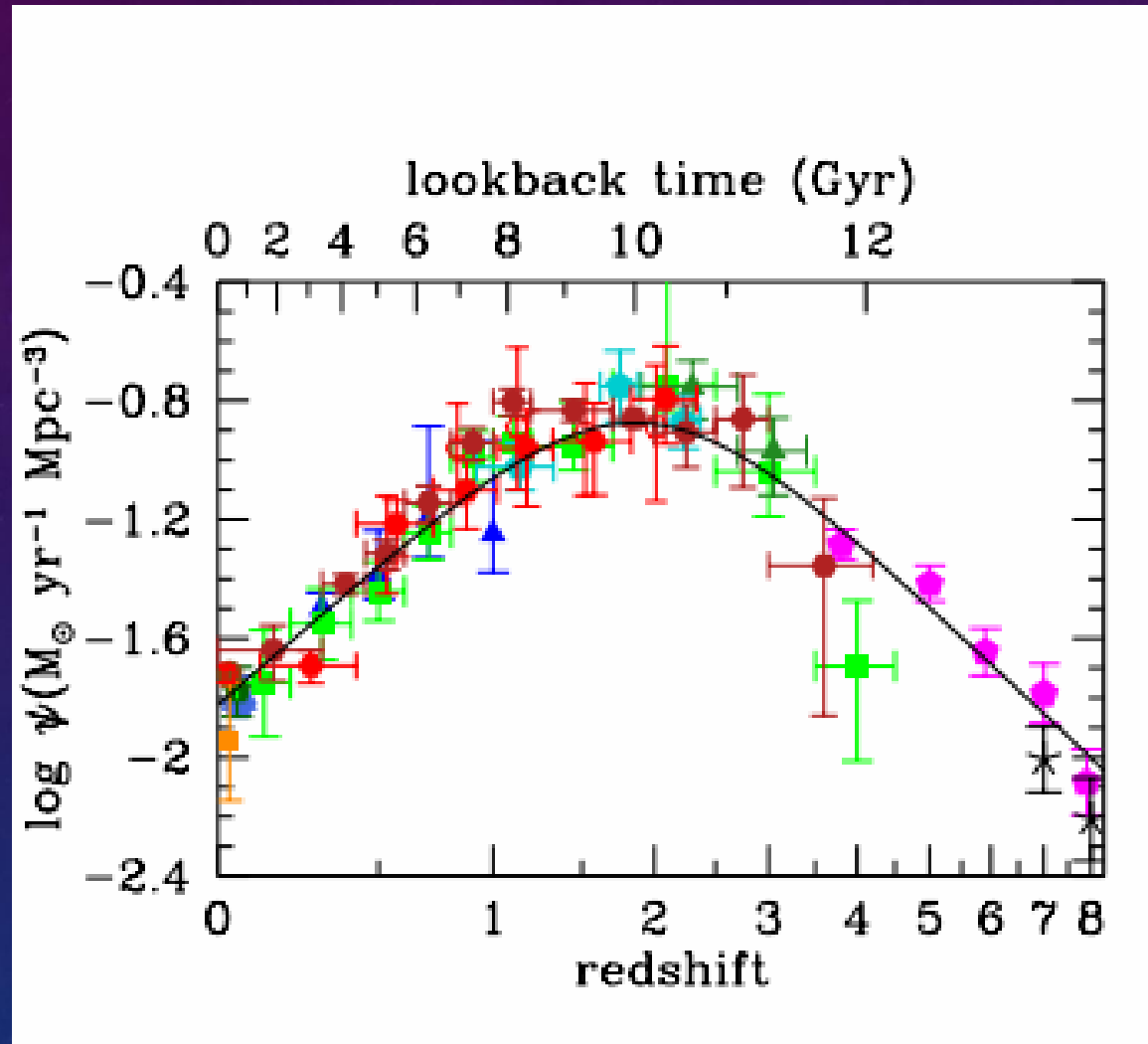
THE COSMIC CONTEXT

- ❖ Big Bang
- ❖ First stars
- ❖ First galaxies
- ❖ The present-day Universe



Credits: https://www.esa.int/ESA_Multimedia/Images/2013/03/Planck_history_of_Universe

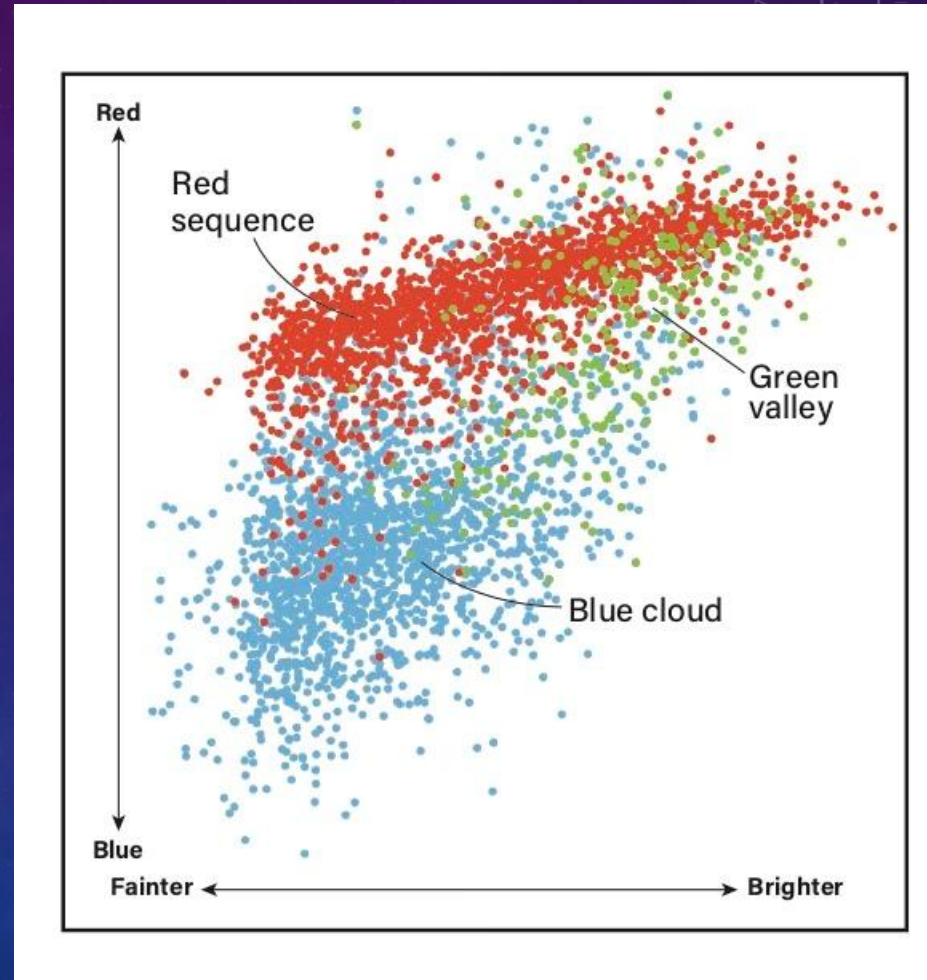
EVOLUTION OF STAR FORMATION



Credits: Madau+14

TYPES OF GALAXIES TODAY

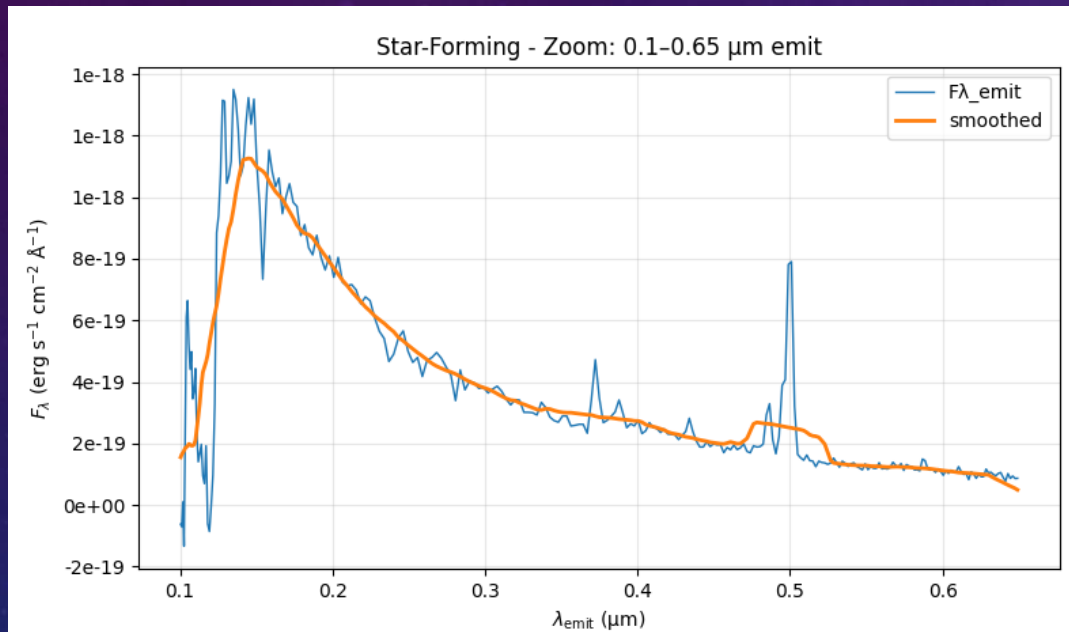
- ❖ Star-forming galaxies → blue
- ❖ Quiescent galaxies → red



Credits: <https://www.astronomy.com/science/the-beginning-to-the-end-of-the-universe-how-to-build-a-galaxy/>

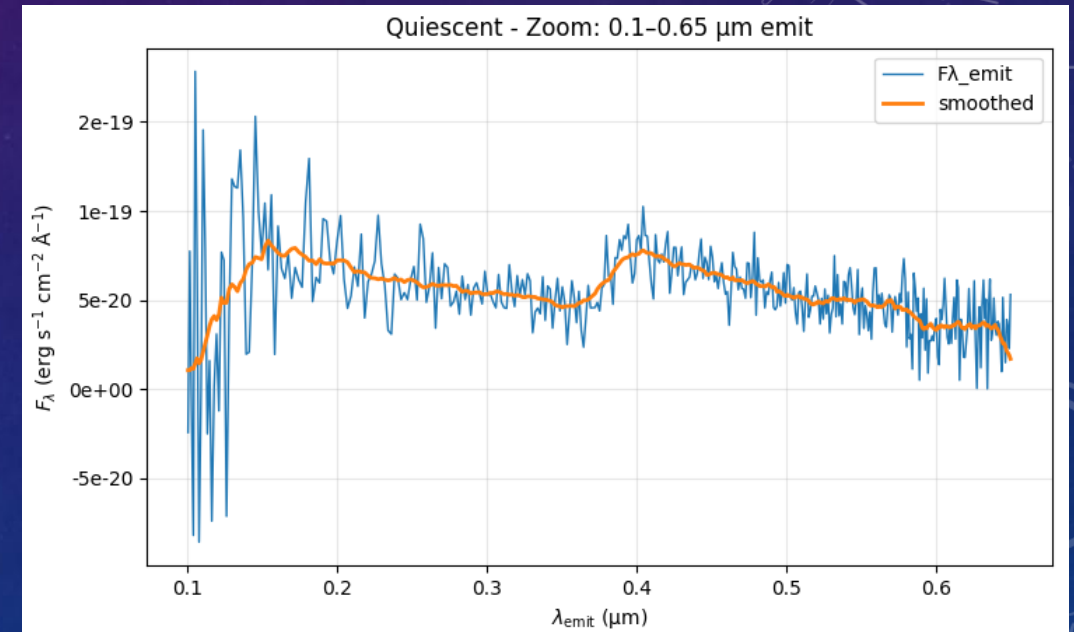
WHAT IS A QUIESCENT GALAXY?

- ❖ Young stars \rightarrow strong UV emission
- ❖ Old stars \rightarrow weaker UV emission



UV

Credits: Arroyo, in prep.



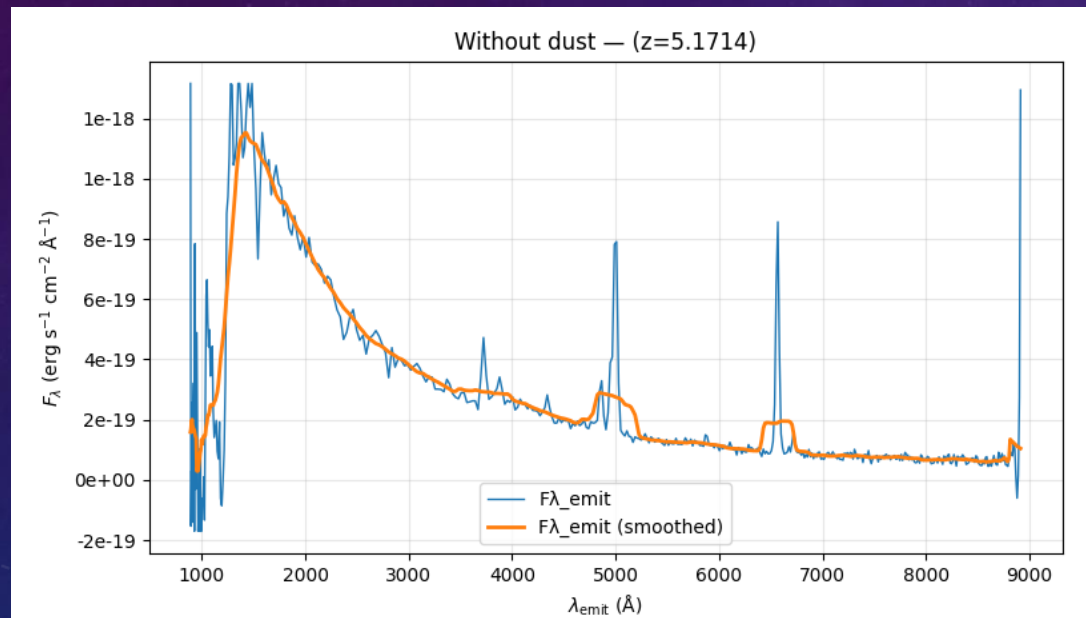
UV

Credits: Arroyo, in prep.

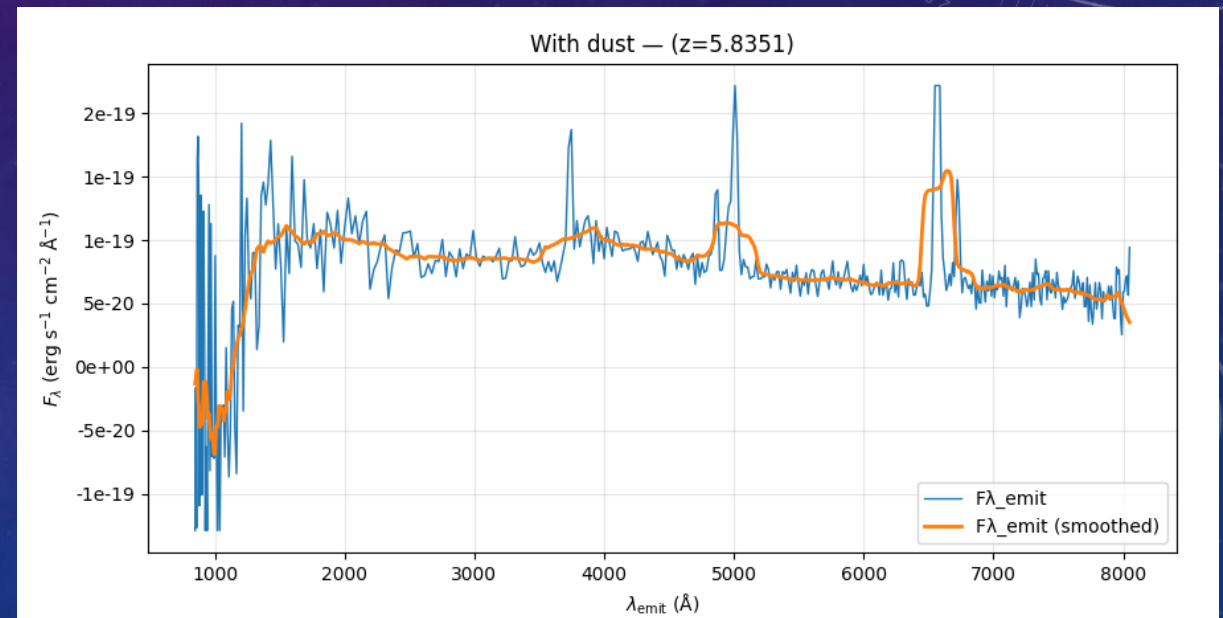
DUST COMPLICATION

The dust absorbs UV light

- ❖ Galaxy looks redder
- ❖ Star-forming galaxy can look like a quiescent one



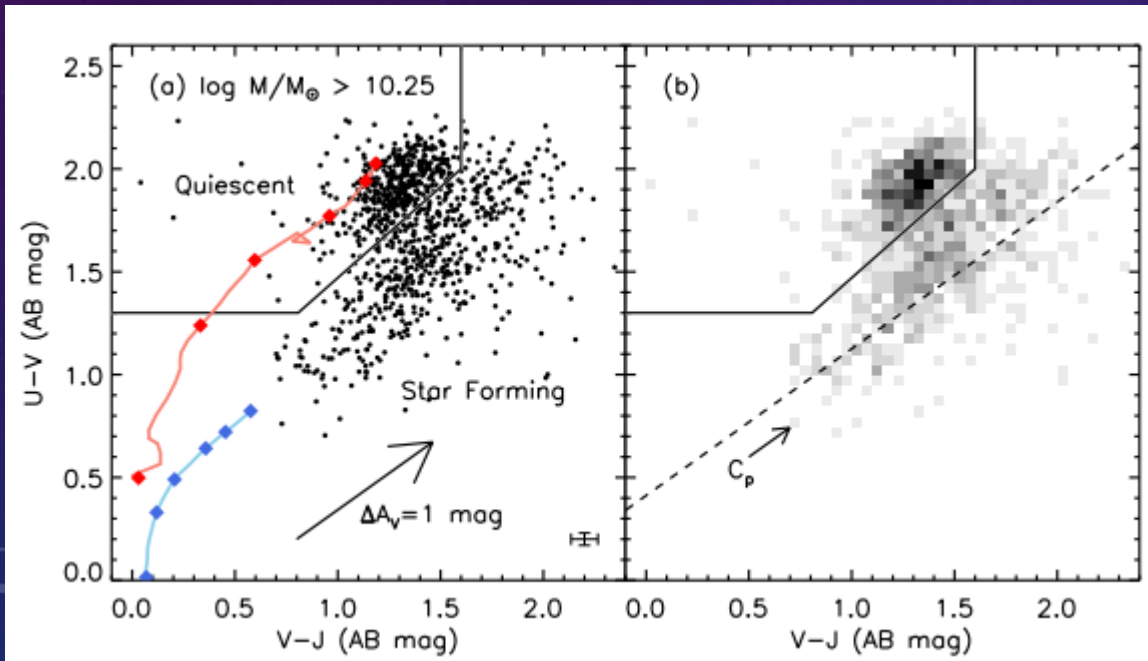
Credits: Arroyo, in prep.



Credits: Arroyo, in prep.

UVJ DIAGRAM

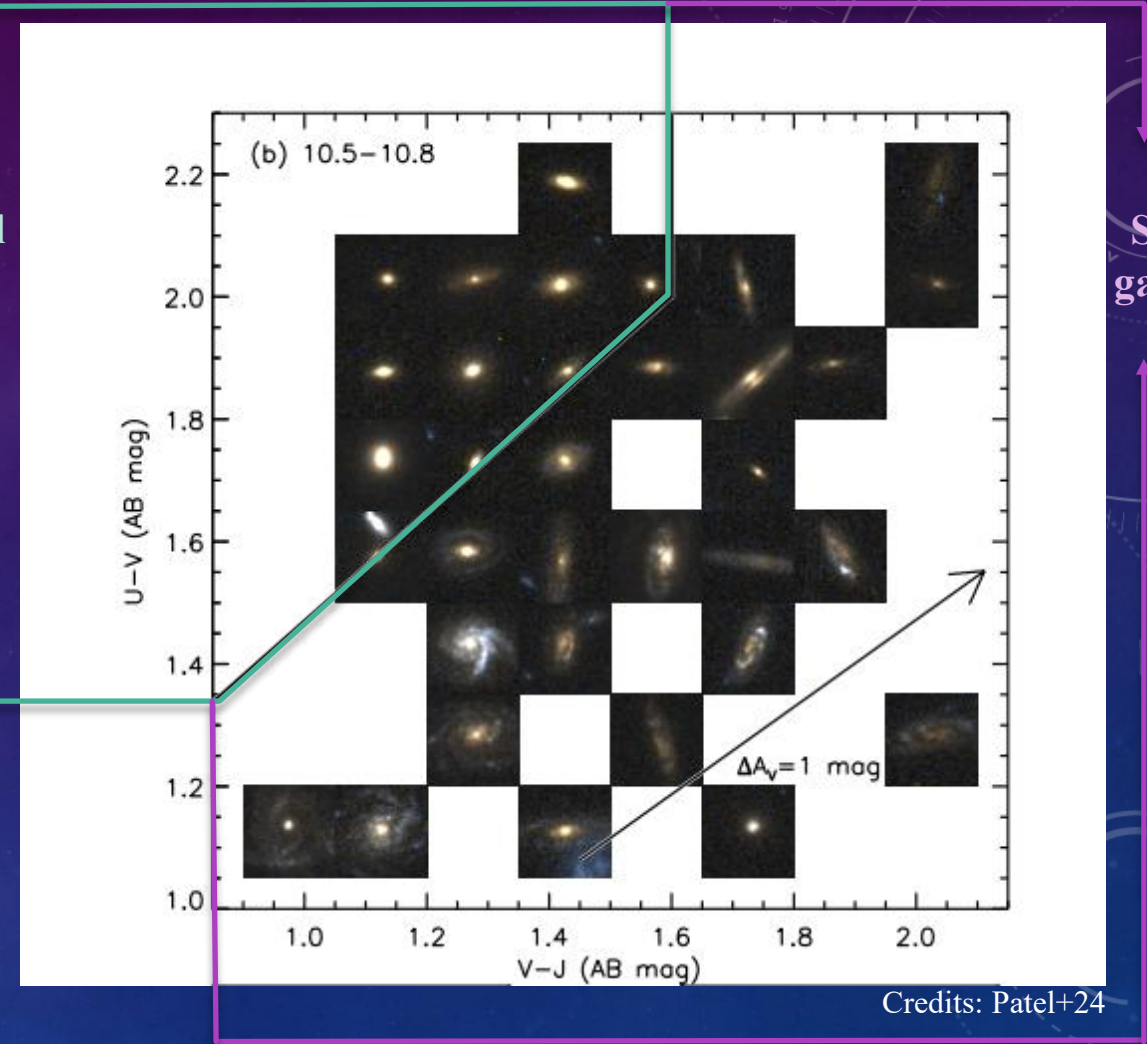
- ❖ Star-forming
- ❖ Dusty star-forming
- ❖ Quiescent



Credits: Patel+24

Elliptical galaxies

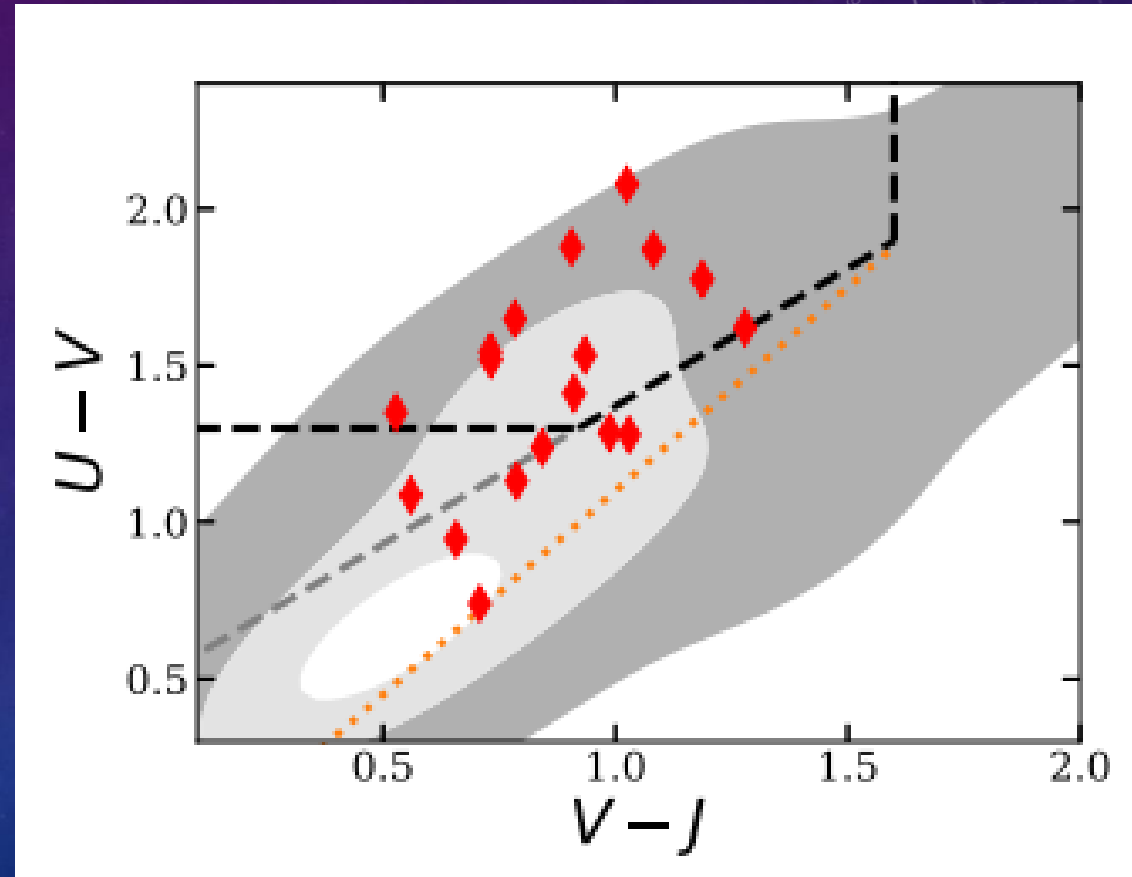
Spiral galaxies



Credits: Patel+24

PROBLEM AT HIGH REDSHIFT

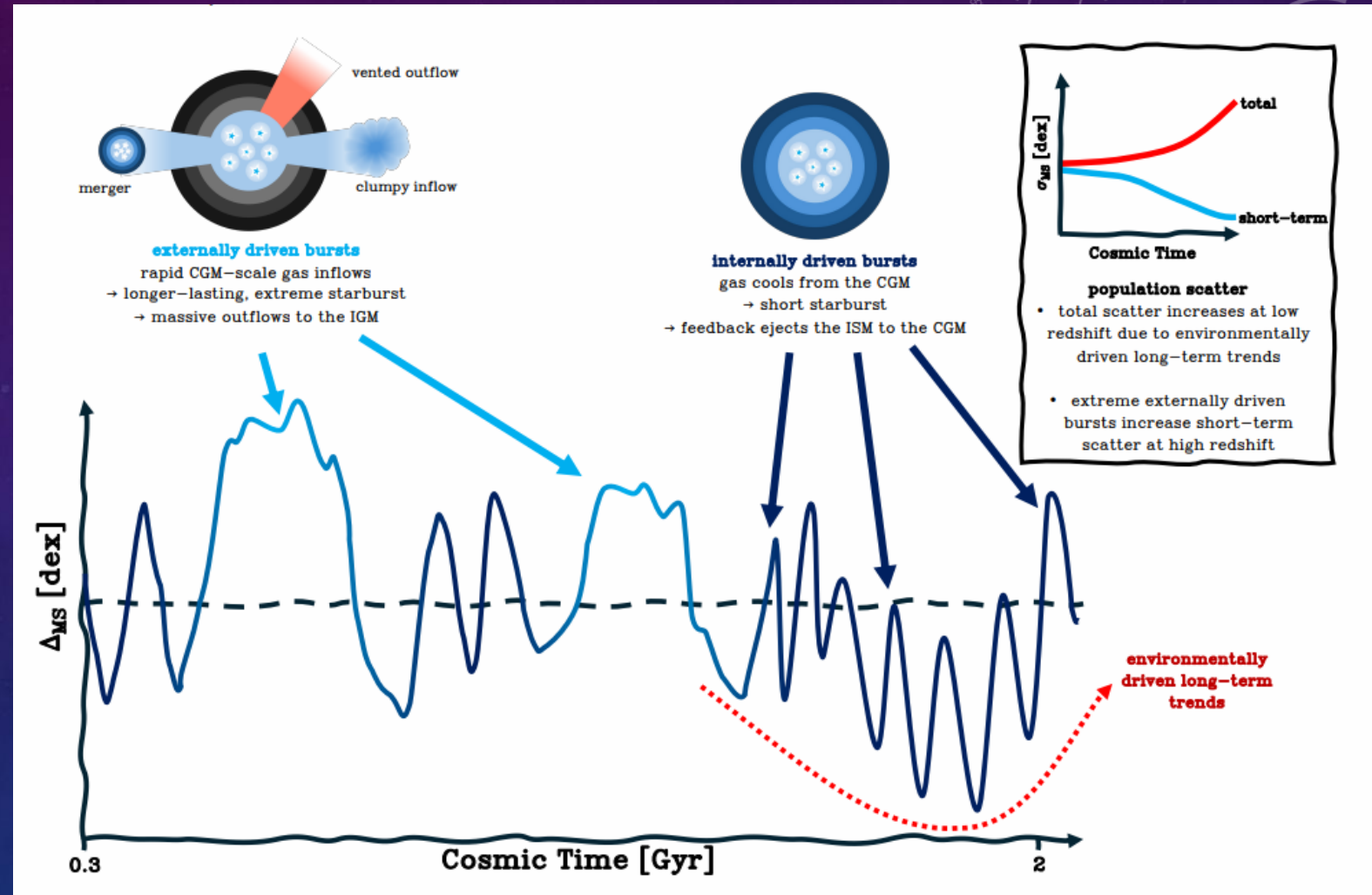
Simulations suggest that UVJ diagram is changing



Credits: Baker+25

WHY?

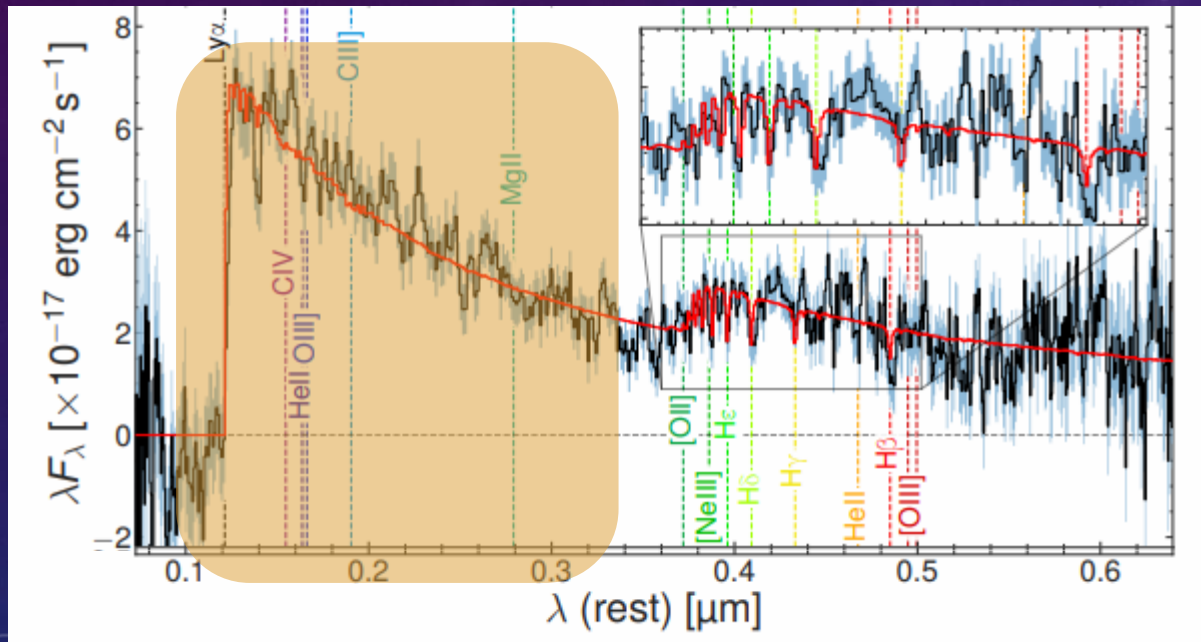
- ❖ Bursty star formation
- ❖ On/Off phases



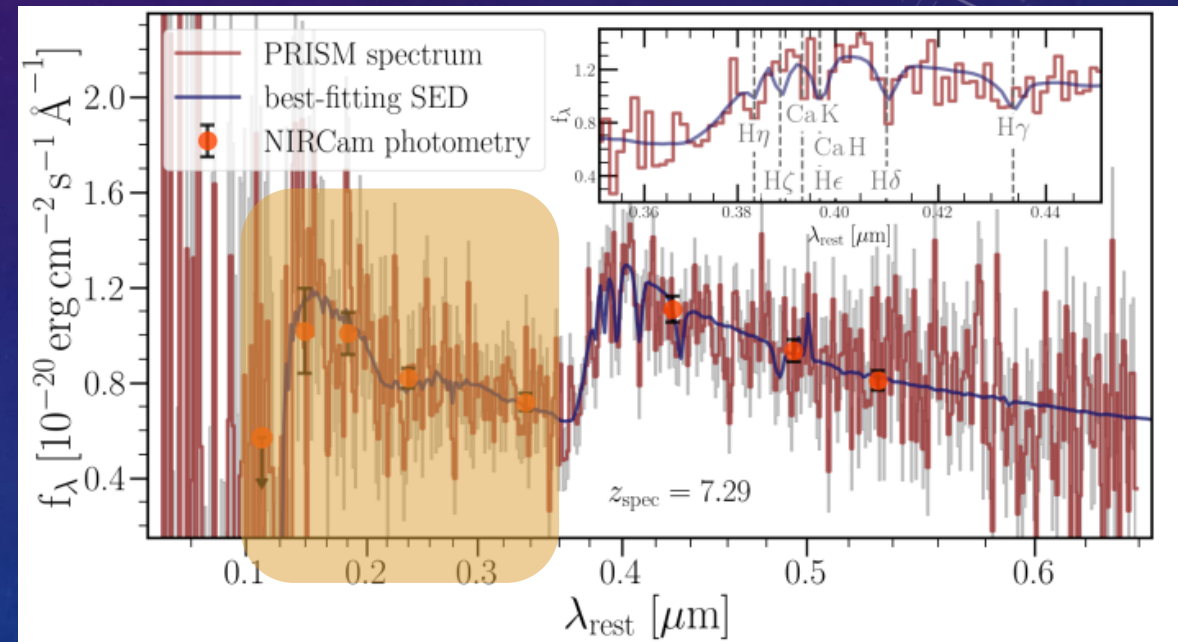
Credits: McClymont+25

DISCOVERY WITH JWST

Dormant Galaxy vs Quiescent Galaxy



Credits: Looser+24



Credits: Weibel+25

OUR QUESTION

Can we still use UVJ diagrams to identify quiescent galaxies in the early Universe?

MY PROJECT

Analyze all public
JWST spectra at $z > 4$

Study continuum
features and emission
lines

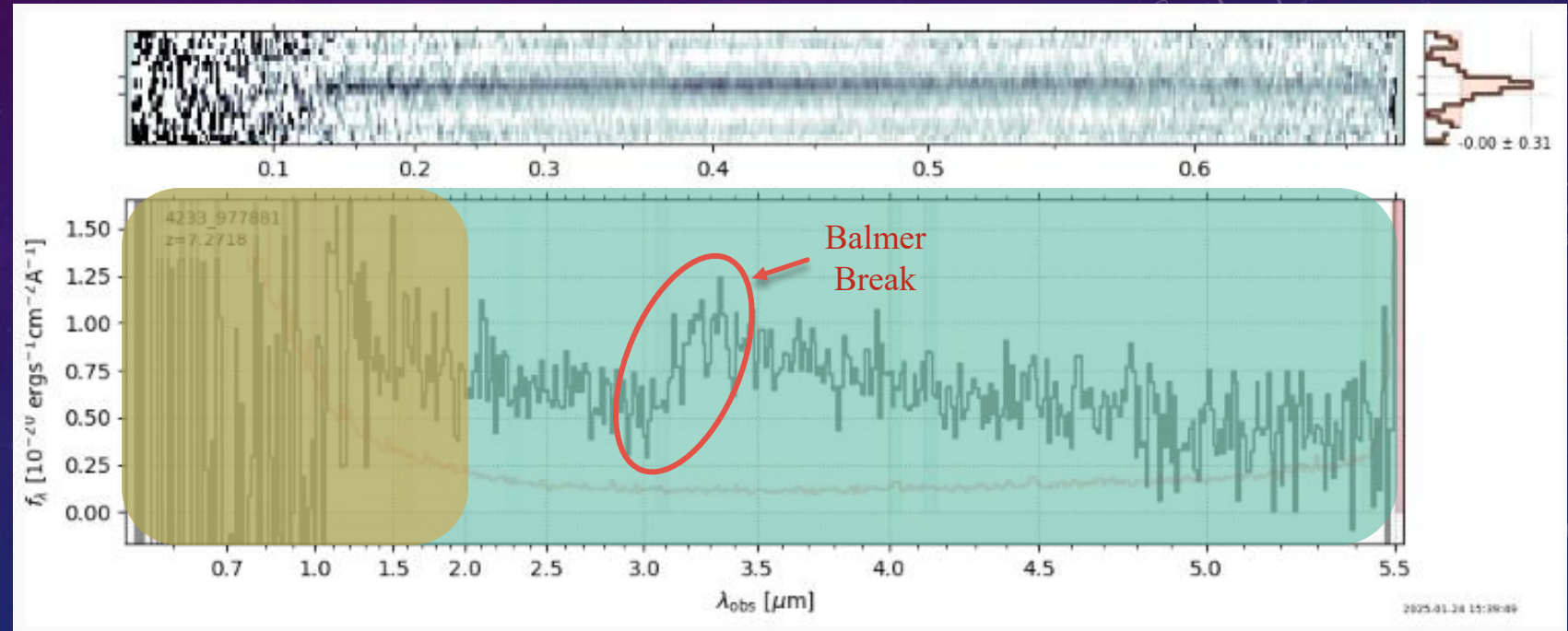
Determine star-
formation histories
with **SED fitting**

DATA

❖ Dawn JWST archive

❖ NIRSpec spectra

❖ Rest-frame optical diagnostics



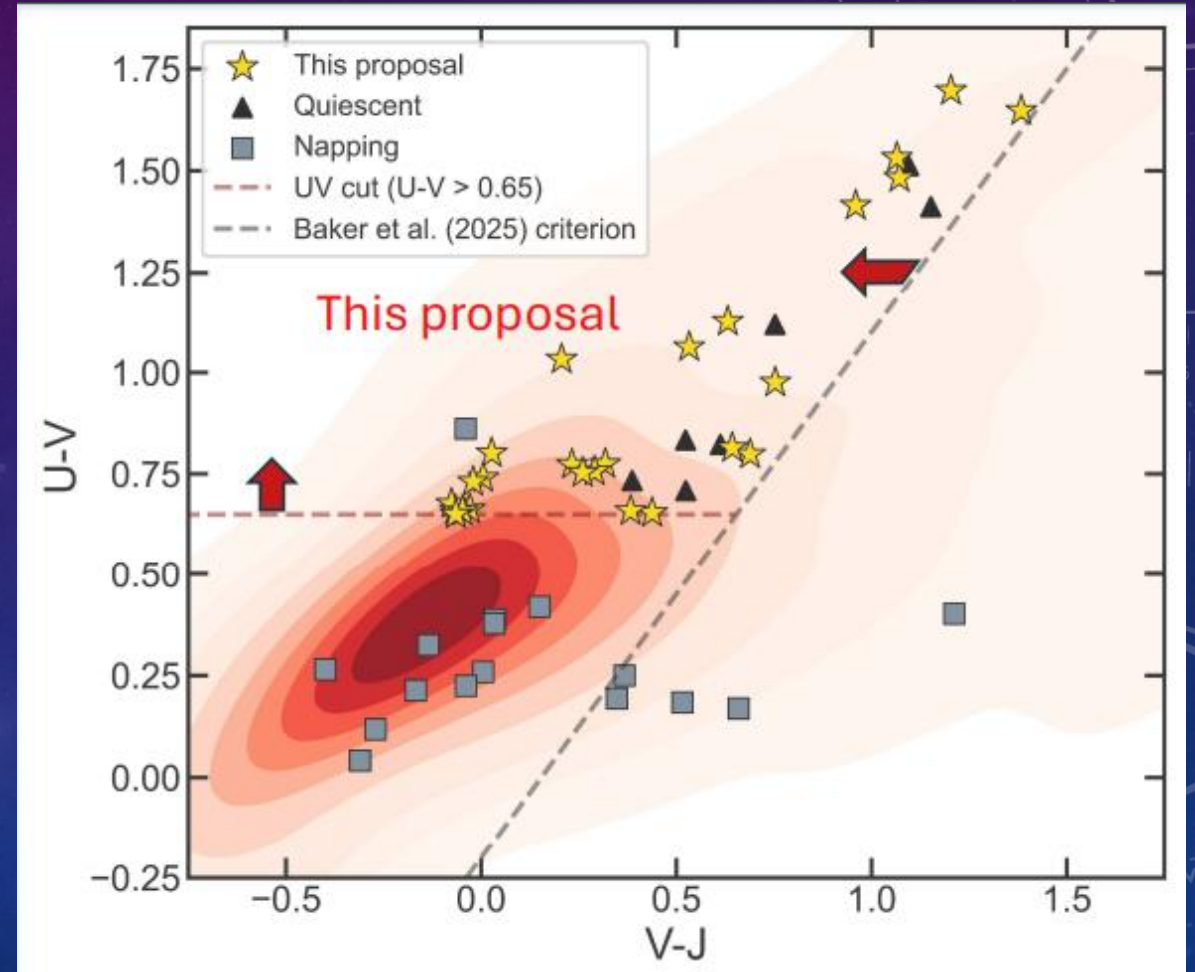
← HST →

← JWST →

Credits: https://s3.amazonaws.com/msaexp-nirspec/extractions/nirspec_public_v4.5.html

PRELIMINARY RESULTS

- ❖ Photometric UVJ distribution
- ❖ Possible quiescent candidates
- ❖ Spectroscopy will test these selections



CONCLUSIONS

Our '3 bullets' are:

- ❖ Early quiescent galaxies challenge galaxy evolution models
- ❖ UVJ may not work at high redshift
- ❖ JWST spectroscopy allows us to test this
- ❖ To be continued...

The background features a gradient from dark purple to blue, overlaid with a pattern of small white stars. Several technical diagrams are visible: a circular gauge with a scale from 0 to 210 and an arrow pointing to approximately 190; a circular diagram with concentric lines and arrows; and a circular diagram with dashed lines and arrows. The text "THANK YOU FOR YOUR ATTENTION" is centered in a white, serif font.

THANK YOU FOR YOUR
ATTENTION

The background is a dark blue gradient with a field of small white stars. Overlaid on this are several technical diagrams in a lighter blue color. In the top right, there is a large circular diagram with concentric circles and radial lines, resembling a scale or a gauge, with numbers from 80 to 210. In the bottom right, there is a smaller circular diagram with concentric circles and a dashed outer ring. In the bottom left, there is a partial circular diagram with a dashed outer ring and an arrow pointing left. In the top left, there is a small circular diagram with a dashed outer ring and an arrow pointing left.

QUESTIONS?