



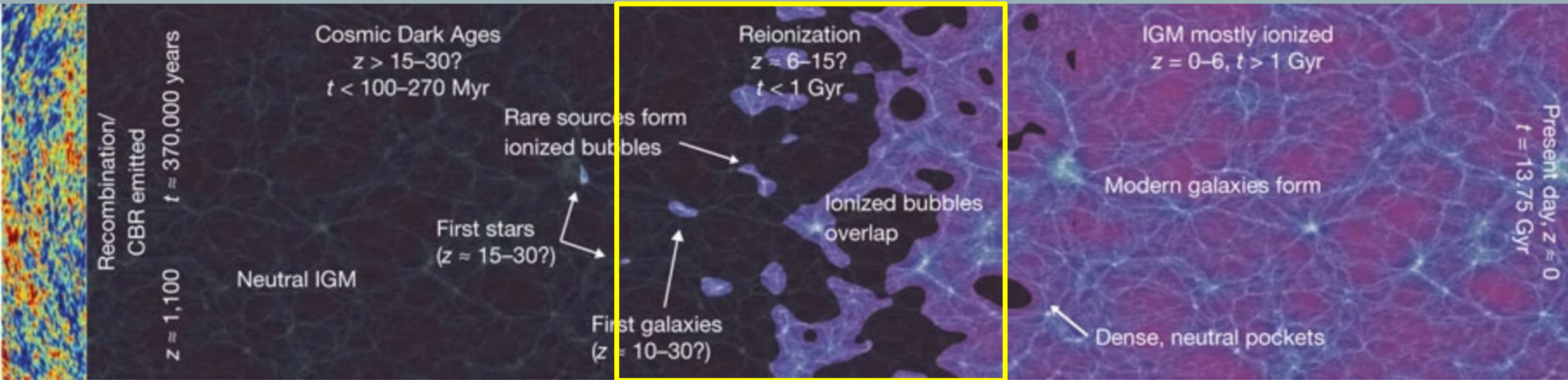
MAPPING STAR FORMATION HISTORIES IN NEARBY  
GALAXIES TO SOURCE LYC PHOTON ESCAPE

Katie Kudla

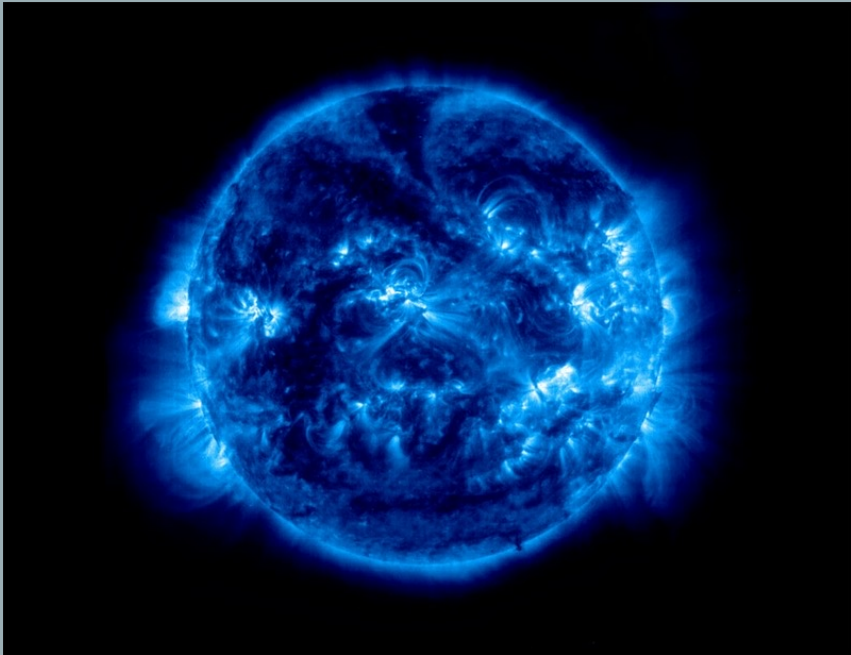
Advisor: Professor Crystal Martin

Mentor: Zixuan Peng

# THE REIONIZATION EPOCH



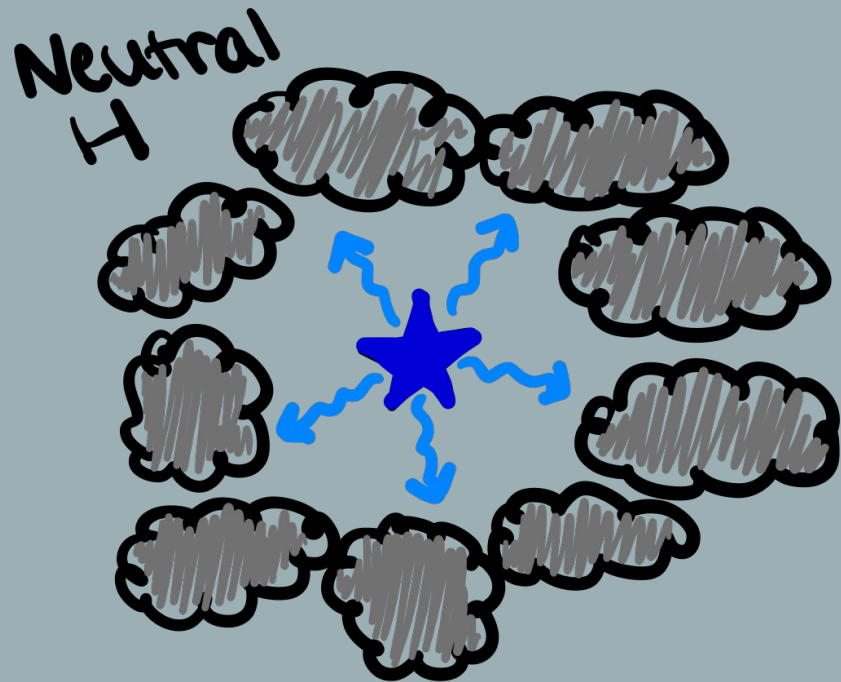
Credit: Robertson et al. 2010

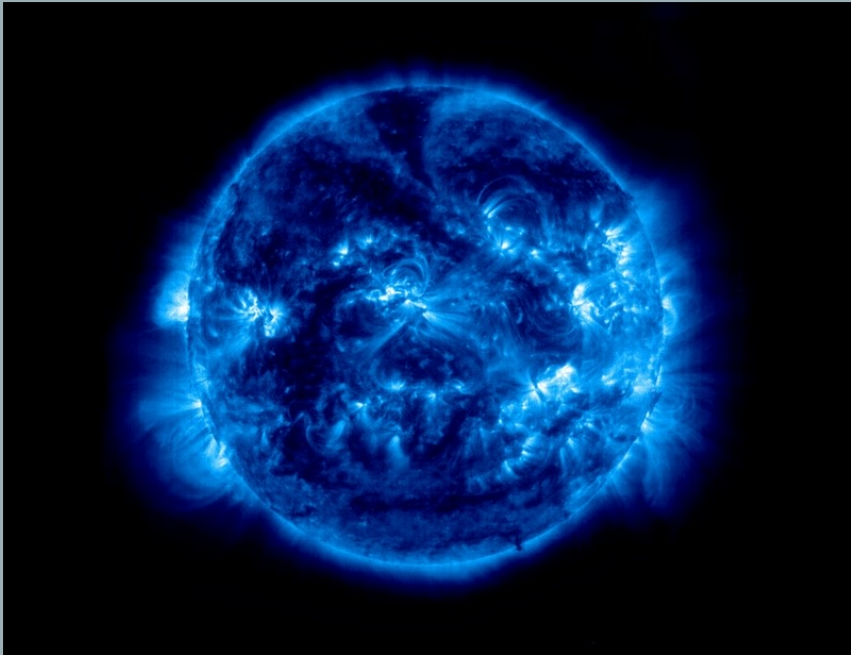


Credit: <https://forums.frontier.co.uk/threads/list-of-o-type-stars.317606/>



Credit: <https://www.skyatnightmagazine.com/space-science/how-galactic-winds-affect-evolution-of-galaxies>





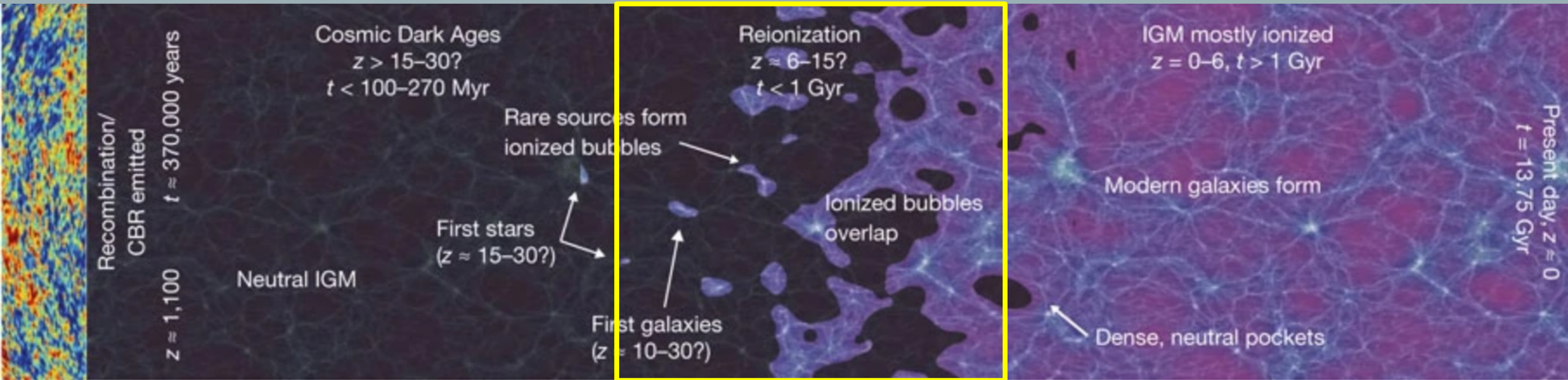
Credit: <https://forums.frontier.co.uk/threads/list-of-o-type-stars.317606/>



Credit: <https://www.skyatnightmagazine.com/space-science/how-galactic-winds-affect-evolution-of-galaxies>

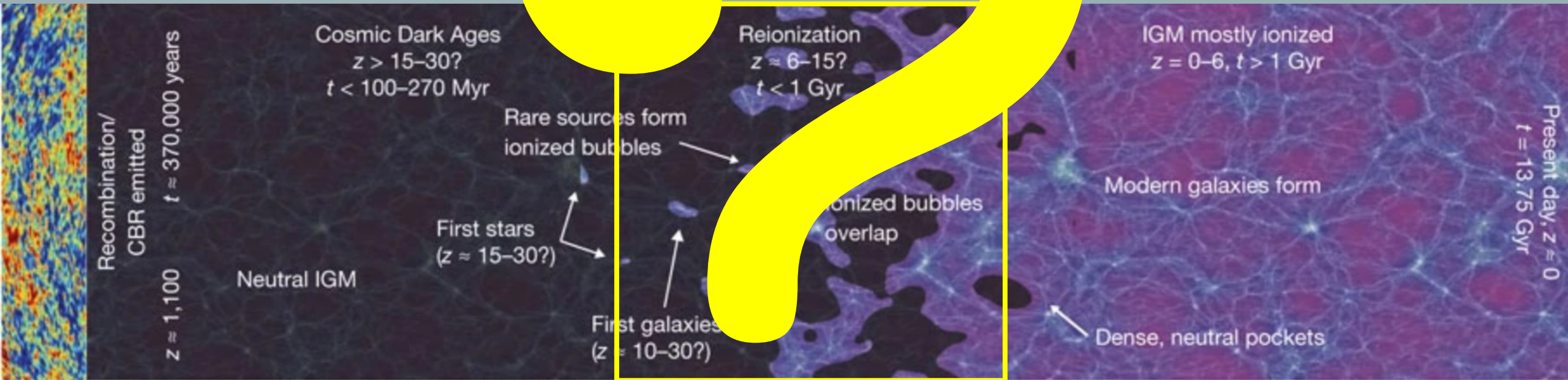


# THE REIONIZATION EPOCH



Credit: Robertson et al. 2010

# THE REIONIZATION EPOCH



Credit: Robertson et al. 2010

## OUR GALAXY SAMPLE

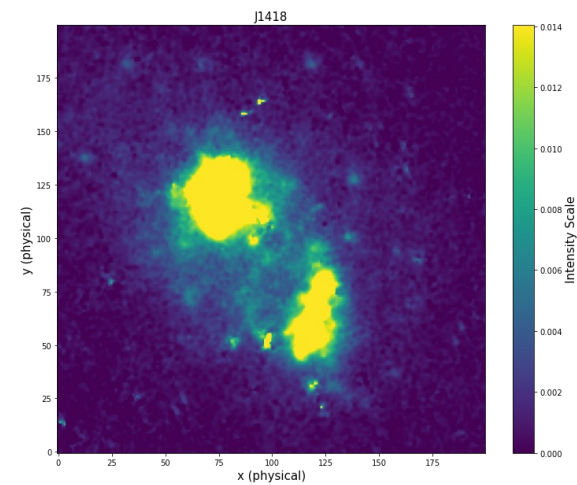
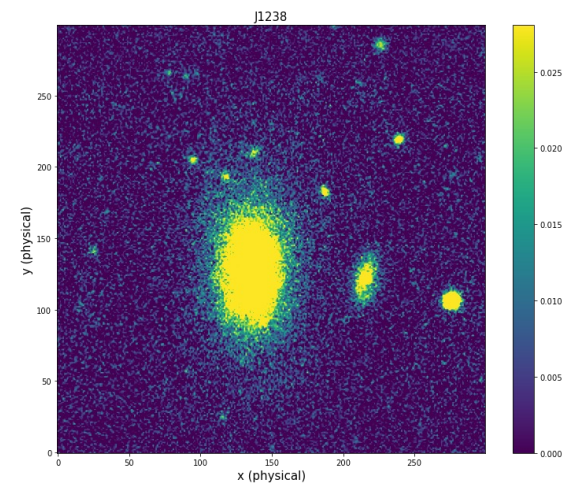
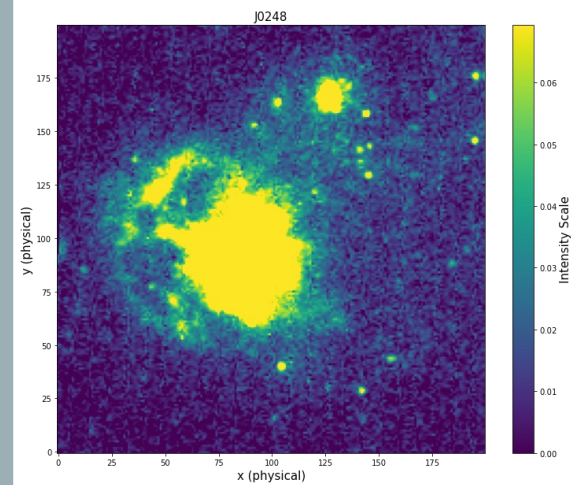
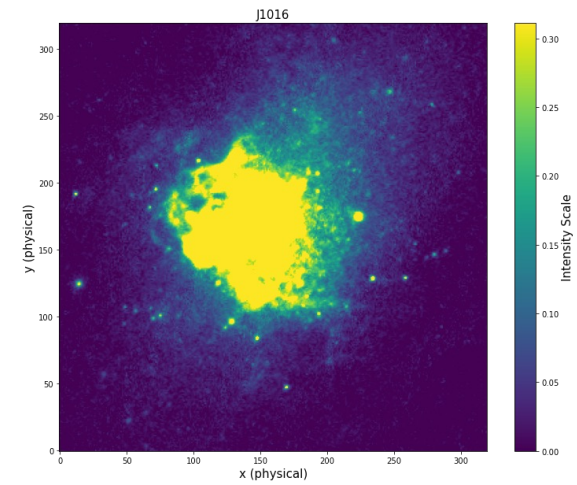
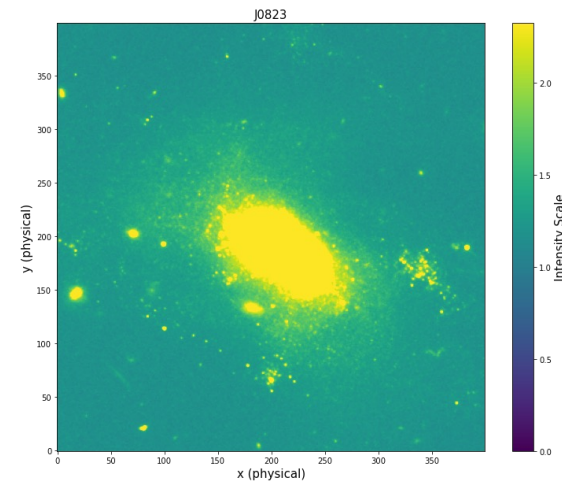
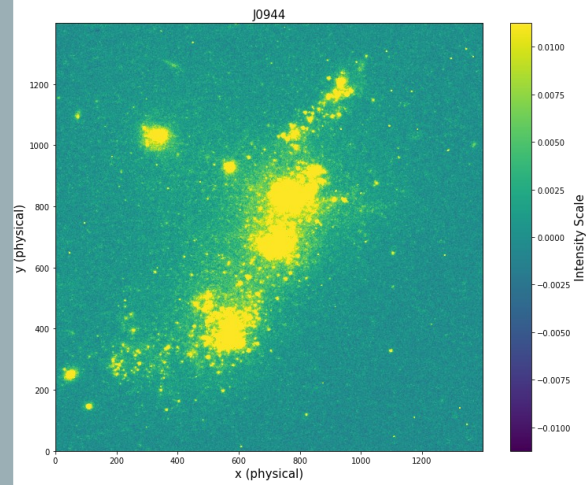
Solution: Map the star formation histories of Reionization Epoch local analogs to source photon escape

- 1) Low mass
- 2) Irregular morphology
- 3) Low metallicity
- 4) High specific star formation rate



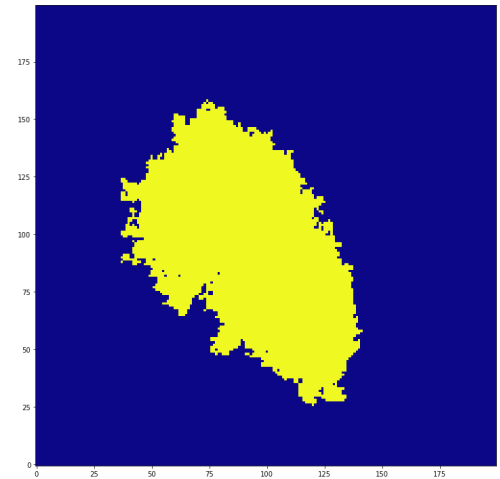
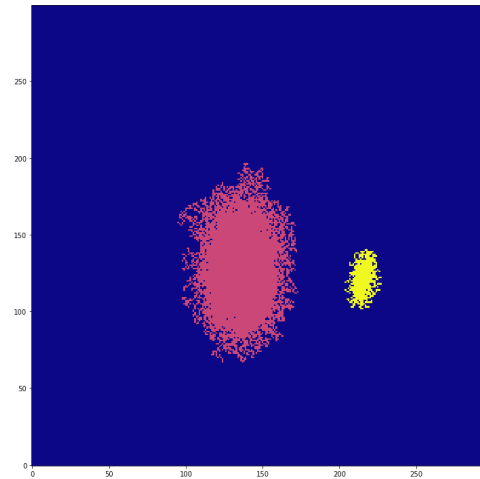
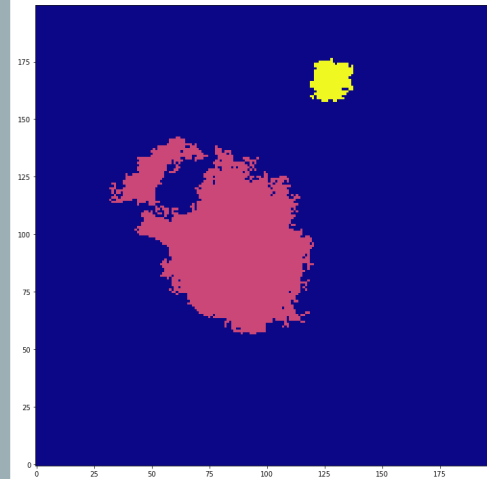
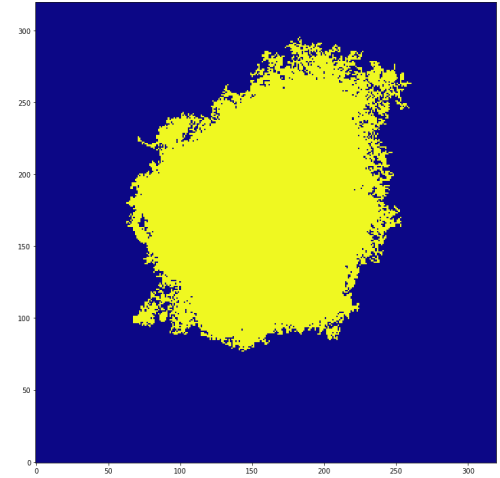
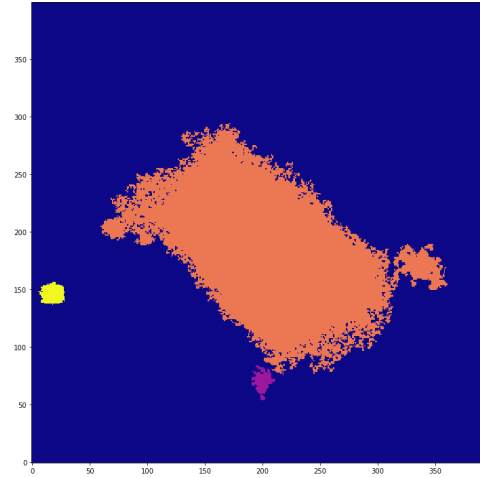
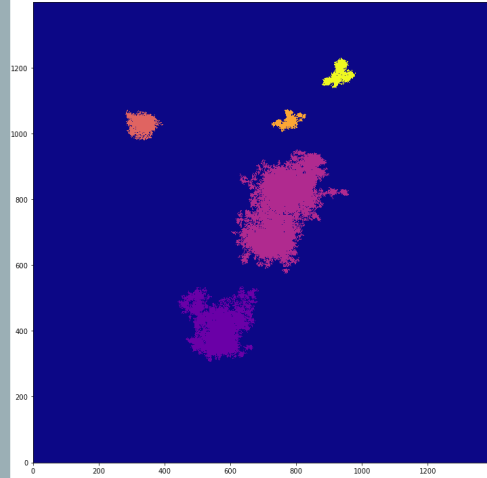
Credit: <https://www.astronomy.com/science/merging-galaxies-wrap-their-black-holes-in-dusty-shrouds/>

# METHODS: IDENTIFY STELLAR COMPLEXES

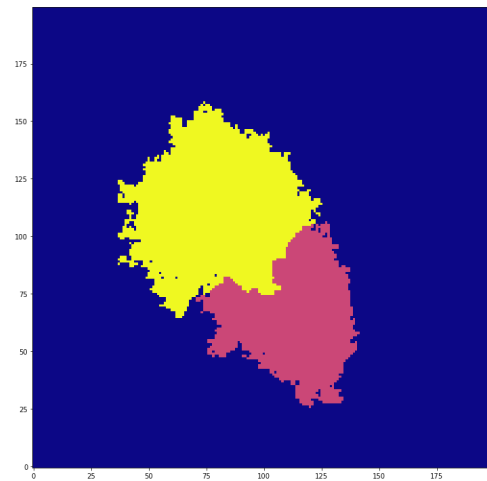
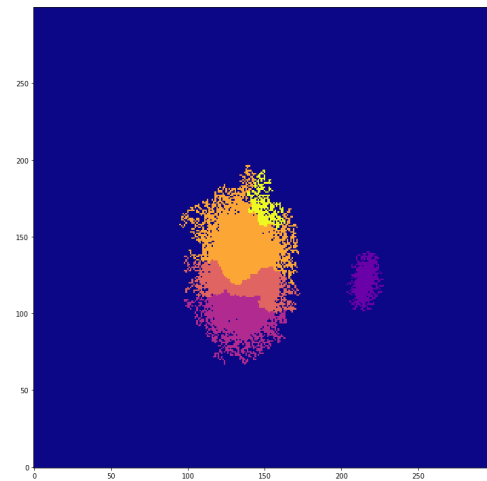
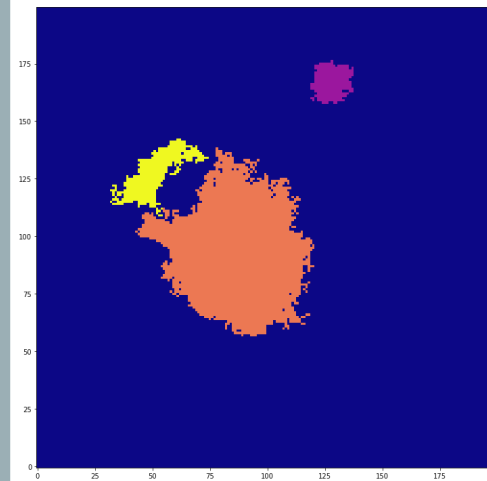
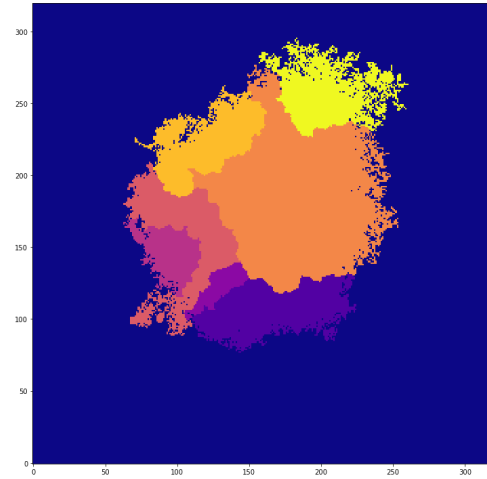
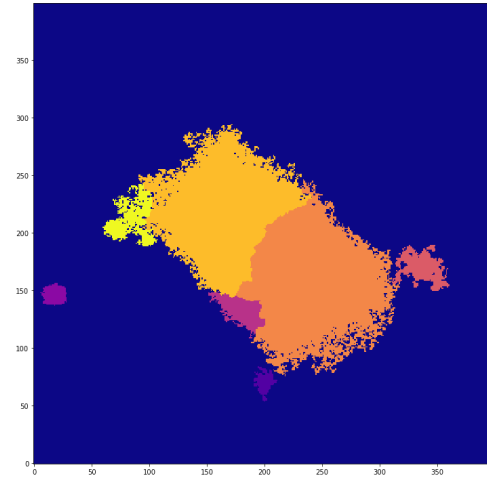
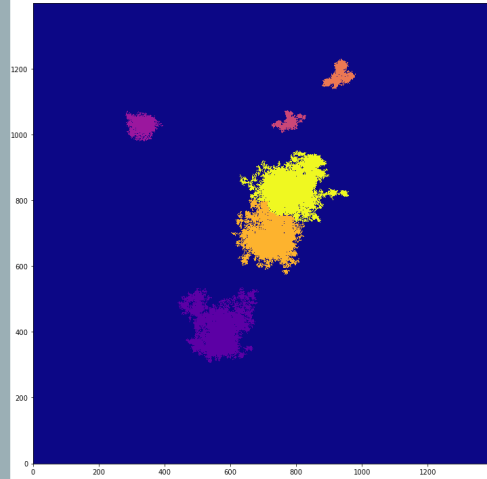




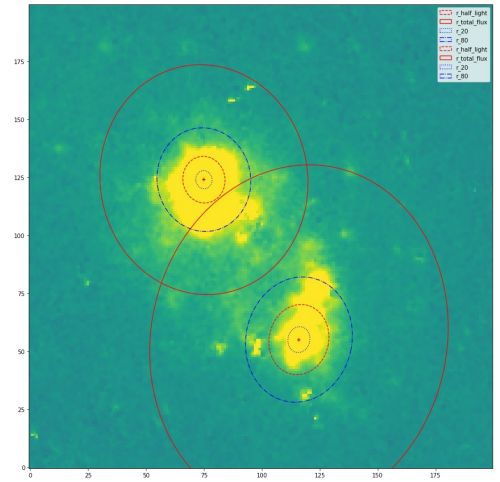
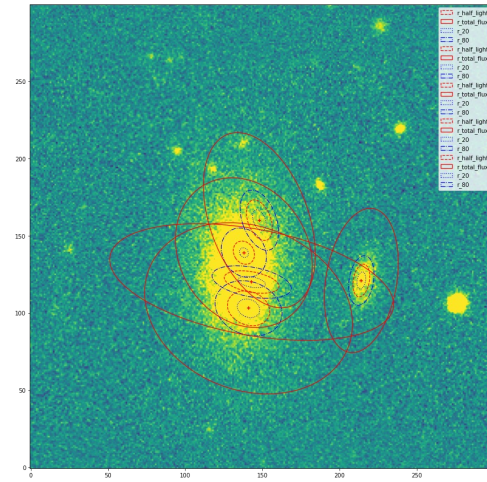
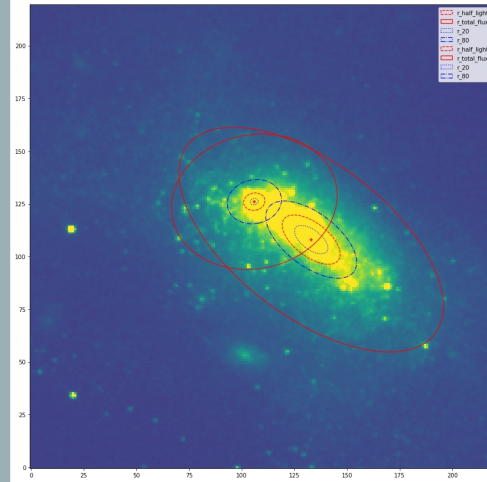
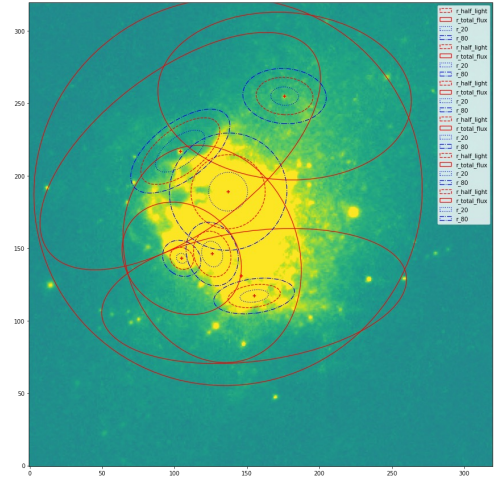
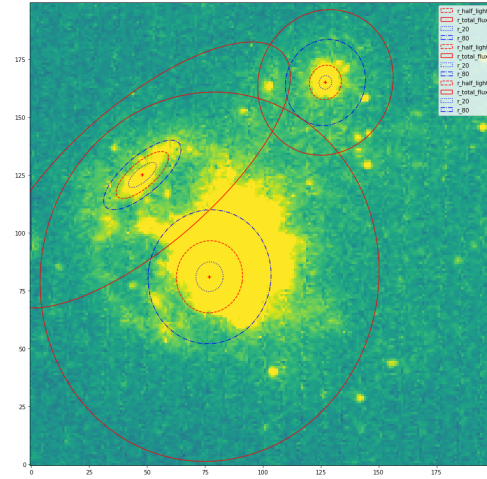
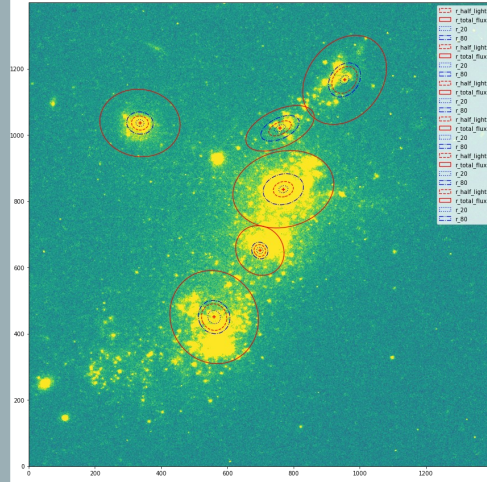
# I. SEGMENTATION



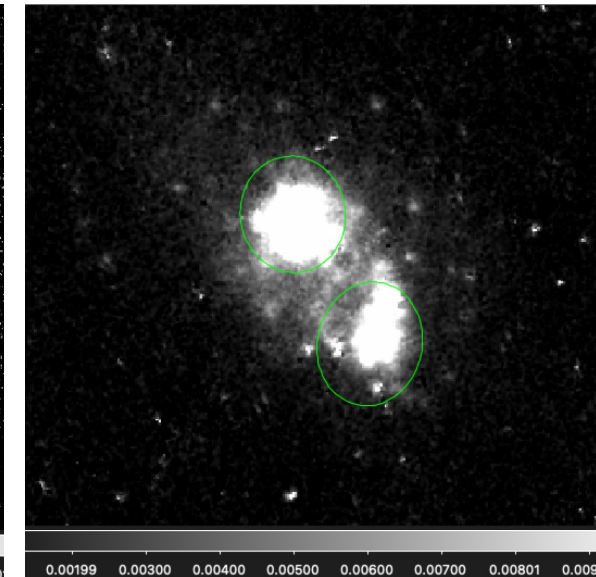
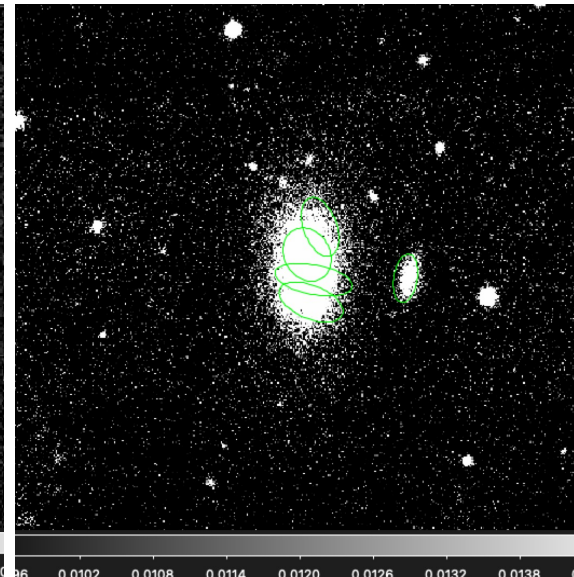
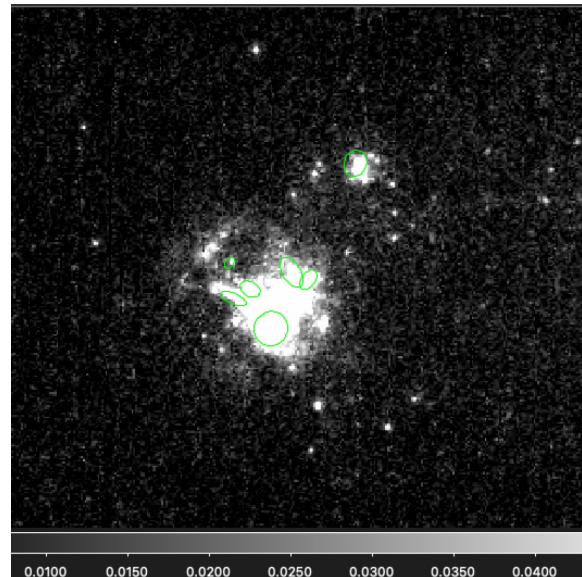
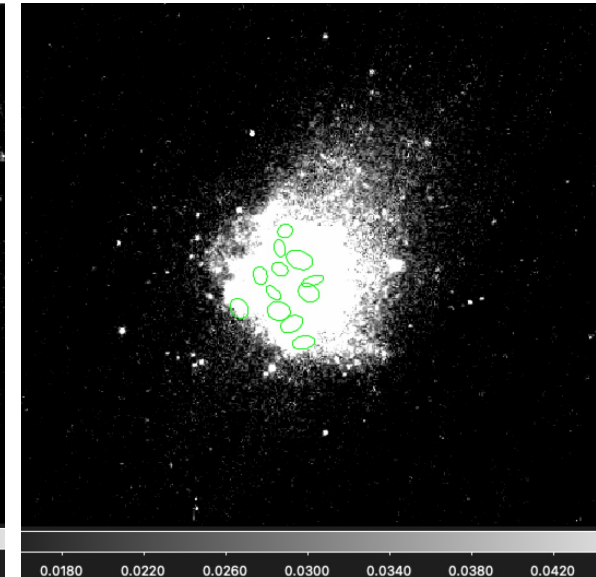
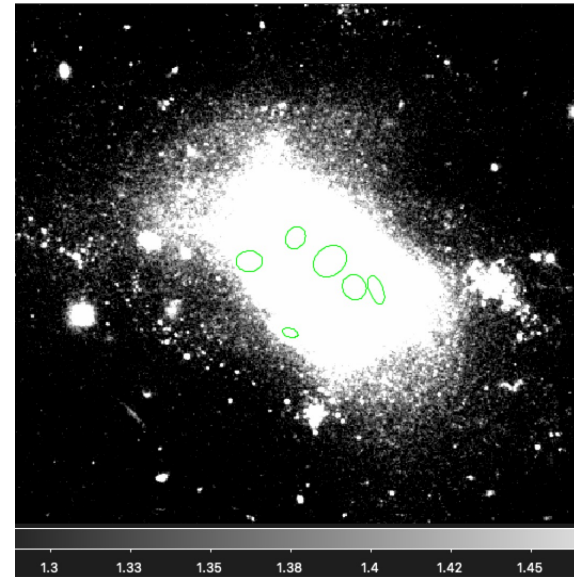
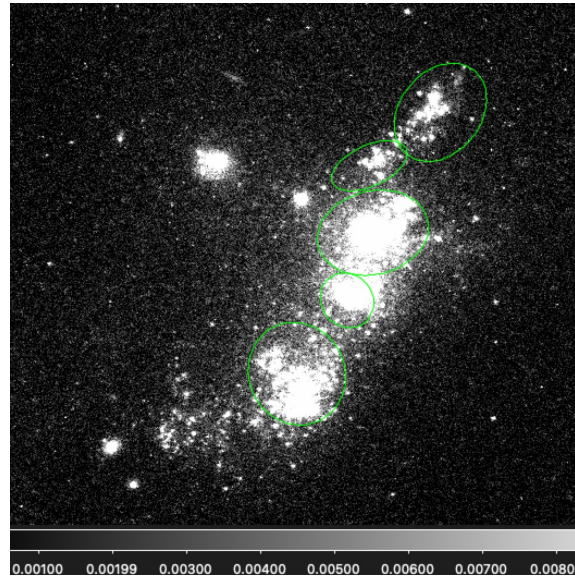
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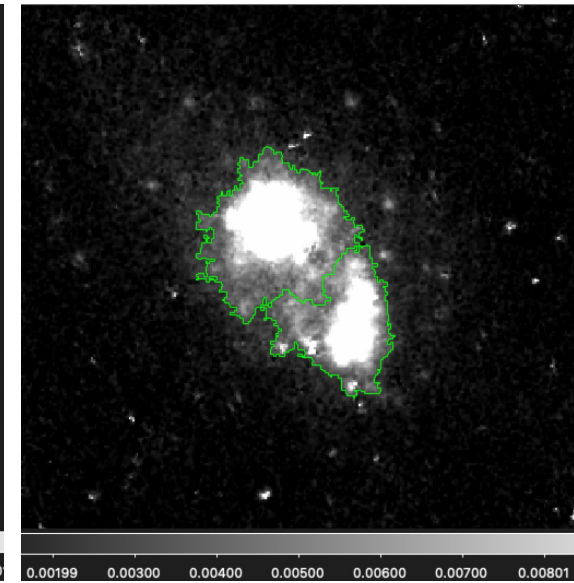
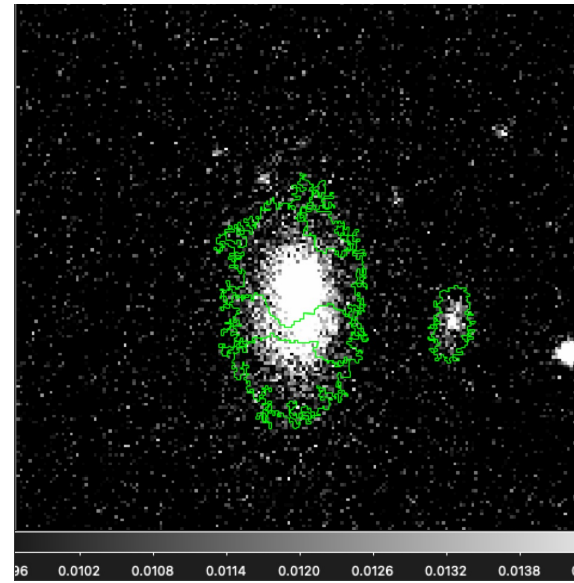
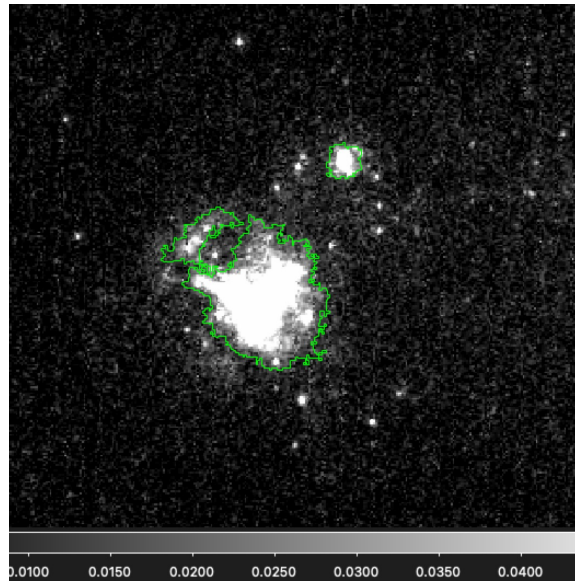
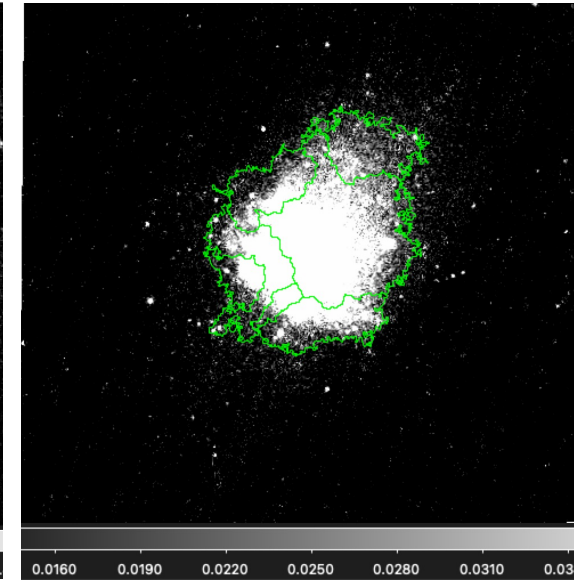
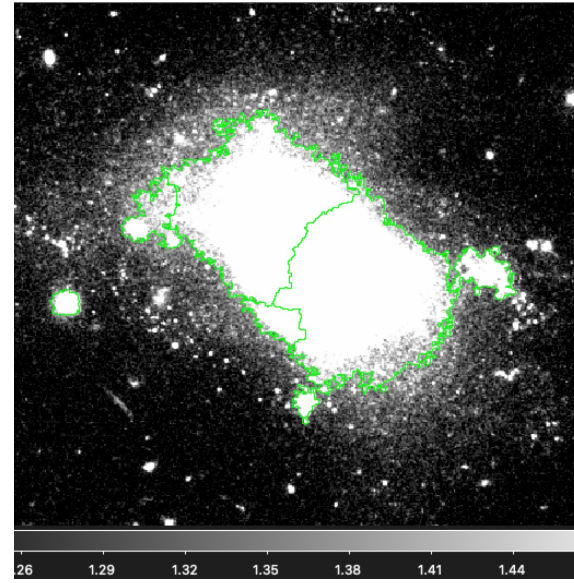
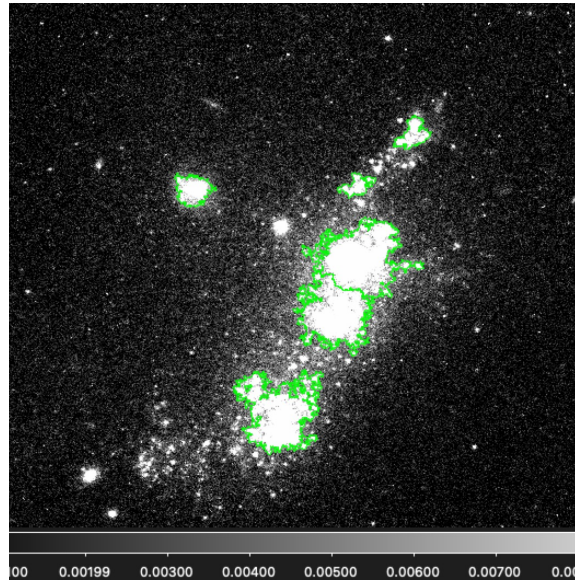
### III. SETTING THE APERTURE



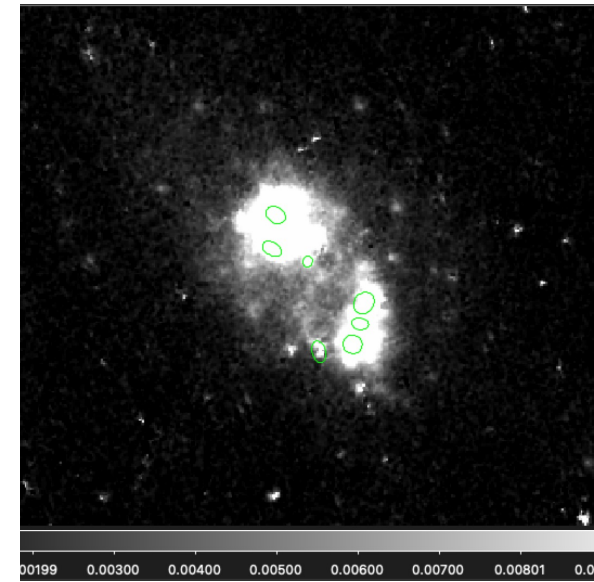
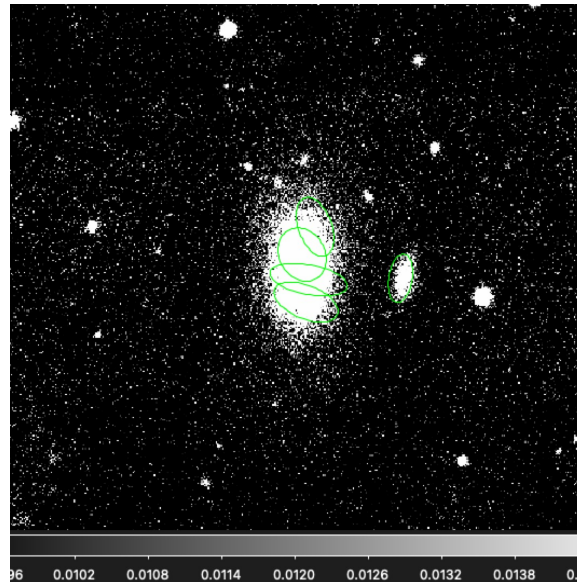
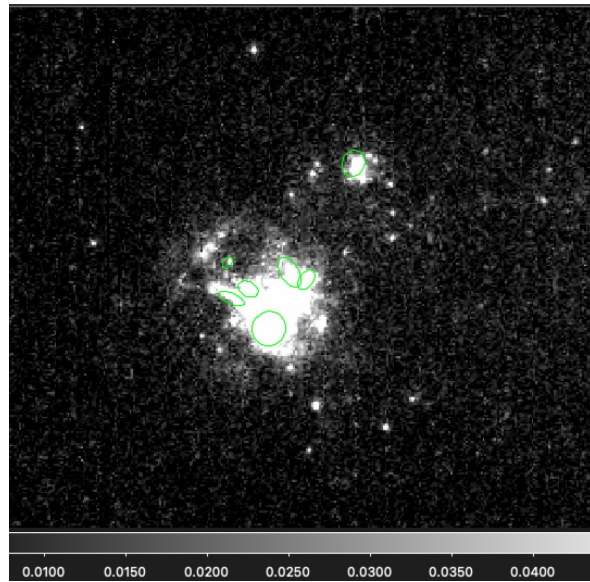
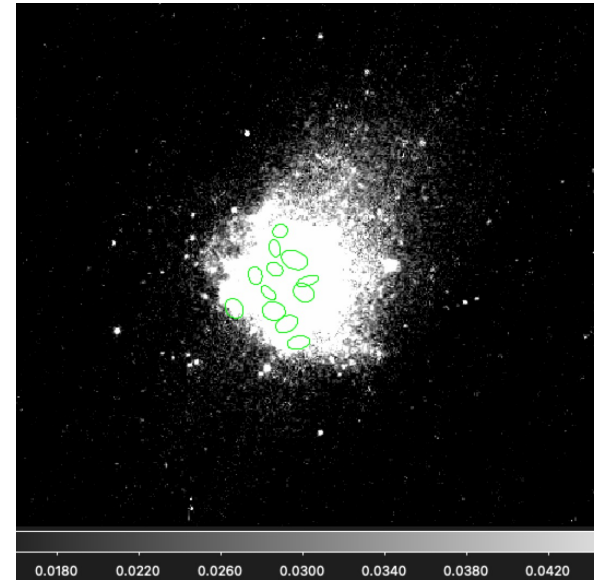
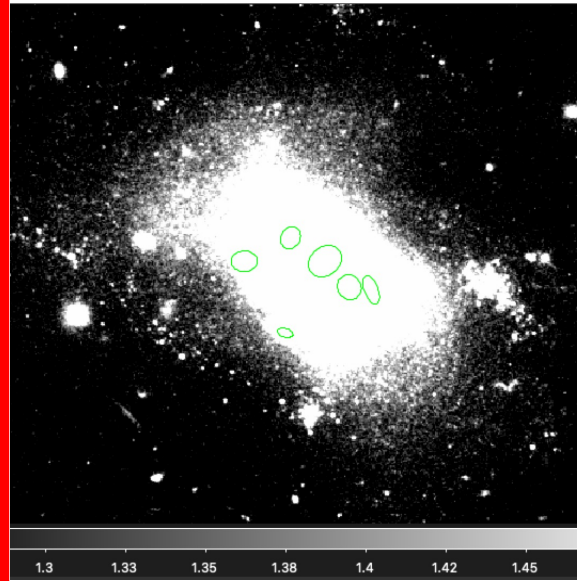
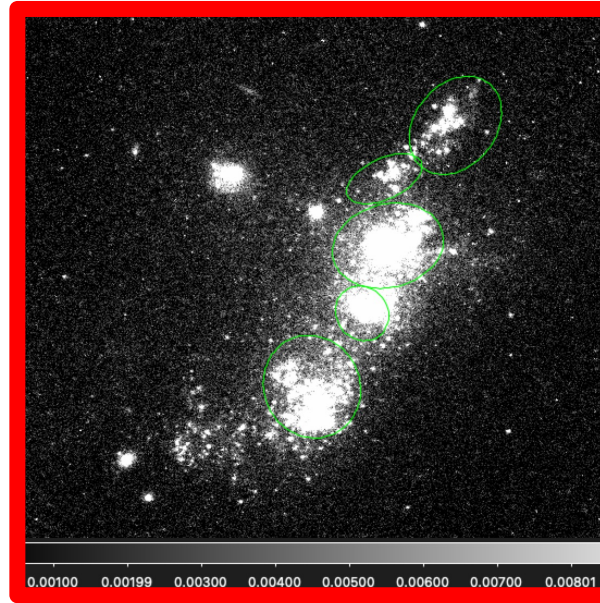
### III. EXTRACTING REGIONS



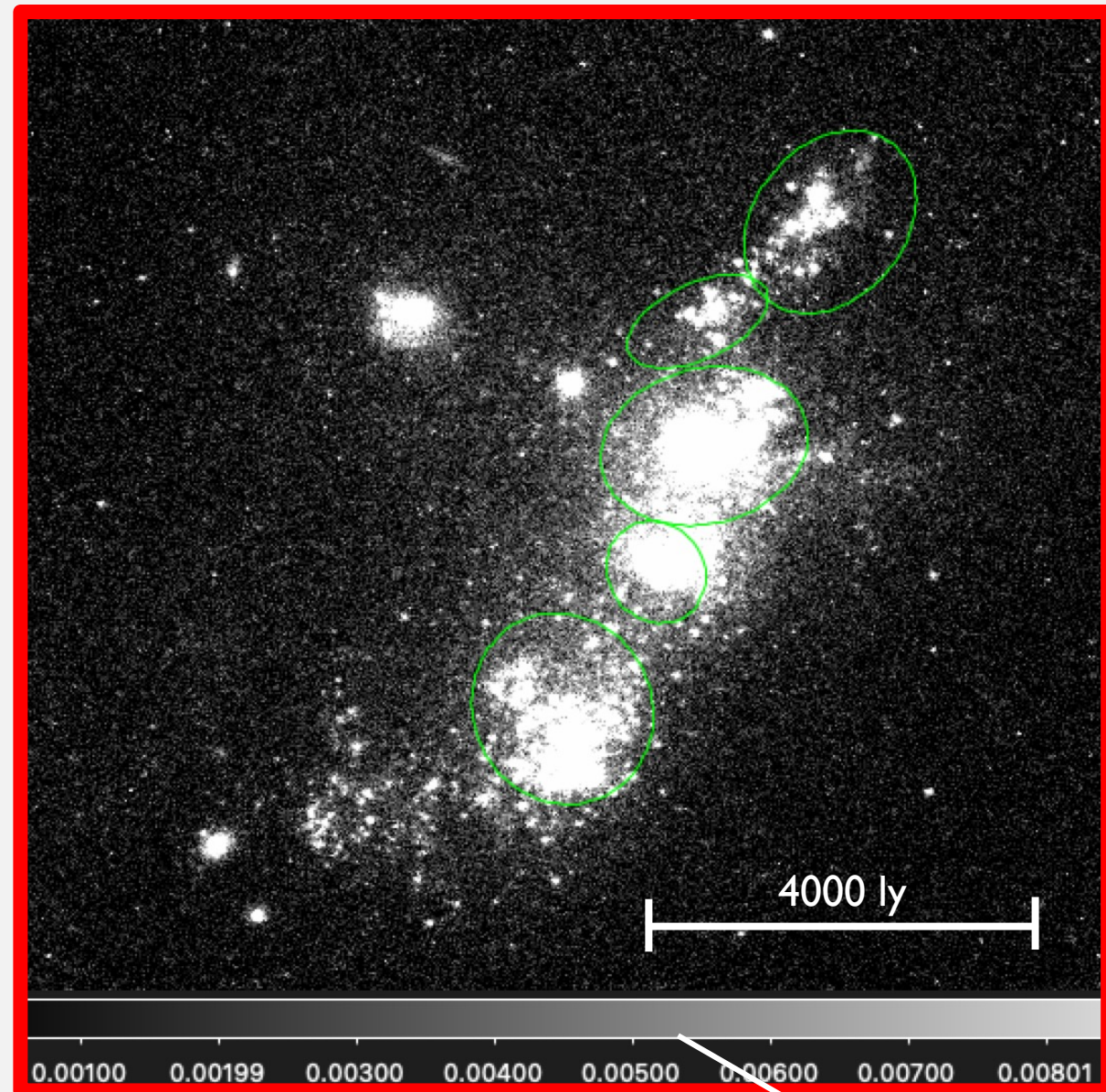
### III. EXTRACTING REGIONS



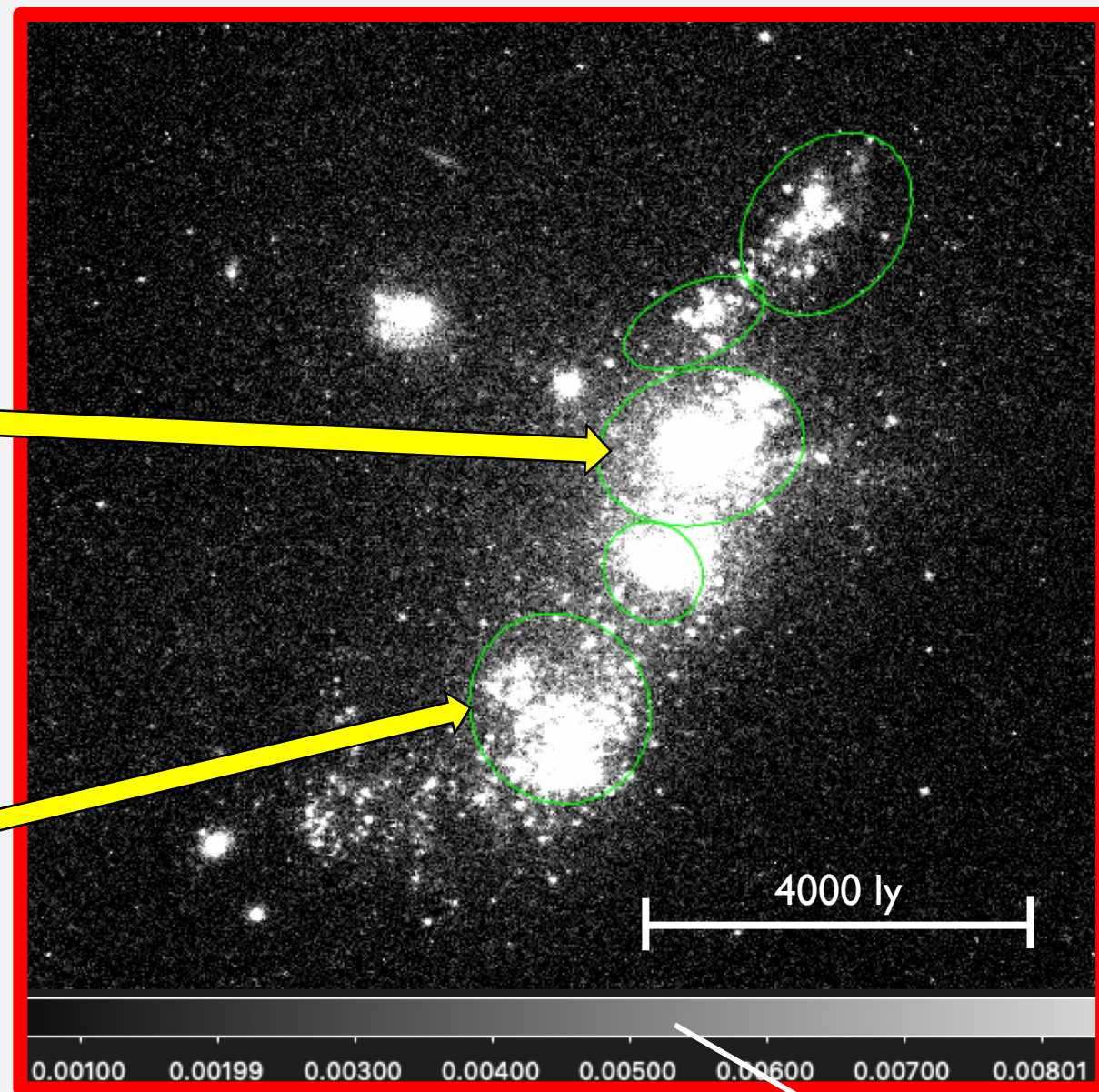
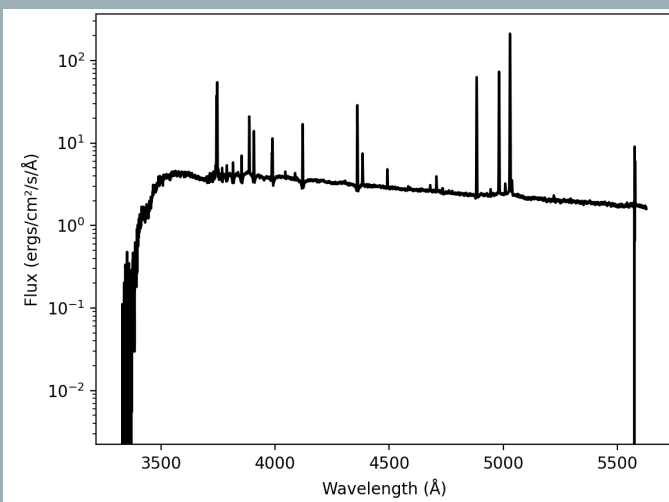
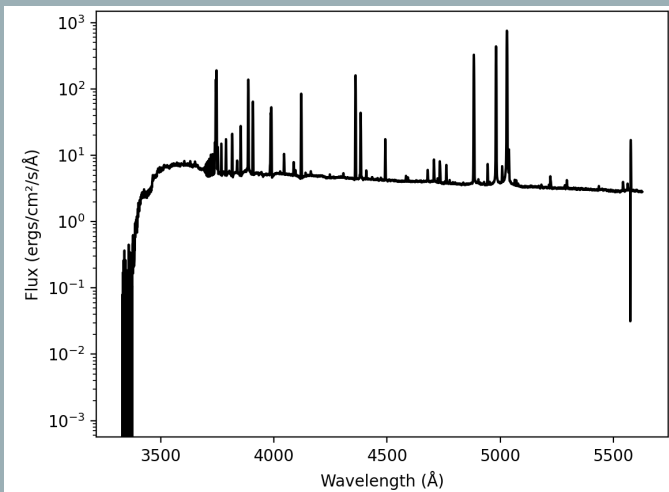
### III. EXTRACTING REGIONS



DATA PROCESSING:  
EXTRACTING THE REGION  
AND SPECTRUM

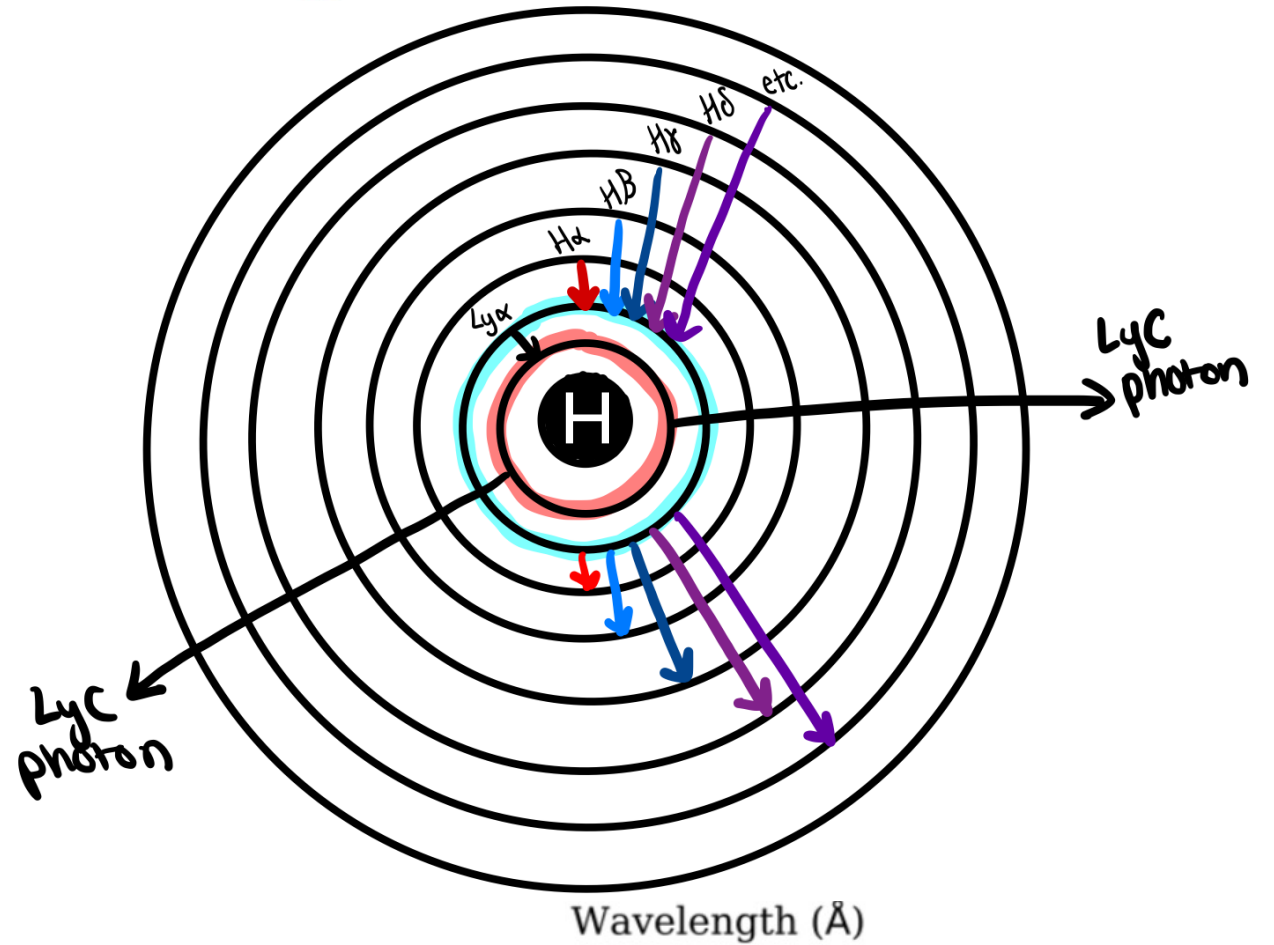
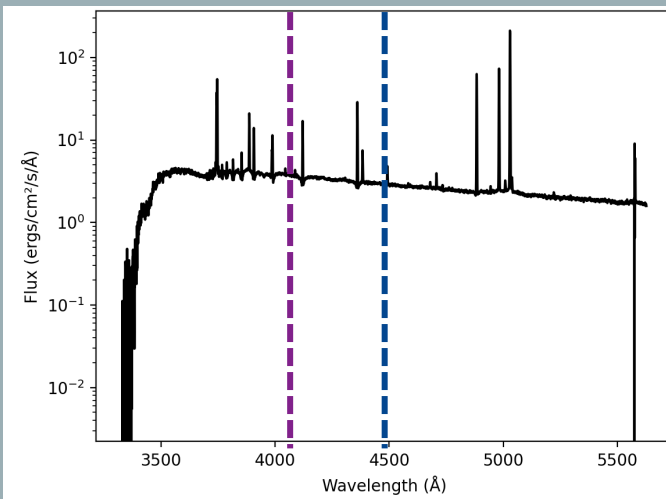
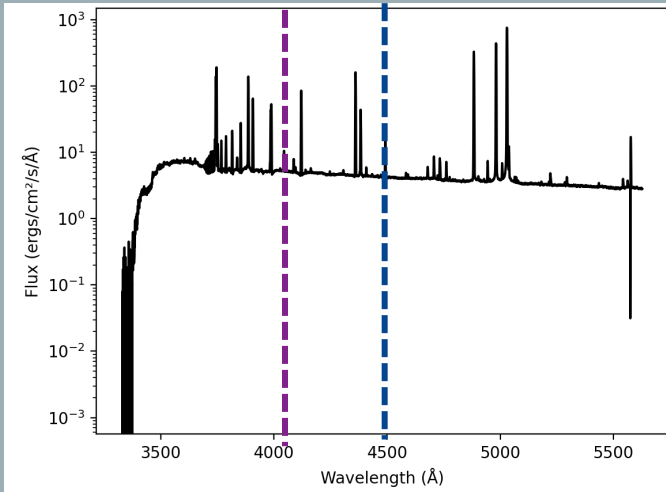


# DATA PROCESSING: EXTRACTING THE REGION AND SPECTRUM

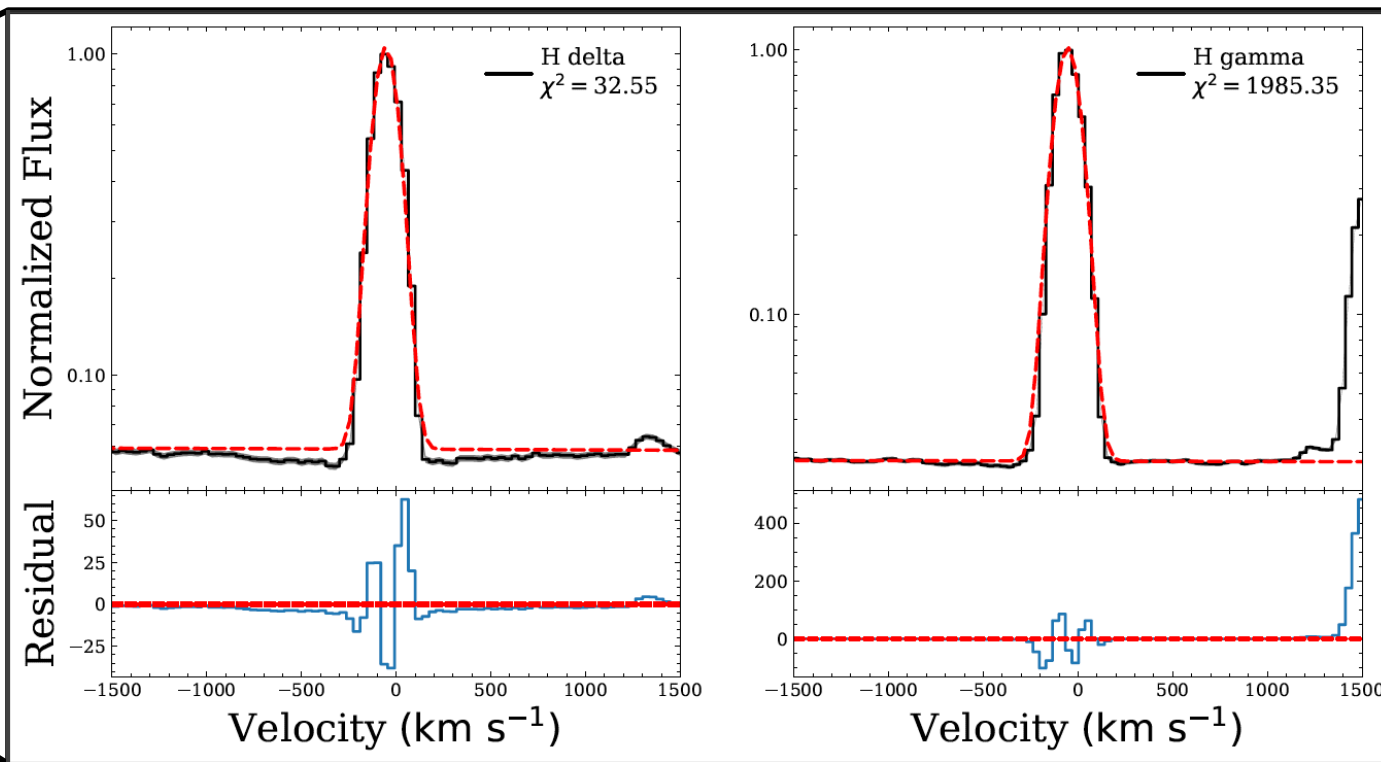
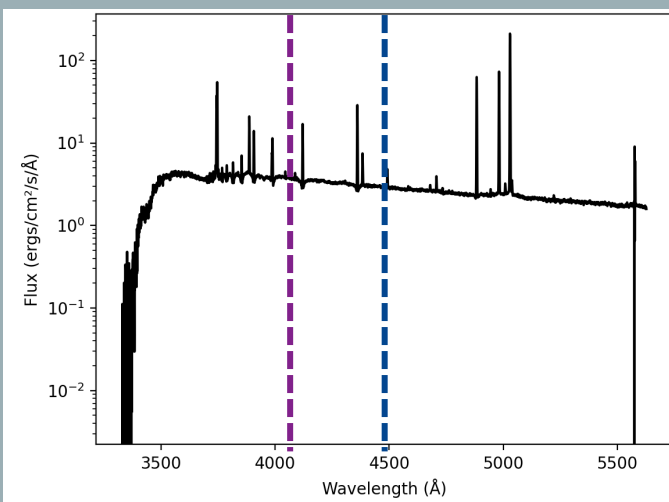
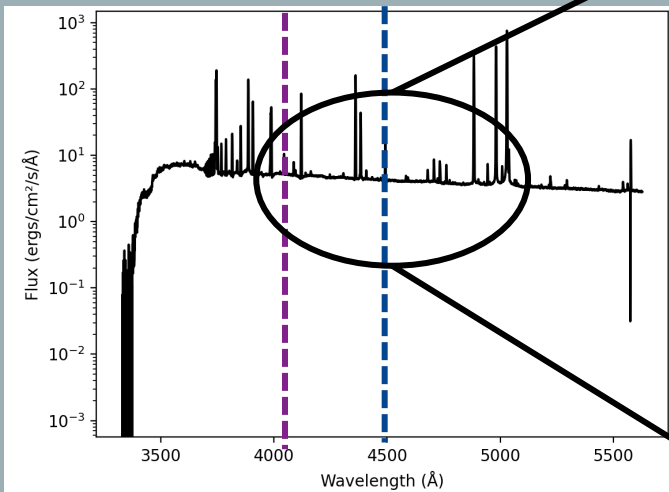




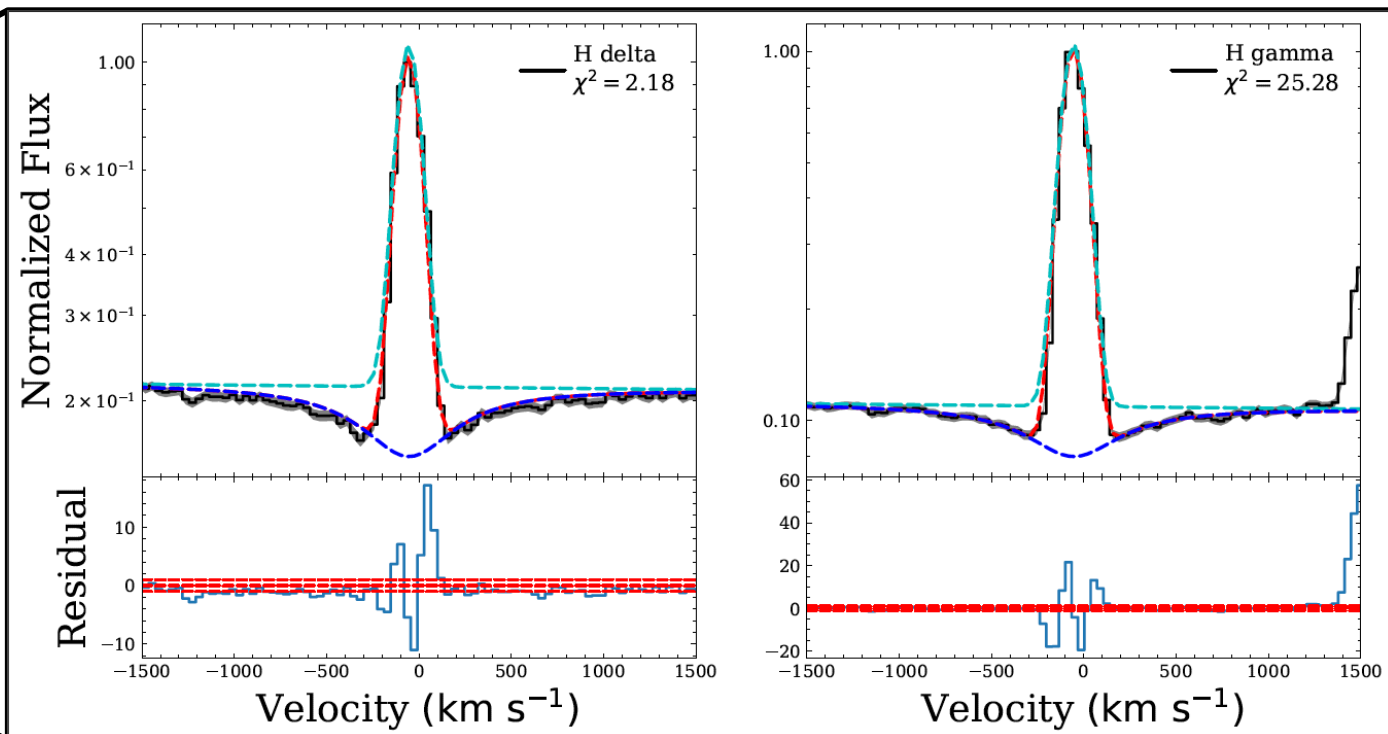
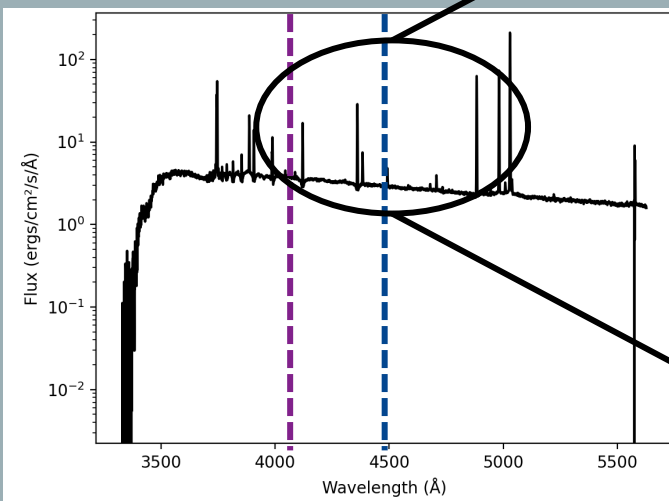
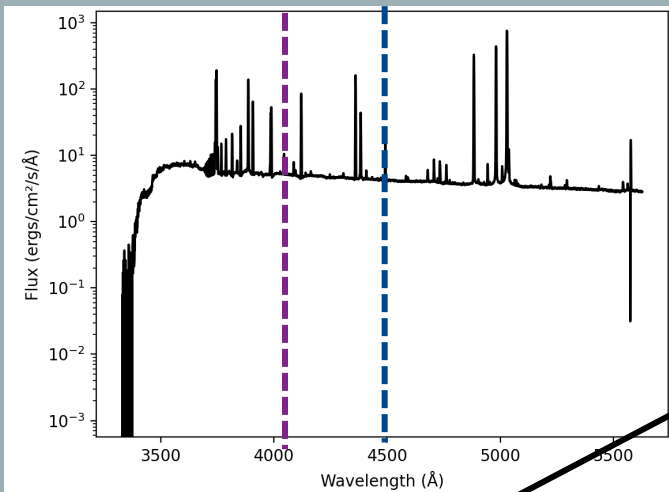
# DATA PROCESSING: OBSERVE THEIR SPECTRA



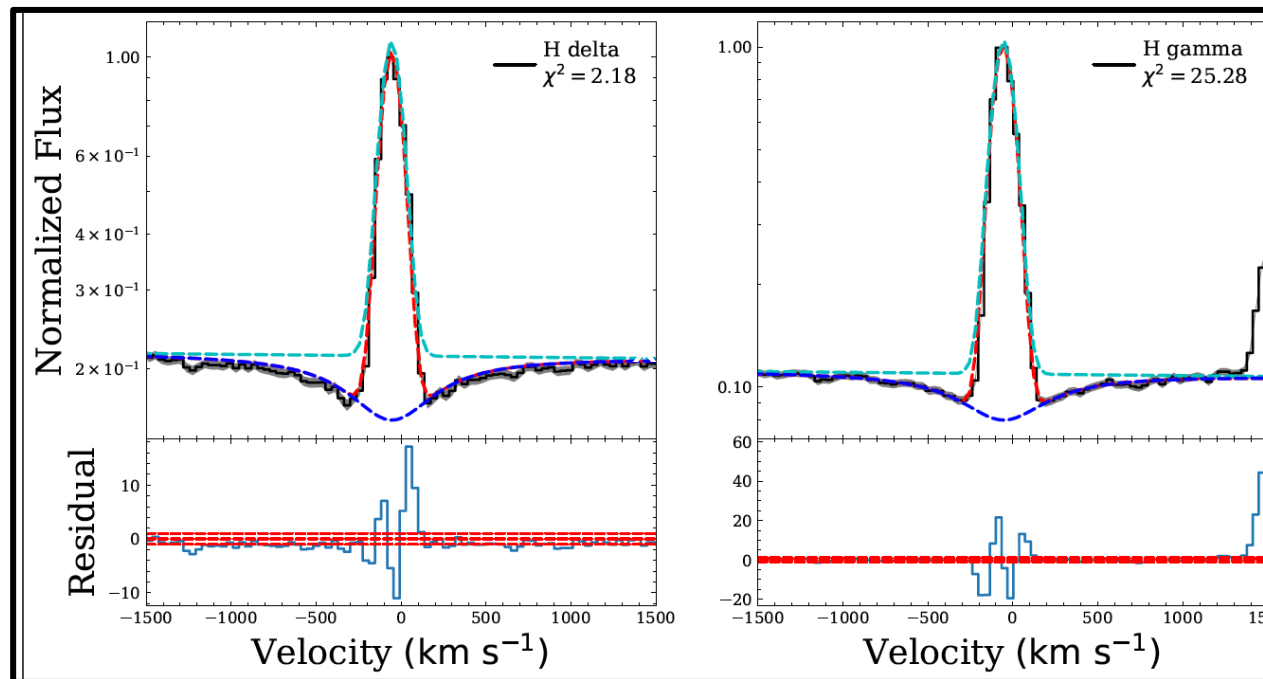
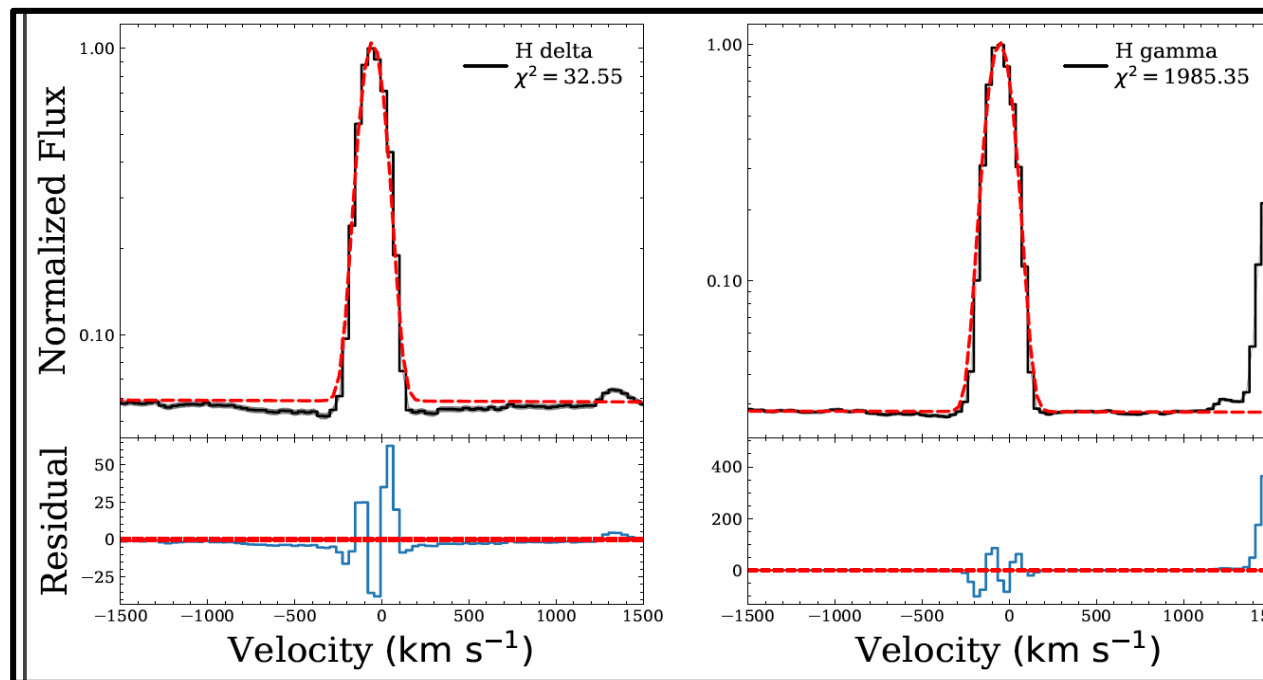
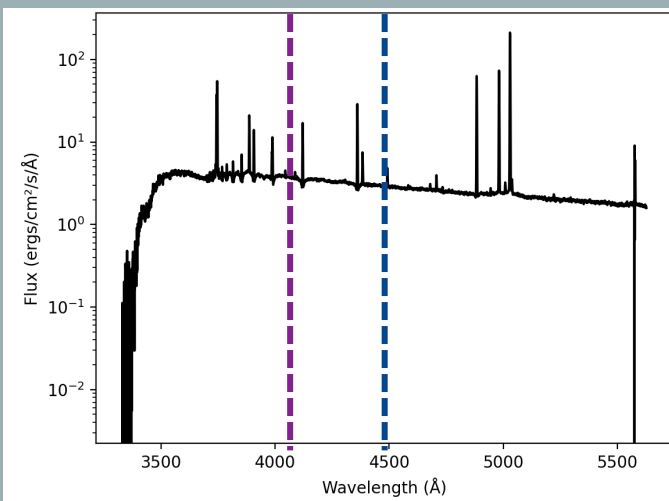
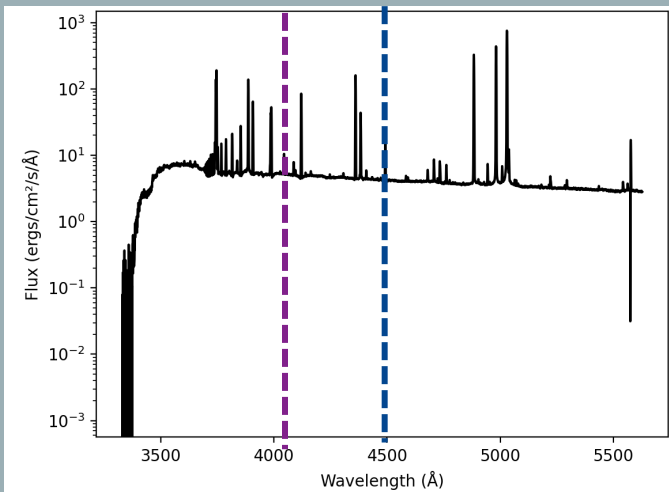
# DATA ANALYSIS: ANALYZE THEIR SPECTRA



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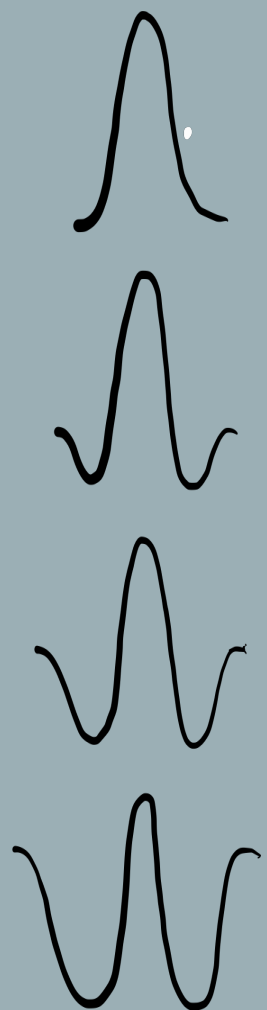


# DATA ANALYSIS: ANALYZE THEIR SPECTRA

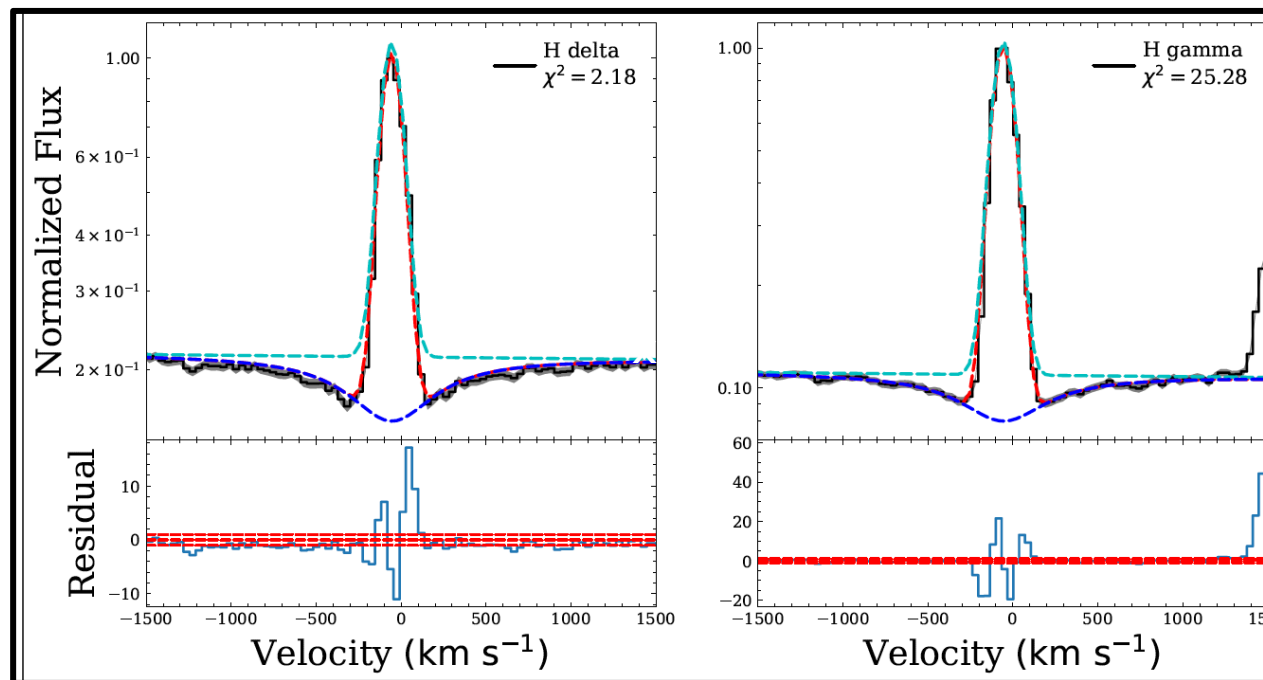
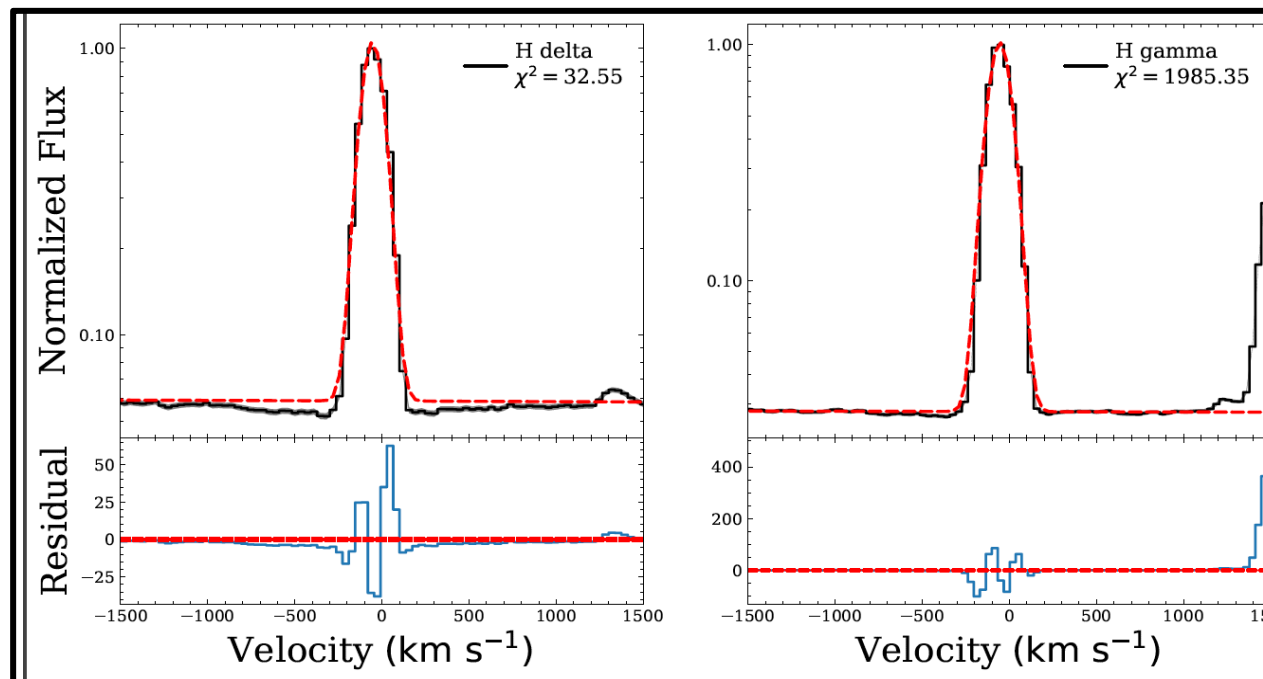


# DATA ANALYSIS: ANALYZE THEIR SPECTRA

EMISSION:  
YOUNGER

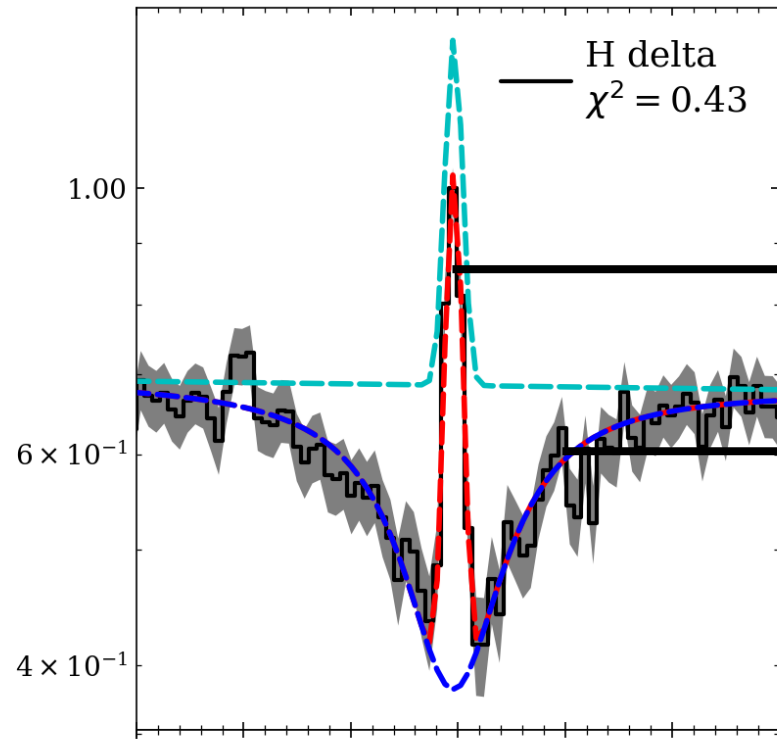


ABSORPTION:  
OLDER



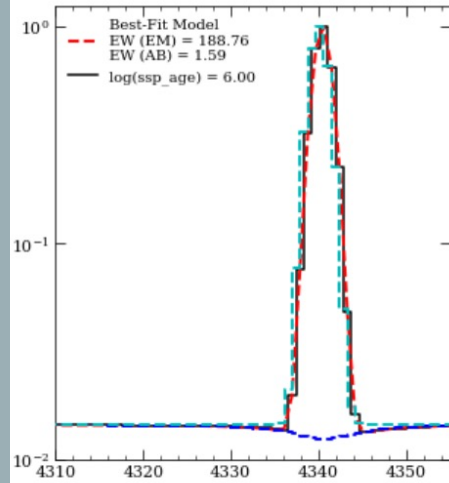
DATA ANALYSIS:  
CALCULATE EQUIVALENT  
WIDTHS

$$EW_{emission} = \int \left( \frac{F_{\lambda}}{F_{continuum}} - 1 \right) d\lambda$$



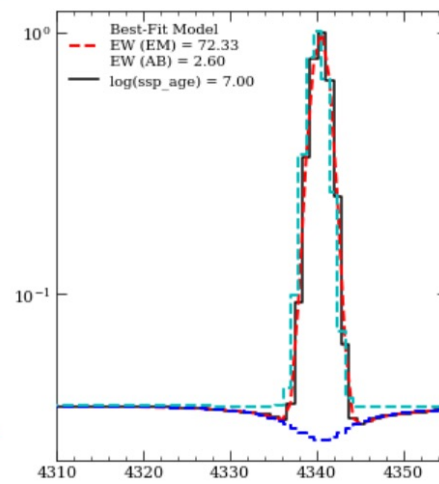
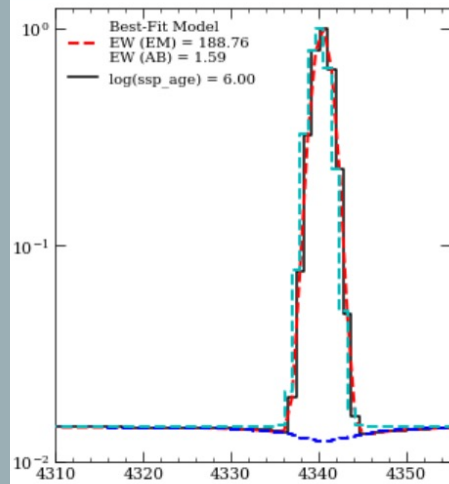
$$EW_{absorption} = \int \left( 1 - \frac{F_{\lambda}}{F_{continuum}} \right) d\lambda$$

DATA PROCESSING:  
GENERATE MOCK  
SPECTRA



$10^6$  years old

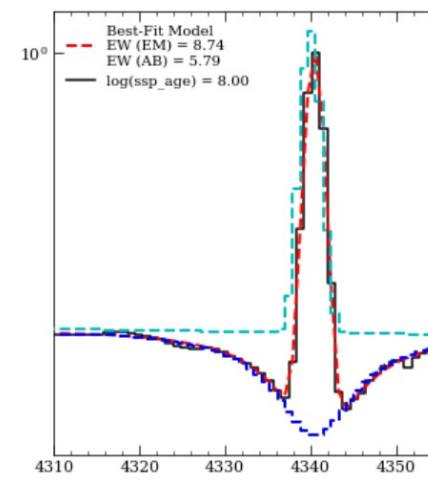
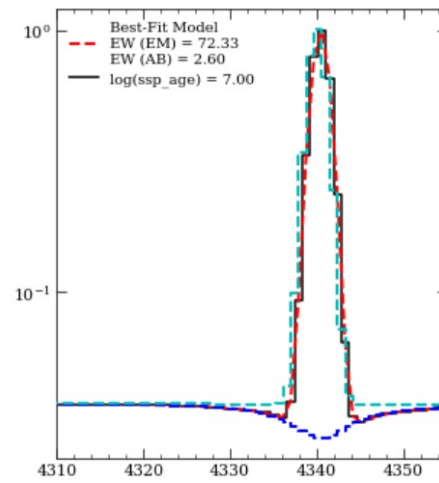
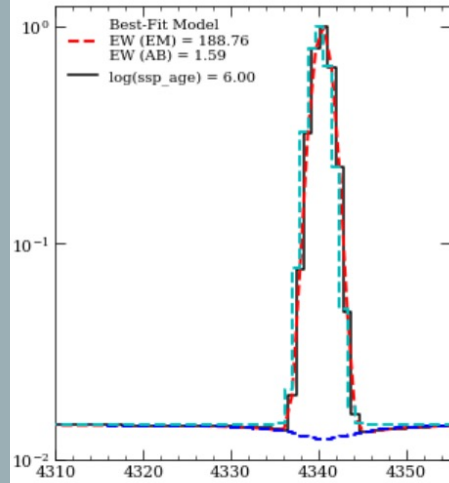
DATA PROCESSING:  
GENERATE MOCK  
SPECTRA



$10^7$  years old

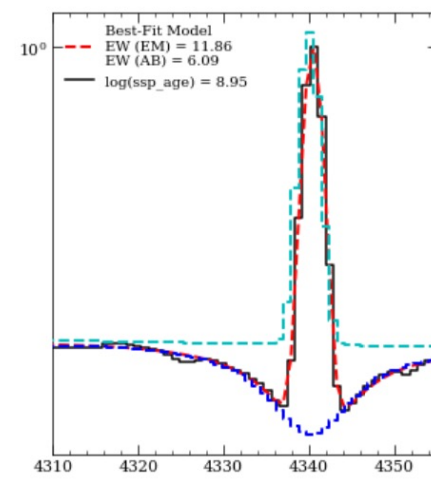
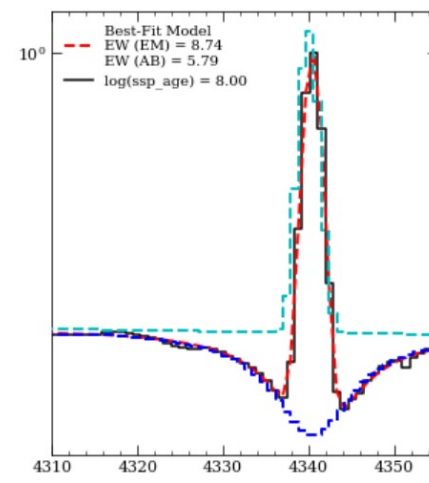
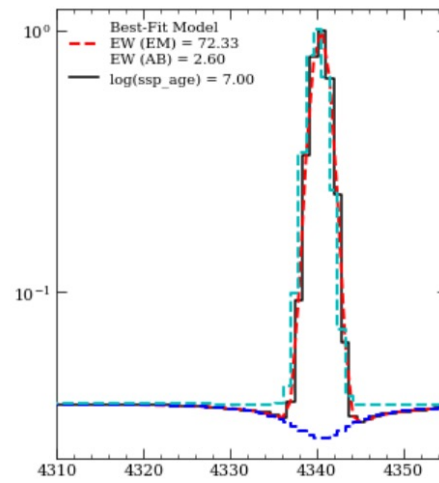
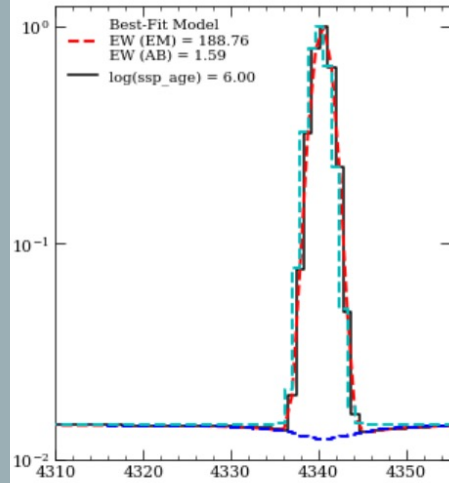


DATA PROCESSING:  
GENERATE MOCK  
SPECTRA



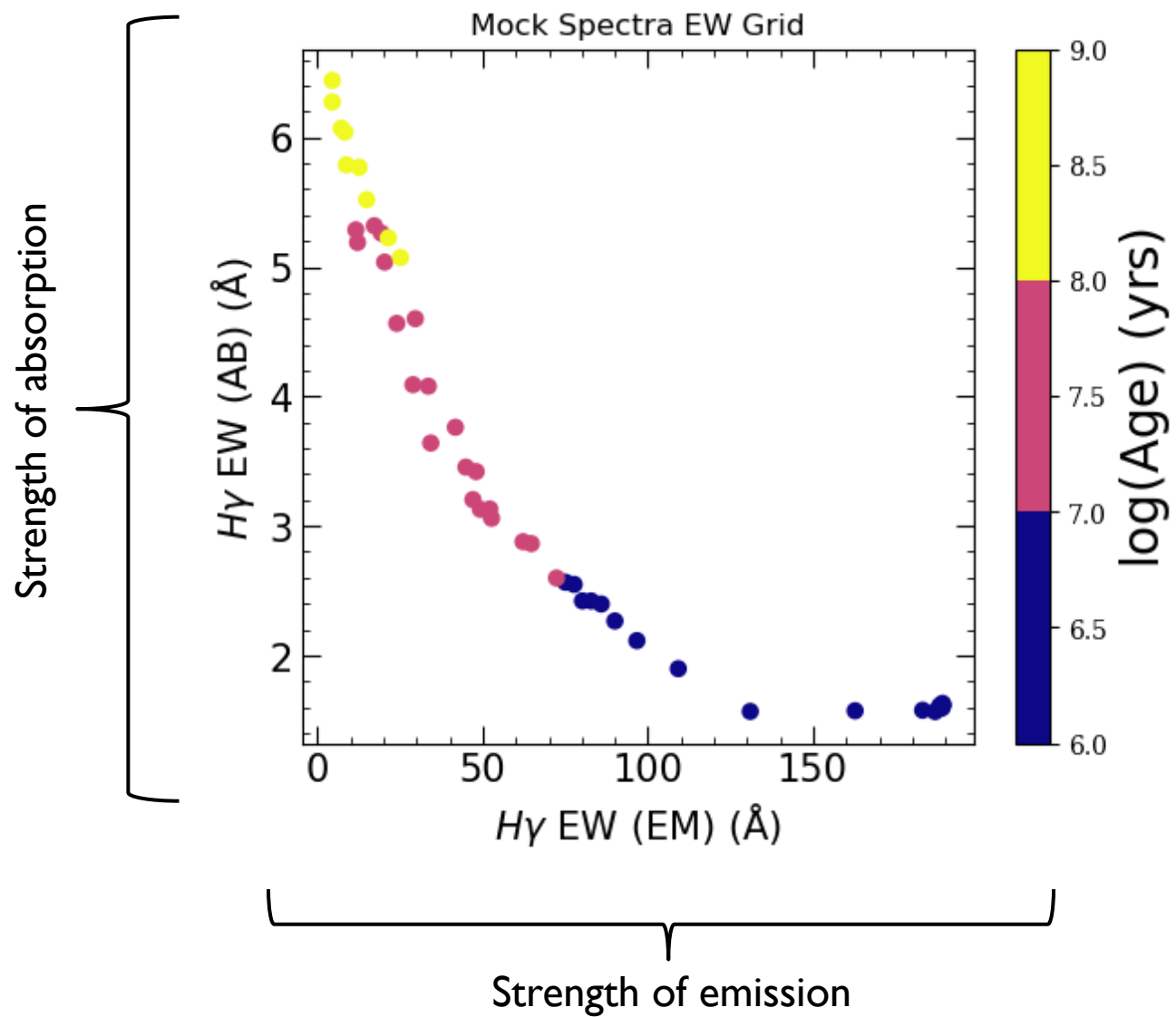
$10^8$  years old

DATA PROCESSING:  
GENERATE MOCK  
SPECTRA

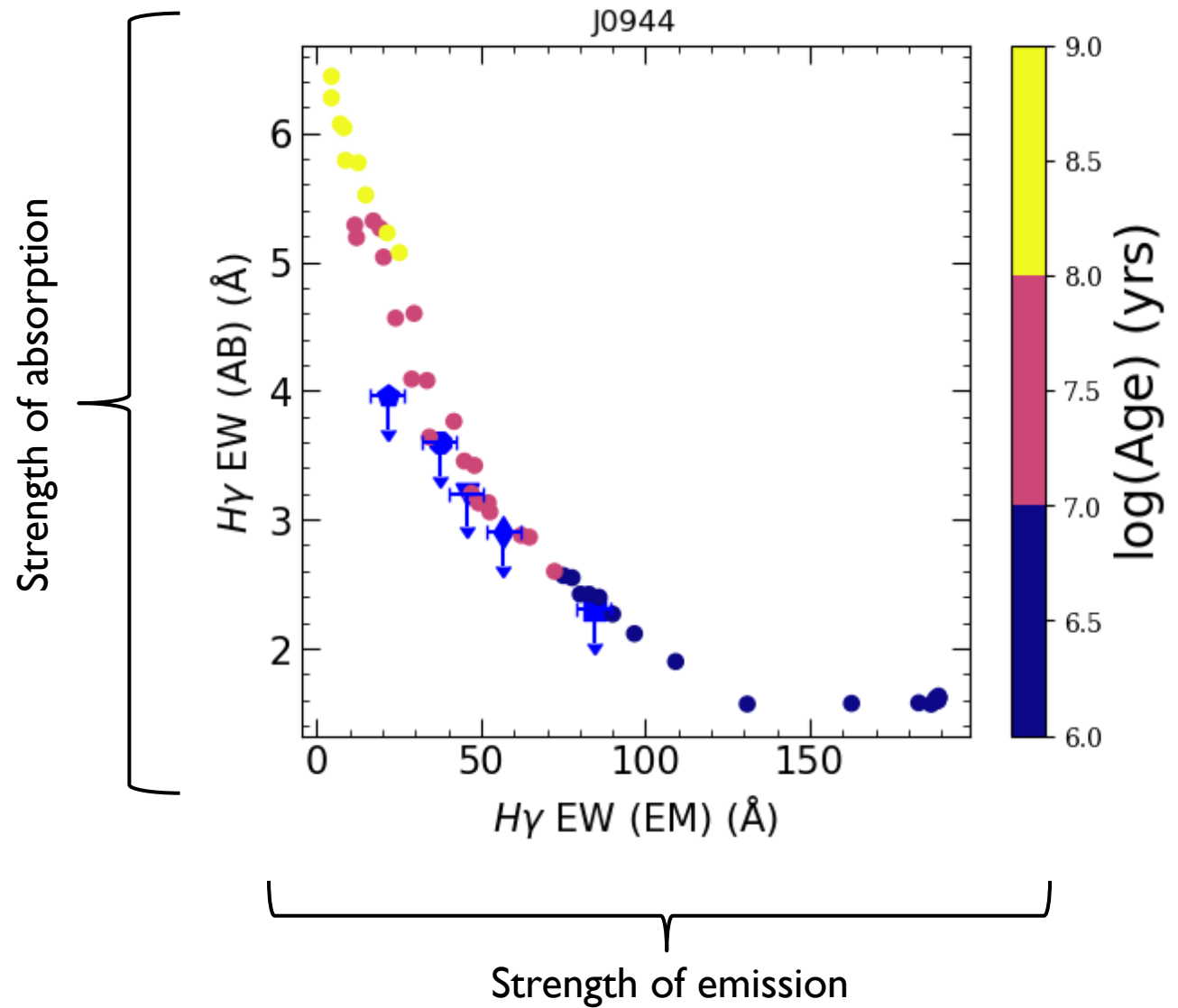


$10^9$  years old

DATA PROCESSING:  
GENERATE MOCK  
SPECTRA



DATA ANALYSIS:  
COMPARE TO  
APPROXIMATE  
STELLAR AGE



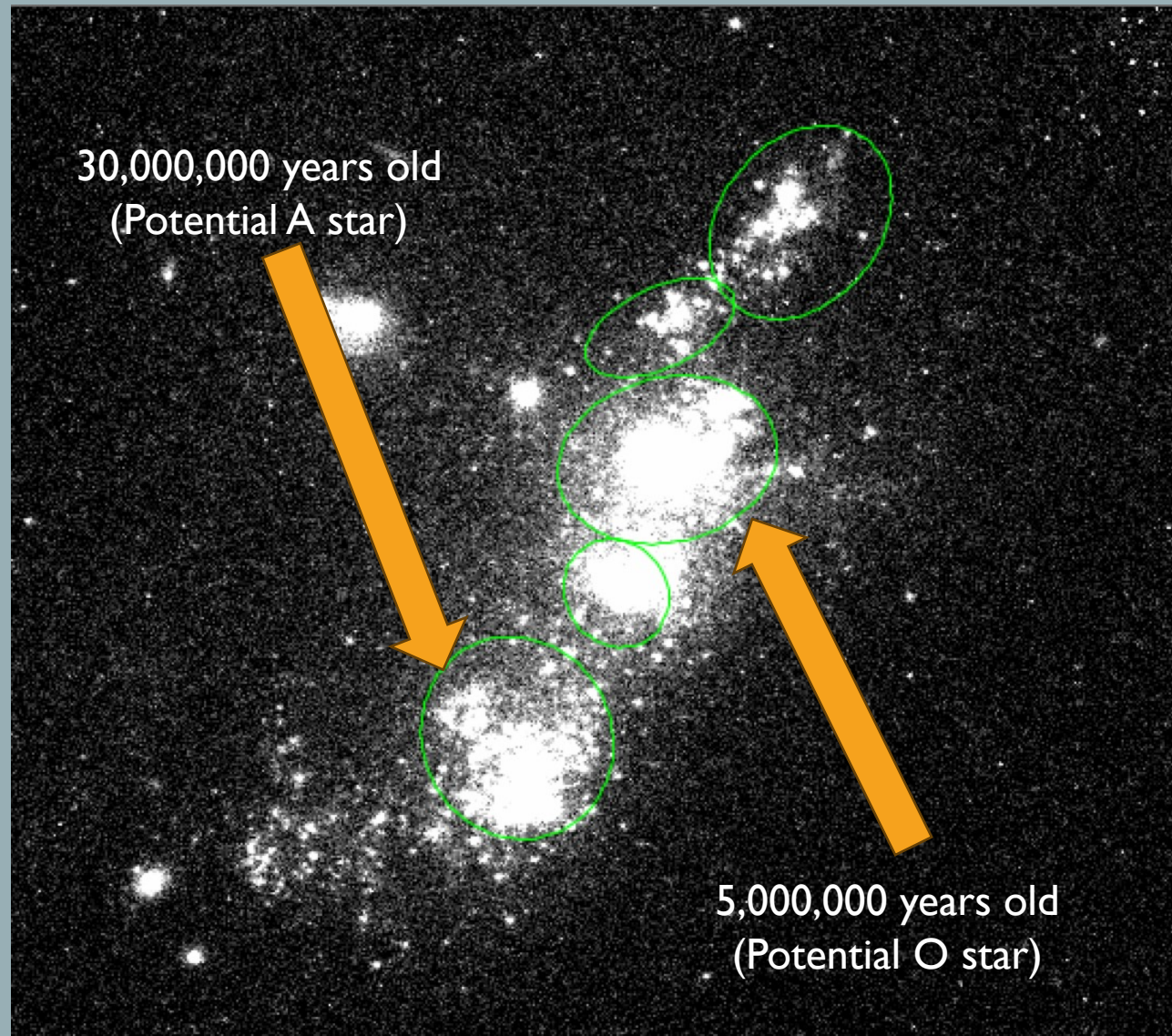
## NEXT STEPS

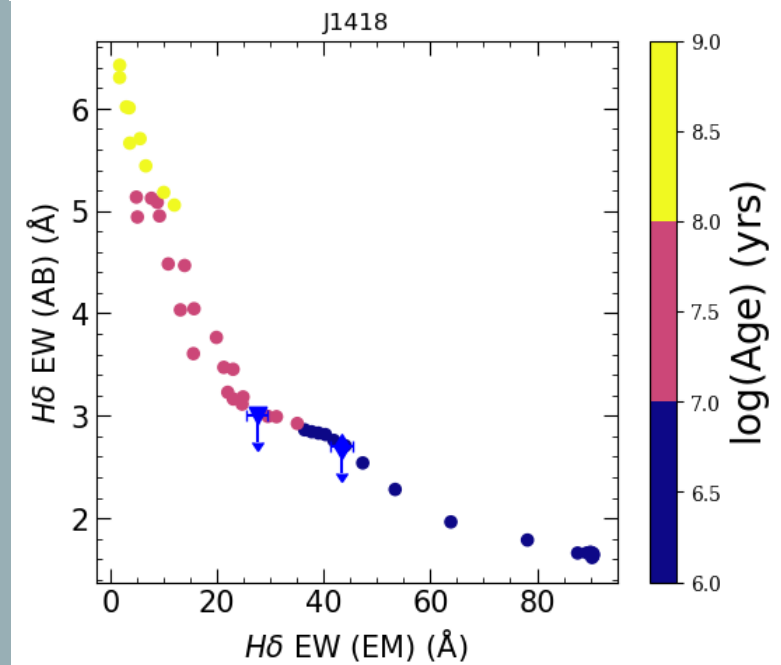
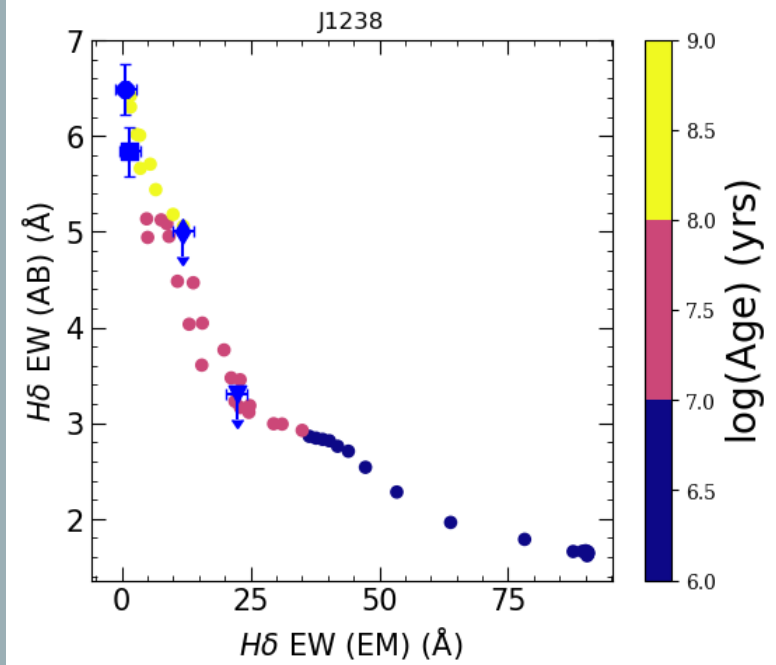
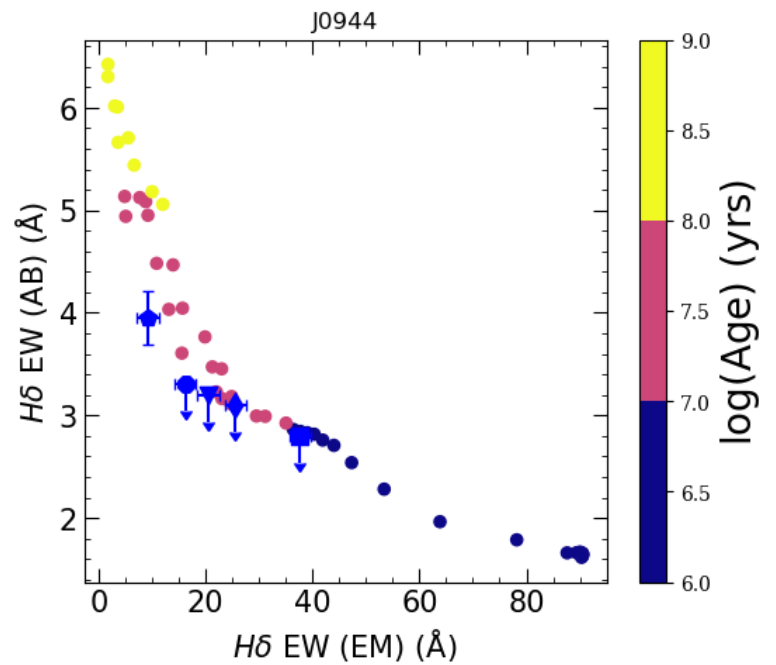
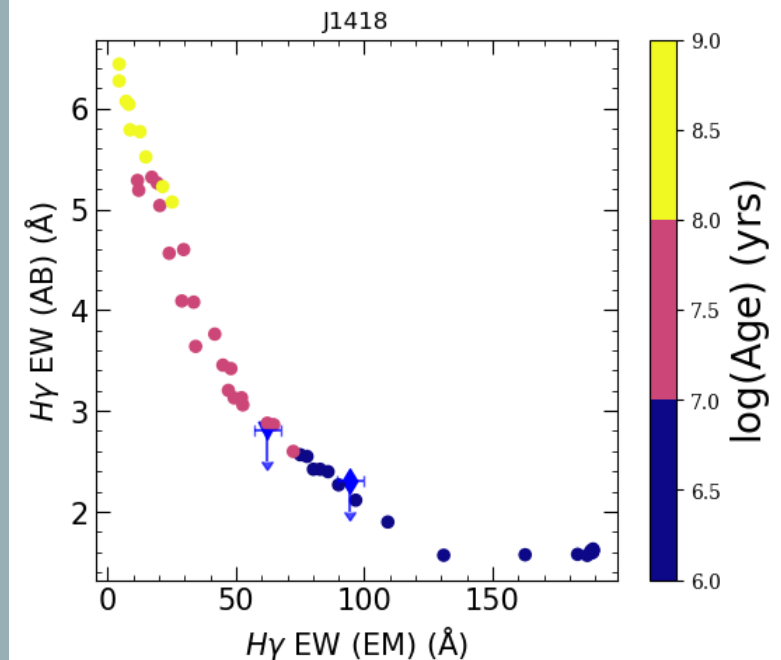
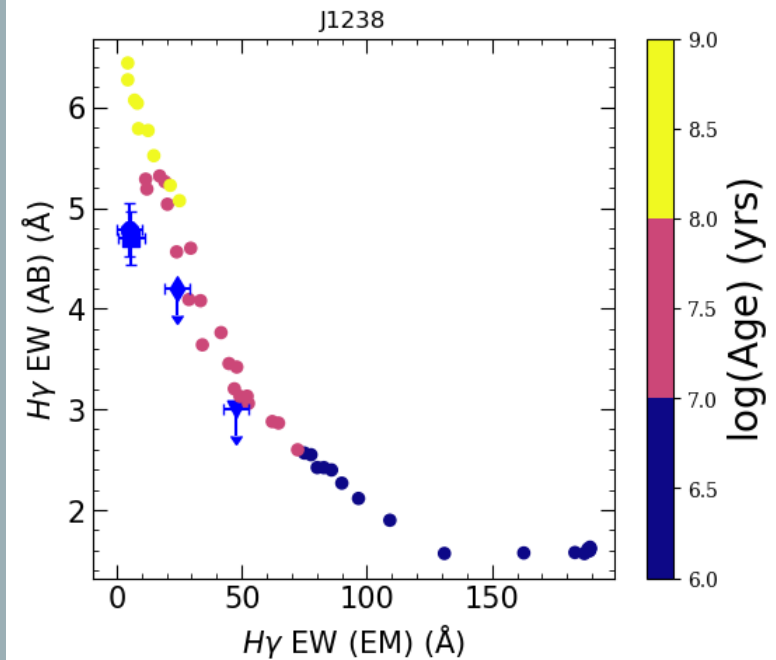
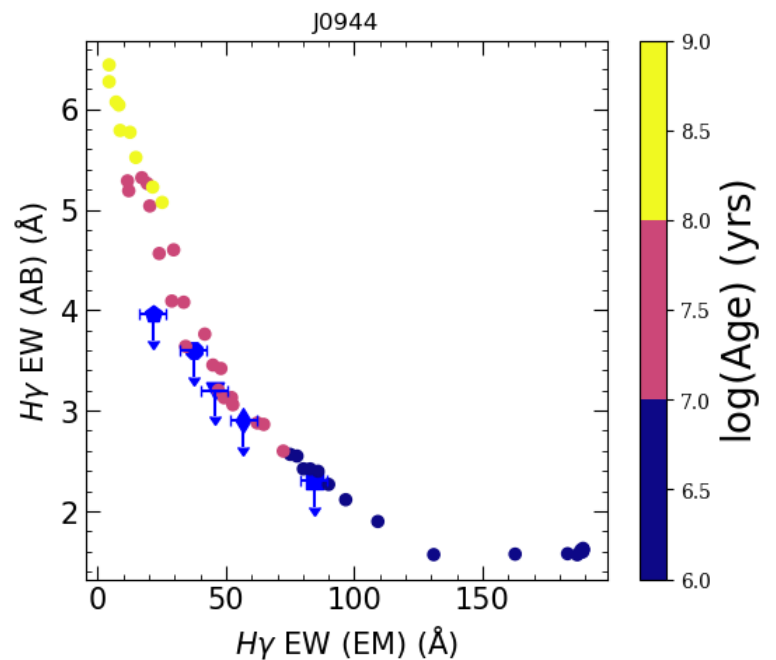
Compare star formation histories of stellar complexes

- Further explore the interactions (if any) between stellar complexes

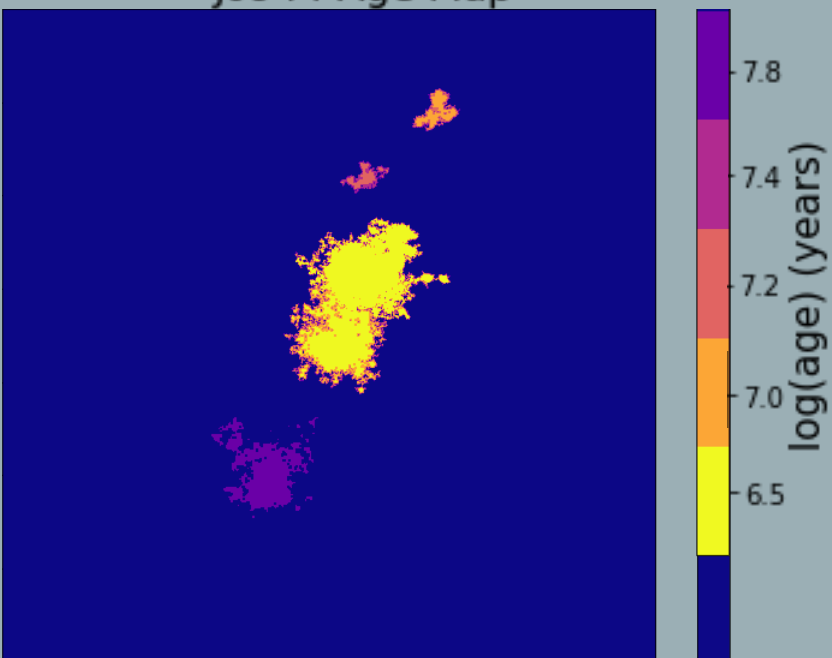
Compare star formation histories across galaxy sample

- Trace trends and outliers (in our sample) to learn more about cosmic reionization

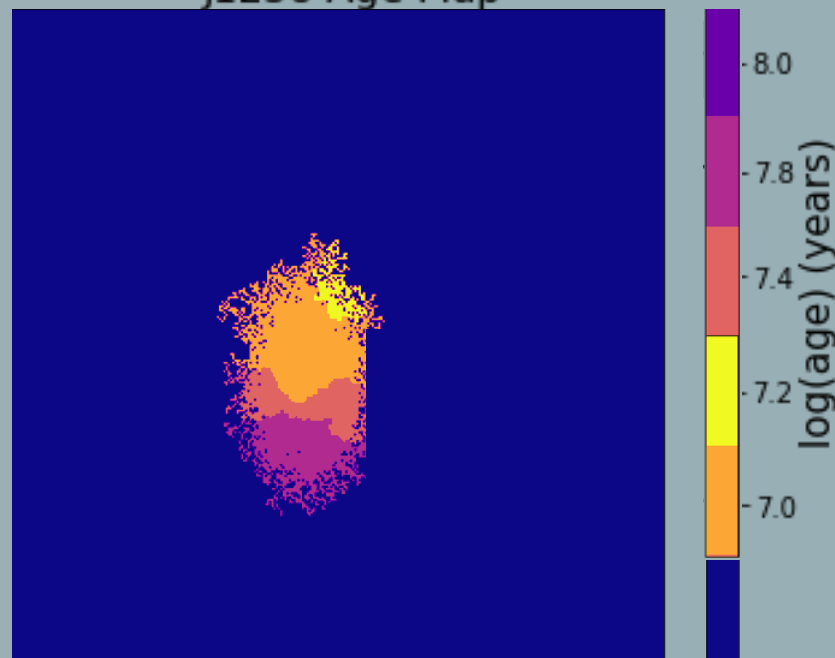




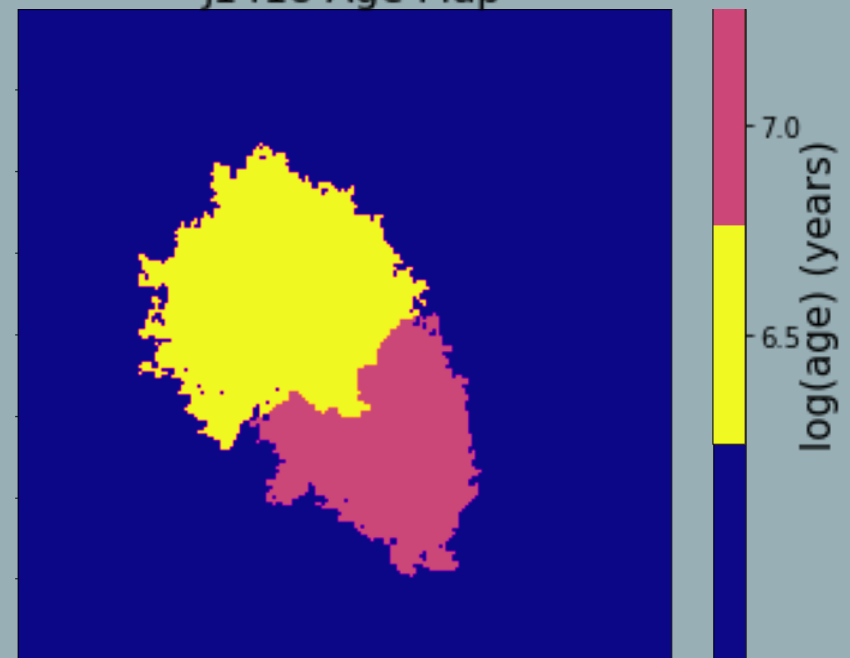
J0944 Age Map

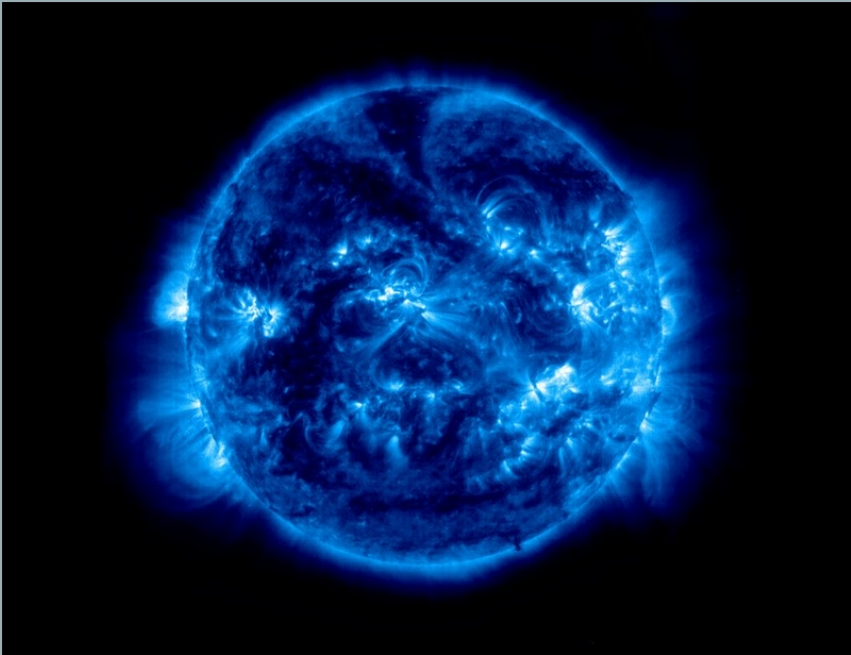


J1238 Age Map

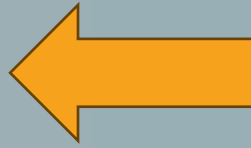


J1418 Age Map





Credit: <https://forums.frontier.co.uk/threads/list-of-o-type-stars.317606/>



Millions of years old

10-100 million years old

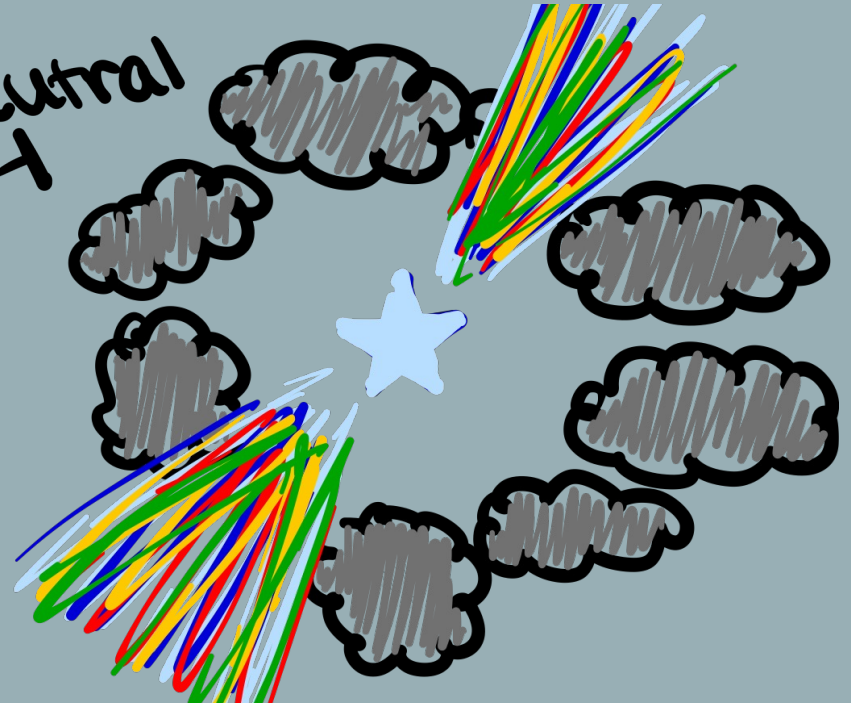


Credit: <https://www.skyatnightmagazine.com/space-science/how-galactic-winds-affect-evolution-of-galaxies>

Neutral  
H



Neutral  
H

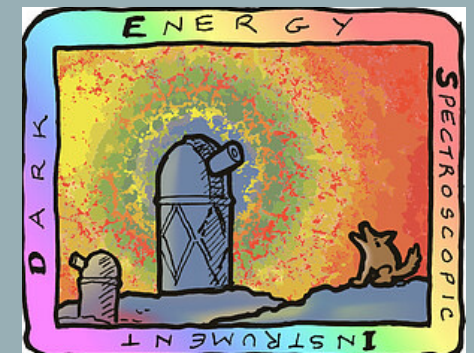
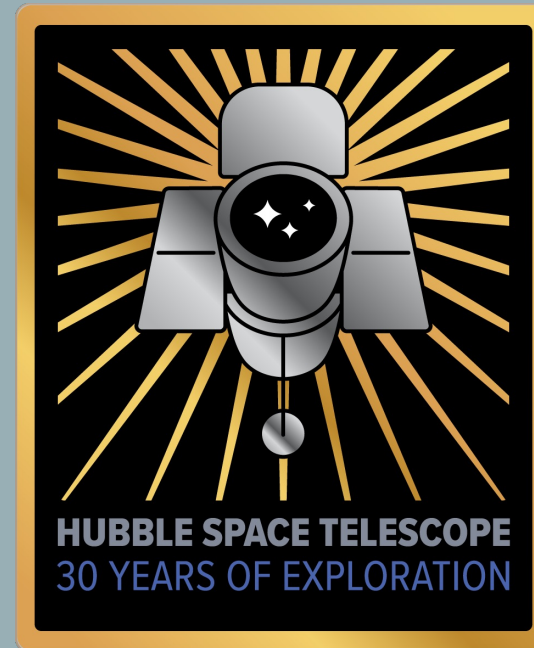
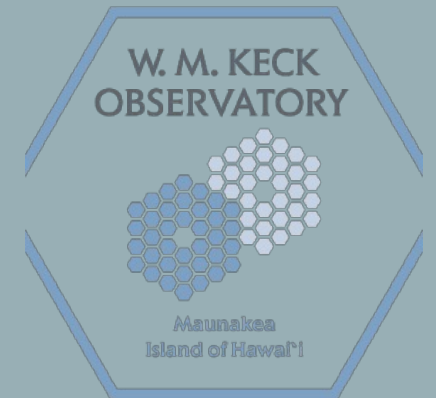




# ACKNOWLEDGEMENTS

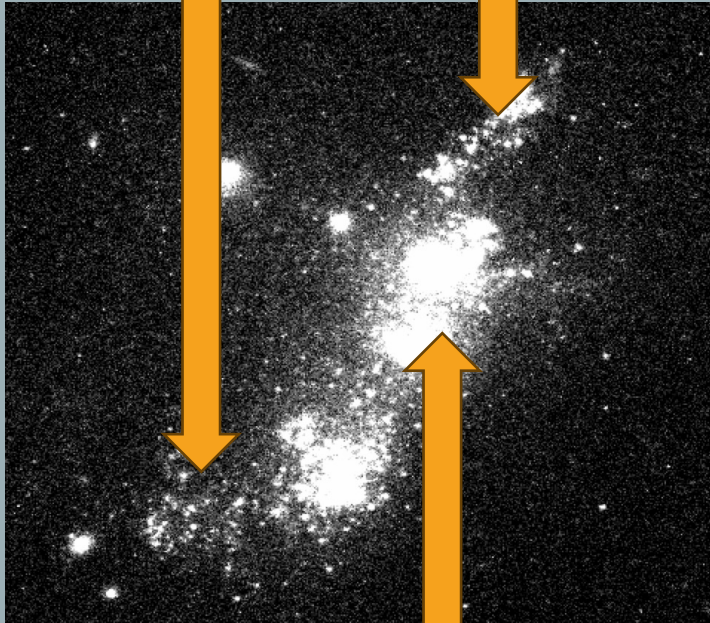
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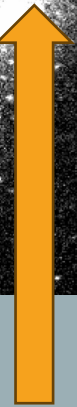


30,000,000  
years old

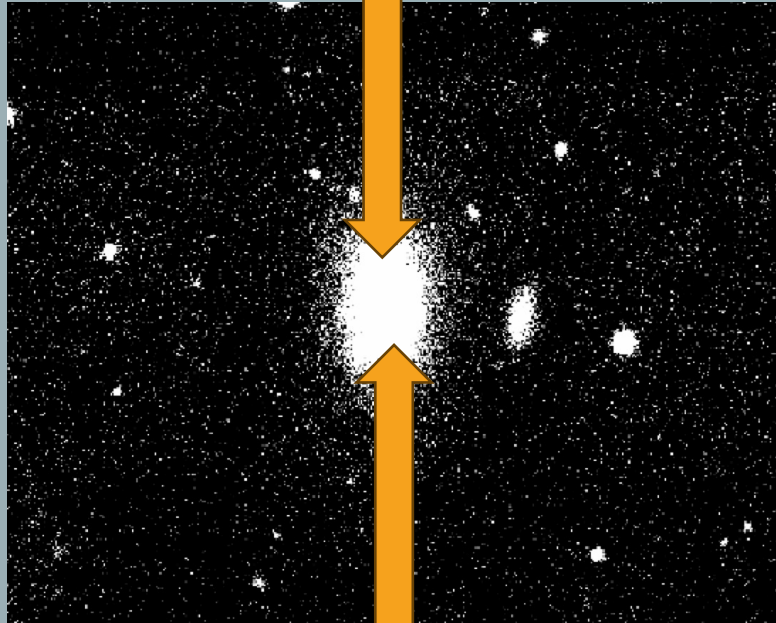
10,000,000  
years old



5,000,000 years old



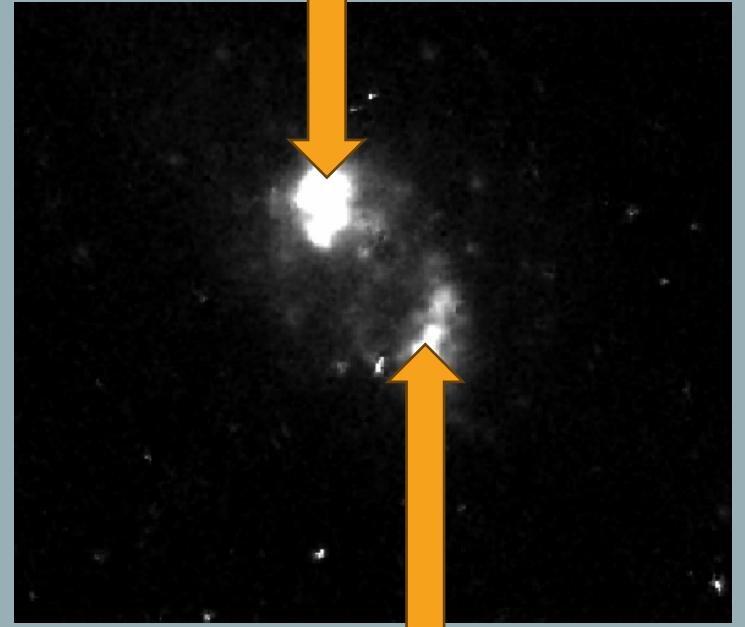
15,000,000 years old



50,000,000 years old



4,000,000 years old



13,000,000 years old

