

# Webb shows areas of new star formation and galactic evolution

April 12 2023

---



This image of the Hubble Ultra Deep Field was taken by the Near-Infrared Camera on NASA's James Webb Space Telescope. The Webb image observes the field at depths comparable to Hubble – revealing galaxies of similar faintness—in just one-tenth as much observing time. It includes 1.8-micron light shown in blue, 2.1-micron light shown in green, 4.3-micron light shown in yellow, 4.6-micron light shown in orange, and 4.8-micron light shown in red (filters F182M, F210M, F430M, F460M, and F480M). Credit: NASA, ESA, CSA, STScI, C. Williams (University of Arizona). Image processing: J. DePasquale (STScI).

On Oct. 11, 2022, NASA's James Webb Space Telescope spent over 20

hours observing the long-studied Hubble Ultra Deep Field for the first time. The general observer program ([GO 1963](#)) focused on analyzing the field in wavelengths between approximately 2 and 4 microns.

We spoke with Christina Williams (NOIRLab), Sandro Tacchella (University of Cambridge), and Michael Maseda (University of Wisconsin-Madison) to learn more about the first observation of the Hubble Ultra Deep Field through Webb's eyes.

## **What is important for people to know about these Webb observations?**

Michael Maseda: The fact that we see hot, ionized gas is telling us exactly where stars are being born in these galaxies. Now we can separate those areas from where stars already existed. That piece of information is very important because, billions of years later, we don't exactly know how galaxies became how they are today. It's important to note that we still haven't seen everything there is to see. Our whole program was ~24 hours, which isn't that much time in the grand scheme of how much time other observatories have looked at it. But, even in this relatively short amount of time, we're starting to put together a new picture of how galaxies are growing at this really interesting point in the history of the Universe.

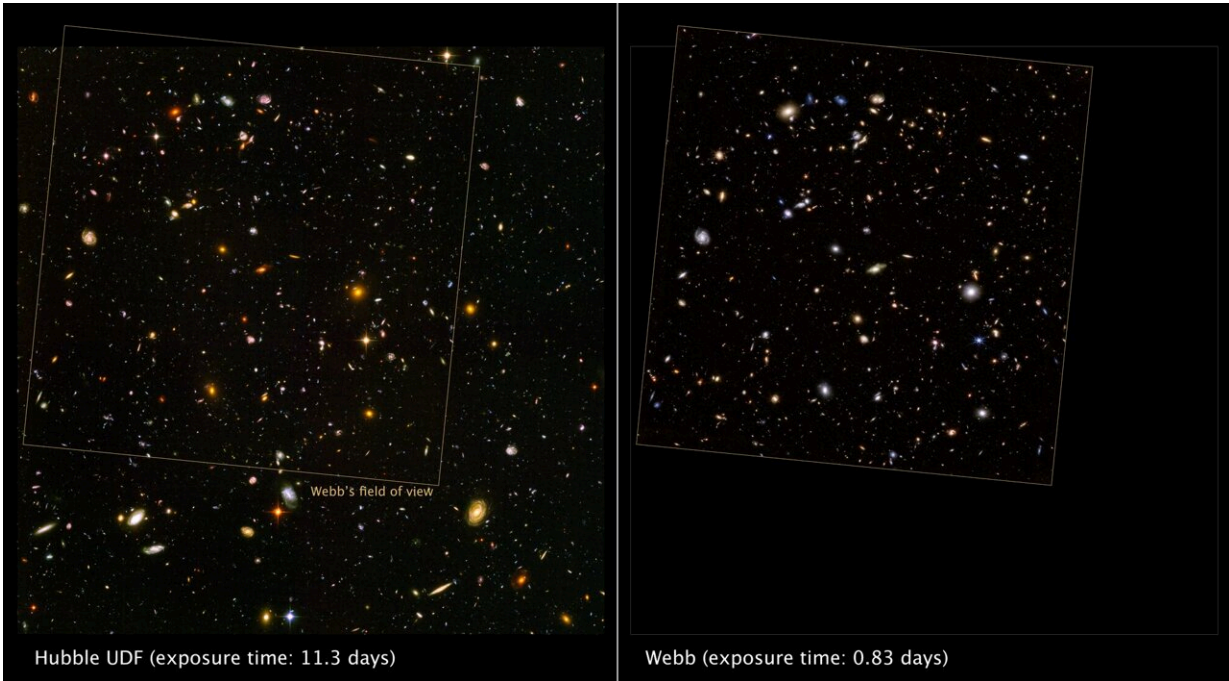
## **What are you interested in learning by exploring the Hubble Ultra Deep Field with Webb?**

Christina Williams: We proposed to image the Ultra Deep Field using some of Webb's NIRCams medium-band image filters, which allowed us to take images of spectral features more accurately than we could with broadband filters because medium-band filters span a shorter wavelength range. This gives us more sensitivity in measuring colors,

which helps us understand the history of star formation and ionization properties of galaxies during the first billion years of the universe, like in the Reionization Era. Measuring the energy that galaxies produced in that time will help us understand how galaxies reionized the universe, reverting it from being neutral gas to once again being an ionized plasma like it was after the big bang.

**Sandro Tacchella:** One of the key outstanding questions in extragalactic astrophysics is how the first galaxies form. Since the medium bands cover a range of different wavelengths, we can either directly find some of the first galaxies in the early universe, or we can age-date the stars in galaxies when the universe was about one billion years old to understand when the galaxy actually formed their stars in the past. This survey helps to pin down the formation of the first galaxies.

**Michael Maseda:** The capabilities that we have with Webb's medium-band filters are actually quite new. We're getting a sort of hybrid between imaging and spectroscopy, so we're getting detailed information for basically all of the galaxies in the field, as opposed to traditional spectroscopy where you could only select a few galaxies in the field of view for study. It's really a complete picture in the sense that this information complements a lot of existing data, not only from Hubble, but ground-based instrumentation like MUSE (the Multi Unit Spectroscopic Explorer) on the Very Large Telescope, where we have spectroscopy at different wavelengths for a number of these objects. MUSE is very good at finding galaxies that have Lyman-alpha emission, or light from ionized hydrogen in these galaxies, which are the type of galaxies that existed when reionization was ending. This new data is a missing piece that we did not have before in terms of understanding the full population of galaxies in this field.



The capabilities of NASA's James Webb Space Telescope's Near-Infrared Camera are on full display in this comparison between Hubble's and Webb's observation of the Hubble Ultra Deep Field. The left, which demonstrates Hubble's observation with its Wide Field Camera 3, required an exposure time of 11.3 days, while the right only took 0.83 days. Several areas within the Webb image reveal previously invisible, red galaxies. Credit: NASA, ESA, CSA, STScI, C. Williams (University of Arizona). Image processing: J. DePasquale (STScI).

### **Was there anything unexpected in these data that surprised you?**

Michael Maseda: I don't know if I was surprised exactly, but the images were even better than I was expecting. In these images, you can actually see by eye that this is ionized gas over a fairly large area. I was expecting everything to be unresolved, but we have a high-enough resolution to actually see it. And I'm pleased to see it because it could have been a lot harder to understand what was happening.

Christina Williams: I think that seeing how beautiful the images are and how high quality they ended up being was definitely a high point. We calculated that we would be able to do things like this, but it was different to see it and have the real data in practice.

## **Why did you elect to make the data immediately public?**

Sandro Tacchella: Galaxies are very [complex systems](#) in which a wide range of different processes work on different spatial and temporal scales, so there are many approaches that can be used to better understand the physics of [galaxies](#). So, making it available to many different groups will facilitate the search for more insight.

Christina Williams: Webb is still very new, and people are still learning the best practices of how to analyze data sets. So, it benefits everyone to have a few [data sets](#) that are available immediately to help people understand the best way to make use of Webb data moving forward, and to better plan programs in future cycles that are based on real experience with data

Provided by Webb Space Telescope

Citation: Webb shows areas of new star formation and galactic evolution (2023, April 12) retrieved 17 April 2024 from

<https://phys.org/news/2023-04-webb-areas-star-formation-galactic.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.