NASA releases first images and data from the James Webb Space Telescope

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The James Webb Space Telescope (JWST), jointly operated by NASA, the Canadian Space Agency (CSA) and the European Space Agency (ESA), has been successfully commissioned. The images and accompanying data released on July 12 are a first glimpse of the full capabilities of the new astronomical observatory and mark a major step forward in humanity's ability to understand the Universe and our place within it.

By all accounts, the imagery unveiled is a stunning scientific achievement. Hundreds of commands from ground control to the astronomical observatory since it launched on December 25 were carried out flawlessly. Thousands of researchers, scientists and engineers in the United States, Canada, Europe and elsewhere in the world worked tirelessly to understand and characterize the spacecraft's performance while in orbit. As a result, the data taken has already pushed past many of the previous capabilities set by earlier space telescopes.

The event also has a mass social character. The first light of the JWST has been anticipated by astronomers and the public for more than a decade. The telescope builds off of the legacy of other space observatories like Chandra, Spitzer and, above all, Hubble which have produced groundbreaking scientific results and have simultaneously captivated and inspired workers and youth across the globe.

Millions watched live as the images were unveiled and millions more have read reports, watched videos, posted on social media and talked among co-workers and friends about what the JWST has so far observed. After many years of delays and a near cancellation in 2011 by the culturally backward American state (the telescope's $10 billion cost could have, after all, been spent on yet another aircraft carrier), the JWST has successfully joined and advanced the constellation of humanity's space-based observatories.

The first operational image taken by the telescope, known as Webb's First Deep Field, depicts the galaxy cluster SMACS 0723. Light from the cluster took 4.6 billion years to reach Earth, providing a snapshot of the galaxies within from that period in cosmic history. The cluster is so massive that it also acts as a lens, its gravity so powerful that light from more distant galaxies is focused and amplified. The JWST was as a result able to gather light from one galaxy that has traveled for 13.1 billion years, originating just a 700 million years after the Big Bang.

The most striking aspect of the image, however, is the improvement in resolution of this deep field over those previously taken by Hubble. One of the chief design considerations of the JWST was to have a 6.5-meter diameter primary mirror, which has a light-collecting area about six times that of Hubble. As a result, it is capable of capturing internal structural details of galaxies that Hubble simply cannot, such as star clusters and other diffuse features.

It is also worth noting that the JWST was able to use its Near-Infrared Camera (NIRCam) instrument to collect the necessary data to produce its image of SMACS 0723 in just 12.5 hours. In comparison, it took Hubble weeks to collect comparable but less resolved data.

The JWST will also be capable of looking back further in time. While the galaxy GN-z11 is the most distant object Hubble has observed, light having traveled 13.4 billion years to be captured, it is expected that the new telescope will break past this milestone in the coming months. The JWST primarily observes wavelengths in the infrared, compared to the visible for Hubble, and is thus designed to observe light that has traveled for even longer.

Another object imaged using the NIRCam was the Carina Nebula. It is located about 7,600 light years from Earth and is a rich target for those studying star and planetary formation. The JWST in particular imaged what are known as the nebula's "cosmic cliffs," which look like a range of mountains and valleys but are in fact the edge of a colossal cavity carved out by stars emitting intense ultraviolet light during their early years after formation.

Past observations of this region have shown star formation, but none have been able to pierce through the gas and dust to the extent achieved by the JWST and at the current resolution. The observations were also aided by the Mid-

Infrared Instrument (MIRI), revealing previously suspected but hitherto unseen areas of star birth.

Astronomers also used NIRCam and MIRI to observe Stephan's Quintet, a visual grouping of five galaxies first observed in 1877. While the leftmost galaxy is not a true member of the cluster (it is 40 million light years away, while the other four are 290 million light years from Earth), the other four are gravitationally bound to each other and a very well-studied group showing how galaxies can be ripped apart as they interact with each other.

The JWST has captured fresh data from these galaxies, including clusters of young stars as well as regions of star formation induced by the mutual interactions. The telescope also imaged a shock wave produced as the galaxy NGC 7318B crossed through the cluster, as well as outflows produced by the supermassive black hole at the center of galaxy NGC 7319. The high resolution provided by the JWST's large size also provided more detail on the hundreds of galaxies in the background, essentially another deep field.

The last image released to show the capabilities of NIRCam and MIRI was of the Southern Ring Nebula, which consists of a binary star system about 2,500 light years away where one of the stars has lost much of its mass at the end of its life through recent periodic ejections of gas and dust. As the stars revolved, they churned the emitted material into a complex network of shells. In addition, the distance of each shell from the binary pair and its molecular composition provide a history of the system over thousands of years, analogous to studying geological epochs using layers of rocks on Earth, allowing researchers to better understand how such star systems evolve.

NASA has also released data taken by the Near-Infrared Imager and Slitless Spectrograph (NIRISS) of the exoplanetary system WASP-96. During a 6.4-hour observing campaign, the instrument watched as a gas giant in that system, one with half the mass and 1.2 times the diameter of Jupiter, passed in front of its parent star. It confirmed previous evidence of water in the atmosphere of a planet 1,150 light years away and provided evidence of haze and clouds that had not previously been detected.

The JWST is also capable of imaging objects in our own Solar System. Part of its commissioning included imaging Jupiter in an attempt to image objects moving rapidly through the telescope's field of view. The Fine Guidance Sensor (FGS) proved fully capable of ensuring that such objects can be tracked and imaged successfully, and as a bonus the NIRCam was shown to be capable of simultaneously imaging both the bright planet and its fainter rings and moons.

Overall, these initial images demonstrate that the JWST is capable of achieving the scientific goals for which it was built: peering farther back into cosmic history and viewing complex astronomical phenomena with more clarity than ever before. Moreover, the final results from the commissioning indicate that the telescope well exceeds its pre-launch specifications in virtually every area of operation. To quote the JWST Science Performance from Commissioning document, "almost across the board, the science performance of JWST is better than expected."

Among the most significant improvements is the telescope's life expectancy. In order to maintain its orbit, which is at Lagrange Point 2 (1.5 million kilometers from Earth), it must use a finite supply of propellant to maintain its station. Initial estimates predicted that the JWST would have enough fuel to last 10.5 years. Final calculations indicate that the launch and insertion into its orbit were so smooth that the spacecraft will be able to carry out observations for at least 20 years.

Of course, the release of the images and the beginning of the telescope's science operations were marred by the intervention of the Biden administration, which released the deep field image of SMACS 0723 a day early. Vice President Kamala Harris, once a career state prosecutor, declared that the JWST will be "for the benefit of humankind." Biden himself, heading a war drive against Russia that threatens to engulf the planet in nuclear annihilation, provided a nationalist overtone, stating the telescope is "for America and all humanity."

But the hypocrisy of Biden and Harris do not diminish the immense scientific and cultural achievement of the James Webb Space Telescope. It is ultimately a demonstration of social progress, of what can be done when humanity's collective energy is put toward social need, in this case a deeper understanding of nature and how humans interact with it. That same understanding is increasingly being applied by the world's population to *social* questions, inevitably leading them to realize the necessity of sweeping away Biden and the capitalist socioeconomic system he and his ilk internationally defend and construct a new and higher social order.