Main instrument for NASA's WFIRST mission completes milestone review

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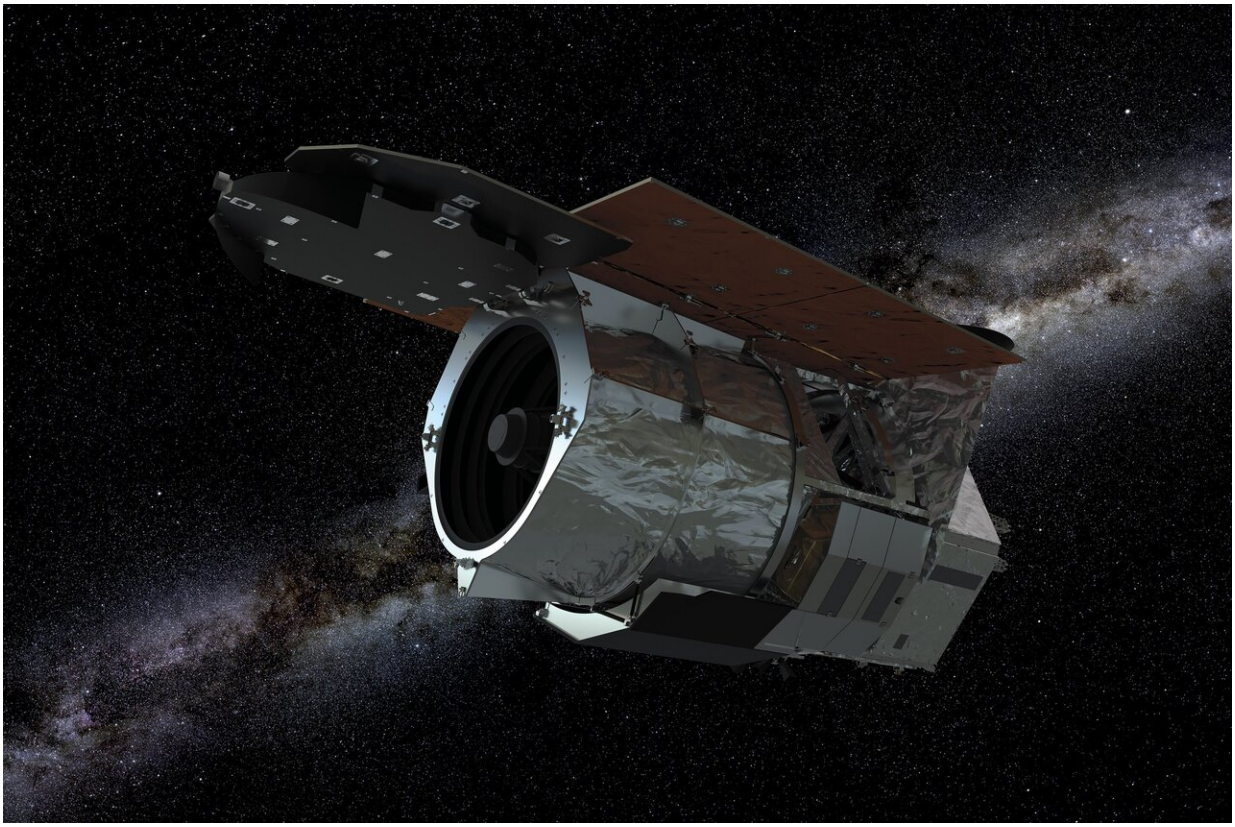

High-resolution still image render of the WFIRST spacecraft against a starry background. Credit: NASA’s Goddard Space Flight Center

In order to know how the universe will end, we must know what has happened to it so far. This is just one mystery NASA's forthcoming

Wide Field Infrared Survey Telescope (WFIRST) mission will tackle as it explores the distant cosmos. The spacecraft's giant camera, the Wide Field Instrument (WFI), will be fundamental to this exploration.

The WFI has just passed its preliminary design review, an important milestone for the mission. It means the WFI successfully met the design, schedule and budget requirements to advance to the next phase of development, where the team will begin detailed design and fabrication of the flight hardware.

"This was an outstanding preliminary design review, providing a snapshot of the tremendous amount of engineering this team has accomplished in a short period of time," said Jamie Dunn, WFIRST project manager at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "The WFI team is well on their way down the path of building a world-class instrument for NASA's next great observatory."

"The preliminary design review is a vital step in the mission because it takes the engineering ideas and assesses them against stringent criteria to make sure they will perform as planned," said Goddard's Mary Walker, instrument manager for the WFI. "This is where we find the things we need to tweak so WFIRST can advance to the next stage in its journey."

Engineers will feed the results of the review into the next design iteration, preparing the instrument for an even more rigorous test—the critical design review, currently planned for June 2020. This will involve data from WFI engineering test units in simulated space environments, including testing at cryogenic temperatures.

WFIRST is a next-generation space telescope that will survey the infrared universe from beyond the orbit of the Moon. Its two instruments are a technology demonstration called a coronagraph, and the WFI. The WFI features the same angular resolution as Hubble but with 100 times

the field of view. Data it gathers will enable scientists to discover new and uniquely detailed information about planetary systems around other stars. The WFI will also map how matter is structured and distributed throughout the cosmos, which should ultimately allow scientists to discover the fate of the universe.

The WFI is designed to detect faint infrared light from across the universe. Infrared light is observed at wavelengths longer than the human eye can detect. The expansion of the universe stretches light emitted by distant galaxies, causing visible or ultraviolet light to appear as infrared by the time it reaches us. Such distant galaxies are difficult to observe from the ground because Earth's atmosphere blocks some infrared wavelengths, and the upper atmosphere glows brightly enough to overwhelm light from these distant galaxies. By going into space and using a Hubble-size telescope, the WFI will be sensitive enough to detect infrared light from farther than any previous telescope. This will help scientists capture a new view of the universe that could help solve some of its biggest mysteries, one of which is how the universe became the way it is now.

The WFI will allow scientists to peer very far back in time. Seeing the universe in its early stages will help scientists unravel how it expanded throughout its history. This will illuminate how the cosmos developed to its present condition, enabling scientists to predict how it will continue to evolve.

"We're going to try to discover the fate of the universe," said Goddard's Jeff Kruk, the WFIRST project scientist. "The expansion of the universe is accelerating, and one of the things the Wide Field Instrument will help us figure out is if the acceleration is increasing or slowing down."

One possible explanation for this speed-up is dark energy, an unexplained phenomenon that currently makes up about 68 percent of

the total content of the cosmos and may be changing as the universe evolves. Another possibility is that this apparent cosmic acceleration points to the breakdown of Einstein's general theory of relativity across large swaths of the universe.

The WFI will test these ideas by measuring matter in hundreds of millions of distant galaxies through a phenomenon called weak gravitational lensing. Massive objects like galaxies and clusters of galaxies curve space-time, bending the path traveled by light that passes nearby. This creates a distorted, magnified view of far-off galaxies behind them. Viewing those distant galaxies will show how matter is structured throughout the universe and across time.

All of the astronomical surveys that WFIRST will conduct rely on the WFI. An extremely stable optical structure is necessary to make the high-precision measurements with both the WFI and the coronagraph. Further ensuring stability, WFIRST will orbit the second Sun-Earth Lagrange point, or L2. At this special location over 930,000 miles (1.5 million kilometers) from Earth, gravitational forces balance to keep objects in steady orbits with very little assistance. The thermal stability of an observatory at L2 will provide a ten-fold improvement beyond Hubble in much of the data the WFI will gather. This degree of stability is impractical with observatories in low-Earth orbit, such as Hubble.

With its large field of view, the WFI will provide a wealth of information in each image it takes. This will dramatically reduce the amount of time needed to gather data, allowing scientists to conduct research that would otherwise be impractical.

"You could do most of the WFIRST science with Hubble, but it might take a thousand years," said Kruk. "We don't want to wait that long."

With the successful completion of the WFI's preliminary design review,

the WFIRST mission is on target for its planned launch in the mid-2020s. Scientists will soon be able to explore some of the biggest mysteries in the cosmos thanks to the WFI's wide field of view and precision optics.

Provided by NASA's Goddard Space Flight Center