Telescope promises new look at universe - if NASA can get it into space

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When it works, and if it works, the James Webb Space Telescope could revolutionize astronomy by peering so deep into space that scientists soon could study the dawn of time.

But construction of NASA's next big telescope has been so hurt by delays and cost overruns that even its staunchest champion in Congress reached a breaking point.

In a letter dated June 29, U.S. Sen. Barbara Mikulski, D-Md., all but ordered NASA Administrator Charlie Bolden to assemble a panel of outside experts to ensure the Webb project doesn't break its latest promise: a 2014 launch on a $5 billion budget.

"We like the concept of the Webb, but I tell you, we're not in the overrun business," said Mikulski, who chairs the Senate subcommittee with oversight of NASA's budget.

NASA agreed to form the panel and placed veteran engineer John Casani in charge.

Even so, keeping the Webb on track won't be easy. Already, the telescope is at least $1.5 billion over budget and three years behind schedule, thanks to poor financial planning and knotty engineering problems, according to government watchdogs.

And further delays and cost overruns are possible. Just last year, Mikulski had to secure an additional $75 million to keep Webb workers on the job as part of the $862 billion stimulus plan passed by congressional Democrats.

The budget-busting hasn't happened in a vacuum either.

An upcoming report from the National Academies is expected to underscore concerns that American astronomy doesn't get the funding it needs - a situation exacerbated by the Webb telescope.

"When Webb bleeds, the rest of space science hemorrhages," said Michael Turner, one of the report's authors and a professor of astronomy and astrophysics at the University of Chicago.

Smaller robotic missions have suffered because of cost overruns with Webb, Turner said. But the project has been kept alive by expectations about what it can do and the need to replace the popular Hubble Space Telescope, which could end operations as early as 2014.

"It's been a long wait, and it's been very expensive. But when it is launched and operating, people are going to forget the wait and how much it cost, and they are going to go gaga about the discoveries," he said.

It can take billions of years for the light of distant stars to reach Earth. As designed, the Webb can see so far into space that it essentially can look back in time.

This quirk in physics will enable Webb scientists to learn more about the events that immediately followed the big bang, a cosmic explosion that scientists think created the universe more than 13 billion years ago.

"We are aiming to see the realm between 250 million years after the big bang to about 400 million years afterward," said Jonathan Gardner, a top Webb scientist. Hubble can only see within 800 million years of the big bang.

"The James Webb is designed to find the first galaxies that formed in the early universe," Gardner said.

Specifically, the Webb and its 21-foot infrared mirror will test the theory that the first galaxies were disorganized and composed of "very large, very bright and short-lived stars," he said.

Instruments onboard the Webb also will help scientists learn more about the chemical makeup of early stars and how elements formed and later dispersed throughout the universe.

"This is all about 'where did we come from? What is our place in the universe?' " Gardner said. "Sometimes science and religion are addressing the same question in different ways."

But before that happens, NASA and its international partners need to make sure it works.

Unlike Hubble, which orbits 350 miles above Earth, NASA plans to station the Webb telescope about 1 million miles away in what's known as a Lagrange point - a cosmic neutral ground where the tug of the Earth and sun even out so that objects in such a spot stay almost stationary.

That way, scientists can focus the Webb's mirror in one direction - deep space - while employing a shield that can block sunlight and keep its temperature-sensitive instruments from getting too warm.

Getting those pieces to work has been difficult, however, and a 2006

report by the Government Accountability Office identified several potential problems. The telescope must be compressed to fit aboard the European Ariane 5 rocket that will launch it, so a key concern was whether the Webb can safely unfold its origamilike mirror and shield once it reaches space.

"If program officials follow the current plan, the maturity of key technologies may not be adequately tested prior to program start," the report noted. "In addition, it appears the program will not have sufficient funding resources to ensure the program's success."

Since then, NASA officials said they have addressed - if not necessarily solved - these problems.

Geoff Yoder, NASA's deputy astrophysics director, said the Webb underwent a major design review this spring and that the appraisal found no "showstoppers" that could kill the project, including difficulties with the shield and mirror.

"That doesn't mean everything is completely done," he said. But he said it's a necessary step to ensure that the Webb works once it gets into space because its distance from Earth means there's no way astronauts could fix it.

"This is something that is a complex, integrated system," he said. "I think the team, technically, is doing a hell of a job."

He deflected most questions about cost and schedule until after the independent team led by Casani finishes its review, probably sometime this fall.

In the meantime, University of Chicago's Turner said the rest of the astronomy community will be rooting for the Webb to succeed - not just

because of what it could do, but also so it no longer acts as a millstone on other projects.

"If we had to do it over again, would we do it differently? Of course," he said, referring to NASA's decision to rely too heavily on experimental technologies when designing the Webb. "But we're not building Model T's here."