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All I Want for Christmas...

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Abstract

"JWST [the James Webb Space Telescope] will let us see clearer and further into the ancient and beautiful story of creation."

Posting about new developments in spacecraft from *In All Things* - an online journal for critical reflection on faith, culture, art, and every ordinary-yet-graced square inch of God's creation.

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On December 11, the *James Webb Space Telescope (JWST)* was finally placed atop the Ariane 5 rocket that will lift it from French Guiana and into orbit "no earlier than Dec 24," according to NASA's latest update (at the time of this writing). The rocket is now fueled for flight and all that remains (along with numerous final checklists) is for the telescope to be wrapped in its specially-designed fairing before launch. For astronomers, this would make for a Christmas gift that has long occupied the wish list, representing more than 30 years of development and $10 billion in costs. [1] I've followed along as a planetary scientist studying exoplanet atmospheres, eagerly anticipating what new things *JWST* can tell us about the chemistry, clouds, and weather on planets orbiting other stars.

The *Webb* telescope represents the successor to the extraordinary *Hubble Space Telescope (HST)*, launched into orbit in 1990. Sporting a 2.4-meter (7 ft. 10 in.) diameter mirror and orbiting above the obscuring clouds and air of the Earth's atmosphere, *Hubble* has had an enormous impact on astronomy, including providing unprecedented views of distant galaxies and new clues about the early history of the cosmos.

For comparison, the 18 hexagon-shaped and gold-layered mirror segments of *JWST* add up to a diameter of 6.5 meters (21 ft. 4 in.). [2] Moreover, a key design feature of *JWST* is its ability to see infrared wavelengths well beyond that of visible light (and beyond what *Hubble* can see). [3] Astronomers are expecting these increased capabilities to be nothing short of revolutionary— not only for our understanding of planetary systems around other stars, but especially to peer even deeper into our universe's past.

Indeed, because light travels at a finite velocity, we are looking into the past every time we observe something—that sunlight you feel on your skin, for example, left our star about eight minutes earlier. [4] The *Webb*—like all telescopes—thus serves as a sort of time machine: the further it can see into deep space, the further *back* it can look into deep time. And its particular design makes *JWST* one of the most powerful time machines ever constructed, sensitive to the light from distant galaxies that has been stretched to redder wavelengths from the ongoing expansion of spacetime. This means that *JWST* will be able to see *some of the first stars and galaxies* that formed following the birth of the universe.

As excitement (and anxiety) builds around the launch of *JWST* and the anticipated advent of a new era of cosmological exploration, we're reminded again of the *revelatory* nature of creation: the way in which it serves as its own witness to its history, laid "before our eyes like a beautiful book." [5] In this way, *JWST* will let us see clearer and further into the ancient and beautiful story of creation.

In these encounters, we also begin to realize not only the sheer scale, majesty, and beauty of the creation, but the power of the One who spoke it into existence. We're reminded of the fact that as we build ever-more powerful tools for exploring creation—revealing what that no human eyes have yet seen—that *we can never see something God has not made*.

In the meantime, we can hope for a successful launch and look forward to whatever amazing new stories creation will tell us about its own beginnings.

So, this year, all I want for Christmas is a time machine.

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1. Initially projected to launch in 2007, predictions for the JWST launch date have become something of an inside joke among astronomers.

2. Given its large size and cooling requirements, *JWST* has to be origami-like folded to fit within the rocket fairing. Fully deployed, the *JWST* sunshield would cover an area roughly the size of a tennis court.

3. *JWST* is sensitive to wavelengths up to 28 microns; *HST* is sensitive to wavelengths of up to about 2 microns; The *Spitzer Space Telescope*, launched in 2003, can observe a broader range of infrared wavelengths than *JWST*, but with less sensitivity.

4. For example, see "Kinds of Science and Exploring the Past"

5. *Belgic Confession*, Article 2; Ps 19:1-2, 97:6, 104; Rom 1:19-20, Heb 11:3, Acts 14:15-17, Job 38ff