

What in the Universe Lies Beyond Hubble?

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The aftermath of the Columbia tragedy and budgetary pressures are forcing NASA to reconsider its plans for the end of the mission of the Hubble Space Telescope around 2010 and Hubble's relationship to its successor, the James Webb Space Telescope (JWST). Part of the debate concerns the role of astronauts in advancing NASA's goals beyond the International Space Station. The sense of that discussion awaits the report of the Columbia Accident Investigation Board expected later this month. Another part of the discussion relates to the role of Hubble as part of an integrated program of astronomical research. It is to this aspect of the debate that I offer these remarks.

Hubble has been a spectacular success for astronomy, for NASA and human spaceflight, and for the nation through an inspiring program of education and public outreach. Fifty years from now, when today's schoolchildren are asked what the Space Shuttle accomplished, repairing and servicing Hubble will stand as an enduring answer. Hubble has observed objects everywhere in the cosmos, from within the solar system and the Milky Way out to the most distant quasars, and advanced almost every field of astronomy, from the formation of stars and planets to the evolution of the Universe itself.

Hubble achieved its breakthroughs by making ten- to hundred-fold improvements in key observational parameters --- angular resolution, sensitivity, and wavelength coverage --- compared to earlier observatories on the ground or in space. After Hubble was launched and subsequently repaired by astronauts whose courage and skill we recognize now even more acutely, it represented another giant leap in the growth of observational capability that has been the driving force in a 500-year long revolution in astronomy. Just as Hubble represented a major advance over the Palomar 200 inch telescope so, too, was Palomar an advance over the Mt. Wilson 100 inch telescope and so on back in time to Galileo's first telescope. But we must see Hubble as a point along this continuum of expanding capabilities. *Astronomy makes its greatest gains as new technologies open our eyes to new phenomena.* In the coming decade we are technologically ready to improve our sensitivity to faint objects by factors of thousands with the Space Infrared Telescope Facility (launching later this summer) and JWST (launching early in the next decade), to use interferometry to find planets around nearby stars, and to open a completely new window on the Universe using gravitational waves.

It is within this context that we should assess the continuing role of Hubble. Exploiting a new capability implies taking enough data to fill in the details of these new phenomena. Thus, NASA should not shortchange the investment inherent in Hubble's existing or planned instruments by curtailing Hubble's mission before its time. While ground-based telescopes equipped to correct atmospheric distortion are catching up with or surpassing some of Hubble's capabilities, the two new Hubble instruments awaiting installation in the telescope will make major advances in wide-field imaging and ultraviolet astronomy not possible from the ground.

However, with the Space Interferometer Mission, JWST, the Terrestrial Planet Finder, and the Laser Interferometer Space Array for gravitational wave astrophysics, NASA is shifting its budgetary focus to new observatories which will enable discoveries we cannot today imagine. These new facilities represent the priorities of the astronomical community as expressed through numerous studies by the National Academy of Science. And, it is important to note, the benefits and often the costs of these telescopes are shared with international partners who confirm our priorities and show that our curiosity about the cosmos is a very basic human impulse.

We should call on the bravery of NASA's astronauts for one last flight to Hubble to add its final suite of instruments, to service its aging systems, and to prepare Hubble for its eventual safe de-orbit into the Pacific Ocean sometime after 2010. But we should not let our attachment to a cherished telescope hold back a new and more capable generation of observatories that will produce the breakthroughs of the future.

The opinions expressed here are those of the author and do not represent those of either the Jet Propulsion Laboratory or NASA. These remarks were first made to a blue ribbon panel chartered by NASA to consider the transition from Hubble and its successor JWST.

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