

National Aeronautics and Space Administration



UNIVERSE | DISCOVER ITS SECRETS

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The universe is everything. It includes all of space, matter, energy, time, and you. NASA's Astrophysics Division is dedicated to exploring the universe, pushing the boundaries of what is known of the cosmos, and sharing its discoveries with the world. The Division continues expanding humanity's understanding of how the universe began and evolved, how it works, and whether there are places beyond Earth where life might thrive. By working together with collaborators and academic partners from all over the world, NASA researchers are making progress towards addressing these tantalizing scientific goals with leading-edge technologies and groundbreaking science.

HOW DID WE GET HERE?



There are many questions associated with the creation and evolution of the cosmos. How were the first stars and galaxies created? How did they influence subsequent galaxy, star, and planet formation? How did the creation of the universe lead to our existence?

With the current fleet of Astrophysics missions, researchers are able to study the first stars and galaxies forming out of the darkness of the early universe with state-of-the-art technologies that act as powerful time machines, peering back over 13.5 billion years.

These space missions are aimed at expanding our knowledge of the universe and how we came to be by using a variety of observational and theoretical techniques. From strategic missions (James Webb Space Telescope, Hubble Space Telescope, Chandra X-ray Observatory, and the future SPHEREx and Nancy Grace Roman Space Telescope) to innovative Explorer-class missions (Neil Gehrels Swift Observatory, NuSTAR, TESS, IXPE, and NICER) to smaller missions flown on CubeSats, balloons, and sounding rockets, the Astrophysics Division enables scientists to collect data that will unfold a wide variety of mysteries of the universe. Learn more: <https://universe.nasa.gov>

HOW DOES THE UNIVERSE WORK?



There are many mysteries of the universe we have yet to understand. Since the early 20th century, scientists have known that the universe is expanding. In the 1990s, researchers discovered that, surprisingly, the expansion is accelerating. This was an astonishing discovery for the

astrophysics community since the universe should be slowing down due to the gravitational attraction between galaxies, but it is doing the opposite. We use the name "dark energy" to refer to the mysterious influence that is responsible for the accelerating expansion of the universe.

Additionally, many galaxies appear to lack sufficient mass to be held together by gravity and should have been torn apart long ago. So, what is causing these unknown phenomena? Dark matter, which makes up 85% of total matter in the universe, is a hypothetical type of matter that responsible for the way galaxies are organized.

The upcoming Nancy Grace Roman Space Telescope, set to launch no later than May 2027, is an observatory designed to unravel the secrets of dark energy and dark matter, as well as search for and image exoplanets, and explore many other topics in astrophysics. Additionally, NASA Astrophysics contributes to ESA's Euclid mission investigating mysteries of the dark universe. Learn more about Roman: <https://roman.gsfc.nasa.gov>

ARE WE ALONE?



Since the dawn of human civilization, humankind has looked to the stars and wondered if life, whether it be similar to our own or not, exists beyond our planet. Until 1992, when the first exoplanets were confirmed, it was uncertain whether there were even any planets outside of our own solar system. Today, thanks to the detailed data from the Astrophysics missions fleet, we now know of over 5,500 planets around other stars and thousands of other planet candidates. Of those confirmed exoplanets, roughly 50 small (roughly Earth-sized planets) orbit within their star's habitable zone, where liquid water, which is essential for life as we know it, could potentially pool under the right conditions.

To take the search for life beyond our solar system a big step forward, NASA is discussing a future mission concept with the capabilities to identify and image Earth-like planets and characterize them for evidence of life. The search for life has long been one of NASA's key priorities, from some of the first exoplanet observations with Hubble, to the Kepler and TESS missions, to a closer study of exoplanet atmospheres with Webb. A mission concept, the Habitable Worlds Observatory, will be designed specifically to look at habitable planets and their atmospheres to help answer the question, "is there life beyond Earth?" Learn more about the Habitable Worlds Observatory: <https://go.nasa.gov/3tEWQcp>