

Review of *The Transiting Exoplanet Survey Satellite (TESS)*

The Transiting Exoplanet Survey Satellite (TESS) is a mindboggling space mission by NASA designed to detect exoplanets, especially those orbiting bright, nearby stars. These stars are essential for detailed follow up observations like measuring the planet's mass, orbit, and atmospheric composition. TESS works by observing the dimming of a star's light as a planet passes in front of it a process known as a "transit." This method is one of the most effective ways to discover and study exoplanets.

Key Features and Functionality

TESS is equipped with four wide-field optical cameras that observe large portions of the sky. It operates in a highly elliptical orbit around Earth, allowing it to scan most of the sky over a few years. It divides the sky into 13 sectors per hemisphere and observes each for around 27 days. This allows TESS to detect planets, particularly those with short orbital periods (like "hot Jupiters"), and identify stars that are most likely to host planets.

TESS can detect planets as small as those similar to Earth and as large as the gas giants, with the main goal being to find planets that are ideal for further study. In its first six years, TESS discovered about 7,000 planet candidates, with several hundred confirmed as real exoplanets.

Contributions to Exoplanet Science

TESS's discoveries have led to a better understanding of different types of planets, including:

- Smaller versions of Neptune, often with thick gaseous atmospheres.
- Planets larger than Earth but smaller than Neptune, which may have rocky surfaces.
- Extremely low-density planets, like HIP 67522 b, which have been classified as "super-puff" planets due to their large, puffed-up atmospheres.

One of TESS's key contributions is its role in identifying planets that can later be studied with other powerful telescopes, such as the James Webb Space Telescope (JWST). JWST has studied several planets discovered by TESS, including TOI-270 d, which has an atmosphere rich in methane, carbon dioxide, and water.

Data Collection and Analysis

TESS collects data by taking images of stars every two seconds. It then processes this data into two main types:

1. Long exposure images of large regions of the sky.

2. High-frequency, detailed images of pre-selected stars to study their light curves more precisely.

Astronomers can use this data to detect transiting planets by identifying periodic dips in star brightness. This method has led to the discovery of many candidate planets, known as TESS Objects of Interest (TOIs).

The Role of Follow Up Observations

Once a potential planet is identified, follow-up observations are crucial to confirm its existence. TESS has a Follow-up Observing Program (TFOP), involving hundreds of astronomers who use ground-based telescopes to measure the planet's mass, size, and other properties. This confirmation process ensures that the planets discovered by TESS are real and not just false positives caused by other phenomena.

TESS's Impact on Other Areas of Astronomy

While TESS is primarily focused on exoplanets, it has also contributed to other areas of astronomy, including:

- TESS has studied the light variations in stars, helping to understand stellar behaviors, such as oscillations in red giants and flares from young stars.
- TESS data has been used to study the variability of distant galaxies and supernovae.
- TESS has monitored asteroids and comets, providing data on their characteristics.

Conclusion

TESS has revolutionized the search for exoplanets by focusing on bright stars, making it easier to confirm planets and study their atmospheres. Its contribution to exoplanet science is immense, having discovered thousands of potential planets, many of which are prime targets for further study. By providing high-quality data for planets around nearby stars, TESS has made a significant impact on our understanding of exoplanets and their environments, laying the foundation for future discoveries with telescopes like JWST.