### **The Transiting Exoplanet Survey Satellite (TESS)**

TESS is a space telescope dedicated to finding exoplanets, with a specific focus on those orbiting bright host stars. The mission's primary goal is to find planets that are favorable for detailed follow-up observations, such as measuring their mass, orbital parameters, and atmospheric composition. This focus on bright stars distinguishes it from earlier missions like Kepler, which primarily targeted fainter, more distant stars for a statistical census of planets.

### **TESS's Design and Operation**

TESS is equipped with four wide-field optical cameras with a specific far-red bandpass (600-1050 nm), chosen for its effectiveness in observing small, red, low-luminosity stars. The cameras have a combined field of view of 24∘×96∘, allowing them to survey a large portion of the sky.

It operates in a highly elliptical, 13.7-day orbit around the Earth. This high-altitude orbit provides a stable environment for precise, nearly continuous observations, free from the atmospheric interference that affects ground-based telescopes. The orbit is also designed to stay away from the Earth and Moon, minimizing stray light and gravitational perturbations.

TESS surveys the sky by dividing each ecliptic hemisphere into 13 overlapping sectors. It observes each sector for approximately 27 days, a duration that is ideal for detecting short-period planets. This strategy allows TESS to survey nearly the entire sky over several years, with regions near the ecliptic poles being observed for much longer durations.

TESS generates two main data products:

* 1. Full-Frame Images (FFIs): These are images with longer exposure times, created by summing groups of consecutive images.
  2. Target Pixel Files (TPFs): For pre-selected stars, TESS retains miniature images with much faster time sampling, allowing for more detailed analysis of their light curves.

### **Key Discoveries and Contributions**

TESS has made significant contributions to exoplanet science, largely because of its focus on bright, nearby stars. This has enabled extensive follow-up observations with other instruments, including the James Webb Space Telescope (JWST).

* Planet Types: TESS has discovered planets orbiting a wide variety of stars, including young, low-mass, and binary stars, and even a white dwarf. Its findings have helped astronomers differentiate between rocky super-Earths and gas-rich mini-Neptunes.
* JWST Targets: A major role of TESS is to find the best targets for JWST to perform atmospheric spectroscopy. TESS has discovered about 75% of the small planets that JWST has observed or is scheduled to observe. Some notable examples include:

HIP 67522 b: A young, Jupiter-sized planet with an extremely low density, classifying it as a "super-puff" planet.

TOI-270 d: A planet with a volatile-rich atmosphere containing methane, carbon dioxide, and water.

GJ 367 b: An extremely dense, airless "lava world" with a radius of 0.70R⊕​.

* Young Planets: TESS's ability to provide precise light curves has been crucial for detecting and studying planets around young, variable stars. These discoveries provide important insights into the early stages of planetary system formation and evolution. Some examples include:

AU Microscopii: The brightest pre-main-sequence star with known transiting planets.

DS Tucanae: A young, solar-mass star with a transiting planet, which has been used to study stellar flares and the star's obliquity.