

Press release



National Institutes of Natural Sciences

Astrobiology Center

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Combination of Space-based and Ground-based Telescopes Reveals more than 100 Exoplanets

Main Topics:

- 60 new planets are discovered. Combined with our previous report, a total of 104 new planets is discovered, which is a record in exoplanet finding in Japan.
- New planets include two dozen planets in multi-planet systems, as well as several ultra-short period (<24 hours) planets.
- 18 of the 60 planets are less than 2 times larger than the Earth.

An international team, including researchers at the University of Tokyo and the Astrobiology Center of the National Institutes of Natural Sciences, announced the discovery of 60 planets using data from the NASA K2 mission and the ESA Gaia mission. Combined with their previous planet haul, announced in August of this year, they have discovered a total of 104 planets, which is a record for Japan. Among the new findings are two dozen planets in multi-planet systems, 18 planets less than 2 times the size of Earth, and several ultra-short-period (USP) planets, which orbit their host stars in less than 24 hours. The team conducted a detailed analysis of 155 planet candidates found in data from the second year of K2 mission operations, leading to a uniform set of candidate dispositions and system parameters. Because of the brightness of their host stars, many of these planets present favorable opportunities for detailed characterization studies to probe their compositions and atmospheres. This new work combines the power of precise time series photometry from K2 with precise astrometry from Gaia, which is the measurement of the positions of stars in the sky. This combination of data powerfully constrains the properties of the host stars and their planets, and only became possible this year with the second release of data from the Gaia mission.

The announcement of this new batch of planets comes on the heels of another study by the same lead author John Livingston, a graduate student at the University of Tokyo. The previous study included 44 planets found by K2, which made it the largest planet haul found by researchers in Japan at the time. “We broke our old record with this new paper,” said Livingston, “so that makes a total of 104 planets from these two studies.” The original Kepler mission came to an end in 2013, when a second of its reaction wheels suffered a mechanical failure. This led to the beginning of an extended mission, known as K2, in which the same space telescope could continue to find planets by executing a different observing strategy. The K2 mission recently came to an end after running out of fuel, but not before discovering over 360 planets. “By extrapolating our analysis of these 155 candidates, we estimate that hundreds of planets remain unconfirmed in the K2 data,” said Livingston. Most of these, however, will require further observations to ascertain their true nature.

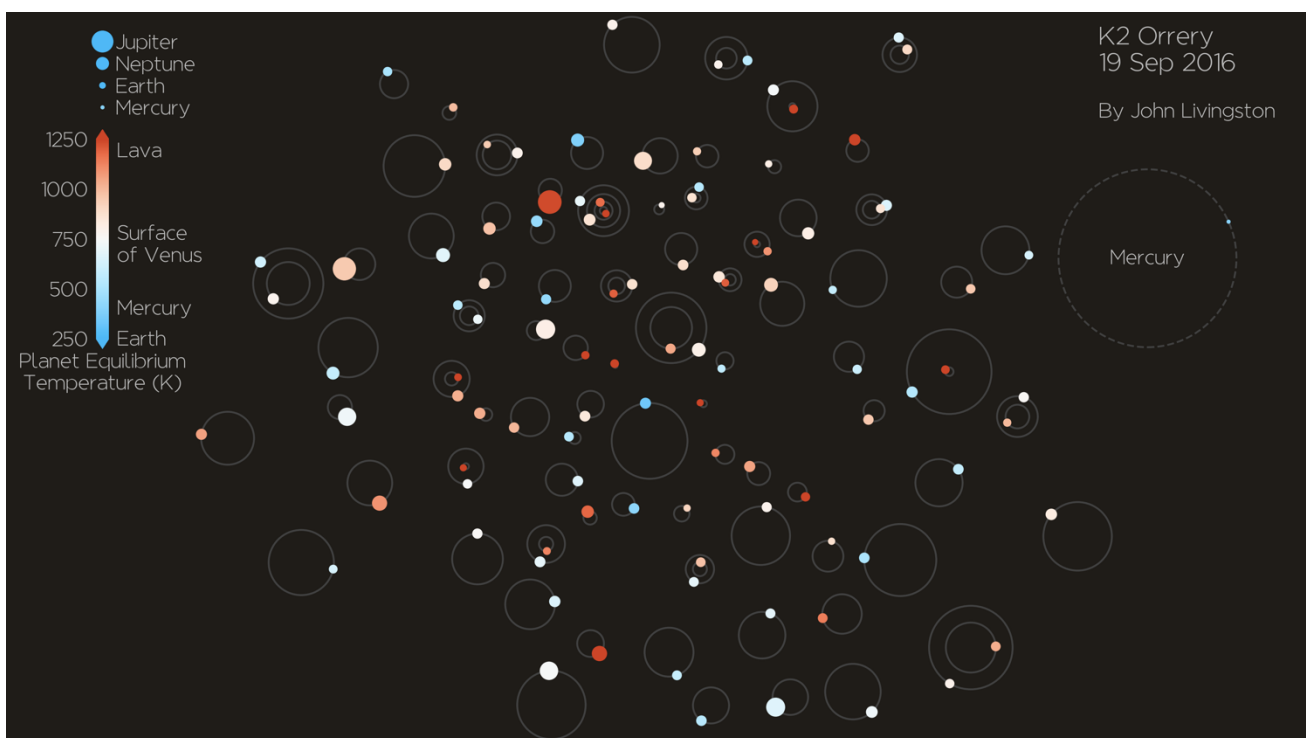


Figure1: Relative sizes, temperatures, and orbits of the exoplanets. Credit: John H. Livingston

The newly announced planet haul contains two dozen planets in multi-planet systems, as well as several USP planets, which are very close to their host stars; a year on one of these planets is less than a day here on Earth. USPs have attracted attention because their formation is currently a mystery, as theory predicts planets should form farther away from their host stars. One of these systems, known as K2-187, contains a total of

four planets, one of which is actually a USP. “This system joins a growing list of USPs in multi-planet systems, which may provide important clues about USP formation pathways,” said Livingston. Those interested in the quest for small planets will not be disappointed: “18 of the 60 planets are less than 2 times larger than the Earth, and are likely to have rocky compositions with little to no atmosphere,” said Livingston.

The team also found that 18 of the 155 planet candidates are actually false positives, in which eclipsing binary stars produce signals similar to those produced by transiting planets. In addition to data from K2 and Gaia, the team characterized the host stars by gathering high resolution adaptive optics and speckle-interferometric images, as well as high resolution spectra. Adaptive optics is a technique to correct distortions caused by the atmosphere by using a deformable mirror that rapidly adjusts its shape to produce a very sharp image. Speckle interferometry is a technique to overcome the same distortions, but without the use of a deformable mirror; instead, a sequence of very short-exposure images is captured, effectively freezing the pattern of atmospheric distortion, and then sophisticated image processing algorithms transform the sequence of images into a single image with a resolution about as high as would be seen without the atmosphere. “With our high resolution imaging we can look for other stars extremely close to the host stars, and with our spectra we can even look behind them,” said Livingston. Such observational methods play an important role in the validation of new planets, and ongoing efforts will lead to the announcement of more planets in the future.

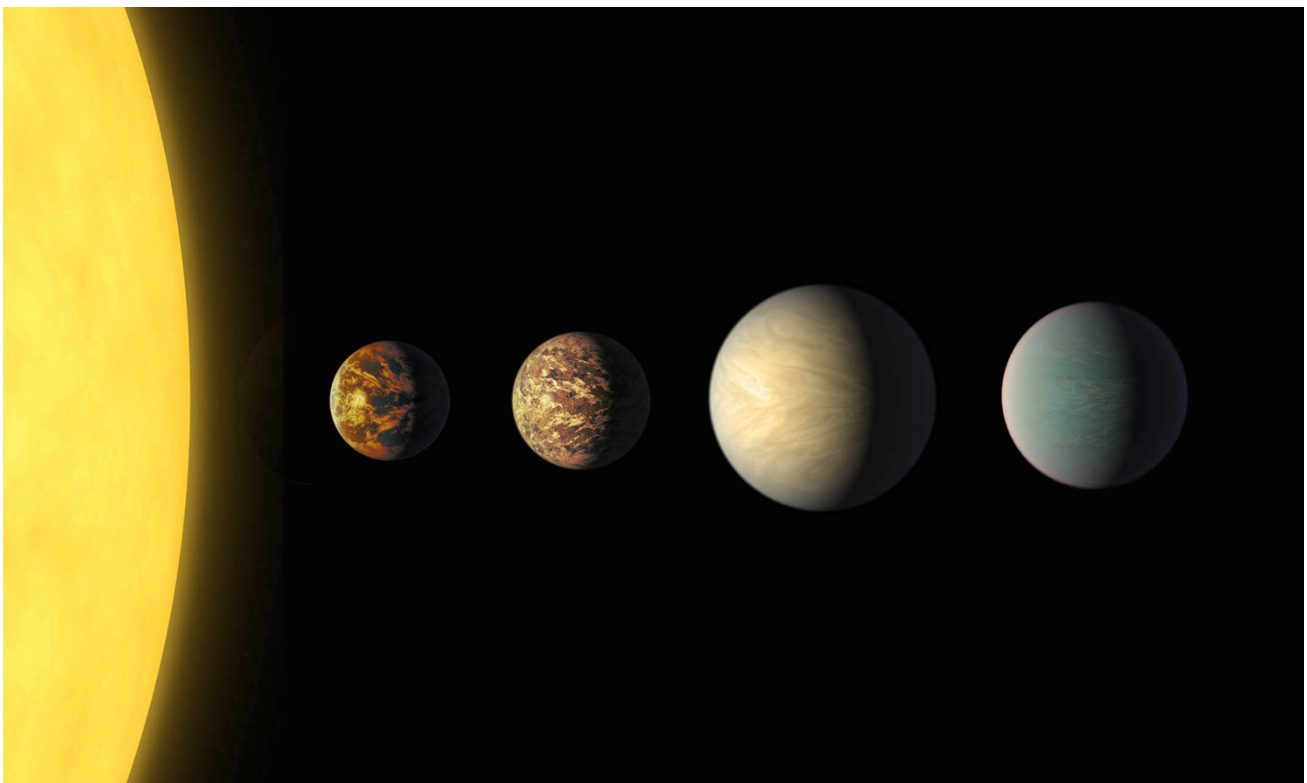


Figure2 : Artist's impression of the planets orbiting K2-187. The relative sizes of the planets and star are roughly correct (but their positions are not): the star is $0.9 R_{\text{sun}}$, innermost planet (USP) is $1.3 R_{\text{Earth}}$, the next one is $1.8 R_{\text{Earth}}$, then $3.2 R_{\text{Earth}}$, and $2.4 R_{\text{Earth}}$. (NASA/JPL-Caltech/R. Hurt, T. Pyle (IPAC), UTokyo/J. Livingston)

Although NASA has now officially retired the Kepler spacecraft, bringing the K2 mission to an end, the baton has been passed to a new NASA mission called TESS, which has already yielded its first planet discoveries. "The future looks bright for transiting planets," said Livingston, "with TESS already here and JWST around the corner, we can look forward to many new exciting discoveries in the coming years."

The new study was published in The Astronomical Journal on November 26, 2018.