# Exoplanets

## IU Eclipse Workshop 2024

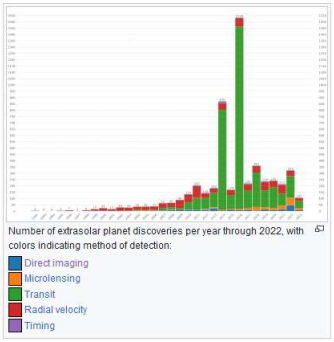
## Introduction

Are we on Earth, alone in the universe? Is our solar system unique? Recent observations of planets, external to our solar system, indicate “no we are not alone”. There are currently more than 5,000 confirmed exoplanets. The question of uniqueness is a current area of intense interest in astronomy.

## Methods

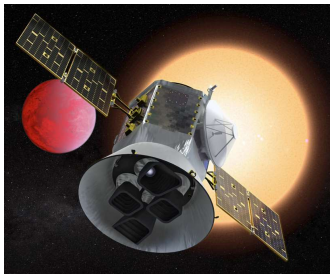
How do we see other planets? Very few planets have been observed with direct observation.

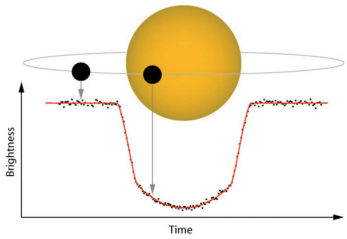
Most planets have been observed via the methods of transit or radial velocity.




## Transit Method

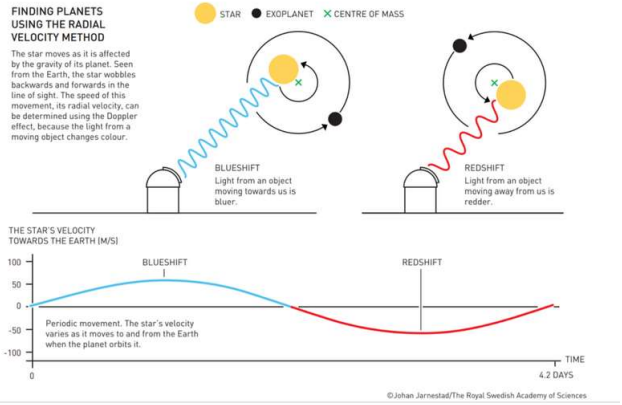
Many space missions have been specifically designed to detect planets using the transit method. One such mission is the Transiting Exoplanet Survey Satellite (TESS).






When a planet passes in front of its host star, from a certain view point, it causes the light of that star to dim. This is known as a transit.

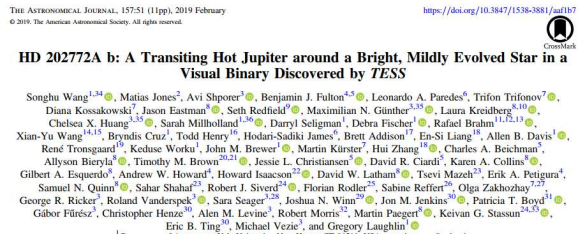
## Radial Velocity Method




The radial velocity method for finding exoplanets. Image credit: Johan Jarnestad/The Royal Swedish Academy of Sciences

## Example Data

From Prof. Songhu Wang, IU Dept of Astronomy



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**HD 202772A b: A Transiting Hot Jupiter around a Bright, Mildly Evolved Star in a Visual Binary Discovered by *TESS***

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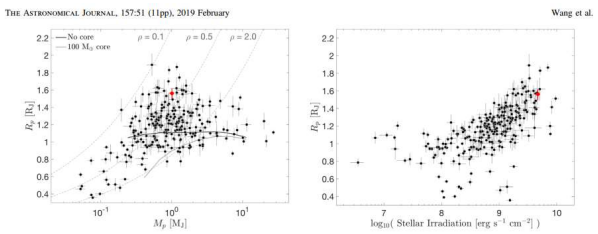
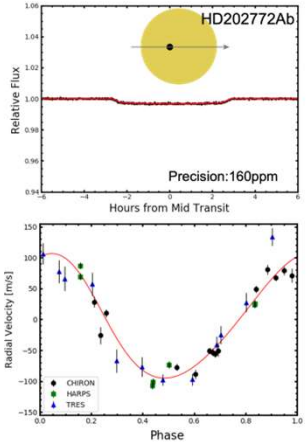


The Astronomical Journal, 157:51 (11pp), 2019 February Wang et al.

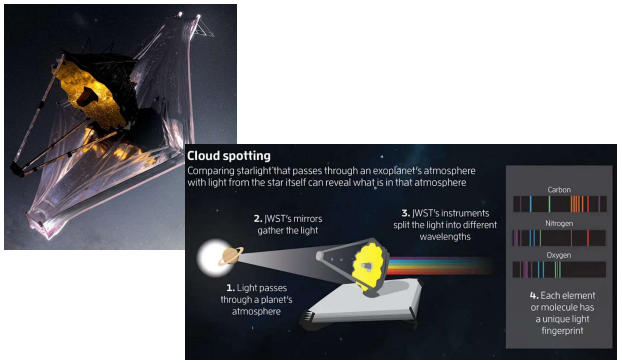
**Figure 7.** The position of HD 202772A b (red) in the space of mass, radius, and irradiation, compared to the population of known transiting gas giant planets (black). In the left panel, the solid lines mark theoretical models taken from Baraffe et al. (2014) for no core (black) and a 100 $M_{Earth}$ core (gray). The dashed lines are isodensity contours. Data were obtained from the NASA Exoplanet Archive (Akeson et al. 2013) on 2018 September 15.

## More Data

Transit data of a “hot Jupiter” observed by TESS via a transit signal and confirmed with radial velocity data. (10.3847/1538-3881/aaf1b7 )




## New Techniques: JWST




References:

1) Prof. Songhu Wang, IU Astronomy
2) Wikipedia
3) https://heasarc.gsfc.nasa.gov/docs/tess/HowToFindAnExoplanet-UserVersion.html
4) https://astrobites.org/2021/06/27/ur-use-of-machine-learning-techniques-to-analyze-radial-velocity-data-to-find-exoplanets/
5) Doi: 10.3847/1538-3881/aaf1b7