# Searching for Extra-Solar Planets via the Transit Method

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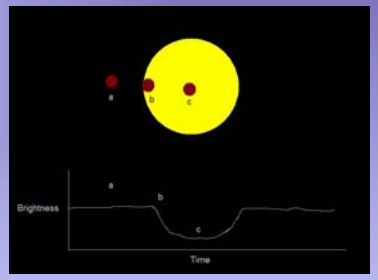
## A Brief History

- The first extra-solar planet was discovered in 1995 orbiting a main-sequence star, and was found using precise radial velocity measurements.
  - These measurements allowed astronomers to analyze the "wobble" of the star caused by the orbiting planet and to thereby determine various physical properties of the planet, such as its mass limit, orbital radius, and orbital period.
  - Since 1995, there have been 109 planets detected in 93 different star system, many of which were found using the radial velocity method.
  - Contrary to our own solar system, many of these newly discovered systems have massive planets with small orbital radii.
- The transit or photometric method detects extra-solar planets by looking for the dimming of the star due to the passage of a planet.
  - The first transiting extra-solar planet was observed in September of 1999 around the star HD 209458.

Image of HD 209458 taken with the URSA telescope.

## The Transit Method

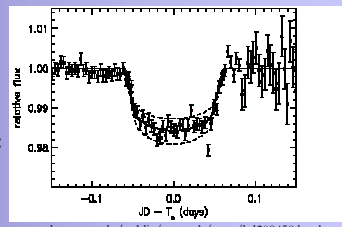
- Step One: Observe a star with a known planet during the predicted transit time of the planet.
- Step Two: Observe the same star when the planet is not in transit.
- Step Three: Compare the magnitudes from both observations.
  - If the magnitude during the transit time is significantly less (1-2%) than the magnitude of the star when no planet is predicted to be in transit, then odds are good that a transit has been detected.
  - If no change in magnitude is detected, then the transit did not occur.




Transit of a planet across its parent star and the corresponding light curve.

## The Transit of HD 209458

- The first transits of the planet orbiting near HD 209458 was observed on September 9 and September 16 of 1999.
  - These transits corresponded to the possible transit times predicted using data gathered with the radial velocity technique.
- The light-curve is shown in the figure to the right:
- The dip in magnitude is less than 2%. Shifts of around 0.001% are detectible.
- The transit data along with the mass from the radial velocity data allowed for the calculation of the planets radius, gravity, and density. Respectively, approximately 91000km, 1.2*10^27kg, and 0.38g/cm^3.




www.hao.ucar.edu/public/research/stare/hd209458.html

Light-curves from the variations in magnitude of HD 209458 due to the transiting of a planet on both September 9 and 16 of 1999.

## Searching for New Transits

- Several stars are be observed this summer for transits.
  - The best candidate is HD 130322, which is due to transit around June 27.
- The ideal scenario would involve observing a transit of one of the stars currently being monitored.
- Negative data is also useful because it could show that the planet does not transit, perhaps because it's orbital plane is at an angle which would not allow for a transit viewable from Earth.
- Images are obtained using a Mead LX200 10-inch f/6.3 telescope with an attached SBIG camera with UBVRI filters, and are processed using the SBIG software CCDOPS version 5 for Windows and are capable of detecting shifts in magnitude of 0.005%.

Image of HD 130322 taken with the URSA telescope.

## Acknowledgements

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