SEARCHING FOR EXTRA-SOLAR PLANETS VIA THE TRANSIT METHOD. C. L. Griffis and C. H. S. Lacy. Arkansas-Oklahoma Center for Space and Planetary Sciences and Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701.

Introduction: The first extra-solar planet was discovered in 1995 orbiting a main-sequence star using precise radial velocity measurements. The radial velocity data allowed astronomers to analyze the "wobble" caused by the orbiting planet and thereby determine various physical properties of the planet, such as its orbital radius, orbital period, and mass limit. Since 1995, there have been 117 planets discovered in 102 different star systems, many of which were found using the radial velocity method [1].

The Transit Method: Recently the transit, or photometric, method has been employed to study systems known to contain planets. The transit method allows astronomers to learn more about the planet, such as the radius, density, and gravity of the planet.

The first step in using this method is to observe a star with a known planet during the predicted time of transit and at times when the planet is known not to be in transit. Measurements of the variable star's and of a control star's apparent magnitudes are taken over the duration of the possible transit and over times when the planet is not supposed to be in transit.

Next the difference magnitude must be found. This is done by subtracting the apparent magnitude of the control star from that of the variable star. This is done to help correct for atmospheric interference.

Following this, the orbital phase for each observation must be found. The orbital phase is the fractional part of the equation $[(t-T_1)/p]$, where t is the date of the observation in the Heliocentric Julian Date (HJD), T_1 is the date of periastran in HJD, and p is the orbital period of the planet in days.

The final step is to generate a light-curve. A light-curve is constructed by plotting the difference magnitudes verse the orbital phases. If a transit was captured, there will be a dip in brightness shown on the light curve. If not, then the light curve should be a fairly straight line.

The Transit of HD 209456: The first extra-solar transit was observed in September 1999 around the star HD 209458, which was already known to have a planet through the radial velocity method. The light-curve is shown in figure 1. The transit data allowed astronomers to calculate the mass, radius, gravity, and density of the planet, respectively: 0.63 M_{Jup}, 1.27 R_{Jup}, 970 cm/s^2, and 0.38 g/cm^3 [2].

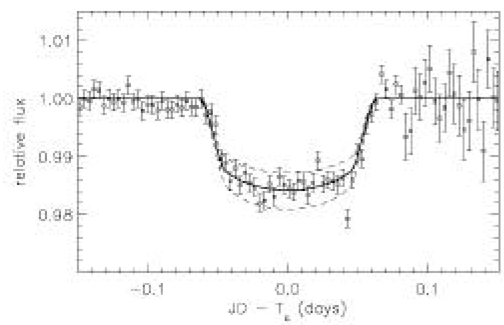

Fig. 1. Superposition of the light-curves from HD 209458 showing the transits captured on September 9 and September 16 of 1999 [2].

Current Target: HD 130322: The system HD 130322 was chosen for observation this summer because it presented the best chance for catching a transit visible in our observation area. The planet has a relatively short orbital period, 10.724 days, with about a 4% chance of a transit being observed.

Observations were made using a Mead LX200 10-inch f/6.3 telescope with an attached SBIG camera equipped with UBVRI filters. The images were processed using the SBIG software CCDOPS Version 5 for Windows. Observations were made on multiple nights, including the night of June 27 UT, one of the nights when a possible transit was observable in our area.

Results of Observations: The data gathered from HD 130322 proved to be rather interesting. The light-curve from the June 27 suggests the possibility that the beginnings of a transit were observed. Figure 2 shows this. The flux is relatively stable through the beginning of the observation, but drops off sharply near the end. If a complete transit had been captured, results similar to those observed with the transits of HD 209458 would be expected.

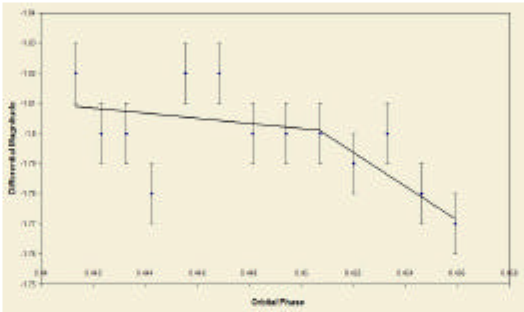

Fig. 2. Light-curve of HD 130322 on June 27 2003 showing possible ingress of transit.

Conversely, the light-curve from the data gathered on July 11 shows little variation in flux, as would be expected during a time when no planet was in transit around the star. See figure 3. Data gathered from other nights when the planet was not in transit show similar results.

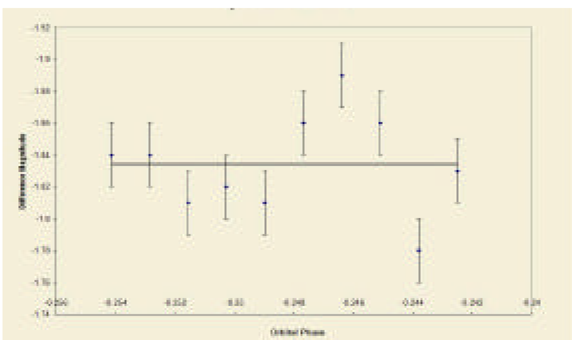

Fig. 3. Light-curve of HD 130322 on July 11 with no planet in transit.

Concluding Remarks: While these results are by no means conclusive proof of a transit, they are enough to cause HD 130322 to warrant further study. If by chance the beginning of a transit was captured on June 27, further observations during other predicted transit times could vary well capture a complete transit, making it only the second known extra-solar transiting planet.

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References: [1] Extrasolar Planets Encyclopedia, www.obspm.fr/planets, maintained by Jean Schneider, © 1996, Observatoire de Paris. [2] D. Charbonneau *et al.* (1999) *Detection of Planetary Transits Across a Sun-like Star*, 4, *Astrophysical Journal Letters.*