Tamap Journal of Physical Science
http://www.tamap.org/

TJOPS-1912-20
Volume 2019, Article ID 2
Review Article

Review of the Methods of Detecting Exoplanets in Binary Stars Systems

Amir Nezam AMIRI[1, 2, *], Mohammad Reza SHAFIZADEH[3], and Behrouz SHOKRI[4]

[1] *International Occultation Timing Association-Middle East Section, Tehran, Iran*
[2] *Physics Scientific Association, Payam Nour University, 19569, Tehran, Iran*
[3] *Physics Scientific Association, PPRC, Science and Research Branch, Islamic Azad University, Tehran, Iran*
[4] *Institute for Research in Fundamental Sciences (IPM), Tehran, Iran*

Received: 15.11.2019 • **Accepted**: 11.12.2019 • **Published Online:** 20.12.2019

Abstract: One of the latest achievements in the past years in Astrophysics is the detection of extra solar planets that have attracted many centers and is finding more interested astrophysicists nowadays. Various methods can detect exoplanets, but the exoplanets which are cantered around the eclipsing binary stars are very especially because according to our facilities These are easier to investigate, Therefore, in this review, we investigate methods to detect and investigate Exoplanets around binary systems.

Keywords: Detection Exoplanets, Binary Systems, Transit, Photometry

1. INTRODUCTION

There are several methods to detecting and studying extra solar planets, such as astrometry, transit, micro lensing, FMA methods and etc., But the data show that these methods are not suitable for the detection and study of extra solar binary system, photometers and transit are used to detect this type of extra solar, while The other methods Have some disadvantages, which make them weak for discovering and surveying the binary extra solar. For example, the Doppler methods are weak in discovering the extra solar because wavelength changes effect are very little such detectors are very costly nor, spectroscopy is weak because in addition to the spectral control spending far too much time trying to in this matter. The micro lensing method loses its efficiency because of the binary of star system. While the binary systems can interfere with the operation of this method, so it is not recommended, and the transit and photometry methods are suggested. According to our studies, photometers procedure, which requires a lot of timing, and is considered as a transit survey, is the most common and easiest method. Data also has shown that these two are the most helpful methods for detecting and observing for most of extrasolar planets in the binary system.

2. TRANSIT METHOD FOR DETECTING EXOPLANETS

When a planet passes in front of its parent star it blocks part of the star flux. To observe such a phenomenon from another star system at a great distance from the planet, the observer has to be within a very restricted region of space. Therefore, any planet around a star does not necessarily transit its host and we will only observe a small fraction of planets as transiting planets. The decrease in luminosity of the host star when the planet transits is also of the order of ~1% for a Jupiter-sized planet around a solar-type star which requires high photometric precision observations carried out during and after the transit event.

* Correspondence: info@iota-me.com

In the following analysis of the transit phenomena, we will assume that planetary orbits are circular and that the surface brightness, mass, and radius of the planet are small compared to that of the parent star. We will also assume that the orbital radius is much larger than the size of the parent star itself [1].

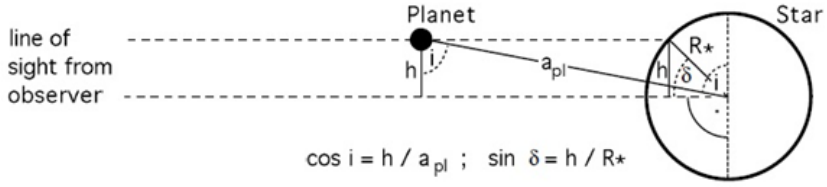

Figure-1. Geometry of planetary transit, showing the relation between latitude of the transit across the central star

Eclipsing binary stars provide us with a special opportunity to employ the transit method, as was first suggested by Schneider and Cheverton (1990). Here we consider the case, that a planet orbits both components of a close binary. By definition, the inclination of the plane of the binary components is close to 90 degrees and can be measured precisely from an analysis of the binaries, light curve. Furthermore, a planetary system is expected to have precessionally dampened. Into the plane of the binary components during its formation (Schneider, 1994a). For suitable eclipsing binary systems, the probability that planets will cause observable transits is close to 100% (Schneider and Doyle, 1995). A further advantage of the observation of binary stars is the unique, quasi-periodic transit signals they would produce. Since the star is double, there will normally be two transits, whose exact shape depends on the phase of the binary system at the time of the planetary transit. Such a signal is well suited to cross-correlation of model transit curves against the observed data, to allow the detection of sub-noise signals (Jenkins, Doyle and cullers, 1996) [2].

3. BINARY EXAMPLES FOR TRANSIT METHOD FOR DETECTING EXOPLANETS

You can see some samples of light curves obtained at the star lensa observatory using either 50cm Newtonian of 60cm Cassegrain telescopes in Fig2. They observe and investigated by Dwarf Project [3].

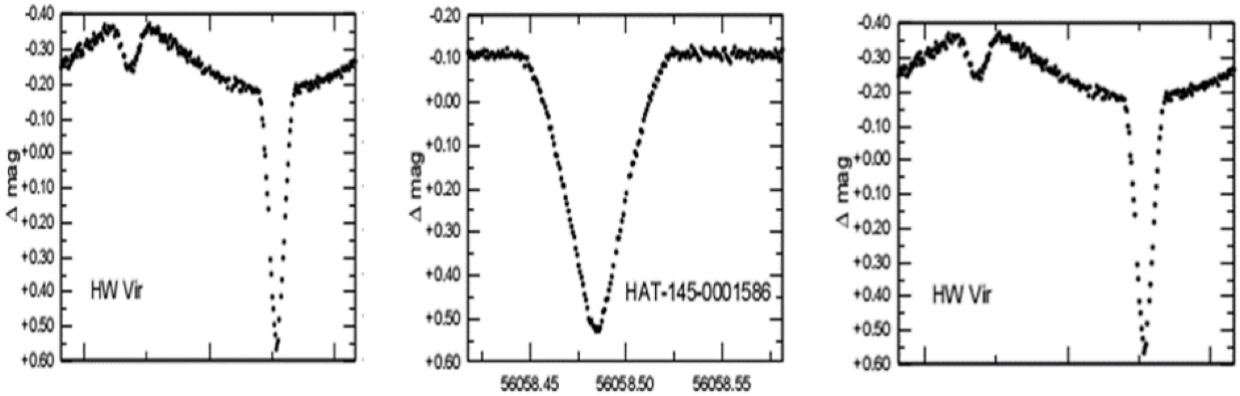

Figure-2. Some samples of LCs obtained at the star lensa observatory using either 50cm Newtonian of 60cm Cassegrain telescopes

3.1 Photometry Methods for Detecting Exoplanets

The discovery of Exoplanets implies that transits should commonly occur. The reduction in the light from the star is simply the cross-sectional area of the planet multiplied by the surface brightness of the disk of the binary stars. The characteristic photometric signature of a transit will include regular repetitions of a limb-darkened ingress and egress and a flat-bottomed dimming, easily discernible from other effects that are intrinsic to the star.

The photometric method should be pursued vigorously from the ground, as a small 1-m class telescope with a wide field CCD detector can accomplish the task.

If the star's photosphere were of uniform brightness, then the fractional decrease in apparent brightness of the star is the area ratio:

$$\pi r^2/\pi R^2, \tag{1}$$

© 2019 by Hasan Kalyoncu University, Gaziantep 27410 Turkey.
Reproduction is permitted for noncommercial purposes.

where πr^2 is the projected area of the planet with radius r, and πR^2 is that of its star with radius R. In fact, the photosphere of a star appears to dim slightly towards the edge (the limb). This limb darkening arises because the radiation we receive from the limb is predominantly from the uppermost regions of the photosphere, which are cooler than deeper down. This modifies the light curve, depending on which chord of the star's disc the planet traverses. With a sufficiently precise light curve a correction can be applied.

Also, dips in apparent brightness can arise from events other than a planetary transit, such as a grazing transit by a fainter companion star. This, and other types of extraneous events can be identified from the shape of the light curve [5].

Jonathan Devor and David Charbonneau describe the Method for Eclipsing Component Identification (MECI), which is an automated method for assigning the most likely absolute physical parameters to the components of an eclipsing binary. MECI is unique in that it requires only the photometric light curve and combined color of the eclipsing binaries. We have implemented this method using published theoretical isochrones and limb-darkening coefficients and publicly released its source code. MECI lends itself to creating large catalogs through the systematic analyses of datasets consisting of photometric time series, such as those produced by OGLE, MACHO, HAT, and many other surveys. We will be presenting the results of data mining the Trans-Atlantic Exoplanet Survey (TrES). This sort of mining technique may be used for both characterizing stellar populations and for discovering rare and interesting binary systems. Of particular interest are the lower main-sequence stars, for which models underestimate their sizes by as much as 20%. The small number of suitable M-dwarf binary systems with accurately determined stellar properties has hampered progress in this area. Finding additional systems by mining Exoplanet Surveys may provide significant benefits for our understanding of such low-mass stars [4].

3.1 A Modern Method

FMA is one of the newly discovered exoplanets, which is used in binary systems and stands for Frequency Map Analyze. This is a method of obtaining a radio map of a binary system at different frequencies over a regular schedule, which can be checked or discovered exoplanets found in the payments system. The method was introduced in 2006 and requires a lot of more researches [7].

4. CONCLUSION

According to this review, transit and photometers are most eligible methods for detecting exoplanets binary systems, meanwhile, the photometer is easier and accurate to use, but transit methods are relatively simple while it can be considered by non-Observatory telescopes, and even the new founds can use these methods for their practical and tentative works.

REFERENCES

[1] Khalid Alsubai, WIDE ANGLE SEARCH FOR EXTRASOLAR PLANETS BY THE TRANSIT METHOD, A Thesis Submitted for the Degree of PhD at the University of St. Andrews.
[2] F.T. O'Donvan, D. Charbonau, TrES-3: A NEARBY, MASSIVE, TRANSITING HOT JUPITER IN A 31 HOUR ORBIT, The Astrophysical Journal, Jul 2007
[3] T. Peribulla, M. Vanko, The Dwarf project: Eclipsing binaries – precise clocks to discover exoplanets, Astron, Nachr
[4] Giffory W.Marcy, DETECTION OF EXTRASOLAR GIANT PLANETS, Astrophysics 1998
[5] Hans- Jorg Deeg, Photometric Detection of Extrasolar Planets by the Transit Method
[6] J. Devor, D. Charbonneau, Using MECI to Eclipsing Binaries from Photometric Exoplanet Surveys, Harvard, Semithsonian Center of Astrophysics.
[7] D. Turrini, M. Barbieri. Exoplanetary formation in S type binary star systems, Mem, SA, IT. 2006

© 2019 by Hasan Kalyoncu University, Gaziantep 27410 Turkey.
Reproduction is permitted for noncommercial purposes.