TIMING VARIATIONS ON BINARIES WITH CoRoT

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Context: CoRoT's exoplanet channel provides continuous light curves for up to 12000 target stars during 150 days. Those light curves are analyzed in the search for planetary transits, but many of eclipsing binary stars (EBs) are also found. In some cases, EBs show changes in the period of their eclipses (timing variations: TVs).

Aims: TVs of eclipses and transits are a useful tool to provide an insight into the physical structure of the system. In this work, we study the capability of CoRoT to measure TVs of EBs and we explore its limits.

Methods: We analyze the eclipses of an EB star to obtain the precise time of the arrival of the signal. We analyze the observed minus calculated (O-C) times of the eclipses in the search for TVs and we characterize them.

Results: We present a study of the object CoRoT-ID 101290947: a m3 = 14.7 eclipsing binary of the LRc01 field with a period of 2.04880 +/- 0.00001 days and eclipse depths of 5%, which shows TVs compatible with the presence of a third body of minimal mass 2.6 solar masses in an orbit with a period of 110 days.

In many cases EBs show changes in the period of their eclipses and sometimes these changes are caused by the presence of a third body in the system. As the EB orbits the center of mass of the three body system, its distance to the observer changes and one can measure the timing variations of the eclipses. This is the so-called light-time effect "LITE" (Irwin 1952, Irwin 1959), which was used by Römer (1676) to measure the value of the speed of light observing the eclipses of the Galilean moons of Jupiter.

There are several possible explanations for TVs in eclipsing systems: we have already mentioned LITE, but pulsations of the components; precession of the orbits (apsidal motion); magnetic activity (works by Hall 1989; Applegate 1992; Lanza et al. 1998); mass loss or transfer between the components are other possible sources of TVs.

In our target we find TVs compatible with the presence of a third body in the system; the period of the TVs is 110 days and the amplitude is 5 minutes, which corresponds to a semi-major axis of 0.62 au and a minimal mass of 2.6 solar masses. The eccentricity is 0.5.

CONCLUSIONS: Often eclipsing binaries show TVs which can be characterized with long term ground observations. But CoRoT, and future missions like Kepler, can explore regions of the parameter space of TV discoveries which are hardly accessible from ground (low amplitude, small period). LITE is favored by the presence of massive objects; with the current design of these missions it is difficult to arrive to the region of the parameter space where circumbinary planets can be found. But we have shown that it is possible to find TVs of stellar mass bodies and characterize them.

REFERENCES

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