*Damnjan Perić**

Određivanje rotacione brzine zvezde analizom Rossiter-McLaughlin efekta kod tranzita ekstrasolarne planete

Svetlost sa dela površine zvezde koji se usled njene rotacije kreće ka posmatraču trpi plavi, dok ona sa dela koji se kreće od posmatrača trpi crveni pomak. Ekstrasolarna planeta prilikom tranzita blokira određeni deo svetlosti, te dolazi do deformacije krive radijalnih brzina. Ova pojava naziva se Rossiter- McLaughlin efekat (RM).

Sintetisana je RM kriva zvezde Kepler-8 (u programskom jeziku C). Uveden je parametar δ, koji predstavlja projektovano relativno rastojanje centara zvezde i planete tako da za $\delta > r_s + r_p$ (gde su r_s i r_p redom relativni poluprečnici zvezde i planete) tranzit ne postoji, pa je promena radijalne brzine 0. Maksimalna luminoznost sistema jednaka je luminoznosti zvezde (jer se luminoznost planete zanemaruje) i normirana je na 1, dok trenutna luminoznost zavisi od faze. Korišćen je kvadratni zakon potamnjenja ka rubu. Uzeto je da se orbite planete i osa rotacije zvezde poklapaju. Koristeći jednačine za površinski sjaj (koji zavisi od potamnjenja ka rubu), dobijeni su koeficijenti neophodni za izra- čunavanje promene radijalne komponente rotacione brzine. Grafički prikazana zavisnost promene rotacione brzine od faze je sintetisana RM kriva.

Sintetisana kriva je poređena sa posmatranom, tako što su svi parametri sistema (relativni odnosi poluprečnika zvezde i planete, inklinacija i period orbite, argument periastera i parametri potamnjenja ka rubu) osim radijalne brzine zvezde bili fiksirani. Rotaciona brzina zvezde je varirana, a najbolje poklapanje dve krive dobijeno je za $V_r = 9.76$km/s, dok iz posmatranja sledi podatak od 10.5 ± 0.7km/s.

Prilikom budućih sinteza RM krive potrebno je uzeti u obzir i promenu u posmatranoj radijalnoj brzini zvezde koja za uzrok ima njeno kretanje oko centra mase sistema, usled moguće velike mase planete, kao i efekat gravitacionog mikrosočiva.

Determination of the Stellar Rotational Velocity Using the Rossiter-McLaughlin Effect in Extrasolar Planetary Transits

Light emitted from the stellar surface which is heading towards the observer (due to the stars rotation) is blueshifted, unlike the one from the surface moving away from the observer, which is redshifted. An extrasolar planet blocks a portion of the light during its transit, which deforms the radial velocity curve of its host star. This phenomenon is called the Rossiter-McLaughlin effect (RM).

The RM curve for Kepler-8 has been synthesized (in programming language C). Parameter δ, which represents the projected relative distance of the bodies, has been introduced. For $\delta > r_s + r_p$ (where r_s and r_p are relative radii of the star and the planet respectively) there is no transit, thus there is no change in radial velocity. The maximum luminosity of the system is equal to that of the star and is normalized to 1, while the observed luminosity depends on the phase. Surface brightness of the star is considered to follow a quadratic limb-darkening law. The rotational axis of the star is parallel to the orbital axis of the planet. Using equations for surface brightness intensity (which depends on limb-darkening), the coefficients needed for further calculations of variations of rotational velocity's radial component have been found. The synthesized RM curve represents variations of rotational velocity as a function of phase.

The synthesized RM curve is matched with the observed one, with all of the system's parameters fixed (relative radii of the star and the planet, orbital inclination and period, argument of periastron and limb-darkening parameters) except for the rotational velocity of the star. The best match of the curves has been achieved for $V_r = 9.76$km/s, whereas the observations suggest this parameter's value to be 10.5 ± 0.7km/s. Future RM curve syntheses should consider changes in radial velocity of the star caused by its movement around the system's center of mass (due to massive planets), as well as the gravitational microlensing effect.