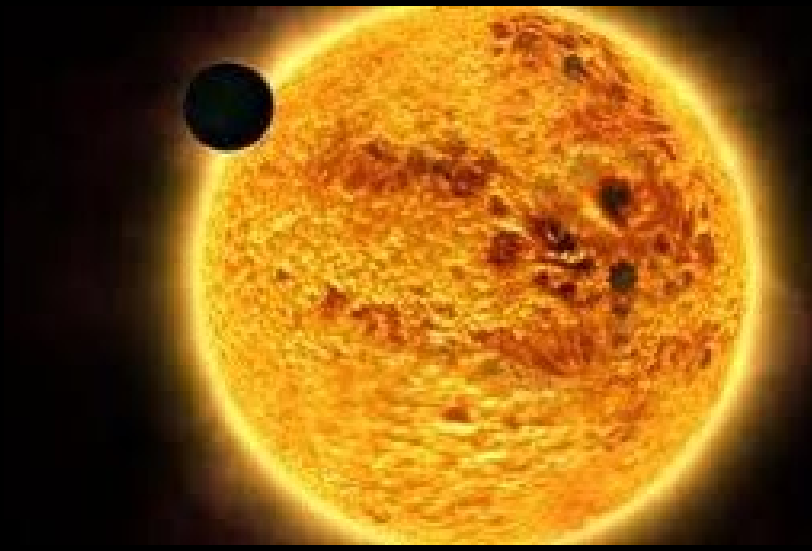
Polarimetry of exoplanetary system CoRoT-2



N.M. Kostogryz, Taras Yakobchuk, A.P. Vidmachenko

Main Astronomical Observatory of NAS of Ukraine, Kyiv, Ukraine

Occultation polarization or *Chandraskhar* polarization

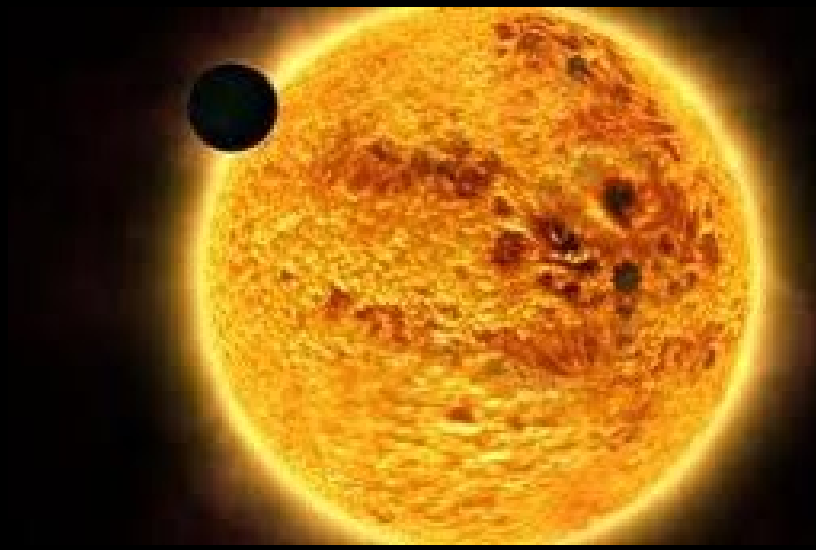
Radiation from an unresolved, centrosymmetric star is normally unpolarized.

The average of the polarization directions of all photons from the star detected by the observer results in zero polarization.

An intrinsic polarization can occur if the star is not centrosymmetric.

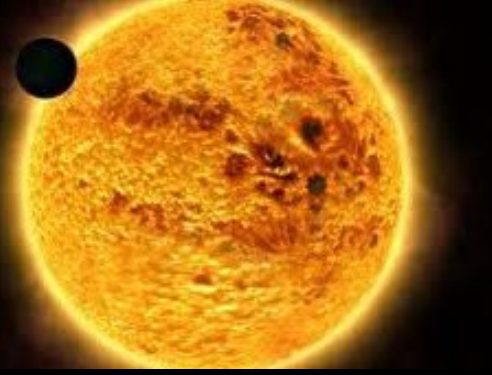
Causes of such anti-symmetry:

- Planet cross the star;
- Spot or spots appear on the star



CoRoT-2

Discovered in 2007 (Alonso et al. A&A)



Host Star

Spectral Type = G7V

Apparent Magnitude = 12.57

Mass = 0.97 (± 0.06) *Msun*

Effective Temperature =
5625 (± 120) *K*

Radius = 0.902 (± 0.018) *Rsun*

Metallicity [Fe/H] = 0.0 (± 0.1)

Planet

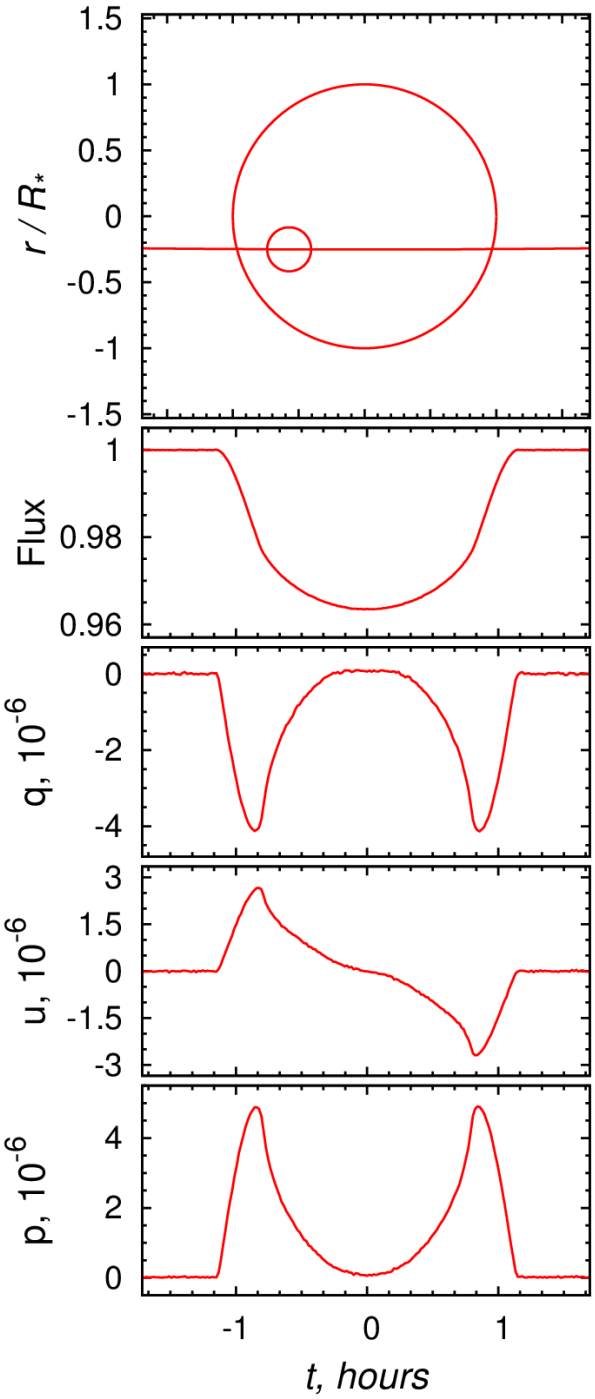
Mass = 3.31± 0.16 *MJ*

Semi major axis = 0.0281 *AU*

Orbital period = 1.743 *days*

Radius = 1.465 (± 0.029) *RJ*

Inclination = 87.84 (± 0.1) *deg*



Planet transit

Did not take into account the effect of the eclipsing system on the *Chandrasekhar* polarization!

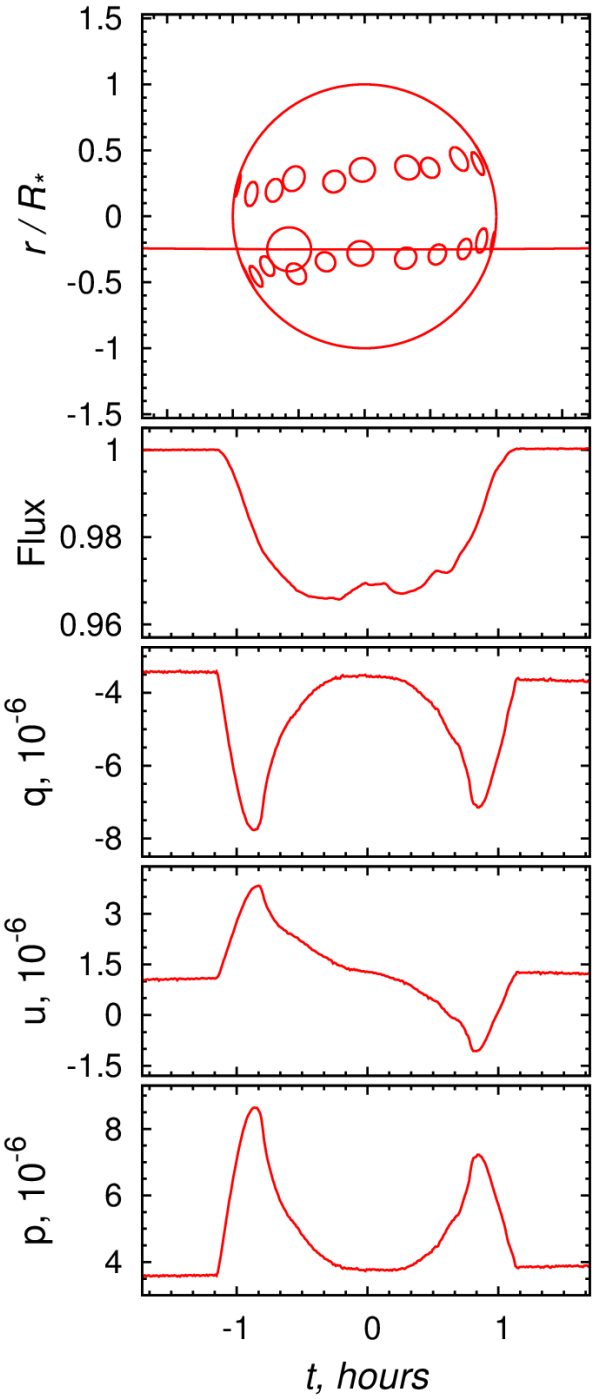
Carciofi & Magalhães *(2005)* first estimated this effect for for the planetary system of G-K-M-T dwarf stars with planets from Earth to the two times of the Jupiter size

Kostogryz et al. (2011) presented the results of modelling polarization produced during planetary transits in the different systems.

P~4.9*10^{-4}% for CoRoT-2

Assumptions:

- The planet is a black body
- Limb-to-center polarization is taken from Trujillo Bueno J., Shchukina N. (2009)
-Limb darkening law (Claret, 2000)



Planet transit and starspot

1 spot on the stellar surface (Silva-Valio et al., 2010):

T = [3600 – 5000] K
φ = [0 – 360] deg
|θ| = [16 – 22] deg
S = [0.15 – 0.25] % of the stellar surface

N = 42 spots
PP= 50 000 000 per one point

Assumptions:
-The spot has zero polarization
-The spot has sharp-edge circular shape
- The spots doesn't change the size and latitude during the modelling time

Conclusions

We have presented the results of Monte Carlo simulations for the planetary transiting system CoRoT-2, calculating the polarization that results an occultation of the star by a transiting planet and the spots on the stellar surface.

Planetary transit produces a polarization maxima at the limb of $4.9*10^{-4}$ %, adopting the solar center-limb polarization.

Depending on the positions and sizes of the spots, polarization value varies substantually.

And the main result is that polarization method could be an independent method to detect and/or to confirm the existence of planet near the star and determine different parameters of the system.