LETTER TO THE EDITOR

Stellar parallax in the Neo-Tychonian planetary system

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Abstract. The recent paper published in European Journal of Physics [1] aimed to demonstrate the kinematical and dynamical equivalence of heliocentric and geocentric systems. The work is performed in the Neo-Tychonian system, with key assumption that orbits of distant masses around the Earth are synchronized with the Sun's orbit. Motion of Sun and Mars have been analysed, and the conclusion was reached that the very fact of the accelerated motion of the Universe as a whole produces the so-called "pseudo-potential" that not only explains the origin of the pseudo-forces, but also the very motion of the celestial bodies as seen from the static Earth. After the paper was published, the question was raised if that same potential can explain the motion of the distant stars that are not affected by the Sun's gravity (unlike Mars), and if it can be used to reproduce the observation of the stellar parallax. The answer is found to be positive.

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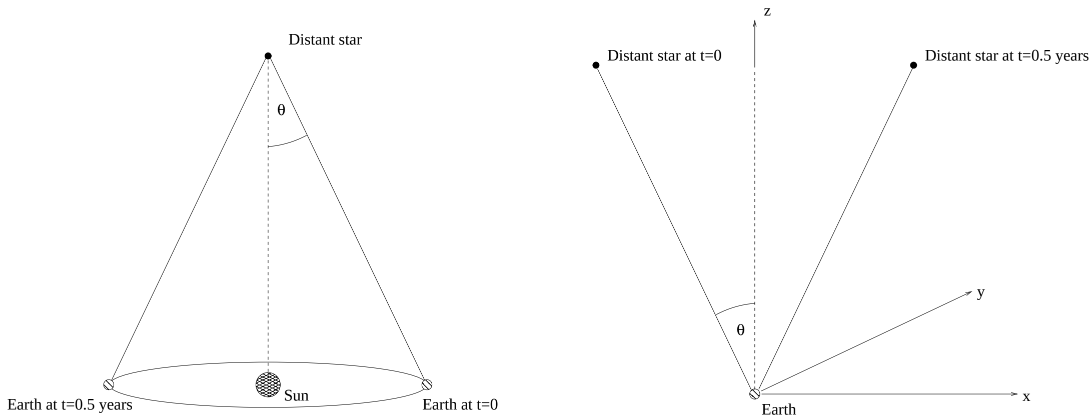

Figure 1. Illustrations of the stellar parallax in the heliocentric (left pannel) versus geocentric (right pannel) frames of reference.

1. Introduction

The well-known effect of stellar parallax can be explained in two ways. The first and most common one is in the heliocentric system, in which the Sun and the observed stars are approximately considered to be at rest. While the Earth moves around the Sun, its position relative to the stars changes, and that results with the effect of motion of the near stars [2]. The parallax is observed using the more distant stars in the background.

Second way to explain stellar parallax is by saying that the apparent movement of the stars is in fact the real motion in the pseudo-potential that is, according to Mach's principle [3], generated by the very fact of the simultaneous accelerated motion of all the bodies in the Universe, including the distant stars.

The comparison between two approaches is given in the Figure 1, with the appropriate choice of coordinate axes that will be used in the calculation which follows.

2. Motion of Proxima Centauri in the Earth's pseudo-potential

Now in order to demonstrate how one can arrive to the correct prediction of the stellar parallax in the Neo-Tychonian system, we will calculate the trajectory of the star Proxima Centauri in the pseudo-potential given by Eq (4.4) in [1, 4],

$$U_{ps}(\mathbf{r}) = \frac{GmM_S}{r_{SE}^2}\hat{\mathbf{r}}_{SE} \cdot \mathbf{r}\,. \tag{2.1}$$

Here G stands for Newton's constant, M_S stands for the mass of the Sun and $\mathbf{r}_{SE}(t)$ describes the motion of the Sun in the Earth's pseudo-potential and was calculated in [1].

The Lagrangian that describes the motion of the Proxima Centauri in the Earth's pseudo-potential is therefore given by (gravitational interaction between the star and the Sun is, of course, neglected):

$$L = \frac{1}{2}m\dot{\mathbf{r}}^2 - \frac{GmM_S}{r_{SE}^2}\hat{\mathbf{r}}_{SE} \cdot \mathbf{r}\,, \tag{2.2}$$

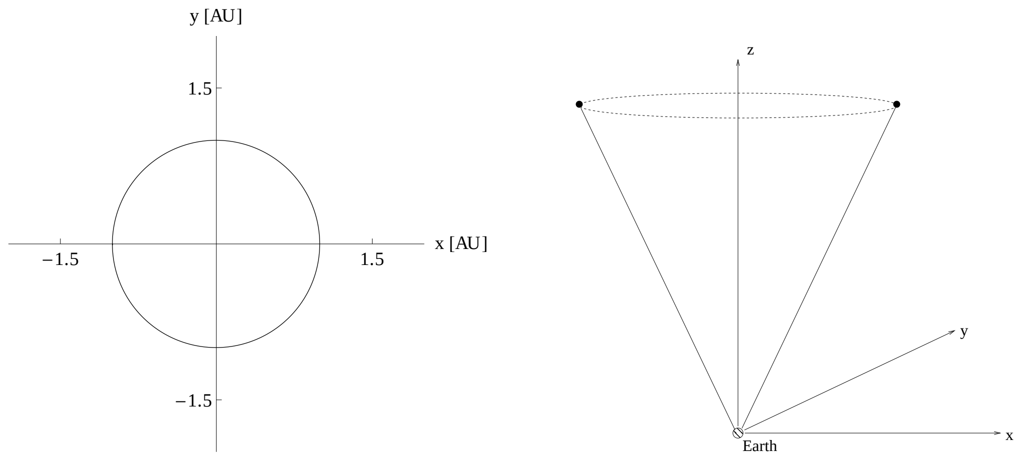

Figure 2. Left pannel displays the result of the numerical solutions for equations of motion derived from the Lagrangian (2.2) over the period of 1 year. It represents the trajectory of the star in the x-y plane, as seen from the Earth. Right pannel illustrates the stellar parallax effect, in consistence with the numerical results.

where m is the mass of the star, and $\mathbf{r}(t)$ describes its motion. The equations of motions are mass-independent, as expected.

The Euler-Lagrange equations for this Lagrangian are solved numerically in the Cartesian coordinate system, using *Wolfram Mathematica* package. The numerical solutions over the period of 1 year are presented in the Fig 2.

Stellar parallax can now be geometrically calculated:

$$\arctan\theta = \frac{r_x(t = 0.5 \text{ y})}{D}, \tag{2.3}$$

where $D = 4.24$ ly is the well-knows distance of Proxima Centauri from the Earth [5]. Using the numerical results obtained above, one can evaluate the expression (2.3). The result is

$$\theta = 3.705 \times 10^{-6} \text{ rad} = 0.76'' , \tag{2.4}$$

which is perfectly consistent with the astronomical data [6].

3. Conclusion

We have analysed the motion of the star Proxima Centauri in the Earth's pseudo-potential previously derived from Mach's principle [1]. The obtained results are in accord with the observed data. The kinematical and dynamical equivalence of Neo-Tychonian and Copernican systems has once again been demonstrated.

Acknowledgments

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