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Dynamic study of possible host stars for extrasolar planetary systems

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Abstract. We present the stellar systems which consist of double and multiple stars with distances $3.5 \div 25$ pc from the Sun, belonging to spectral classes F, G, K, M, having masses from 0.3 to 1.5 solar mass and can, in principle, possess planetary systems. On the basis of observations with Pulkovo 65 cm refractor the relative positions of double stars, the parameters of motion, the orbits and also the ephemeris for the nearest epochs have been computed.

Keywords. stars: binaries, stars: planetary systems, habitable zones

1. Introduction

The astrometric positional observations of single, double and multiple stars, which are located near the Sun, are carrying out in Pulkovo observatory many years. Observations are made by means of 26-inch refractor (D = 65 cm; F =10413 mm) since 1956. We have long-term series to $40 \div 50$ years of photographic observations with yearly error about 10 mas. The telescope functions in an automatic mode. Since 2007 year the CCD camera is used. The results of our observations of about 300 stars are collected in the Catalog of Relative Positions of Double Stars (Kiselev *et al.* 2014). Owing to the physical properties (a spectral class, masses, the distance to the Sun and the duration of positional observations, which allow to obtain precise parameters of movement) these stars could become objects of observations for programs exoplanets searches. It is known, that some projects are aimed at searches of planets by means of astrometric methods. These programs include the research of stars of F, G, K and M spectral classes (see, for instance, CAPS program by Boss *et al.* 2014 and also future project NEAT with expected microseconds precision by Malbet *et al.* 2014).

2. Results of observations

We investigate wide double stars with separation $\geqslant 4$" and with $m < 13$ mag. For computing orbits we use Apparent Motion Parameters method, see the description in Kiselev & Romanenko (1996) and Kiselev *et al.* (2014). This method allows to calculate an orbit and dynamical mass of a double star on the basis of observations of a short arc if the parallax and the relative radial velocity are known. The orbits for about 50 pairs have been determined. We have the close pairs with semi-axis major a from 33 to 200 AU and periods $P < 2000$ years and more wide pairs with periods up to several tens of thousands of years. In the table 1 we give a short list of stars having Pulkovo orbits, their ADS and WDS numbers and spectral classes for two components. In the table 2 we give the new orbits of three stars, the distance of a star from the Sun - D and the minimum

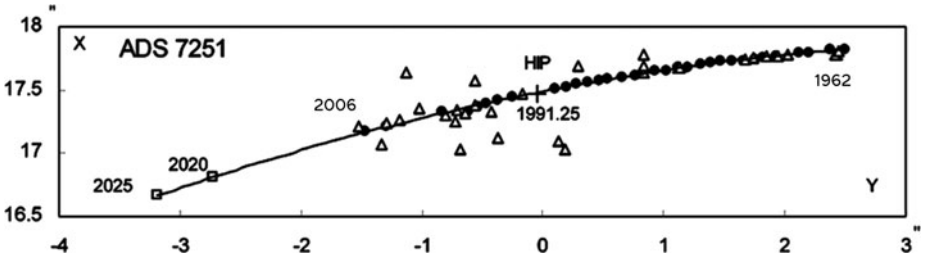

Figure 1. ADS 7251, the solid circles - Pulkovo observations in 1962-2006, the triangles - the positions from WDS catalog, the cross - Hipparcos 1991.25 and the squares - the ephemeris for 2020 and 2025 years. X=$\rho \sin\theta$, Y=$\rho \cos\theta$.

Table 1. List of the selected stars.

ADS	WDS	Sp	ADS	WDS	Sp	ADS	WDS	Sp	ADS	WDS	Sp	ADS	WD	Sp
48	00057 +4549	K6V M0V	8002	10596 +2527	K0 -	8861	13195 +3508	M1V M3V	10288	16579 +4722	K0V K0V	11632	18428 +5938	M4 M4
2427	03162 +5810	M2V M2V	7251	09144 +5241	M0V M0V	9031	13491 +2659	K4V K6V	10329	17033 +5935	K4V M0	12169	19121 +4051	G5V G5V
2757	03470 +4126	K1V K2V	8100	11152 +7329	K5 M0	9090	14025 +4620	M3 M3	10386	17101 +5429	K8V K8V	12815 16Cyg	19418 +5032	G2V G2V
5983	07202 +2159	F0IV K6V	8250	11387 +4507	G0V -	9696	15292 +8027	K0V K0V	10759	17419 +7209	F5IV F8V	14636 61Cyg	21069 +3845	K5V K7V

Table 2. Orbits of binary stars and astrometric signal due to possible planets.

ADS	a, au	P, yr	e	$i^\diamond$	$\omega^\diamond$	$\Omega^\diamond$	T_p, yr	D, pc	a_p, au	$A_\oplus$, μas	A_{Jup}, mas
7251 A	136.9	1528.0	0.08	141.0	210.4	216.6	1882.8	6.1	0.25	0.20	0.06
B									0.24	0.20	0.06
11632 A	93.4	1094.1	0.42	106.7	319.3	145.1	1835.2	3.5	0.22	0.52	0.16
B									0.14	0.36	0.11
14636 A	81.8	674.3	0.50	132.5	156.3	177.1	1728.5	3.5	0.35	0.44	0.14
B									0.26	0.39	0.12

Note: a_p is a semi-major axis of a planet's orbit, which we proposed equal to the inner edge of habitable zone. HZ was computed according to Selsis *et al.* 2007.

of astrometric signal from planets located near to the inner edge of HZ with the Earth's ($A_\oplus$) and Jupiter's (A_{Jup}) masses.

We hope that our astrometric observations can be useful for comprehensive study of stars with possible planetary systems.

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