

## SUMMARY

**of publications of cand. phys.-mat. sci. Assoc. Prof. of Astronomy Chair at the Faculty of Mathematics and Mechanics, SPbSU**

**Baluev Roman Vladimirovitch**

**"Search and investigation of exoplanets using new methods of observation and data processing techniques,"**

**Nominated for the SPBSU Science work Prize in the category "For Scientific Contribution of Young Researchers"**

Results of the scientific work of Baluyev Roman Vladimirovich devoted to exoplanetary research are nominated. Exoplanets are planets outside the Solar System. This scientific area is the young and violently developing branch of astronomy. The applicant investigated dynamics of the known planetary systems, performed organization of observations of exoplanetary transit timing, processing of observations, search of new exoplanets, statistical analysis of ensemble of discovered exoplanets. R.V. Baluyev research is at an intersection of different disciplines as for 70% include development of new methods of applied mathematics for statistical analysis of data and efficient computer algorithms of their processing which are necessary for the work is in the field.

The research was conducted by the applicant since 2008, but only the publications published during 2015-2019 are submitted for nomination. The attached list includes 9 articles indexed in Web of Science and Scopus databases, and 8 of them published in journals of Q1 quartile. There is a review article. In the majority of articles R.V. Baluyev is the leading or the only author, emphasizing his defining personal contribution to the published scientific results. The Hirsch index of the author on Web of Science is 12, average citation level is 14.74 citations per article. Since 2012, scientific work led by R.V. Baluyev was multiply supported by different grant foundations, confirming its high scientific importance. Funding for the total amount of 15 mln 200 thsd rubles is so far received (2012-2013 RFBR grant, 2014-2015 RFBR grant, 2014-2015 the Russian President grant for support of young scientists — candidates of science, 2017-2019 RFBR grant, 2019-2022 RNF grant). Two last scientific projects (RFBR and RNF) are performed on the basis of St. Petersburg State University.

The list of the main scientific results of the applicant during 2015-2019 is included below. The result of item 6 was included into the list of outstanding astronomical results for 2018, according to Scientific Council on Astronomy of the RAS (earlier works of R.V. Baluyev for 2011 and 2013 were also included in similar lists, but they are not listed below).

1. Baluev (2015a). The long-term set of works is completed on the analytical determination of significance values of periodograms, based on periodic models of different complexity (from a usual sinusoid to Keplerian radial-velocity curve).

2. Baluev (2015b). Based on radial-velocity noise variations in high-precision measurements of 55 Cnc (a star orbited by a 6-planetary system), the magnetic activity cycle was found, with a period about 13 years, that is close to Solar period. Later on, this result was confirmed and improved in independent work of Bourrier et al. (2018), who determined this period to be about 10.5 years or 11.8 years from the spectral H-alpha index and from the S-index, respectively.

3. Baluev et al. (2015, 2019). Homogeneous processing ~80000 photometric measurements for ~300 planetary transits, taken both from the amateur databases, and from scientific literature, was carried out. New estimates of planetary parameters were obtained, and possible transit timings variations (TTV) were

investigated. The derived timing measurements are publicly released. In 2019 this work was redone with extended data (above 300000 photometric measurements, above 1000 planetary transits), also including an analysis of radial velocities obtained from international partners. Empiric corrections were derived to the known stellar limb darkening models (Claret & Bloemen). For the planet WASP-4 b, a TTV signal was suspected in 2015; in 2019 this suspect was increased based on new data, and in 2020 we eventually confirmed a nonlinear TTV trend for this target (the publication of 2020 was not included in the list due to the Prize rules).

4. Baluev & Shaidulin (2015). The new model of the Rossiter-McLaughlin effect (a spectroscopic planetary transit) is constructed. The model is applicable also in case of a star eclipsed by an object of any size (not only a planet). It considers the corrections depending on average characteristics of spectrum lines and on the method used for radial-velocity determination.

5. Fischer et al. (2016). The long-term set of works is completed, devoted to the development of high-precision modeling of stellar radial velocities, taking into account noise effects generated by stellar activity.

6. Baluev (2018); Baluev & Shaidulin (2018). New original method of recovery of a statistical distribution function (probability density) from an the input random sample is constructed, based on the continuous wavelet transform. This method is applied to univariate distributions of various exoplanetary parameters. For subsample of giant exoplanets statistically significant condensation in a transition zone of 100-300 days is detected, between the so-called "valley of the periods" and planets with the large orbital periods. According to the evolutionary models which are available in literature, this zone is related to the effect of ice accumulation in a protoplanetary disk.