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Observations

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My institution, the Southeast Iceland Nature Research Center, has published the fourth report about observations, obtained from 'Nes Observatory' in Iceland ~2019. The main text is Icelandic, but an abstract and a summary (in the end of the report), and the text of figures includes English, hopefully enough to get some idea about the projects.

The report can be accessed here: https://nattsa.is/wp-content/uploads/2020/06/Stjornuathuganir_2020-rafraent-final.pdf

Abstract: This report highlights astronomical observations in 2019, obtained from the Nes Observatory at Hornafjordur, Southeast Iceland. It reviews photometrical observations of the eclipsing EW stars 473 Cam, OT UMa, GY Psc, V 801 And and V 712 And, and the well known EA star Algol. The aim of these projects was to determine accurate timings of the mid-eclipses and compare to predictions. Routinely these do not coincide. One of the reasons is that in close systems mass transfer can influence the orbital period. The estimations not only test accepted periods and Epochs but constrain the stability in such systems. As a byproduct, with the lightcurves and several published parameters, three of these stars are modelled.

The Epochs of most of observed objects are obsolete but useful for observed minus calculated examination. The Bright Transiting Exoplanets (BTE) WASP 12b, HAT-P-9b, XO-6b, HAT-P-19b, Qatar 4b, Qatar 1b, HAT-P-53b, WASP 33b and HAT-P-38b were observed in the same seasons. The general goal is to estimate deviation in duration, depth and time. The results from observations of eclipsing binaries and exoplanet transits were submitted to the international databases of B.R.N.O. and TRESCA, the Variable Star and Exoplanet Section of Czech Astronomical Society, where they are accessible to the astronomical community. Distance measurements of the open cluster NGC 7654 (M 52) are represented and spectral images of selected variable stars, captured with a slitless spectroscope. The report details the data acquisition, processing and finally the results with some conclusions.

Previous reports were published in 2016, 2018 and 2019.The first two are in Icelandic only. The third report, published in 2019, was applied with an English abstract, text of figures and a summary of the observations. So is this one. They are available at https://nattsa.is/utgefid-efni/. The goal is to reveal astronomical observations that are altogether implemented in Iceland.

Summary: The report highlights astronomical observations, obtained at the Nes Observatory, in Southeast Iceland. This facility was established in 2017 by the author. The majority of the observations presented here was implemented with a 406 mm SCT ACF telescope, or a 80 mm apochromatic refractor. Current report overviews results of photometrical observations of several eclipsing binary stars of EW and EA type and Bright Transiting Exoplanets (BTE's).

The goal is usually to determine timings of mid-eclipses or transits and compare the results to predicted timings. The observations examine not only the predicted periods and Epochs but provide information about the stability in such systems. Results of these observations of eclipsing binaries and exoplanet transits were submitted to the international databases of B.R.N.O. and TRESCA, the Variable Star and Exoplanet Section of Czech Astronomical Society, where they are accessible to the astronomical community.

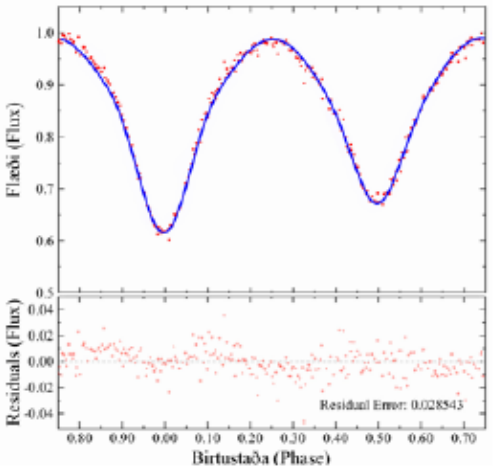
An observation of the EW star V 473 Cam was obtained on December 28 2018. A time deviation of only one or two min-

utes was observed in a row of secondary and primary eclipses. Predicted timings were therefore assumed to be valid and there seemed little need to continue observing this star.

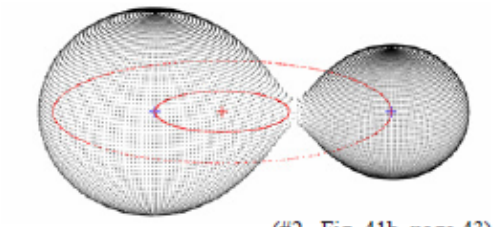
Nevertheless the results were used to create a physical model, based on parameters published by Kjurkchieva and others (2017). Several observations of the EW overcontact binary OT UMa revealed unusual time deviations of eclipses vs predictions. A depth difference of primary and secondary eclipses was recorded. The eclipses are not in agreement with the ephemeris predictions at B.R.N.O. and VSX websites, based on an Epoch from 1999. Accessible data at the B.R.N.O. database were reviewed to trace the paradox. O–C graph (Observed minus Calculated) indicates a large time deviation since the 1999 Epoch. The light curve of eclipses correlates with the results of Kjurkchieva and others (2019), and fits a theoretical model of the binary based on their parameters.

Observations of GY Psc started in the autumn of 2018 (published in previous reports) and are reviewed here together with results from 2019. VSX and B.R.N.O. websites do not provide the same period with their ephemeris. Mid-eclipse determinations have never coincided with their predictions. The phase diagram and examination of O—C timings represent significant instability which might be caused by an orbital fluctuation of the system. This makes it a tedious task to predict eclipses correctly. V 801 And is a little known EW eclipsing binary in Andromeda, of which very few observations have been made in the last 10 years. Measurements were made in October 2019.

The results indicate that the Epoch provided on VSX website is obsolete. The VSX predicted timings of primary eclipses has an error of ~5h21m and at B.R.N.O. website the mid-eclipses occur about 32 min earlier than predicted. Measurements, originally submitted by P. Vance to the AAVSO database, were applied with the author´s results to provide a new Epoch. A hypothetical model was constructed for comparison with the data. The author was supervised by David Bradstreet Ph.D, designer of the Binary Maker 3 software.



(#1, Fig. 41a, page 43)



(#2, Fig. 41b, page 43)

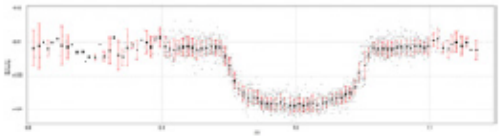
The model suggests that the system is an overcontact binary and that the larger mass star has a cooler surface than the smaller one. It should be noted that the hypothesis fits the data obtained with V filter only and is not intended be accepted literally. Determination of the actual mass ratio should be based on radial velocity measurements, which presently are unavailable for this star. The exercise was undertaken more or less for enjoyment. V 712 And is a neglected EW eclipsing binary in Andromeda. However as it is a magnitude 10 star it is a good target with a small telescope.

In this project the period and Epoch of the star were examined. Observed eclipses occurred about 30 minutes earlier than

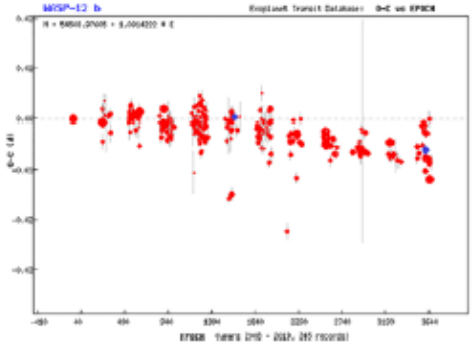
predicted. The observations support a published period of 0.3672 day. The eclipse of Algol, on November 17, 2019 was found to be ~18min51sec later than the predicted timing, published by the Almanak Háskóla Íslands, in Iceland.

Several astronomical websites predict Algol's primary mid-eclipse, but based on different Epochs or period. The accepted apparent magnitude out of eclipse, is 2.12, but the star dims by 1.3 magnitude during the eclipse. Transits of nine BTE's were observed in 2019. The general aim of such observations is to determine time deviations (Transit-Timing Variations: TTV), duration and depth of transits.

The first transit of the year was of the notable exoplanet WASP 12b, observed on January 5.



(#3, Fig. 57, page 55)

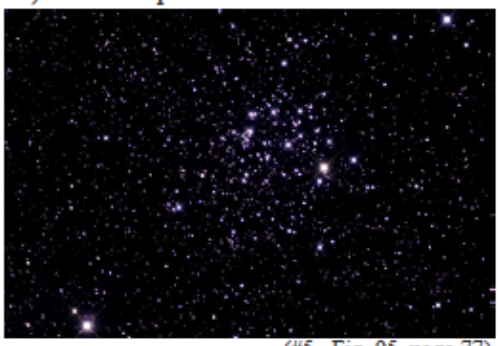


(#4, Fig. 59, page 56)

The author made his first observation of this planet's transit in 2013. These two transits are briefly examinated. This is a weird exoplanet facing a horrible fate in a far away future. On January 25, 2019 a transit of the exoplanet HAT-P-9b was observed. A comparison of the results, that were obtained with a 40 cm mirror, to an earlier one, from 2016, with a 30 cm mirror, indicates similar residuals on both occasion. The third event that season was observed on February 1, 2019 of the transiting XO-6b. The transiting HAT-P-19b was observed on September 1, 2019 followed by an, observation of Qatar 4b on October 25, 2019. The residuals of the data came to >0.01 mag., a consequence of a harsh weather condition that night, heavy wind and turbulent airmass.

Observation of HAT-P-53b transiting was made on November 13, 2019. This was the author's third observation of a transit of this exoplanet. On this occasion a full moon illuminated the sky. A transit of Qatar 1b was observed on November 16, 2019, under fair weather conditions. Two observations of the transiting exoplanet WASP 33b, obtained at an interval of seven years are described. The first one, on November 12, 2012, was the author's second observation of such an event and achieved with limited experience. The second observation was done on November 25, 2019. Comparing these observations a difference in photometric deviation is evident. The author's lack of experience is to blame for the high deviation (0.05 mag) in the first case, compared to the photometric deviation of 0.005 mag in the latter.

An observation of the transiting HAT-P-38b was made on November 26, 2019. The residuals of the data came to 0.005 mag. The mid-transit occurred 17 minutes earlier than predicted. Interestingly the O—C results indicate a shortening of orbital time. Five observations, distributed from autumn 2017 to 2019 were aimed at the galactic cluster NGC 7654 (Messier 52) in Cassiopeia.



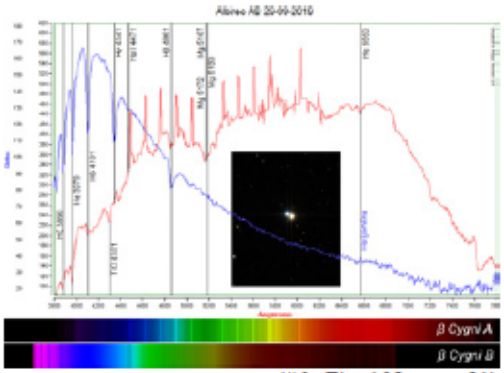
(#5, Fig. 95, page 77)

The goal was to see if the data, collected with a 40 cm SCT telescope, would be acceptable for distance estimations, reddening and age. 290 stars within the cluster's core were photometrically studied with B, V and R filters.

Known variables were included but catalogued WDS binaries excluded to constrain the main sequence profile. A density profile was used to compare the numbers of stars, counted in the B and R bands, out to about 11' from the centre. Fewer stars were counted in blue, indicating an interstellar extinction in the direction of the cluster. The data of B and V were used for a main sequence fitting, and the distance of the cluster estimated.

The results varied, depending on whether atmospheric corrections were added or not. Uncorrected, the distance came to 1424±284 parsec (4642 light years). With corrections the result was 1520±300 parsec (4957 light years) was found. This cluster is estimated to be less than 100 M yrs old, but that it has formed in a hierarchial manner over long time.

The result of the present observations implies that a bright galactic cluster can be studied with a telescope of this size (40 cm). Finally, spectral images captured of selected variable stars are presented. The stars are α Aquilae (Altair), δ Cephei, μ Cephei (Erakis), P Cygni, β Cygni (Albireo), 61 Cygni.



(#6, Fig. 108, page 91)

Photo/Graphic Captions & Details:

#1. Fig. 41a, page 43:
Model of the overcontact binary V 801
a) The result is an overcontact binary, a system deformed by tidal forces. Red crosses locate the center of the masses and the barycenter of the system.

#2. Fig. 41b, page 43:
b) Measured values (red dots) and theoretical model (blue line) fitted, using the q-method. Residuals describe the quality of the fitting.

#3. Fig. 57, page 55:
By adding data, submitted by ten other transit observers to the TRESCA databank, to authors observations a clearer view emerges of the light curve of the transiting planet (light grey colored). The data was then combined into a 5 minute bins (black dots with red deviation bars).

#4. Fig. 59, page 56:
O–C determination. Blue points are the author's measurements. Results from TRESCA website. WASP-12b is a weird exoplanet facing a horrible fate in a far away future.

#5. Fig. 95, page 77:
The galactic cluster NGC 7654 (Messier 52).

#6. Fig. 108, page 91:
Comparison of the spectrum of the optical double star Albireo (β Cygni). The spectral type of the amber colored β CygA (red line, brighter star) is K2 II but the blue colored β CygB (blue line) is B8 V.