Taurus Hill Observatory Season 2021 = 2022 Exoplanet Observations Review

H. Haukka^{1,2}, V-P. Hentunen¹, M. Nissinen¹, T. Salmi¹, H. Aartolahti¹, J. Juutilainen¹, E. Heikkinen¹ and H. Vilokki¹

(1) Taurus Hill Observatory, Varkaus, Finland (veli-pekka.hentunen@kassiopeia.net) (2) Finnish Meteorological Institute, Space Research and Observation Technologies, Finland

Taurus Hill Observatory (THO) [1], observatory code A95, is an amateur observatory located in Varkaus, Finland. The observatory is maintained by the local astronomical association Warkauden Kassiopeia. THO research team has observed and measured various stellar objects and phenomena. The observatory has mainly focused on exoplanet light curve measurements, observing the gamma ray bursts, supernova discoveries and monitoring [2]. We also carry out long term monitoring projects [3].

The results and publications that pro-am based observatories, like the THO, have contributed, clearly demonstrates that pro-amateurs are currently a significant resource for the professional astronomers and even more so in the future [4] [7].

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Season 2021 – 2022 Exoplanet Observations Review

	0.95	TOI 2152.1 b	Taurus Hill Observatory Veli-Pekka Hentunen	Taurus Hill Observatory (A95), Varkaus, Finl Veli-Pekka Hentunen		TOI 1455.01	b	Taurus Hill Observatory (A95), Varkaus, Finlan Veli-Pekka Hentunen
			JDmid: 0.54164				JDmid: 0.39514	
-	∂e9én-	-		transit end-	0.07 tra	nsit begin		transit end

A total of about 30 exoplanet observations and transit measurements were done during the observation season 2021/2022. All the measurements have been uploaded to the TRESCA database [5]. In total, about 250 light curve observations have been sent directly to TRESCA from the Taurus Hill Observatory.

The season highlights that we consider to be the most important could be the clear time deviations from the forecasts for a few TESS candidates, and in particular the Qatar-8b transit time deviations. The TOI1582.01b transit was not detected during the predicted period at all, so it differed quite a bit from the predicted one. These observations are presented in the following figures on the right.

The quality of the telescopes and CCD-cameras has significantly developed in the latest 20 years. Today it is possible for pro-am's to make high quality measurements [4] [7] with a scienticically valid precision. In the THO we can measure exoplanet transits with < 10 millimagnitude precision when the limiting magnitude of the observed object is 15 magnitudes. At very good conditions it is possible to detect as low as 1 to 2 millimagnitude variations in the light curve.







All observatory buildings of the Taurus Hill Observatory site. Image: Esa Heikkinen.

References [1] Taurus Hill Observatory website, http://www.taurushill.net



Top left: TOI2152.01b. The transit occurred about 20 minutes earlier than predicted. **Top right:** TOI1455.01b. The transit occurred 1.6 hours earlier than predicted. **Bottom left:** TOI1168.01b. The transit occurred about 1.7 hours earlier than predicted. **Bottom middle:** TOI1582.01b. Not any clear transit was detected. **Bottom right:** Qatar-8b. The transit happened about three hours later than predicted. Images: Taurus Hill Observatory / TRESCA.

Adapting a New Camera for Measurements

The main equipment throughout the winter were Celestron C-14 SC telescope with a Paramount MEII tripod and an SBIG ST-8XME CCD camera with Baader Bessell BVRI photometric filters.During the spring 2022, an ASI2600MM Pro CMOS camera was tested for the first time in Taurus Hill Observatory with a Chroma I filter connected to a Meade 16" ACX -telescope (with a Paramount ME tripod) for light curve measurements in the WASP-12b observations on March 31, 2022. At the same time, the object was also detected with the SBIG ST-8XME CCD camera connected to the Celestron C-14 SC -telescope. The results were very similar, so the CMOS camera is well suited for light curve measurements. An interesting feature of the transit of the WASP-12b was that immediately after the actual transit there was a very small dimming of 3 to 5 mmag, which lasts for about 30 minutes. MaxIm DL v6.08 software was used for imaging and image calibration, AIP4Win v2.4.10 software was used for the photometric measurements.

The weather was even throughout the dark winter season from August to the end of April. The clearest nights were in March-April. Overall, the winter was very rainy, there was an exceptional amount of snow. In addition to the exoplanet observations, Taurus Hill Observatory focused on comet imaging, DS imaging and the detection of GRB 220101A after-gamma glow, for which circular GCN 31356 [6] was published.

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[3] A massive binary black-hole system in OJ 287 and a test of general relativity; M. J. Valtonen, H. J. Lehto, K. Nilsson, J. Heidt, L. O. Takalo, A. Sillanpää, C. Villforth, M. Kidger, G. Poyner, T. Pursimo, S. Zola, J.-H. Wu, X. Zhou, K. Sadakane, M. Drozdz, D. Koziel, D. Marchev, W. Ogloza, C. Porowski, M. Siwak, G. Stachowski, M. Winiarski, V.-P. Hentunen, M. Nissinen, A. Liakos & S. Dogru; Nature - Volume 452 Number 7189 pp781-912; Nature Publishing Group; 2008

[4] Transit timing analysis of the exoplanet TrES-5 b. Possible existence of the exoplanet TrES-5 c; Eugene N Sokov, Iraida A Sokova, Vladimir V Dyachenko, Denis A Rastegaev, Artem Burdanov, Sergey A Rusov, Paul Benni, Stan Shadick, Veli-Pekka Hentunen, Mark Salisbury, Nicolas Esseiva, Joe Garlitz, Marc Bretton, Yenal Ogmen, Yuri Karavaev, Anthony Ayiomamitis, Oleg Mazurenko, David Alonso, Sergey F Velichko; Monthly Notices of the Royal Astronomical Society, Volume 480, Issue 1, October 2018, Pages 291–301, https://doi.org/10.1093/mnras/ sty1615

[5] TRESCA; var2.astro.cz/tresca/transits.php?pozor=Veli-PekkaHentunen&object=&p age=1&lang=cz

[6] Hentunen V-P, Nissinen M, Heikkinen E; GCN 31356; https://gcn.gsfc.nasa.gov/gcn/gcn3/31356.gcn3

[7] Discovery of a young low-mass brown dwarf transiting a fast-rotating F-type star by the Galactic Plane eXoplanet (GPX) survey; P. Benni et.al.; MNRAS 000, 1–13 (2020); DOI: 10.1093/mnras/stab1567

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More information about the Taurus Hill Observatory research

If You would like to get more information about the research work made at the THO, please visit our website in the address *http://www.taurushill.net*. We recommend that You also visit the Variable Star and Exoplanet Section of Czech Astronomical Society (*http://var2. astro.cz/EN*/) website. We are grateful to the Finnish Meteorological Institute who sponsored this poster.

