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YETI - The Young Exoplanet Transit Initiative

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Abstract. The Young Exoplanet Transit Initiative (YETI, Neuhäuser et al., 2011) is a world-wide collaboration of up to 2 m-class telescopes to continuously monitor the photometry of stars, which are members of young (age $\lesssim 100$ Myr) nearby ($d \lesssim 2$ kpc) open star clusters.

Although the telescopes of the YETI network exhibit only small diameters, a photometric precision on the few milli-mag level is reached, which allows the detection of young transiting exoplanets and the precise measurement of their transit light curves, which is the primary goal of YETI. In addition, as secondary science of this initiative, for all stars, located in the observed fields of view, their photometric variability of any kind is investigated within a range of time between minutes up to years.

So far, several open star clusters could already be monitored in many photometric campaigns, successfully carried out over at least three subsequent years. Each of these YETI campaigns typically lasts for about two weeks, sufficiently long to detected all transit events of young exoplanets, which revolve on close-in orbits around the observed target stars. For detected transiting planet-candidates their radii are derived from the obtained transit light curves and follow-up observations are carried out to rule out false positive scenarios and eventually to determine the masses of these companions. The radius and mass determination of detected young exoplanets allows to probe their internal structure, and eventually will constrain planet formation and evolutionary models and their time-scales.

In a talk, presented at the conference *Observing techniques, instrumentation and science for metre-class telescopes II* on 26 September 2018, I gave an overview of YETI and presented first results obtained during the last years in the course of this initiative. Furthermore, in my talk I reported on upcoming follow-up observations, proposed and scheduled for detected planet-candidates at 10 m class telescopes.

Key words: exoplanets – photometry – transit observations

1. First results of YETI

Although the photometric monitoring of the young open star clusters, conducted in the course of YETI, was just recently finished, and data-reduction and analysis are still ongoing for several clusters, first results of this project were already published during the last years, based on observations carried out at the observatories that cooperate within the YETI network.

So far, a large amount of imaging data could be taken for YETI using this telescope network. For example, at the University Observatory Jena the YETI clusters were observed in hundreds of nights using the instruments (STK, CTK, and RTK, Mugrauer & Berthold, 2010; Mugrauer, 2009, 2016) operated at the observatory, which results in about 1.6 TB of science data that could be recorded for YETI at this observing site since 2009.

In those YETI clusters, which were the first to be investigated and whose data have already been fully analyzed, transiting planet-candidates were reported. Among them, 2 planet-candidates in the young open star cluster Trumpler 37 (Errmann et al., 2013, 2014), one candidate in NGC 7243 (Garai et al., 2016), as well as a young transiting exoplanet-candidate of the weak-lined T Tauri star CVSO 30 in 25 Ori (Raetz et al., 2016). In addition, close to this young star a direct imaging planet-candidate was reported, which was detected with the adaptive optics imager NACO/VLT, and whose spectroscopic properties were determined with the integral field spectrograph SINFONI/VLT (Schmidt et al., 2016). Hence, if confirmed, CVSO 30 could be the first system known with both a close-in transiting exoplanet and a directly imaged planet on a wider orbit. Furthermore, an interesting transit-signal was found in the light curve of a member of IC 348, which is probably a grazing eclipsing binary, composed of a K0 pre-main-sequence star with a low-mass companion with a mass close to the stellar/substellar mass-border (Fritzewski et al., 2016). Further observations are needed to characterize the true nature of the detected transit-signal, and in particular for mass determination.

Meanwhile, also additional planet-candidates could be revealed among members in other YETI clusters but data analysis is still ongoing. In order to rule out false-positive detections for all identified presumable planet host stars, follow-up high contrast adaptive optics imaging observations, multi-band photometric monitoring, low-resolution spectroscopy, and eventually also radial-velocity measurements are carried out, which are currently ongoing.

Beside the detection of young exoplanets, which is the primary science goal of YETI, the photometric variability of the stars, located within the observed field of views, is investigated as secondary science. In the course of YETI so far several rotating and flaring T-Tauri stars could be identified and their photometric variability, as well as the distribution of their rotational periods and flaring rates, were investigated (e.g. GM Cep in Trumpler 37, Chen et al., 2012). Furthermore, many new eclipsing binary stars and pulsating variables were detected, and their orbital and/or physical properties could be determined.

2. Online material

The slides of my talk are available online for download in the pdf-format at:
`https://www.astro.uni-jena.de/Users/markus/26092018/talk.pdf`

A list of all publications, referenced on the slides in my talk, is summarized in the following section.

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