INAF – TIME ALLOCATION COMMITTEE

Application for observing time **Category: C**

Period AOT39 (April 2019 – September 2019) **Submit using: www.tng.iac.es/submit.html**

1. Title

The TESS/HARPS-N synergy: opening the treasure chest of small planets transiting bright stars

2. Abstract

Despite the great progress in searching for small exoplanets (R_p=1 - 4 $R_\oplus$), we still do not have a good understanding of these objects. Although super-Earths (R_p=1-2 $R_\oplus$) and sub-Neptunes (R_p=2-4 $R_\oplus$) are the most numerous planets in the Milky Way, their formation and evolution remain poorly undestood. Radii, masses, and the resulting bulk densities are key parameters to investigate planetary composition and internal structure and thereby learn about the formation of these alien worlds. The TESS space mission has just started to provide us with small transiting planets around nearby (< 100 pc) bright (5<V<11 mag) stars, enabling exquisite mass determinations via radial velocity (RV) measurements for a large population of super-Earths and mini-Neptunes. We propose to use HARPS-N to perform a high-precision RV follow-up campaign of bright TESS stars hosting close-in (a < 0.1 AU) small planet candidates. We expect to confirm and derive the mass of ∼3 planets using HARPS-N, significantly increasing the number of currently known small planets with precise mass determinations. This will allow us to explore the internal structure and composition of small alien worlds, and investigate their origin.

3a. Number of requested hours per telescope and instrument

TNG					REM	
DOLORES	DOLOR.+MOS	NICS	HARPS-N	GIANO-B	ROSS	REMIR
			30			

3b. Observing modes

TNG:		Visitor	X	Service		ToO
REM:		Rapid Response		Queuing		ToO

4a. Preferred months

first choice: Apr/May; Aug/Sep second choice:

4b. Other scheduling constraints (use also box 14)

5a. Past and future of the project

a) Hours already awarded to the project: 140

b) Hours foreseen to complete the project:
(not including this request)

6. Principal investigator

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7. Co-investigators (name and institution)

S. Albrecht, Aarhus University, Denmark
O. Barragán, Dip. di Fisica (UniTo), Italy
F. Cusano, INAF-OA-Bologna, Italy
M. Esposito, INAF-OAC-Napoli, Italy
E. Knudstrup, Aarhus University, Denmark
M. C. Maimone, Dip. di Fisica (UniTo), Italy
M. Fridlund, Onsala Space Observatory, Sweden

8. Status of the project

Telescope	Instrument	Date	Hours	Notes
TNG	HARPS-N	April-June 2016	16 hours	Follow-up of K2 stars (PI: Albrecht, A33TAC_11)
TNG	HARPS-N	Mar-Aug 2016	28 hours	Follow-up of K2 stars (PI: Gandolfi, A33TAC_15)
TNG	HARPS-N	Jan-Mar 2017	18 hours	Follow-up of K2 stars (PI: Albrecht, A34TAC_10)
TNG	HARPS-N	Jan-Mar 2017	28 hours	Follow-up of K2 stars (PI: Gandolfi, A34TAC_44)
TNG	HARPS-N	Oct 2017-Mar 2018	30 hours	Follow-up of K2 stars (PI: Gandolfi, A36TAC_12)
TNG	HARPS-N	Apr 2018-Sep 2018	20 hours	Follow-up of K2 stars (PI: Gandolfi, A37TAC_37)

Description

HARPS-N Runs in Apr-Aug 2016 (A33TAC_11 + A33TAC_15): RV follow-up of K2 candidates in Field 6, 7, and 8. PIs: Gandolfi and Albrecht. Data fully reduced and analysed. Accurate mass determinations of 4 transiting small planets (see Fig. 2). **Four papers recently published (see below).**

HARPS-N Runs in Jan-Mar 2017 (A34TAC_10 + A34TAC_44): RV follow-up of K2 candidates in Field 10. PIs: Gandolfi and Albrecht. Data fully reduced and analysed. Accurate mass determinations of 4 transiting small planets (see Fig. 2). **Three papers published (see below).**

HARPS-N Run in Oct 2017 - Mar 2018 (A36TAC_12): RV follow-up of K2 candidates. PI: Gandolfi. About 35% of telescope time lost due to bad weather conditions. Data fully reduced and analysed. Accurate mass determinations of 2 transiting small planets (see Fig. 2). **Three papers published.**

HARPS-N Run in Apr 2018 - Sep 2018 (A37TAC_37): RV follow-up of K2 candidates. PI: Gandolfi. Confirmed 1 super-Earth and 2 Neptune-size planets (three papers in preparation).

Publications

1) Barragán, Grziwa, Gandolfi et al. 2016, AJ, 152, 6. “K2-98b: A 32 $M_\oplus$ Neptune-size planet in a 10-day orbit transiting an F8 star”.
2) Eigmüller, Gandolfi et al., 2017, AJ, 153, 130. “K2-60b and K2-107b. A sub-jovian and a jovian planet from the K2 mission”.
3) Grziwa, Gandolfi et al., 2016, AJ, 152, 132. “K2-31b, a grazing transiting hot Jupiter on an 1.26-day orbit around a bright G7V star”.
4) Johnson, Gandolfi, Fridlund et al. 2016, AJ 151, 171. “Two Hot Jupiters from K2 Campaign 4”.
5) Nespral, Gandolfi, Deeg et al., 2017, A&A, 601, A128. “Mass determination of K2-19b and K2-19c from RVs and transit timing variations”.
6) Smith, Gandolfi, Barragàn et al. 2017, MNRAS 464, 2708. “K2-99: a subgiant hosting a transiting warm Jupiter in an eccentric orbit and a long-period companion”.
7) Van Eylen et al. 2015, ApJ 820, 56. “Spectroscopic follow up of 3 exoplanet systems from the first K2 campaign”.
8) Van Eylen, Albrecht, Gandolfi et al. 2016, AJ 151, 143. “A short-period planet orbiting a subgiant star”.
9) Gandolfi et al., AJ, 154, 123. ”The transiting multi-planet system HD 3167: a 5.7 $M_\oplus$ Super-Earth and a 8.3 $M_\oplus$ mini-Neptune”.
10) Guenther, Barragán, Gandolfi et al. 2017, A&A, 608, A93. “K2-106, a system containing a metal rich planet and a planet of lower density”.
11) Fridlund, Gaidos, Barragán, Gandolfi et al. 2017, A&A, 604, A16. “K2-111b: a short period super-Earth transiting a metal poor, evolved old star”.
12) Hirano, Dai, Gandolfi et al. 2018, AJ, 155, 127. “Exoplanets around Low-mass Stars Unveiled by K2.”
13) Persson et al. 2018, A&A, 618, A33. “Super-Earth of 8 $M_\oplus$ in a 2.2-day orbit around the K5V star K2-216”.
14) Van Eylen et al. 2018, MNRAS, 478, 4866. “HD 89345: a bright oscillating star hosting a transiting warm Saturn-sized planet observed by K2”
15) Johnson et al, 2018, MNRAS, 481, 596. “K2-260 b: a hot Jupiter transiting an F star, and K2-261 b: a warm Saturn around a bright G star”
16) Korth et al. 2019, MNRAS, 482, 1807. “K2-140b and K2-180b: characterization of a hot Jupiter and a mini-Neptune”.

9a. If this proposal is a part of a PhD thesis, write here the name of the student, the thesis title and briefly describe the relevance of these observations for the thesis goals.

E. Knudstrup. Tentative title: “Exoplanets in space and time with TESS”. The proposal is linked to the PhD thesis of E. Knudstrup (supervisor: S. Albrecht) and the HARPS-N data are crucial for his thesis.

9b. Is this, or a similar application submitted to other time allocation committees (e.g. ESO, TNG-CAT, ITP)? If yes, please specify which and explain if and why the proposals should be considered complementary.

We want to obtain precise and reliable measurements of the properties of small planets: this requires a large amount of manpower and telescope resources. We therefore decided to join forces (Gandolfi+Albrecht). We believe that this maximizes the science output and makes better use of telescope resources than forming smaller groups each one with less telescope resources. The PI of the present project is also PI of an ESO/HARPS large program to follow-up TESS targets in the Southern hemisphere that are not accessible with Northern facilities.

10. Description of the programme (max. 3 pages, including references, tables, and figures.)

A) Scientific rationale Should someone ever ask you "*Which objects will allow us to dramatically increase our knowledge on exoplanets in the nearby future?*" make sure your answer is "*Planets transiting bright nearby stars!*" The passage of a planet in front of its host star provides us with a wealth of precious information that allows us to thoroughly investigate the nature of planetary systems other than ours. **The fraction of light occulted by a planet during a transit is proportional to its size**. When combined with **radial velocity (RV) measurements** of the host star, transit photometry gives us access to the geometry of the orbit (inclination, semi-major axis, eccentricity), enabling the measurement of the **planetary mass, radius, and mean density**. This allows us to study the internal structure and composition of planets by comparing their positions on a mass-radius diagram with theoretical models (Fig. 1). The density and orbital architecture give us important hints as to planet formation and evolution (Winn & Farbrycky 2015). In-transit spectroscopy can probe the physical and chemical properties of planet atmospheres (e.g. Snellen et al. 2010).

Studies of the properties of transiting planets are leading us to the new era of "comparative planetology", in which our Solar System can finally be put in a broader context. Space-based transit surveys such as CoRoT, Kepler, and K2 have given us ground-breaking new insights into the demographics of exoplanets in the Milky Way, unveiling the spectacular diversity of planetary systems. Kepler has unveiled a *cornucopia* of small planets that have no counterpart in the Solar System. About 25 % of Sun-like stars in our galaxy host super-Earths (R_p=1-2 $R_\oplus$, M_p=1-10 $M_\oplus$) and sub-Neptunes (R_p=2-4 $R_\oplus$, M_p=10-30 $M_\oplus$) with orbital periods shorter than 100 days (Marcy et al. 2014). Although the superb photometry of Kepler has given us access to the small-radius domain, our knowledge on the composition of super-Earths and sub-Neptunes is still quite limited. Mass determinations with a precision (better than 10–15 %) that allows us to distinguish between different internal compositions have been possible only for a few dozen super-Earths and Neptunes (Fig. 1). This is because of the small RV variation induced by such planets and the faintness of most of Kepler host stars (V > 13).

For planets in this size range, a wide diversity of compositions are possible a priori; rocks, ices (H_2O, NH_3, CO), and gases (H, He) can all make significant contributions to both mass and volume of planets (Rogers & Seager 2010a,b). Even methane planets might exist (Helled et al. 2015). **The best way to investigate the structure of these alien worlds is by determining their mean densities. This can be achieved by accurately measuring both the planetary radius – via space-based transit photometry – and mass – via high precision RV measurements**. This allows us to answer the following questions: What is the composition and internal structure of small planets? Does their density depend solely on their mass? Does the stellar radiation and distance from the host star affect their composition and structure? Which role do the host star mass, metallicity, and age play? Do small planets migrate as giant planets do? By accurately measuring host star metallicities and planetary densities we learn if close-in rocky planets are cores of hot Jupiters with stripped-away envelopes (Rappaport et al. 2013), or originated as rocky or Neptune-size planets (Winn et al. 2017).

Close-in planets ($a \leq$0.1 AU) are the most favourable cases in transit search programs, as the transit probability is higher ($\propto a^{-1}$) and the induced RV wobble is larger ($\propto a^{-0.5}$). NASA's recently launched TESS satellite (Ricker et al. 2016) will allow us to make a huge leap forward in our understanding of the diverse composition of close-in small exoplanets, and has already discovered its first planet, a super-Earth transiting the naked-eye star π Mensae (Gandolfi et al. 2018, Huang et al. 2018). Unlike previous missions, TESS is carrying out an all-sky photometric search for transiting planets around nearby (< 100 pc) bright stars ($5 < V < 11$), so that detailed characterizations of the planets and their atmospheres can be performed. TESS transiting planets will have the most precise masses, radii, and densities. The survey is broken up into 26 sectors – each sector being observed for ∼28 days and consisting of 4 cameras with a combined FOV of $24°\times96°$. Candidate alerts are being released on a regular basis and the first full-frame images will be delivered in Dec 2018, followed by a data release every month. Compared to Kepler, TESS will photometrically monitor stars that are generally brighter by 3 magnitudes (a factor 16!) over a solid angle that is larger by a factor of 300. The opportunity for exoplanetary science is terrific! Detailed simulations of TESS's planet yield (Barcley et al. 2018) predict that over the 2-year mission ∼500 mini-Neptunes ($2 < R_p < 4\ R_\oplus$) and ∼200 super-Earths ($1 < R_p < 2\ R_\oplus$) will be found to transit bright stars, implying ∼25 small planets per sector, in agreement with the number of candidates detected in the first 2 TESS sectors.

We have assembled a team with vast experience on exoplanet detection and characterization. Our **Italian** and **Nordic** teams joined forces to make better use of our resources and telescope time and, most importantly, to be able to tackle ambitious planet characterizations, not possible by each team alone. The outcome of our previous follow-up of K2 planets with HARPS-N is outstanding (Fig. 1 & 2): 16 papers based on HARPS-N data have been already published (e.g., Gandolfi et al. 2017, Fridlund et al., 2017, Barragán et al. 2018). By focusing on bright (V<11) TESS stars combined with high-precision (1 m/s) HARPS-N RVs, we can now tackle even more ambitious planet detections, building up a sample of small planets with well known masses, radii and densities.

B) Scientific aim **We propose to perform a HARPS-N RV follow-up of ∼6 small planets transiting bright TESS stars**. The false positive rate of TESS small planet candidates is expected to be ∼30 % (Barcley et al. 2018). Assuming a conservative 40-50 %, **we expect to confirm and precisely (10-15 %) derive the masses of ∼3 planets**. We aim at **a)** enlarging the sample of small planets with precise mass, radius, and density determinations; **b)** enabling meaningful studies of the internal structure of this poorly understood class of planets; **c)** enabling first ensemble studies of these objects (distributions and correlations among the system parameters) and learn about their formation and evolution. Our project will open a new era in the study of close-in small planets, providing the community with cornerstone objects amenable to atmospheric characterization with both ground- and space-based facilities (GIANO, JWST) and the next generation of extremely large telescopes.

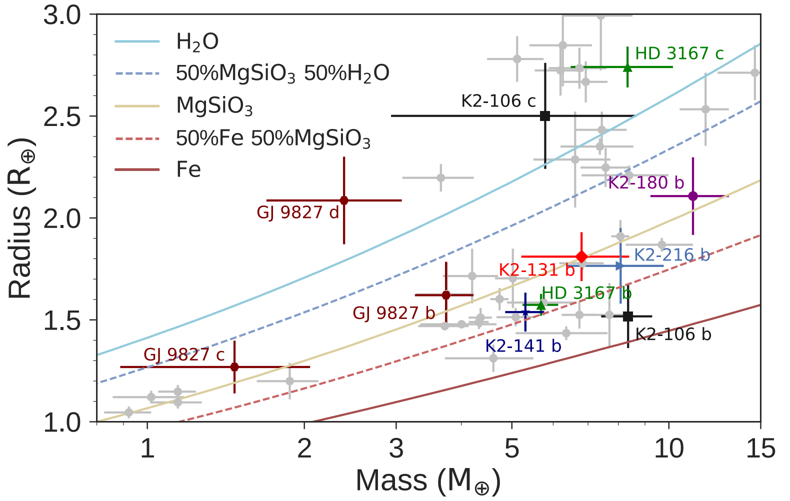

Figure 1: Mass-radius diagram for well-characterized (4σ precision level or better) super-Earth and Neptune planets. Internal compositions of exoplanets can be inferred by comparing the position of the objects with theoretical models. The solid and dashed curves are theoretical models for different internal compositions. The relative errors of radii of small TESS planets are about 6-8 %, depending on target brightness and planet's size. To avoid that mass errors dominate planetary density determinations, the mass should be measured with relative errors less than 3 times the relative errors of the radius; e.g. 18-24 % or $\sim$4-5 σ, depending on the target. The family portrait of small K2 planets whose masses have been measured by our team are overplotted/labelled with different symbols and colours (see also Fig. 2).

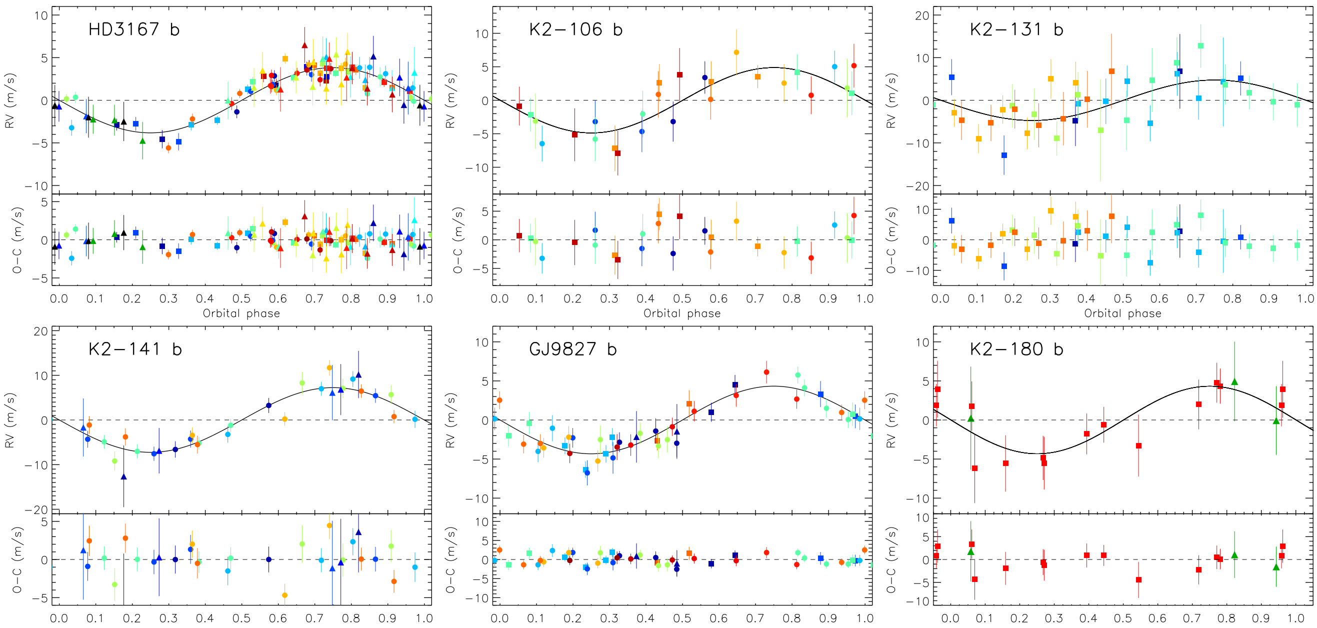

Figure 2: FIES (triangles), HARPS-N (squares), and HARPS (dots) RVs and Keplerian fit to the data of the ultra-short period (P<1 day) super-Earths HD 3167 b (M_p=5.4±0.4 $M_\oplus$; Gandolfi et al. 2017), K2-106 b (M_p=7.7±0.8 $M_\oplus$; Guenther et al. 2017), K2-131 b (M_p=6.5±1.6 $M_\oplus$, Dai et al., 2017), K2-141 b (M_p=5.3±0.5 $M_\oplus$, Barragán et al. 2018), GJ 9827 b (M_p=4.1±0.6 $M_\oplus$, Prieto-Arranz et al. 2018) and of the Neptune planet K2-180 b (M_p=11.5±3.1 $M_\oplus$, Korth et al. 2018) whose masses have been determined by our team. For a given symbol, different colours refer to multiple observations per night.

References: Barcley et al. 2018, ApJS, 239, 15; Barragán et al. 2018, A&A, 612, A95 (Fig. 2); Dai et al., 2017, AJ, 154, 226 (Fig. 2); Eigüller et al. 2016, AJ, 153, 130; Fridlund et al., 2017, A&A, 604, A16; Gandolfi et al., 2017, AJ, 154, 123 (Fig 2); Gandolfi et al., 2018, A&A, 619, L10; Guenther et al., 2017, A&A, 608, A93 (Fig. 2); Helled et al. 2015, ApJL, 805, 11; Huang et al. 2018, ApJ, in press; Korth et al. 2019, MNRAS, 482, 1807 (Fig. 2); Marcy et al. 2014, PNAS 111, 12655; Rappaport et al. 2013, 773, 15; Rogers & Seager 2010, ApJ, 712, 974; Rogers 2015, ApJ, 801, 13; Snellen et al. 2010, Nature, 465, 1049; Van Eylen et al., 2018, MNRAS, 478, 4866; Persson et al. 2018, A&A, 618, A33; Prieto-Arranz et al. 2018, A&A, 618, A116 (Fig. 2); Winn et al., 2017, AJ, 154, 60.

11. List of targets (note that the absence of a proper object list and information may weaken the proposal)

Name	α	δ	Epoch	Mag.	Time	Additional Information
Sect. 2,Camera 1	23:28:19	-23:03:52	J2000	5-11	3h	The coordinates refer to the centre of TESS Camera 1 of Sector 2. Targets within ∼12 degrees from the centre.
Sect. 3,Camera 1	01:08:41	-12:13:22	J2000	5-11	3h	The coordinates refer to the centre of TESS Camera 1 of Sector 3. Targets within ∼12 degrees from the centre.
Sect. 4,Camera 1	02:47:14	-02:45:36	J2000	5-11	3h	The coordinates refer to the centre of TESS Camera 1 of Sector 4. Targets within ∼12 degrees from the centre.
Sect. 5,Camera 1	04:28:13	+03:32:02	J2000	5-11	4h	The coordinates refer to the centre of TESS Camera 1 of Sector 5. Targets within ∼12 degrees from the centre.
Sect. 6,Camera 1	06:11:15	+05:24:28	J2000	5-11	4h	The coordinates refer to the centre of TESS Camera 1 of Sector 6. Targets within ∼12 degrees from the centre.
Sect. 7,Camera 1	07:52:43	+02:34:30	J2000	5-11	4h	The coordinates refer to the centre of TESS Camera 1 of Sector 7. Targets within ∼12 degrees from the centre.
Sect. 8,Camera 1	09:29:28	-04:10:31	J2000	5-11	3h	The coordinates refer to the centre of TESS Camera 1 of Sector 8. Targets within ∼12 degrees from the centre.
Sect. 9,Camera 1	11:02:49	-13:27:21	J2000	5-11	3h	The coordinates refer to the centre of TESS Camera 1 of Sector 9. Targets within ∼12 degrees from the centre.
Sect. 10,Camera 1	12:39:36	-23:53:16	J2000	5-11	3h	The coordinates refer to the centre of TESS Camera 1 of Sector 10. Targets within ∼12 degrees from the centre.

12. Observational strategy and justification of requested time, including overheads.

We propose to observe with HARPS-N ∼6, well selected, bright stars ($5 \leq V \leq 11$) from the northernmost TESS Camera (#1) in Sectors 2, 3, 4, 5, 6, 7, 8, 9, and 10. The RV semi-amplitude variation induced by a 10 $M_{\oplus}$-mass planet in a 3-day circular orbit around a 1-solar mass star (a =0.04 AU) is ∼4.5 m/s. HARPS-N is the state-of-the-art spectrograph specifically designed to provide very high precision RV measurements, the only instrument in the northern hemisphere capable to achieve the ∼1 m/s level precision needed to detected the Doppler reflex motion of low-mass small exoplanets.

Given the position and size of the proposed TESS fields, service-mode observations evenly distributed in April-May and August-September are suited for the proposed program. Single-epoch observation per target per night are preferred. Multi-target observations per service night are possible.

Based on our experience with previous HARPS-N RV follow-ups of planetary candidates and the exposure time calculator, 25-min exposures will enable RV precisions of ∼1 m/s and SNR∼60 on a slowly rotating (vsini $<$ 3 km/s), V≈11 mag, solar like star, averaging out both granulation- and oscillation-induced jitter. Assuming 5 min overheads (preset, target acquisition, CCD readout), we need 0.5 h per target per observation epoch.

The first spectrum will allow us to remove rapidly rotating stars, double-lined binaries, multiple systems, and blends of spectral components. Thanks to the precise transit ephemeris from TESS, a second spectrum at a different epoch will give us a first estimate of the RV amplitude, where large amplitudes (several km/s) indicate single-lined binary systems. Thus 2 exposures of 0.5 h per target are needed to rule out false alarm cases, leading to a total of 6 h. Based on the expected false positive rate of TESS planets and our experience with RV follow-up of CoRoT, Kepler, and K2 transiting candidates, we anticipate that ∼3 candidates will be confirmed as *bona fide* planets around quiet solar-like stars ($\log R'_{HK} < -5.0$). Observations to generate evenly covered RV curves of these 3 systems are expected to require another ∼24 h, leading to a total of 30 h.

As the determination of the planetary proprieties strongly depends also on the knowledge of the host star, the co-added HARPS-N spectra will be used to derive the fundamental stellar parameters (effective temperature, surface gravity, metal abundance), which along with Gaia parallax and evolutionary tracks, will provide the stellar mass and radius, and hence the planet mass and radius.

We emphasize that all aspects of the present project will serve to prepare Europe's next space programs for exoplanetary science, namely, CHEOPS and PLATO. One of the main objective of CHEOPS and PLATO is the study of small planets. Given the small number of small planets with precise mass, radius, and density determinations, we are confident that every single discovery will be a test bench for planet formation theories. Our sample will provide theorists with a solid base of observational data. Given the impact of our discovery for the study of properties of small planets, we plan to publish a paper for each discovery.

13. Requested instrument(s) setup

Id	Instrument	Binning	Filter(s)	Slit	Grism	Time	Additional Information
1	HARPS-N	1x1	none	115000		30hr	2nd fibre on sky or simultaneous FP, depending on target brightness (see below).

14a. Moonlight constraints

Max. # of days from new moon 10

14b. Scheduling constraints, special requirements and other remarks
(please include justification of constraints in 14a)

Given the magnitude upper limit of our targets (V=11), grey/dark time is preferred with illumination fraction <70% and moon distance >50 deg. For the faintest targets (9<V<11), we will monitor the sky-background with the sim. sky fibre. For the brightest targets (V<9), we will use the sim. FP. In case of poor sky conditions, the observations will focus on the brightest targets. Service-mode observations (1-3 h blocks) randomly distributed in Apr/May and Aug/Sep are suited for this program. Should the required scheduling be complicated, half nights (preferably non-consecutive) are also fine in Apr/May (1st half) and Aug/Sep (2nd half).

15. Observational background of the applicants

Name of the observer(s) at TNG: D. Gandolfi, S. Albrecht, F. Cusano, M. Esposito, E. Knudstrup, M. Fridlund can carry out visitor mode observations, if no service mode can be allocated for scheduling reasons.

Experience of the observer(s) with the requested TNG instrument(s)

D. Gandolfi, S. Albrecht, F. Cusano, M. Esposito are very familiar with the TNG instruments and environment.

We stress that the results we anticipated in previous HARPS-N runs have been achieved. We precisely measured the masses of 16 small transiting planets: K2-19 b & c (Nespral et al. 2016); GJ 9827 b, c, d (Niraula et al. 2017; Prieto-Arranz et al. 2018), C5 4238 b (Nowak et al. 2018); K2_234 b (Van Eylen et al. 2018); K2-216 b (Persson et al. 2018); K2-180 b (Korth et al. 2019); K2-261 b (Johnson et al. 2018), EPIC 246471491 b & c (Palle et al. 2018), HD 3167 b & c (Gandolfi et al. 2017), K2-131 b (Dai et al., 2017), K2-106 b & c (Guenther et al. 2017). The large number of planets discovered and characterized by our team serves as strong evidence that our objectives will be achieved.

HARPS-N targets will be ranked according to brightness and level of magnetic activity. Small planets transiting bright, inactive (log RHK < 5.0), well-vetted, slowly-rotating (v sini < 3 km/s), solar-like stars will have the highest priority. Before investing HARPS-N time, the transit light curve will have to pass all relevant tests (e.g., transit shape and duration, odd-even depth variation) to exclude obvious eclipsing binary scenarios. We will use structure models to study planetary internal compositions, in combination with thermodynamic and geophysics toolkit for small planets (e.g., https://burnman.org/) and precise stellar metallicity.

Experience of the observer(s) with other telescopes/instruments

All the applicants have long experience in exoplanet detection and characterization by transit and RV methods, and have multi-competences in spectroscopy and photometric data reduction, spectral analysis, and RV measurements with many instruments such as FIES, HARPS-S, HARPS-N, HIRES, FLAMES, UVES, SARG. Our transit detection team can produce high-quality transiting candidates and has all the routines needed for a swift characterization. Our team has extensive experience with rapid transit detection, vetting, and characterization of K2 transiting planet candidates. Building on this expertise, we will continue this effort for TESS observations. Our team spans all required skills to quickly and effectively detect and characterize new transiting planets. We have experts in photometric data analysis (e.g., CoRoT, Kepler, K2) and in-house state-of-the-art transit detection algorithms and target vetting procedures. We further have experts in stellar characterization. Similarly, we have many years of experience with RV campaigns in follow-up of transiting planets, and will apply lessons learned from K2 for the TESS target selection and observing strategy.