Time Allocation Committee for
MPG time at the ESO 2.2m-telescope
c/o MPI für Astronomie
Königstuhl 17
D-69117 Heidelberg / Germany

Application No.
Observing period **Autumn 2021**
Received

APPLICATION FOR OBSERVING TIME

from [X] MPIA [ ] MPG institute [ ] other

1. Telescope: 2.2-m **[X]** **L**

2.1 Applicant

Dr. Olga **Zakhozhay**	MPIA / MAO NASU (Kiev, Ukraine)
Name	Institute
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street	ZIP code - city
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ESO User Portal username	e-mail

2.2 Collaborators

R. Launhardt[1], Th. Henning[1]	[1]MPIA
name(s)	institute(s)
S. Reffert[2], M. Kürster[1], T. Trifonov[1]	[1]MPIA, [2]LSW
name(s)	institute(s)

2.3 Observers

Olga Zakhozhay	
name	name

By specifying the names under item 2.3 it is obligatory to also send out these observers to La Silla, if required. Correspondence on the rating of this application will be sent to the applicant (P.I.) as quoted under 2.1 above.

3. Observing programme: Category: [E]

Title : **Radial Velocity Survey for Planets around Young stars (*RVSPY*)**

Abstract : We propose to continue our radial velocity search for planets around young stars with debris disks. By the end of the 6th observing semester, we have obtained at least one sufficient series of high-cadence observations for 106 of all 111 survey targets. During the following semesters, we plan to complete the initial high-cadence survey for the 5 remaining stars and to obtain follow-up spectra with individually adapted cadence for 48 targets which are down-selected from the full sample. The large target overlap between our RV survey and the NaCo–*ISPY* ESO–GTO direct imaging survey will enable us to infer the up-to-date most robust constraints on the occurrence and properties of giant planets in debris disks.

4. Instrument: [ ] WFI [X] FEROS [ ] GROND

5. Brightness range of objects to be observed: from 4.5 to 10.6 V-mag

6. Number of hours:

applied for			already awarded	still needed
62			885	400
no restriction	grey	dark		

7. Optimum date range for the observations: .... 10.2021 – 03.2022
Usable range in local sideral time LST: .... 20h – 17h

Astrophysical context

Planets and some brown dwarfs (BD) are born in gaseous protoplanetary disks that surround young stars during the first few million years. While we now regularly gain new insights into the structure and composition of protoplanetary disks, detections of forming protoplanets in such disks are still extremely challenging and therefore rare [22, 1, 19, 9]. Within only a few million years, protoplantary disks lose their gas due to accretion onto the star and newly formed planets, but also via disk winds. By this time, the primordial dust has coagulated to pebbles and planetesimals or has been accreted onto planets. Collisional cascades within the disk then lead to the formation of debris dust. Relatively massive debris disks characterize the phase after initial planet formation, when the planetary systems still evolve due to dynamical interactions. By this time, the stars experience already much less chromospheric activity than at younger ages such that planet searches become possible, albeit still challenging [20]. Several properties of debris disks like, e.g., outer dust belts that are larger than predicted by collisional cascade models, or the co-existence of hot inner dust belts, can be explained by the action of newly formed planets [15]. Thus, the observable properties of debris disks could be indicative of embedded planetary systems. Yet, the relation between debris disk properties and the existence and properties of planets is observationally poorly constrained. There is, however, growing evidence that the frequency of giant planets (GP) in young debris disks is significantly higher than around main-sequence (MS) stars [14]. In order to systematically investigate the relation between debris disk properties and GPs, we have initiated the large NaCo–*ISPY* ESO–GTO direct Imaging Survey for Planets around Young stars [10]. Since this imaging survey is only sensitive to companions at large separations (>5-10 au), we have launched in 2017 the first and complementary radial velocity (RV) survey for planets in shorter orbits around these debris disk stars (*RVSPY*).

Immediate aim

We propose to continue our systematic *RV* survey for GPs and BDs around debris disk stars in orbits shorter than probed by direct imaging. The immediate aim of this proposal is two-fold: *(1)* Complete the initial screening of all 111 selected targets for both activity-related rotational modulation and the presence of hot companions (HC), which both have typical periods of a few days and thus require high-cadence observations, and *(2)* Continue the longer-term *RV* monitoring of those targets that have proven to have low-enough activity jitter to allow for the detection of potential longer-period (up to 2-3 yrs) GPs. Since HCs induce much larger *RV* signals than longer-period planets, they are also the 'easiest' targets. Longer-period planets induce smaller RV amplitudes and are difficult to identify if the activity-related *RV* jitter is too large. Therefore, the initial high-cadence phase of our survey aims at searching for HC and characterizing the stellar activity jitter, which is a prerequisite for identifying those stars for which we have a chance of detecting longer-period planets. Figure 4 shows the achievable companion mass detection limits for 1-year orbital periods, here assumed to be $3\,\sigma$ above the activity jitter derived from the high-cadence observations. Based on this evaluation, we have selected those stars that are suitable for longer-term *RV* monitoring to search for planets on longer-period orbits and thus further decrease the gap in orbital separations probed by imaging and the *RV* search. Figure 1 illustrates the detection spaces of the two related surveys. This evident synergy is thus far unique and makes the proposed *RV* survey scientifically extremely valuable. Target selection criteria are described in Box 8e. Target list parameter distributions are shown in Fig. 2. Sample size and number of required data points are justified in Box 10.

Previous work

During the first six semesters, we have observed all 111 stars in high cadence, but 5 stars have insufficient/interrupted time series. Preliminary analysis of the *RVs* shows that we can sub-divide our sample into 5 categories: *(1)* stars with companion candidates (Fig. 5), *(2)* stars with indication of a long-term *RV* trend, *(3)* stars with evidence for rotational modulation, *(4)* binary stars, and *(5)* stars with inconclusive RV modulation. 18 stars from categories *(1)* and *(2)* have the highest priority for follow-up observations (Box 9), among which 9 stars have indications for short period (<14 d) and 9 for long-period (>14 d) signals.

Layout of observations

We request 62 hrs distributed in 2 blocks of 14–17 consecutive nights to complete the initial high-cadence survey (5 stars) and to follow up the most promising targets for longer-term monitoring with individually adapted cadence. The high-cadence observations will be interlaced with the follow-up monitoring observations. Spectra will be taken in the object–calibration mode of FEROS. Selected RV standards will be observed during each run.

Strategic importance for MPIA

The search for and characterization of exoplanets is one of the key research topics at MPIA. Exploiting the synergy of this survey with the NaCo-*ISPY* survey is a strategic key project of the PSF department. Such a survey will only be successful if it is carried out without larger interruptions over a time span of several years and is therefore only feasible in the framework of guaranteed time observations.

8b. Figures and tables

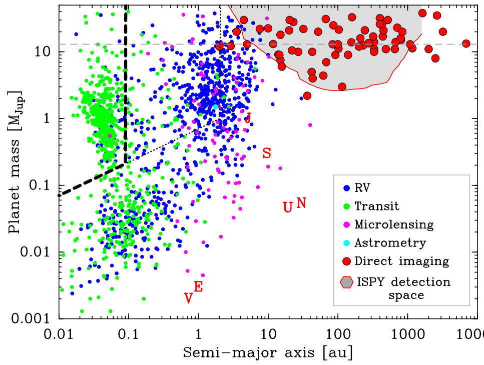

Figure 1: Distribution of planet mass vs. orbital separation of known exoplanets as listed on exoplanet.eu. Detection methods are marked by different symbols and colors. The grey-shaded area shows the parameter space probed by NaCo-*ISPY*. The black dashed and dotted lines show the parameter space probed by the *RVSPY* high-cadence survey and the three year extension.

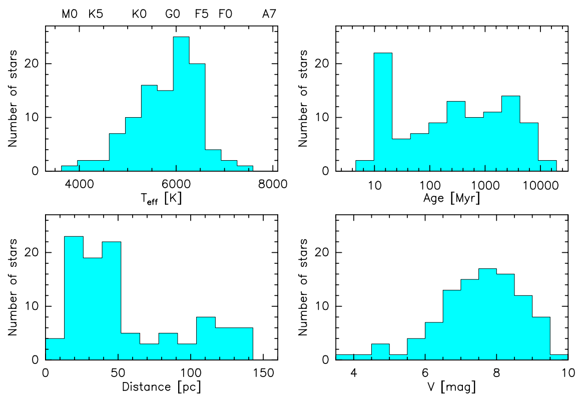

Figure 2: Distribution of effective stellar temperatures (and spectral types), ages, distances, and V magnitudes of our survey targets.

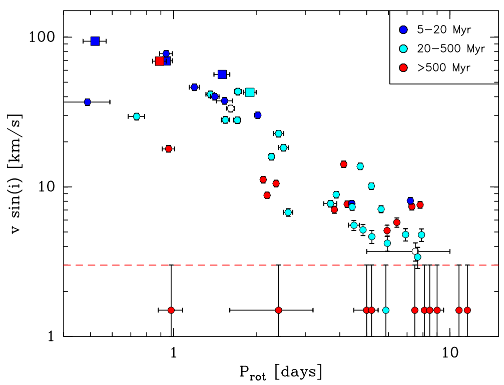

Figure 3: *RVSPY* FEROS derived $v\,sin\,i$, vs. stellar rotation periods derived from TESS light curves. Ages are color-coded. Squares mark targets with a strong positive $BS(RV)$ correlation ($r_P > 0.7$). The horizontal dashed red line marks the lower sensitivity limit of our $v\,sin\,i$ measurements).

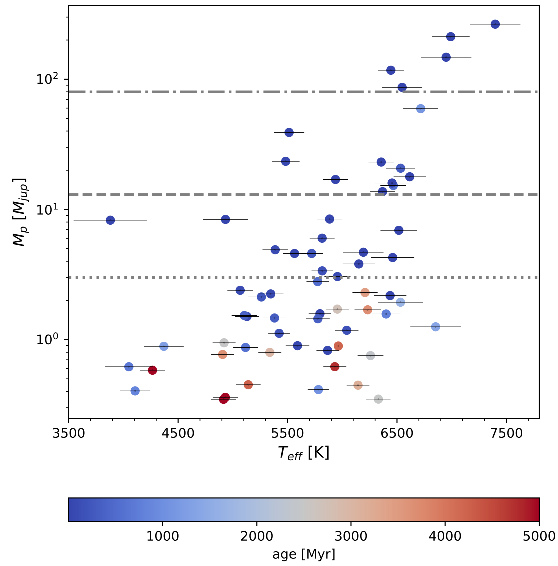

Figure 4: Masses of P=1 yr hypotetical companions that induce an RV amplitude 3× larger than the activity jitter RMS derived from the high-cadence observations, vs. host star $T_{\rm eff}$. The dot-dashed line marks the boundary between the stellar and substellar regimes and the dashed line marks the boundary between the planetary and brown dwarf regime. The dotted line marks the $3\,M_{\rm Jup}$ planetary mass that will be used prioritize the targets.

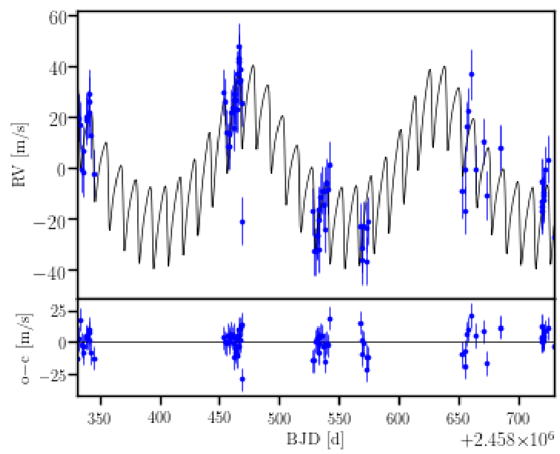

Figure 5: FEROS *RV*s of HD 23484 (blue circles) and best fit model (χ^2_ν=1.18) with two companions with m sin(i)∼0.6 and ∼0.2 M_{jup} and periods of 159 and 12 days, respectively (black curve). The lower panel shows the *RV* residuals.

8e. Current logistics of PhD thesis/long term programme

General: While we are still completing the initial high-cadence survey for those targets that did not get sufficient high-cadence sequences due to weather or technical problems, the present proposal aims already mostly on follow-up monitoring of promising targets identified from the high-cadence observations during the first three observing years of the *RVSPY* program. The follow-up monitoring for individual targets may extend up to 4–5 yrs, with the observing load decreasing over time. Depending on the level and time scales of the activity jitter, follow-up observations for identifying longer-term *RV* variations also require taking several (of order five) spectra, distributed over a few nights, to average out the short-term jitter, which is mostly caused by rotational modulation.

Continuity in the project is guaranteed by the PI (OZ) having a permanent position (in Ukraine) and an agreement with MPIA (TH) for long-term guest status with an initial 1-year stay at MPIA and later frequent short-term visits. Other members of the team also have permanent or longer-term positions. Extensive expertive in observing, data reduction, and analysis is available in the team. Computing and data storage capacities at MPIA are available and arranged (e.g., access to the astro-node cluster).

Target selection: Our target list contains only stars with confirmed debris disk signature and with ages $\geq$ 10 Myrs (to avoid the most active early phases). Spectral types are restricted to the range F5–M3 (with very few exceptions) because earlier types have too broad and too few spectral lines and later spectral types are known to have less massive debris disks and fewer giant planets. We also set a brightness limit at V$\leq$10.5 mag to limit individual exposure times. About 50% of our targets are also being imaged with NaCo in the framework of the *ISPY* GTO program (due to various method-related constraints, complete overlap is not possible). We have queried the ESO archive for useful RV data (FEROS, HAPRS, HIRES) for all $\approx$200 target candidates from our master list complied with the above selection criteria. We keep stars with less than 10 archive spectra in our final survey list. Stars with $\geq$120 spectra are excluded, but we will analyse their archive data in the same way as our own FEROS spectra and include the results in our survey analysis. For stars with an intermediate number of archive spectra, we verified case by case whether sequences of spectra with sufficiently high cadence are available and included or rejected them from our survey list. The final survey target list consists of 111 stars which are evenly distributed over the sky.

Complementary data: We will complement our spectra by all available archival spectra which qualify for our purposes and can be calibrated to be combined with our FEROS data. Furthermore, the majority of our targets (88%) are in the TESS observing list. The analysis of the TESS data that are already publicly available already allowed us to derive the rotational periods for the majority of our stars (see Fig.3 and [27] for more details). We are also prepared to exploit the *Gaia* individual measurement data when they will be released to bridge the remaining gap at orbital separations of a few au in detection space.

Analysis tools and strategy: The unofficial sub-title of our initial high-cadence survey, *"Hot planets and rubble - lets face the trouble"*, already suggests that planet signals won't come out easy for these still relatively young stars and we have to deal a lot with the effects of stellar activity. Rotational modulation of spectral line shapes can both induce large RV jitter that may mask a planetary RV signal or even mimic a planetary signal when the spots are very stable. Therefore, we need to analyse and cross-correlate with the RV variations several activity indicators (well-established ones, but also new ones recently developed by us), like, e.g., Ca II line emission, H_α line parameters, the V I and Fe I line depth ratio, the bisector velocity span, displacement, and curvature, or the chromatic RV index, which is now routinely used in the *Carmenes* M-star survey [26]. While the reduction of the spectra and extraction of RVs will be done in a semi-automatic fashion with the *CERES* pipeline [2], the spectral type classification and extraction of most activity indicators will be done with the *ZASPE* [3] and *ATHOS* [8] pipelines. For the analysis, we have all necessary tools available: individual line measurement (e.g. for equivalent width), circumstellar disk component analysis, bisector analysis, synthetic spectrum calculation and fitting, multicomponent Gauss fitting for wind/accretion analysis, spot modelling, periodograms (GLS, LS, BGLS, and others), 2D line velocity maps including 2D periodograms, Kepler orbit fitting (for single and multiple planets), etc. Based on our results together with the information about spectral type, $v \sin i$, stellar inclination and age of each individual target we are identifying quiet stars and stars for which the activity can be modelled well enough. These stars are the targets for the longer-term monitoring phase of our survey, which is aimed at detecting and characterising planetary companions with longer periods (up to 2 yrs).

Publication plan: We submitted a first paper about preliminary results of the first year of high-cadence survey to A&A in July 2020. However, the editor did not accept this paper about partial results and requested us to complete the high-cadence survey before attempting to resubmit a new version of the paper. We are currently revising this paper with the high-cadence survey current-status results of all 106 observed targets. The latest version of this paper draft is attached to this proposal. In addition, a paper about the discovery of sub-Jupiter mass companions to one of our target stars is already in an advanced stage. Additional publications on individual targets with interesting results (activity, multiplicity or HCs) are in the stage of discussions and preliminary analysis - more observational data are needed for solid conclusions.

9. Objects to be observed

(Objects to be observed with high priority should be marked in last column)

Designation	α (2000)	δ (2000)	magnitude in spectral range to be observed	priority
HD 870[a]	$00^h\,12^m\,50^s.249$	$-57^\circ\,54'\,45.390''$	7.226	2[b]
HD 3296	$00^h\,36^m\,01^s.854$	$-05^\circ\,34'\,14.590''$	6.71	2
HD 3670	$00^h\,38^m\,56^s.704$	$-52^\circ\,32'\,03.420''$	8.21	2
HD 5133	$00^h\,53^m\,01^s.135$	$-30^\circ\,21'\,24.900''$	7.171	2
HD 7570	$01^h\,15^m\,11^s.122$	$-45^\circ\,31'\,54''000$	4.96	2
HD 13246	$02^h\,07^m\,26^s.020$	$-59^\circ\,40'\,45.780''$	7.5	2
HD 20759	$03^h\,19^m\,23^s.566$	$-36^\circ\,33'\,53''550$	7.71	2
HD 23484	$03^h\,44^m\,09^s.173$	$-38^\circ\,16'\,54.380''$	6.996	1
BD +23 551	$03^h\,48^m\,16^s.910$	$23^\circ\,38'\,12.500''$	10.11	2
HD 28069	$04^h\,25^m\,57^s.34$	$05^\circ\,09'\,00''52$	7.4	2
HD 28447	$04^h\,30^m\,20^s.057$	$28^\circ\,07'\,54''800$	6.515	2
HD 33081	$05^h\,07^m\,08^s.669$	$-17^\circ\,17'\,59''710$	7.04	1
SAO 150676	$05^h\,40^m\,20^s.736$	$-19^\circ\,40'\,10''830$	8.961	2
HD 43989	$06^h\,19^m\,08^s.050$	$-03^\circ\,26'\,19''990$	7.95	2
HD 48370	$06^h\,43^m\,01^s.023$	$-02^\circ\,53'\,19.340''$	7.91	2
HD 50571	$06^h\,50^m\,01^s.015$	$-60^\circ\,14'\,56.920''$	6.098	1
HD 53143	$06^h\,59^m\,59^s.850$	$-61^\circ\,20'\,12''570$	6.81	1
HD 57703	$07^h\,23^m\,04^s.61$	$18^\circ\,16'\,24''28$	6.8	2
HD 59659	$07^h\,28^m\,30^s.06$	$-49^\circ\,08'\,58''89$	8.9	1
HD 76151	$08^h\,54^m\,17^s.948$	$-05^\circ\,26'\,04''060$	6.0	2
HD 76748	$08^h\,54^m\,51^s.204$	$-63^\circ\,42'\,06''990$	9.44	1
HD 76653	$08^h\,55^m\,11^s.782$	$-54^\circ\,57'\,56''770$	5.698	1
HD 84075	$09^h\,36^m\,17^s.823$	$-78^\circ\,20'\,41''590$	8.59	2
HD 104231	$12^h\,00^m\,09^s.405$	$-57^\circ\,07'\,02''000$	8.54	2
HD 105912	$12^h\,11^m\,21^s.799$	$-03^\circ\,46'\,43''940$	6.94	1
HD 108857	$12^h\,30^m\,46^s.274$	$-58^\circ\,11'\,16''770$	8.6	1
HD 111520	$12^h\,50^m\,19^s.717$	$-49^\circ\,51'\,48''960$	8.87	2
HD 114082	$13^h\,09^m\,16^s.190$	$-60^\circ\,18'\,30''050$	8.21	1
HD 118972	$13^h\,41^m\,04^s.171$	$-34^\circ\,27'\,50''970$	6.92	2
HD 125451	$14^h\,19^m\,16^s.220$	$13^\circ\,00'\,15''760$	5.41	1
MML 43	$14^h\,27^m\,05^s.561$	$-47^\circ\,14'\,21''750$	10.585	1
HD 129590	$14^h\,44^m\,30^s.964$	$-39^\circ\,59'\,20''610$	9.33	1
HD 131156	$14^h\,51^m\,23^s.28$	$19^\circ\,06'\,02''28$	4.54	1
HD 134910	$15^h\,13^m\,50^s.39$	$-40^\circ\,25'\,01''91$	9.6	2
HD 135953	$15^h\,19^m\,05^s.420$	$-36^\circ\,21'\,44''210$	9.36	2
HD 138398	$15^h\,33^m\,51^s.925$	$-50^\circ\,05'\,23''890$	8.29	2
HD 141011	$15^h\,48^m\,24^s.783$	$-42^\circ\,37'\,05''010$	8.97	2
HD 143811	$16^h\,03^m\,33^s.425$	$-30^\circ\,08'\,13''360$	8.91	2
HD 145560	$16^h\,13^m\,34^s.333$	$-45^\circ\,49'\,03''660$	8.9	2
HD 146181	$16^h\,16^m\,28^s.370$	$-38^\circ\,44'\,12''360$	9.16	2
HD 180134	$19^h\,18^m\,09^s.760$	$-53^\circ\,23'\,12''800$	6.36	1

[a]We list here only 40 (sorted by RA) of 53 follow-up survey targets due to the space limitations.
[b]Priority 1 is given to the most promising targets based on the initial high cadence survey (for more details see "Previous work" in Box 8a). Priority 2 is given to the stars for which the existence of long period can not be excluded according to figure 4 and currently available data.

10. Justification of the amount of observing time requested:

For statistical reasons, in order to put robust constraints on the frequency of GPs in debris disks and their relation to debris disk properties, we would ideally have a sample size of ≥200 stars. Taking into account the time that is realistically available with FEROS, the minimum number and sampling of data points per star for the proposed initial high-cadence screening, the target selection criteria set by the observing method and instrument (see Box 8e), and the number of suitable stars matching our selection criteria for which we found a sufficient number of qualified spectra in the ESO archives (these stars will not be re-observed, but re-reduced and included in our statistical analysis), we down-selected the list of targets for this survey to 111 stars. Including archival data, which will be included in our statistical survey analysis, we will then have a total sample size of ≈200 stars.
To characterize the stars for activity-related rotational modulation and identify HC candidates, we need about 15 high-SNR spectra for every star, distributed such that the relevant periods (distribution mean ≈3–4 days) are sampled. Since the more quiet stars in our sample have an RV jitter of order 10–20 m/s, we aim for an intrinsic RV precision of the same order, which we are typically achieving with an $SNR \approx 100$. Based on experience (more accurate than the ETC), we need integration times between 3 min for stars with V≤ 6 mag and 20 min for stars with V= 10 − 11 mag to achieve this. With integration times adapted to each individual star, we need a total of 10.5 hrs integration time (or 14.0 hrs of telescope time, accounting 4 min overhead per pointing) to obtain one high-SNR spectrum for each of the 53 target stars that we intent to observe in the next semesters.
In P101-106,we already have got 885 hrs and observed all 111 survey stars in high cadence. However, for 5 of these stars, we could not obtain sufficiently sampled time series due to weather and technical losses. Therefore, in p107 and p108, we anticipate to observe these 5 stars with high-cadence and to follow-up those 48 stars with individually adapted cadence (mostly 3-7 observations per run), which are the most promising candidates for longer-term RV monitoring. To continue our program at the same pace and be able to complete the initial high-cadence screening of all 111 survey targets with at least 15 spectra per star, we therefore request a total of 62 hrs of telescope time in the autumn 2021 semester (p108), subdivided into two observing blocks with 12 − 14 consecutive nights each.

11. Constraints for scheduling observations for this application:

The requested two observing blocks can be scheduled with at least 3 month separation across the semester in service or visitor mode. The best and most complete scheduling of the requested 62 hrs can be achieved when the observations are scheduled during October 2021 (30.5 hrs) and March 2022 (31.5 hrs). Each observing block ideally consists of the even fractions of 12 − 14 consecutive nights (i.e. ∼2.2 hrs per night in October and ∼2.3 hrs per night in March). This will allow us to observe all stars which require high-cadence follow-up observations during 14 consecutive nights. The targets we follow-up for longer-period companions will be observed about 3–4 times within one week of the run to account for the stellar rotational modulations.

12. Observational experience of observer(s) named under 2.3:
(at least one observer must have sufficient experience)

OZ, RL, SR, MK, TT all have a large observing experience with FEROS and other high resolution spectrographs.

13. Observing runs at the ESO 2.2m-telscope (preferably during the last 3 years)
and publications resulting from these

Telescope	instrument	date	hours	success rate	publications
2.2m	FEROS	many runs	many hours	80%	[21, 22, 16, 17, 18, 11, 7]
3.5m	HARPS	P97	120	70%	[23, 24]
2.2m	FEROS	P99	20	80%	[24]
2.2m	FEROS	P101	165	87%	[27] [a]
2.2m	FEROS	P102	130	92%	[27] [a]
2.2m	FEROS	P103	140	79%	[27] [a]
2.2m	FEROS	P104	150	50%	[27] [a]
2.2m	FEROS	P105	140	0	--
2.2m	FEROS	P106	140	50%	[27] [a]
2.2m	FEROS	P107	140	observations ongoing	observations ongoing

[a] We are currently preparing for submission the first paper that will introduce the results of the initial high-cadence survey, see *Publication plan* in Box 8e for more details (the latest version of the draft is attached to this proposal).

14. References for items 8 and 13:

[1] Biller et al. (2012): *A likely close-in low-mass stellar companion to the transitional disk star HD 142527*, ApJL, **753**, L38

[2] Brahm et al.(2017a): *CERES: A Set of Automated Routines for Echelle Spectra*, PASP bf 129, 034002

[3] Brahm et al.(2017b): *ZASPE: A Code to Measure Stellar Atmospheric Parameters and their Covariance from Spectra*, MNRAS **467**, 971

[4] Chen et al. (2014): *The Spitzer Infrared Spectrograph Debris Disk Catalog. I. Continuum Analysis of Unresolved Targets*, ApJS **211**, 25

[5] ESO Science Archive: http://archive.eso.org

[6] Extrasolar Planets Encyclopaedia: http://exoplanet.eu

[7] Fang et al. (2014): *GW Orionis: Inner disk readjustments in a triple system*, A&A **570**, 118

[8] Hanke et al. (2018): *ATHOS: On-the-fly stellar parameter determination of FGK stars based on flux ratios from optical spectra*, A&A **619**, 134

[9] Keppler et al.(2018): *Discovery of a planetary-mass companion within the gap of the transition disk around PDS 70*, A&A **617**, A44

[10] Launhardt et al.(2020): *ISPY-NACO Imaging Survey for Planets around Young stars. Survey description and results from the first 2.5 years of observations*, A&A **635**, A162

[11] Kóspál et al. (2014): *Radial velocity variations in the young eruptive star EX Lup*, A&A **561**, 61

[12] Marshall et al.(2014): *Interpreting the extended emission around three nearby debris disc host stars*, A&A **570**, A114

[13] MASCARA survey: http://mascara.strw.leidenuniv.nl

[14] Meshkat et al.(2017):*A Direct Imaging Survey of Spitzer detected debris disks: Occurrence of giant planets in dusty systems*, AJ **154**, 245

[15] Moór et al.(2015): *Stirring in massive, young debris discs from spatially resolved Herschel images*, MNRAS **447**, 577

[16] Müller et al. (2011): *A young star has reached its rotational limit*, A&A **530**, A85

[17] Müller et al. (2011): *HD 144432: A young triple system*, A&A **535**, 3

[18] Müller et al. (2013): *Reanalysis of the FEROS observations of HIP 11952*, A&A **556**, 3

[19] Rameau et al. (2013): *Confirmation of the Planet around HD 95086 by Direct Imaging*, ApJL, **779**, L26

[20] Scott (2017): *The long-term evolution of stellar activity*, Living Around Active Stars, Proceedings IAU Symposium **328**, 252

[21] Setiawan et al. (2007): *Evidence for a planetary companion around a young star*, ApJ **660**, L145

[22] Setiawan et al. (2008): *A young massive planet in a star-disk system*, Nature **451**, 38

[23] Trifonov et al. (2017): *Three planets around HD 27894. A close-in pair with a 2:1 period ratio and an eccentric Jovian planet at 5.4 AU*, A&A **602**, 8

[24] Trifonov et al. (2018): *New HARPS and FEROS observations of GJ1046*, RNAAS, **2**, 180

[25] Wright et al.(2012): *The Frequency of Hot Jupiters Orbiting nearby Solar-type Stars*, ApJ **753**, 160

[26] Zechmeister et al. (2017): *SERVAL - The spectrum radial velocity analyser*, A&A, **69**, A12

[27] Zakhozhay et al. (2021): *Radial Velocity Survey for Planets around Young stars (RVSPY)*, A&A, in preparation (the latest version of the draft is attached to this proposal)

Tolerance limits for planned observations:

maximum seeing:	$2''$	**minimum transparency:**	60%	**maximum airmass:**	1.8
photometric conditions:	no	**moon: max. phase / $\angle$:**	$1/10^{\circ}$	**min. / max. lag:**	0/0 nights