SPICA-VIS

Science Survey Management

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CHANGE RECORD

ISSUE	DATE	SECTION	COMMENTS
1	05/05/2020	All	Creation DM/NN
1.1	20/05/2020	4	DM: definition of flags ***Type, Priority, Activity***. Details of parameters and catalogues of WP8
1.2	25/05/2020	4	NN: Definition of flags '***Sbcr***'. Details of parameters and catalogues of WP7
1.3	26/05/2020	Annex	DM: New Annex summarizing the flags
1.4	26/05/2020	4, Annex	NN: Introduction of ***Priority_wps***, ***Priority_sbcr*** and ***Priority_obs***
1.5	26/05/2020	4, Annex	NN: Introduction of ***Priority_LD*** and ***WP*****,** additional activity flags
1.6	03/06/2020	3, 4, Annex 2	NN/DM: coordination of the work (Section 3) and new figure. NN: Introduction of flag ***Quality*** and annex 2 about common and specific parameters.
1.7	09/06/2020	3	NN/DM: Text summarizing the strategy.
1.8	18/06/2020	All	Improvement of the text. Polishing. Add of a summary in Sect. 4. Improvement of annex. Start to include WP1 parameters from table of RL.
1.9	30/06/2020	All	Version almost ready for the Design Review
2.0	25/08/2020	All	Polishing of text by NN. NN: description of flag Quality in the Annex

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1. Scope

The scope of this document is to describe the construction of the list of targets, its management, and the different tasks to be accomplished for the realization of the science survey with CHARA/SPICA.

2. The SPICA/Science Group Working Groups

One of the main goals of the CHARA/SPICA instrument (Mourard et al. 2018) is to measure a sample of 1000 stars and to feed the OIDB database of JMMC. Observations are expected to start at the end of 2021. We have defined a first phase of 3 years aiming at measuring 800 diameters and obtaining 200 images of surface of stars. In the second phase (after 2024 and the knowledge of the PLATO field), an additional effort will be done to cover extensively the PLATO field, and additional science programs will be developed. After the launch of the PLATO mission (2027), CHARA/SPICA will continue its science collection and will serve as ground follow-up of interesting PLATO targets.

By considering 4 stars per sub-spectral type and class reachable by CHARA/SPICA and a time constrain of 3 years 2022-2024 (80 nights per year, 15 stars per night) we obtain these numbers for each WP (800 diameters based on 2 observations per stars, 200 images based on 10 observations per star) with the following code: D for diameter determination, I for "images", but it can also mean "full characterization" of stellar activity or a binary monitoring.

To realize the scientific objectives of the CHARA/SPICA project which have been mainly defined during the kick-off meeting in January 2019 (https://chara-spica-ws.sciencesconf.org/), the Science Group has defined 13 workpackages that are shortly presented hereafter:

- **WP1 – Exoplanet Host Stars**
  - Survey: 60D+5I = 65* for analysis of fundamental parameters of stars and planets + inputs for SBCR (WP7) + input for study of stellar activity (WP8, 9, 12) + input for LD (WP11)
  - *R. Ligi, T. Boyajian, A. Chiavassa, A. Gallenne, R. M. Roettenbacher, R. Szabos, M. Wittkowski, T. Guillot, A. Crida, S. Albrecht, Borgniet, S., D. Mourard, N. Nardetto*
- **WP2 – known asteroseismic targets F5 to K7 dwarfs**
  - Survey: 185D+16I = 200* for analysis of fundamental parameters of stars + inputs for SBCR (WP7) + input for study of stellar activity (WP8, 9, 12) + input for LD (WP11)
  - *O. Creevey, K. Belkacem, T. Boyajian, R. Ligi, T. Morel, R. M. Roettenbacher, R. Szabo, W. J. Chaplin, D. Mourard, N. Nardetto, M. Bazot, D. B. Palakkatharappil*
- **WP3 – known asteroseismic targets F5 to K7 giants (and sub-giants)**
  - Survey: 92D+8I = 100* for analysis of fundamental parameters of stars + inputs for SBCR (WP7) + input for study of stellar activity (WP8, 9, 12) + input for LD (WP11)
  - *K. Belkacem, O. Creevey, R. Ligi, R. M. Roettenbacher, R. Szabos, W. J. Chaplin, D. Mourard, T. Morel, Y. Lebreton, S. Deheuvels, N. Nardetto, M. Bazot*
- **WP4 – B4-F5 asteroseismic/pulsating stars**
  - Survey: 252D+22I = 275* for analysis of fundamental parameters of stars + inputs for SBCR (WP7) + input for study of stellar activity (WP8, 9, 12) + input for LD (WP11)
  - *N. Nardetto, M. Wittkowski, A. Salsi, G. Duvert, A. Chelli, P. Mathias, possibly K. Perraut to be contacted*
- **WP5 – K7 to M dwarfs**
  - Survey: 64D+3I = 67* for analysis of fundamental parameters of stars + inputs for SBCR + input for study of stellar activity (WP8, 9, 12) + input for LD (WP11)

- *T. Boyajian, R. Ligi, T. Morel, A. Salsi, D. Graczyk, N. Nardetto*

- **WP6 – O, B1, B2, B3:**
  - Survey: 83D+7I = 90* for analysis of fundamental parameters of stars + calibration of the SBCR + input for study of stellar activity (WP8, 9, 12) + input for LD (WP11)
  - *D. Graczyk, A. Salsi, N. Nardetto, A. Meilland, A. Domiciano*
- **WP7 – SBCR Analysis: WP to be connected to WP1, 2, 3, 5 and 6**:
  - A priority flag will be given in the lists of stars from WP1-6 in order to cover the HR diagram with 4 stars per sub-spectral type and class. If necessary, additional stars will be added. The priority given to stars in WP1-6 will depend also on their photometric precision, in particular in K. The role of WP7 is then to provide a general statistical approach (i.e. different SBCRs) all over the HR diagram, and to include also a systematics due to stellar activity, in particular in coordination with WP8 (multiplicity), WP9 (rotation) and WP12 (wind). SBCR are used for different purpose: O, B1, B2, and B3 for the calibration of the distance scale, B4-F5 to fill the current gap in the interferometric databases, and stars later than F5 for the preparation of the PLATO space mission.
  - *N. Nardetto, A. Salsi, T. Boyajian, A. Chiavassa, A. Gallenne, P. Kervella, T. Morel, R. Szabos, M. Wittkowski*
- **WP8 – Binaries:**
  - Survey: 60I for analysis of fundamental parameters of stars (in particular the mass) in HR diagram. This WP has its own list and may receive inputs from WP1, 2, 3, 4, 5, 6 during the observations themselves.
  - *D. Mourard, O. Creevey, A. Gallenne, P. Kervella, Y. Lebreton, F. Millour, N. Nardetto*
- **WP9 – Rotation:**
  - Survey: 60I for analysis of the rotation of stars in HR diagram. This WP has its own list and may receive inputs from WP1, 2, 3, 4, 5, 6 during the observations themselves.
  - *A. Domiciano, A. Gallenne, P. Kervella, A. Meilland, M. Rieutord, P. Stee, R. M. Roettenbacher, A. Claret, S. Albrecht, M. Borges, N. Nardetto*
- **WP10 – YSOs:**
  - Additional program with 15I. No particular connexion with other WPs
  - S. Kraus, R. Ligi, D. Mourard, A. Meilland, M. Borges
- **WP11 – Limb-darkening:**
  - The priority and suitability flags from WP1-6 will be used to optimize the coverage of the HR diagram. . If necessary, additional stars will be added for diameter + LD measurements.
  - A. Claret, P. Kervella, D. Mourard, N. Nardetto, A. Domiciano, M. Borges, S. Ridgway
- **WP12 – Winds & Environment**
  - Survey: 64D+4I = 68* or 15I for analysis of the wind and environment of stars in HR diagram. This WP has its own list and may receive inputs from WP1, 2, 3, 4, 5, 6 during the observations themselves.
  - *M. Wittkowski, A. Chiavassa, C. Paladini, F. Millour, A. Lamberts (all have to be contacted)*
- **WP13 – Galactic Archeology**
  - Additional program; number of target to be specified as well as possible coordination with other WPs
  - *C. Soubiran, O. Creevey, P. de Laverny, N. Nardetto, ... to be specified*

The work is animated through an interactive webpage:

https://labs.core-cloud.net/ou/UMR7293/CHARA%20SPICA%20Science%20Group/SitePages/Home.aspx

An overleaf document and a python notebook are associated to each WP.

From this general description, one can see that many interactions exist between the different WPs and that the activities in the different WPs are sharing many activities in common. The purpose of this document is to present the tasks that will have to be realized to correctly manage the SPICA Science Survey.

3. General architecture of the Science Survey Management

One of the main objectives of the CHARA/SPICA science group is to build, based on an extensive interferometric survey of about 1000 objects, a public catalogue of measured stellar and planet parameters. This catalogue must be built and managed in a collaborative way among the work-packages and has to be dynamical. Dynamical means that the list of stars to be observed or the associated strategy as well as some of the input parameters (*for e.g.* the Gaia parallax) can be updated in the database all over the execution of the survey.

As presented in Sect. 2 of this document, the survey is divided in Work Packages (WP). Their activity is firstly focused on an "overleaf" document which aims at detailing the following information:

- the astrophysical objectives,
- the description of criteria for the target list determination,
- the requirement from CHARA/SPICA observations,
- and the way the analytical or numerical high-level parameters (i.e. output parameters based on analytical formula or dedicated numerical codes) for the public catalogue will be derived together with their accuracy.

The Science Survey Management document (this document) describes the methodology shared between all WPs for the construction and management of the dynamical database of observations. It identifies different tasks (hereafter "T") either at the general level (T5 & T6) or shared among the different WPs:

- T1 is dedicated to the management of all stars for which detailed imaging will be done. It is based on the parameters and criteria of WP8/9/12. It consists in creating a python module to extract the list of stars and all the relevant parameters. T1 should set the identification flag related to the corresponding individual WP (flag '**WP**'), the flag '**Type**' (i.e. "image"), and the '**Priority**' flag.
- T2 is dedicated to the management of all stars for which the angular diameter (and when possible, the limb darkening) will be measured. It is based on the parameters and criteria of WP1-6. It consists in creating a python module to extract the list of stars and all the relevant parameters. As for T1, T2 should set the identification flag related to the corresponding individual WP (flag '**WP**'), the flag '**Type**' (i.e. "diameter"), and the '**Priority**' flag.
- T3 should identify any stellar activity in the list of stars created by T2, by using various kinds of tools, strategy, catalogues and/or references. The flag '**Activity**' is set in T3. The stars that have been flagged by T3 might be interesting for imaging, and as such, they should be evaluated in T1 and possibly feed the target list of stars of T1.
- T4 is devoted to flag in the global list of stars the ones suitable to build the Surface-Brightness Color Relations (flag '**SBCR**'). If necessary, some stars could be added to the initial lists to fulfill specific requirements.
- T5 is dedicated to the definition of the observing and calibration strategies, and to manage, dynamically, the final list of stars that will be observed, based on various kinds of priorities. T5 defines the flag '**Final Priority**' which will be used for the night scheduling.
- T6 is related to the automatic DRS of CHARA/SPICA.
- T7 concerns the definition of the validity check of data, in terms of signal to noise ratio and in terms of validation with respect to the specific science objective. T7 should set the Flag '**Quality**' based on the criteria defined by the different WPs.

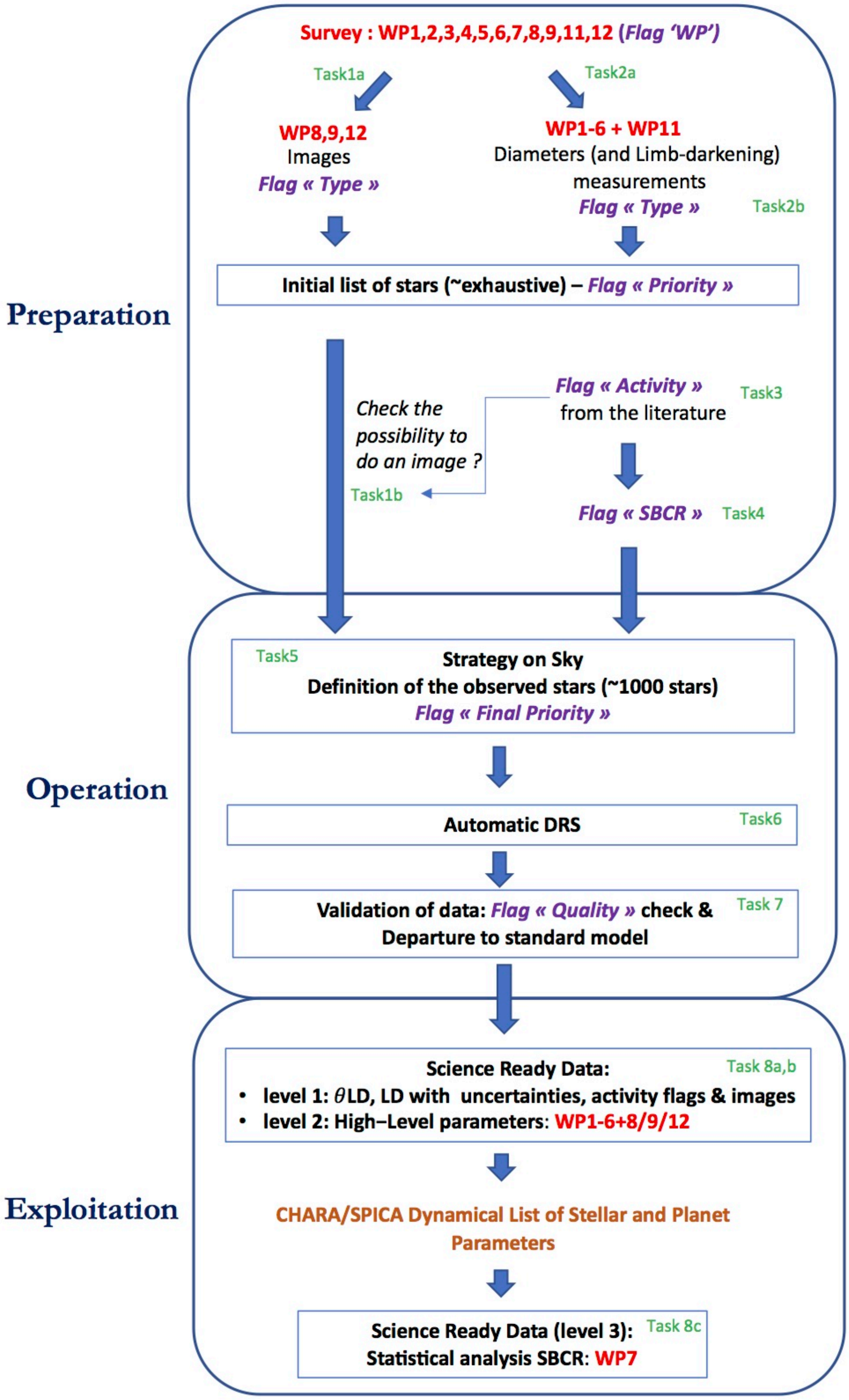
- T8 concerns the production of the "Science Ready Data" to build the final public catalogue of stars and planets parameters.

As a summary, for each WP, the work will consist in the following activities which aims at coordinating the work in the overleafs, the different Tasks, and in building specific python codes:

1) Each WP will develop a *prototype* python code to implement the strategy defined in the overleaf. This code generates a list of stars, including the, **WP**, **Type** and **Priority** keywords. In some specific cases, it could be simplified to a simple list of stars. Each WP should define the list of specific columns in the database on top of the common parameters. The summary of common parameters and additional specific parameters to each WPs is summarized in the annex of this document.
2) Then, each WP should clarify the methodology for defining the stellar **Activity** flags**.** Besides W7, have to define the methodology and associated **SBCR** flags in order to build the SBCRs.
3) The *prototype* python codes made by each WPs will be merged in order to have a unique code generating the global list of stars, together with the **WP, Type**, **Priority, Activity** and **SBCR** flags. The global code will also set the **'final priority'** flag that will be used to define the night scheduling. This final priority flag will slightly move the priorities given by each WPs in order to optimize the observations, the building of SBCRs and LD analysis all over the HR diagram.
4) After the execution of the observations, the automatic DRS will provide calibrated data, which will feed the dynamical database. Each WP should clarify the criteria for setting the **Quality** flag and validate the observations. In some cases, new observations could be needed, or the strategy should be adapted and a feedback to the database will have to be done. Note that T8a (see figure below) is particularly dense with extraction of angular diameter, limb-darkening measurement, derivation of uncertainties, creation of an automatic diagnostic of stellar activity directly from CHARA/SPICA visibility curves, creation of images, …
5) The last activity concerns the production of the science ready data to feed the final output catalogue. Each WP should clarify the tools and strategies to do this part of the work in the overleaf, and provide a python module that will read the input parameters in the database as well as values associated to observations (diameters, limb-darkening,…), make some calculations, and fill the values associated to high-level parameters directly into the global database.

Summary:

- *Prototype python codes for each WPs (with WP, Type and Priority flags)*
- *Merge of all WPs prototype codes into a unique python code that includes also the Activity and SBCR flags as well as the constraints from the observing strategy (final priority). The python codes will create a dynamical database.*
- *The observations and the DRS will feed the database with angular diameters, limb-darkening, and images, together with uncertainties, and a quality flag will be added (leading possibly to a re-observation of the stars).*
- *Each WP will use a python code to read relevant input parameters/observations into the dynamical database and generate the high-level parameters calculations in the database.*



Survey : WP1,2,3,4,5,6,7,8,9,11,12 (Flag 'WP')
Task1a
Task2a
WP8,9,12
Images
Flag « Type »
WP1-6 + WP11
Diameters (and Limb-darkening) measurements
Flag « Type »
Task2b
Initial list of stars (~exhaustive) – Flag « Priority »
Preparation
Check the possibility to do an image ?
Task1b
Flag « Activity »
from the literature
Task3
Flag « SBCR »
Task4
Task5
Strategy on Sky
Definition of the observed stars (~1000 stars)
Flag « Final Priority »
Operation
Automatic DRS
Task6
Validation of data: Flag « Quality » check &
Departure to standard model
Task 7
Science Ready Data:
Task 8a,b
• level 1: θLD, LD with uncertainties, activity flags & images
• level 2: High–Level parameters: WP1-6+8/9/12
Exploitation
CHARA/SPICA Dynamical List of Stellar and Planet Parameters
Science Ready Data (level 3):
Task 8c
Statistical analysis SBCR: WP7

4. Detailed description of the tasks

We introduce a first flag of the input catalogue which corresponds to the corresponding WP, called ***WP***

Task 1: Astrophysical objectives of the 'Images' part of the survey

Task 1a: The details of this task can be found in the overleaf documents of the WP 8, 9, and 12. The flags for these WPs will be ***WP=*** *'8', '9'* and '*12*', respectively.

We define the second flag of the input catalogue, which is called ***Type***.

- WP8 is devoted to the extraction of masses of binary systems as an input for stellar evolution codes. We identified 16 stars from the catalogue of Graczyk+2019, 25 stars from the Eker+2014 catalogue, 179 stars from the Pourbax+2015 catalogue, and finally it is easy to complete this sample by searching in the Hipparcos-Gaia catalogue generated by Kervella+2019 (more than 3200 possible targets), if it appears necessary to cover certain specific parts of the HR diagram. The flag ***Type*** for these stars will be set to 'IB'. These stars should obey to the classical constraints in terms of magnitude and declination. We consider separations between 0.15 and 10 mas, separations larger than 4 times the diameter (well detached systems), and flux ratio larger than 0.05.
- WP9 is devoted to study gravity darkening and flattening within the HR diagram for fast and slow rotators. The flag ***Type*** for these stars is set to 'IR'.
- WP12 is devoted to characterizing the stellar wind in HR diagram. The flag ***Type*** for these stars will be set to 'IW'.

Python notebooks will be developed to dynamically generate the list of targets. The codes are prototypes, that will be merged in a global python code in order to generate the whole list of stars observed by CHARA/SPICA (see Section 4). WP8, 9 and 12 have to validate the suitability of the targets for an efficient imaging program. Thus, a third flag called ***Priority_wps*** is also defined and correspond to the priority given by each WP (8, 9, 12, and the others). Its value is ranging from 0 to 2, 2 being the lowest priority. WP8, 9 and 12 have to manage the flag ***Priority_wps*** for an optimal coverage of the HR diagram in terms of study of the stellar activity.

Task 1b: W8, 9, and 12 may receive objects coming from WP1-6, as flagged for their interest in 'activity' and potentially considered for more detailed studies. This task is devoted to the validation of the suitability for imaging or not.

As an example, a star can be flagged WP='1' because it is an exoplanet host stars (see Task 2a below), but the star is rotating, and it seems interesting to image it (to extract its flatness for instance). Then it will be flagged Type = 'IR', and not Type='DIA' or 'DLD' (see below).

Task 2: Astrophysical objectives of the 'Diameters' part of the survey and classification of the 'Diameters' performance

Task 2a: The details of this task could be found in the overleaf documents of the WP 1 to 6. Python notebooks (prototypes) will be developed to generate dynamically the list of targets. The prototypes codes will be merged when ready (see Section 4).

We use here the first flag of the input catalogue, which is called ***WP**,* as already introduced.

- WP1 is devoted to link stellar and exoplanetary parameters, for exoplanet in transit. The flag will be ***WP***='1'.
- WP2 is devoted to perform 'à la carte' asteroseismic analysis, constrain 'scaling relations' and do age-dating. The flag will be ***WP***='2'.
- WP3: the same as WP2 put for sub-giants and giants in order to study the mixed modes also. The flag will be ***WP***='3'.
- WP4 is devoted to fill the B4-F4 part of the HR diagram for SBCR and for various pulsating star analysis. The flag will be ***WP***='4'.
- WP5 is devoted to extremely late-type (K8 to M) calibration of SBCR. The flag will be ***WP***='5'.
- WP6 is devoted to extremely early-type (O, B1, B2, B3) calibration of SBCR for extragalactic distances determination, with a particular attention to stellar activity in this part of the HR diag. The flag will be ***WP***='6'.

Task 2b: The purpose of this task is to classify any star of the 'Diameters' part either for just angular diameter measurement (***Type***='DIA') or angular diameter and limb darkening measurement (***Type***='DLD'). It is based on the performance tables presented in the section 'Specifications and Performance' of the collaborative website. A python module will be created and shared by all prototype codes.

After the merge of all WPs codes, a ***Priority_LD** will be given* according to the HR diagram coverage, and the objectives described in the WP11 overleaf.

Task 3: Stellar activity flags

By successive queries on various databases on Vizier, the purpose of this task is to set *a priori* flags on any star of the 'Diameters' survey for describing the possibility of activity.

We define a new flag of the input catalogue, which is called ***Activity*** with possible values as:

- Multiple stars = 'BIN'
- Rotators = 'ROT'
- Stars with wind = 'WIND'
- Stars with disk = 'DISK'
- Variable = 'VAR'
- Pulsating = 'PULS'

WP8, 9 and 12 will have to define the criteria and catalogues for their specific activity. Depending on the criteria developed by the WPs, this task is also responsible for identifying if the star is potentially suitable to be integrated into the 'Images' part of the survey. If so, it should fulfil the requirements established in Task1, and his type should change from DIA or DLD to IB, IR or IW.

This task will be included in the global python code, i.e. after the prototype python code of each WPs have been merged.

Task 4: Construction of the SBCR samples

This task aims at setting the priority level for the stars of the core 'Diameters' sample in order to build a Surface Brightness Color relation. We introduce a new flag called ***sbcr***. It consists in correctly selecting stars in order to:

1. obtain a typical density of 4 stars per sub-spectral channel and class all over the HR diagram. WP7 will potentially fulfil the HR diagram with additional specific stars for SBCRs. A flag (***sbcr***='HDHR') will be used for stars which are in an 'High Density' part of the HR diagram. An python algorithm will be included in the general python code. This algorithm can rely either on the spectral type and/or class of the stars or the *log g* and color (G-Ks) magnitudes.
2. verify the access to adequate photometric measurements. We need a precision (for G and Ks) of 0.015 magnitude for WP1-5 and 0.03 magnitude for WP6. Stars with poor photometry will be flagged (***sbcr***='PoorP').
3. verify the access to adequate extinctions estimations (A) and precision. We need a precision of 0.15 magnitude for WP1-5 and 0.3 for WP6 (see overleaf). The stars with poor estimation of extinctions will be flagged (***sbcr***='PoorA'). See the overleaf for a detailed description of how the extinction in the Gaia (Ag) and 2MASS (Ak) bands will be estimated.
4. the stellar **activity** flags will be used in order to build the SBCR and associated uncertainties.

The level of priority resulting from the combination of these 4 criteria (high priority for stars with high precision in photometry, accurate estimate of extinction, non-active and filling the HR diagram), will be defined with a flag (***Priority_sbcr***).

The role of WP7 is then to provide a general statistical approach (i.e. different SBCRs) all over the HR diagram, and to include also a systematics due to stellar activity, in particular in coordination with WP8 (multiplicity), WP9 (rotation) and WP12 (wind), in the framework of Task 8.

This task will be included in the global python code.

Task 5: Defining the observing strategy and finalizing the levels of priority

On the basis of the list of targets and flags generated by the previous tasks, the purpose here is to continue the selection of stars and the setting of priorities on the basis of the observing strategy (minimization of altitude and azimuth changes) and of the calibration strategy that are considered for the execution of the science programs.

A flag of priority, called ***Priority_Obs*** is introduced.

The ***Final priority*** to observe the star will be a combination of ***Priority_WPs, Priority_LD, Priority_SBCR and Priority_Obs***, with a weight or a methodology that still have to be clarified, and that is exactly the purpose of this task. The idea is to move only slightly the initial ***Priority_WPs.***

This task will be included in the global python code.

Task 6: Data Reduction Pipeline

Described in document "SPICA-VIS-0006" describing the general SPICA data flow and the data reduction software.

Task 7: Validation of data, quality check

The purpose of this task is to define criteria for the validation of the data recorded during the night and processed by the automatic pipeline. A flag “**Quality**” will be used.

- identification of any issues (during observations, …)
- identification of bad calibrators
- analysis of the transfer function
- SNR on the raw and calibrated measurements
- departure from the standard model: χ^2 criteria?
- stellar activity diagnostics in order to generate a specific stellar activity flag (Task 8a below)…

In some cases, this task will lead to a new classification of a target for potential new observations. This task will be included in the global python module on the basis of the criteria and specifications developed in the different WPs. These criteria should be explicitly defined in the two main scenario of measurements: 1/ angular diameter and 2/ angular diameter and limb darkening. In the case of the 'Images' program, a more complete analysis on a multi-night basis will be necessary.

Task 8: production of the science ready data

Task 8a: On the basis of the reduced and calibrated data, some tools have to be developed to extract the science ready data: angular diameter, limb darkening, activity flags, images… and their related uncertainties. This will form the first level of science output.

Task 8b: The second level of science output is the extraction of the high-level stellar parameters from the input parameters and observations: radius, effective temperature, masses… as described in the overleaf of each WP.

Task 8c: And the third level is the statistical analysis of the whole survey to allow the production of new SBC relations and their optimized way of using them in terms of validity domain and bias management. This work is related to WP7

Annex 1: Summary of flags

1. **WP**
    a. This flag indicates from which list the star comes
    b. Values:
        i. 1: exoplanet host stars
        ii. 2: dwarf asteroseismic targets
        iii. 3: (sub-)giant asteroseismic targets
        iv. 4: B4-F5 stars
        v. 5: K7-M stars
        vi. 6: O, B1, B2, B3 stars
        vii. 7: possible additional stars from WP7 devoted to fill the HR diagram
        viii. 8: multiple stars
        ix. 9: rotating stars
        x. 11: possible additional stars from WP11 devoted to fill the HR diagram
        xi. 12: winds
        xii. 13: Galactic Archeology
2. **TYPE**
    a. This flag describes the type of data used to feed the science program
    b. Values:
        i. IB: imaging binary or multiple system (WP8)
        ii. IR: imaging of fast rotator star (WP9)
        iii. IW: imaging the circumstellar environment of winds (WP12)
        iv. DIA: simple measurement of angular diameter with assumption on the limb darkening profile.
        v. DLD: measurement of the angular diameter and the limb darkening profile.
3. **ACTIVITY**
    a. This flag is based on the existing knowledge of the target, based on the literature. It gives *a priori* information on the known characteristics of the star in terms of activity. As a star can have several kinds of activity, we will define several activity flags (Activity_BIN, Activity_ROT, …) and affect Boolean values to these flags.
    b. Values
        i. BIN: the star is a binary? (YES/NO)
        ii. ROT: the star is rotating? (YES/NO)
        iii. WIND: the star has wind? (YES/NO)
        iv. DISK: the star has a disk? (YES/NO)
        v. …
4. **SBCR**
    a. This flag gives an information related to the priority of the target with respect to its use for the SBCR calibration.
    b. Values
        i. HDHR: flag that indicates that the star is part of a high-density part of the HR diagram (i.e. more than 4 stars are in this sub-spectral type and class, or equivalently, in a fraction of color and log g).
        ii. PoorP: flag indicating a poor photometry for the star

iii. PoorA: flag indicating that the extinction is unprecise or particularly large.
iv. Priority_sbcr: from 0 to 2, based on a combination of HDHR, PoorP and PoorA

5. PRIORITY

a. This flag describes the importance of the target
b. ***Priority_wps*** : priority given by each WPs 1-6+8/9/12. Value from 0 to 2, 0 being the highest priority
c. ***Priority_LD***: priority given by WP11 in order to fill the HR diagram in term of LD measurement. Value from 0 to 2, 0 being the highest priority
d. ***Priority_sbcr*** : priority given by WP7 for SBCR. Value from 0 to 2, 0 being the highest priority
e. ***Priority_obs*** : priority given by Task5 for observing strategy. Value from 0 to 2, 0 being the highest priority
f. ***Priority*** : The Final priority to observe the star will be a combination of Priority_wps, Priority_LD, Priority_sbcr and Priority_obs, with a weight or a methodology that still have to be clarified, and that is exactly the purpose of task 5. The idea is to move only slightly the initial ***Priority_wps.***
g. P0 should approximately account for 50% of the initial catalogue

6. QUALITY

a. This flag is devoted to the data quality control
b. ***Quality_OB*** : we can imagine a quality value provided by the SPICA Observations Controler (SOC) on the specific Observing Block (OB) of observation. This quality can rely on conditions of observations (seeing, clouds, …) and quality of the fringe tracking. Values of 0 to 2, 0 being the highest quality.
c. ***Quality_CAL*** : if the visibility curve of the calibrator shows a departure from the standard models (because of stellar activity for instance), then the science dataset should be flagged accordingly. Values of 0 to 2, 0 being the highest quality.
d. ***Quality_TF*** : the analysis of the transfer function all over the night (stability, …) will be used to flag the OBs quality. Values of 0 to 2, 0 being the highest quality. Note that *Quality_CAL* can be used for this analysis.
e. ***Quality_SNR*** : the analysis of statistical uncertainties on raw and calibrated visibilities of the target, as well as systematical uncertainties (due to the uncertainty on the diameter of the calibrator) should be evaluated. Values of 0 to 2, 0 being the highest quality.
f. ***Quality_FIT*** : the visibility curve (for data with Type='DIA' or 'DLD') will be fitted with atmosphere models (Kurucz, MARC, …) under the hypothesis that there is no stellar activity. If a departure to the model is identified (using a χ^2 criteria or any other method to be defined), then the star can be flagged as active (flag activity). Some tools will be developed (if possible) to identify the type of activity (BIN, ROT, WIND, …) and the flag activity will be used. In any case, the data can be re-analysed in the framework of Task T1 and it can be decided to possibly re-observe the star (to confirm the departure, or for an image). Thus, a value will be given to the *Quality_FIT*: values of 0 to 2, 0 being the highest quality (i.e. no departure to the standard models). We could define 1 to indicate that the star should be re-observed

to confirm the departure and 2 to indicate that the star should be re-observed for imaging.

Annex : List of parameters and flags (except flags observations and operation, see SPICA-DB requirements)

1. **Parameters common to all WPs**
    a. RA: Right Ascension
    b. DEC: Declination
    c. GAIA_ID: Gaia identifier (I/345/gaia2)
    d. HD number
    e. **flag_wp = [1 , … , 13]**
    f. **flag_priority_wps = [0, 1, 2] (0 = highest priority)**
    g. **flag_type = [IB, IR, IW, DIA, DLD]**
    h. **flag_priority_LD = [0, 1, 2] (0 = highest priority)**
    i. SpT : Spectral Type from Simbad (src.spType)
    j. Bmag (I/259)
    k. e_Bmag (I/259)
    l. Vmag (I/259)
    m. e_Vmag (I/259)
    n. Rmag (estimated II/346/jsdc_v2)
    o. Imag (estimated II/346/jsdc_v2)
    p. Jmag (II/246)
    q. e_Jmag (II/246)
    r. Hmag (II/246)
    s. e_Hmag (II/246)
    t. Kmag (II/246)
    u. e_Kmag (II/246)
    v. Ksmag (II/246)
    w. e_Ksmag (II/246)
    x. Lmag (II/311/wise)
    y. e_Lmag (II/311/wise)
    z. Mmag (II/311/wise)
    aa. e_Mag (II/311/wise)
    bb. Nmag (II/311/wise)
    cc. e_Nmag (II/311/wise)
    dd. Plx (I/345/gaia2)
    ee. e_Plx (I/345/gaia2)
    ff. Gmag (I/345/gaia2)
    gg. e_Gmag (I/345/gaia2)
    hh. BPmag (I/345/gaia2)
    ii. e_BPmag (I/345/gaia2)
    jj. RPmag (I/345/gaia2)
    kk. e_RPmag (I/345/gaia2)

ll. Fbol (calculated from various photometry, sources, tbd ?)
mm. teff (simbad, various sources, tbd)
nn. e_teff (simbad, various sources, tbd)
oo. log g (simbad, various sources, tbd)
pp. e_log g (simbad, various sources, tbd)
qq. Fe_H (simbad, various sources, tbd)
rr. e_Fe_H (simbad, various sources, tbd)
ss. vrot.sini (simbad, various sources, tbd)
tt. e_vrot.sini (simbad, various sources, tbd)
uu. flag_activity_ROT = YES/NO
vv. flag_activity_ROT = YES/NO
ww. flag_activity_WIND = YES/NO
xx. flag_activity_DISK= YES/NO
yy. flag_sbcr_HDHR=YES/NO
zz. flag_sbcr_PoorP=YES/NO
aaa. flag_sbcr_PoorA=YES/NO
bbb. flag_priority_sbcr=[0,1,2] (0 = highest priority)

2. Input parameters specific to each WP

a. WP1
  i. TRANSIT_DURATION: Duration of transit
  ii. TRANSIT_DEPTH: transit depth
  iii. TRANSIT_PERIOD: period of the transit
  iv. IMPACT_PARAMETER:?
  v. RV_K: semi amplitude of the radial velocity curve
  vi. …

b. WP2
  i. …
  ii. …

c. WP3
  i. FREQ_IND: flag indicating the detection of individual oscillation modes
  ii. DELTANU: large separation of acoustic modes
  iii. NUMAX: frequency of maximum power of acoustic modes
  iv. R_SSR: stellar radius obtained from seismic scaling relations (SSR)
  v. M_SSR: stellar mass obtained from seismic scaling relations
  vi. LOGG_SSR: log of surface gravity obtained from seismic scaling relations

d. WP4
  i. …
  ii. …

e. WP5
  i. …
  ii. …

f. WP6
  i. …
  ii. …

g. WP7

      i. …
      ii. …
   h. WP8
      i. …
      ii. …
   i. WP9
      i. **VSINI** : projected rotation velocity
      ii. **M** : stellar mass
      iii. **Teff :** stellar effective temperature (polar and/or equatorial TBD)
      iv. **R :** stellar radius (polar and/or equatorial TBD)
      v.
   j. WP10
      i. …
      ii. …
   k. WP11
      i. …
      ii. …
   l. WP12
      i. …
      ii. …
   m. WP13
      i. …
      ii. …

3. High level <u>analytical</u> parameters for each WP

   a. WP1
      i. **L:** stellar luminosity
      ii. **Teff :** stellar effective temperature
      iii. **R :** stellar radius
      iv. **Rho** : stellar density
      v. **M** : stellar mass
      vi. **Age** : stellar age
      vii. **Rp_(i)** : radius of planet i
      viii. **Mp_(i)** : mass of planet i
      ix. **Density_(i)** : density of planet i
      x. **Correlation :**
      xi. a : semi-major axis
      xii.
      xiii.
   b. WP2
      i. …
      ii. …
   c. WP3
      i. …
      ii. …

iii.

d. WP4
    i. …
    ii. …
e. WP5
    i. …
    ii. …
f. WP6
    i. …
    ii. …
g. WP7
    i. …
    ii. …
h. WP8
    i. …
    ii. …
i. WP9
    i. **epsilon** : flattening (1-Rpol/Req)
    ii. **ReqRpol** : equatorial-to-polar radii ratio (Rpol/Req)
    iii.

j. WP10
    i. …
    ii. …
k. WP11
    i. …
    ii. …
l. WP12
    i. …
    ii. …
m. WP13
    i. …
    ii. …

4. High level <u>numerical</u> parameters for each WP

a. WP1
    i. …
    ii. …
b. WP2
    i. …
    ii. …
c. WP3
    i.

- **ii.**

d. WP4
- **i.** …
- **ii.** …

e. WP5
- **i.** …
- **ii.** …

f. WP6
- **i.** …
- **ii.** …

g. WP7
- **i.** …
- **ii.** …

h. WP8
- **i.** …
- **ii.** …

i. WP9
- i. …
- ii. …

j. WP10
- **i.** …
- **ii.** …

k. WP11
- **i.** …
- **ii.** …

l. WP12
- **i.** …
- **ii.** …

m. WP13
- **i.** …
- **ii.** …