



Telescopio Nazionale Galileo

# **GIARPS mode**

## **Short Observer's Guide**

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# 1 Introduction

## 1.1 Scope

This document is a short guide for simultaneous GIANO-B and HARPS-N (GIARPS mode) observations. The contents of this document will be continuously modified with the most up-to-date information.

## 1.2 GIANO-B and HARPS-N Web Pages

GIANO-B Web Page is available at: <http://www.tng.iac.es/instruments/giano-b/> .

HARPS-N Web Page is available at: <http://www.tng.iac.es/instruments/harps/> .

Please refer to these web pages for general information and description of the instruments. Also, additional resources, as exposure time calculators, catalog file examples, etc., for observation preparation are provided through the pages.

## 1.3 Contact information

The observers are encouraged to send a feedback on this document. Please email to Avet Harutyunyan (avet at tng.iac.es).

## 1.4 Reference documents

This guide assumes that the observers are familiar with the use of both GIANO-B and HARPS-N as standalone instruments. Please read the GIANO-B and HARPS-N Observer Manuals available on the corresponding web pages, since this guide refers heavily to those documents.

# 2 Start-up and initialization

The startup of both GIANO-B and HARPS-N has to be carried out independently and as described in the respective manuals. After that, both instruments have to be initialized. All initialization steps executed through the two Sequencers can be carried out independently,

except of the “Start TEL” command of HARPS-N and “Set GIARPS” command of GIANO-B. These two commands are conflicting and cannot be executed simultaneously. First, GIANO-B “Set GIARPS” has to be executed, followed by the HARPS-N “Start TEL”.

When the two instruments start-up and Sequencer initialization is finished, the Telescope Operator has to set GIANO-B AG into “GIARPS” mode (following instructions in the manual). The AG state (ON/OFF) and operation mode (GIANO/GIARPS) can be verified through GIANO-B Sequencer Auto-guider Status led and its label.

### **3 Afternoon calibrations**

The afternoon calibrations of both instruments can be done independently. Please follow the steps described in the instrument manuals for this and take into account that the standard calibrations set for each instrument requires 35-40 minutes to be executed. GIANO-B pre-slit and HARPS-N front-end units are sufficiently sealed, thus the calibrations can in principle be carried out simultaneously by the two instruments.

### **4 GIANO-B slit auto-calibration**

GIANO-B slit auto-calibration has to be carried out in the afternoon, similarly to the GIANO-B standalone observation cases and as described in the instrument observer manual. Also, when required, the auto-calibration can be done during the night. See 10 for more information on night time slit auto-calibration.

### **5 NSTS OB preparation**

GIANO-B and HARPS-N observing OBs has to be prepared independently through respective NSTSs. Please refer to the instrument manuals to prepare the OBs.

For HARPS-N any type of “Obs” OBs can be used, i.e. there is no restriction on the type of the NSTS acquisition template use due to GIARPS mode observations.

In GIARPS mode, only GIANO-B on-slit A-B nodding observations can be carried out. Only “GIANO\_acq\_nodAB\_GIARPS” acquisition template, especially designed for GIARPS mode observations, has to be used. In order to execute the observations correctly,

please ensure to use this template in the GIANO-B NSTS catalog file. In case regular (GIANO-B exclusive) “OB\_Obs\_NoddingAB” OBs are already loaded into the NSTS, “Change ACQ” command can be used to convert “GIANO\_acq\_nodAB” to “GIANO\_acq\_nodAB\_GIARPS”. Please bear in mind that this operation gives correct results only for conversions between the two above mentioned acquisition templates.

## 6 Exposure times selection

For a given science target observation, the total exposure times of the GIANO-B and HARPS-N OBs can be different. It is practically impossible to perfectly synchronize the detector integrations, including readouts of the two instruments and with additional overheads due to GIANO-B noddings, etc. Fortunately, this is not strictly necessary as no problems occur should one of the instruments end the exposures before the other. That said, the observing time has to be managed in the most efficient way, so some care has to be taken to choose similar exposures for the two observations. Overheads due to multiple detector read-outs for both instruments, plus A-B noddings in GIANO-B case have to be considered in the total exposure times estimate.

## 7 Auto-guider (AG) setup

During the instrument start-up, GIANO-B AG has to be turned on and initialized, as described in the manual. Before the GIARPS mode observations start, the AG has to be set to “GIARPS” operation mode. This is done using the “GIARPS” switch button on the “GIANO guiding mode” pane of the AG GUI. The AG state (ON/OFF) and operation mode (GIANO/GIARPS) can also be verified through GIANO-B Sequencer Auto-guider Status led and its label. In GIARPS mode it is recommended to use the 8”x8” guiding box, which can be selected in the pull-down menu on the “Box controls” pane of the GUI.

## 8 Telescope focusing

In GIARPS mode GIANO-B and HARPS-N share the same telescope focus. At the beginning of the night HARPS-N focusing has to be done following the steps described in the HARPS-N instrument manual. In case the focus set automatically at the pointing time is not optimal, GIANO-B AG acquisition images can be used to refine the telescope focusing through the procedure described in the manual.

## 9 GIARPS mode dichroic

When observations in GIARPS mode have to be carried out, the dichroic enabling GIARPS mode has to be inserted. This can be done either by the TNG Staff Astronomer / visiting observer through the GIANO-B Sequencer “Set GIARPS” command or by the Telescope Operator through a specially designed maintenance interface. In case this is done by the Telescope Operator, the corresponding instrument mode led and label on Sequencer will indicate “GIARPS”.

In case GIARPS mode observations are combined with GIANO-B or HARPS-N only observations during the same night, the dichroic has to be placed and removed as necessary. This can be done as many times as required during the night. The switch between GIANO-B and GIARPS mode can again be done both through Sequencer “Set GIANO” and “Set GIARPS” commands as well as the maintenance interface by the Telescope Operator. The observer has to warn the Telescope Operator before executing these commands. The switch to HARPS-N only observations has to be done only through the maintenance interface by the Telescope Operator or the TNG Staff Astronomer.

## 10 Observing

Once the OBs of the same target are ready for both instruments, they have to be loaded into and executed by the corresponding Sequencers. This is done by clicking “Next OB” button on the two Sequencers. It is not strictly required to click on Next OB at the same time. The OB execution by the two Sequencers can be done in parallel as the operations by the two instruments are independent.

The best practice is as follows:

- HARPS-N OB is launched first, as this OB execution includes the telescope slew and normally lasts longer.
- GIANO-B OB is launched, while HARPS-N OB executes the telescope slew, first AG image acquisition image.
- A HARPS-N acquisition image is obtained when the telescope slew ends and the “Repoint” command is issued to center the target star on the fiber A. At this point, the GIANO-B OB execution either still has to take its acquisition image, or has already taken one without the target star in the field, as the telescope was still slewing. In the latter case, a new acquisition image has to be taken using GIANO-B Sequencer “Expose” command.
- When the target star is centered on the HARPS-N fiber, it will at the same time visible on the GIANO-B acquisition image. No target re-centering of any type has to be done with GIANO-B.

- Finally, the Sequencer “Go” command has to be executed first for HARPS-N and then for GIANO-B. One may delay GIANO-B “Go” command execution until the HARPS-N AG starts guiding on the target, in order to secure these steps one by one.

Sometimes a GIANO-B slit auto-calibration is required during the night time before a science target observation. In such cases, it is importante to do the calibration after the corresponding telescope pointing is concluded. This can be done as follows:

- First the HARPS-B OB is loaded and executed, among the other actions carrying out the telescope slew and the first AG image acquisition of the target field. When the acquisition image is obtained, no commands are issued on HARPS-N Sequencer, leaving the OB execution paused.
- The GIANO-B slit auto-calibration is done
- The GIANO-B OB is loaded and executed. In the meanwhile, HARPS-N “Repoint” command is done on its Sequencer, centering the target star on the fiber. When the GIANO-B AG image is acquired, the target should already be in the field, otherwise a new acquisition can be done through “Expose” command of GIANO-N Sequencer.
- When the target is on HARPS-N fiber and at the same time in GIANO-N field, the Sequencer “Go” command has to be executed first for HARPS-N and then for GIANO-B, as above.

For the use of “Repoint”, “Expose”, “Go” Sequencer commands, as well as GIANO-B slit auto-calibration, please refer to the manuals of the two instruments.

## 11 Observation interruptions

It is important to take into account that when the HARPS-N Sequencer “Abort” command is issued to stop the HARPS-N observation, the telescope tracking is stopped, thus effectively interrupting the GIANO-B observation as well.

On such an event, after stopping HARPS-N observation, it is recommended to issue the abort command also for GIANO-B to ensure its detector integration and AG are stopped correctly.

Differently from the HARPS-N one, GIANO-B Sequencer offers two ways of aborting the observations: with and without stopping the telescope tracking.

As the naming suggests, “Abort and stop telescope” command of GIANO-B Sequencer interrupts the GIANO-B detector integration and AG, together with the telescope tracking.

This causes also any simultaneous HARPS-N observation to stop.

“Abort” command instead stops GIANO-B observation but keeps the telescope tracking.

Any parallel HARPS-N observation continues unaffected.

GIANO-B Sequencer “Abort” command is particularly useful when GIANO-B observations have to be restarted due to any issue, while maintaining the HARPS-N one uninterrupted.

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## 12 Shut-down

The two instruments can be shut-down independently following the instructions in the corresponding manuals. Moreover, a shut-down of one instrument can be done while the other is observing.

## 13 GIARPS mode observations summary

For sake of clearness, a concise observer action list of typical GIARPS mode observations is reported below. For each operation in the list, more detailed instructions are available in the corresponding chapters of the guide.

### ☉ Afternoon

- Instruments start-up and initialization of GIANO-B and HARPS-N (chapter 2).
- Standard calibrations of GIANO-B and HARPS-N (chapter 3).
- GIANO-B slit auto-calibration (chapter 4).
- NSTS OB preparation for both instruments (chapter 5).

### ☉ Nautical dusk

- Telescope focusing with HARPS-N (chapter 8).
- GIARPS mode dichroic positioning (chapter 9).
- GIANO-B AG setup (chapter 7).

### ☉ Night

- On-sky observations (chapter 10).

### ☉ Nautical dawn or after the end of on-sky observations

- GIANO-B wavelength U-Ne calibration (see GIANO-B Observer Manual).
- Instruments shut-down (chapter 12).