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GREGOR:
Integral Field Unit (IFU) interface manual

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1 Scope

This manual explains the functionalities of the Integral Field Unit motorization software for the GRIS instrument.

2 Reference and applicable documents [if needed]

GCS - GREGOR Control System

ICS - Instrument Control System

GRIS - GREGOR Infrared Spectrograph

DCP - Device Communication Protocol

CoSM - Communication of Short Messages system

AO - Adaptive Optics

VI - Virtual Instrument

See:

- IFU Instrument documentation
- GRIS observation manual - GRE-GRIS-IAC-MAN-0009_v003_grismanual.pdf
- Commissioning tests of an Integral Field Unit (IFU) at GREGOR solar telescope

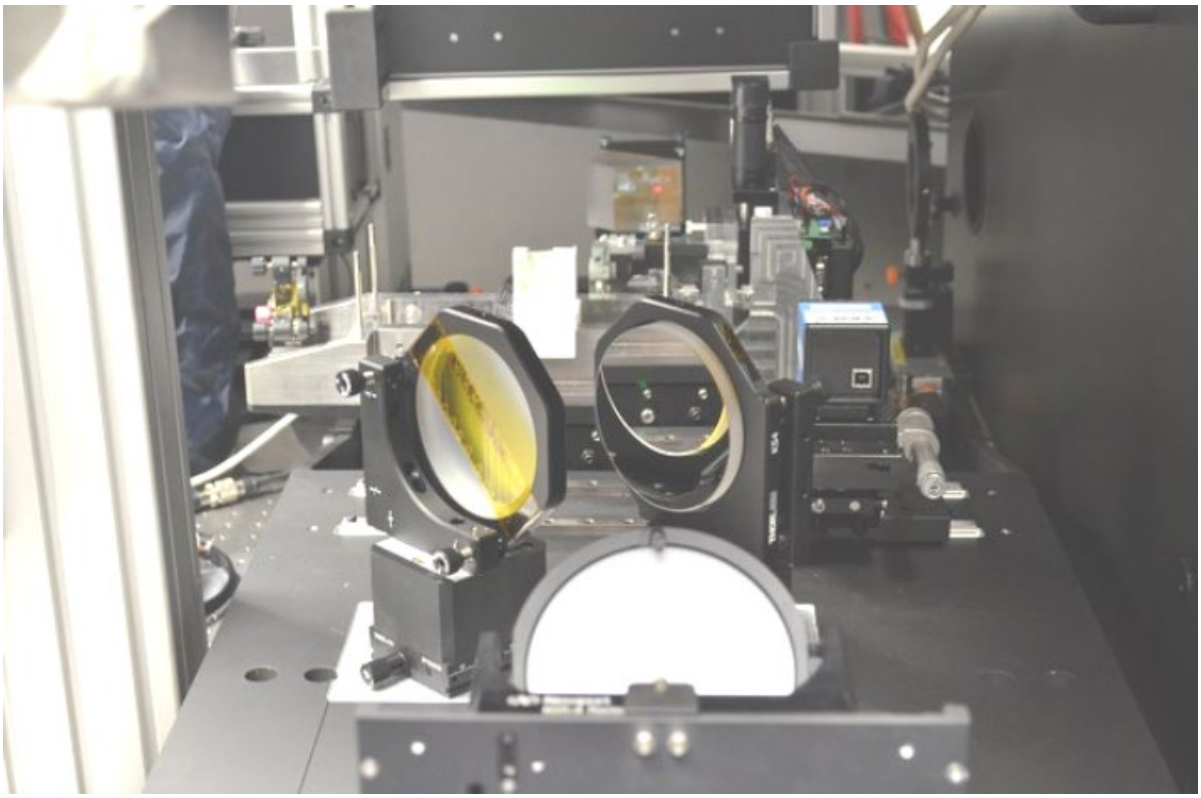
3 Overview

The IFU is based on image-slicers and 2D-Field-of-View Scanning System (FoV-SS) for the GREGOR Infrared Spectrograph (GRIS). It is equipped with a motorization which allows 3D of freedom, in a way to scan a region of 1 arcmin^2. It is located in the beam after M16, at the IR-F4 focal plane of the telescope. The IFU motorization has to be synchronized with the acquisition of images (GRIS camera). For this purpose, its interface receives the commands from the GRIS software (Polar), and moves the slicer assembly with a 3 axes motorization.

Part of the light passes though the FoV-SS, going to the spectrograph, while most of the focal plane image is reflected onto the Slit-jaw cameras for a visual reference of the slit on the images.

The IFU interface also controls a second device, a lens located on the slitjaw bench, which must be moved in a synchronized way with the FoV-SS mask, in order to keep it in focus.

The motorization, driven by four Faulhaber driver modules, is controlled by the IFU interface, as other small motorizations at GREGOR, through the network (Xport/CoSM) to the motor driver, at its serial line port.



IFU bench

4 Features

The IFU interface drives 4 motors, for vertical slit position (X), for horizontal axis (Y), for beam length compensation (Z) and the last for Focus compensation (F) same axis as SlitScanner. Motors are maintained enabled as the supported weight tends to pull the device out of the desired position.

The X, Y, and Z axes are referenced using encoder index detection, for a high positioning repeatability.

A fifth motor has been planned for inserting/extracting the polarimeter into/from the optical path, but it is currently moved manually. Its control commands are already implemented in the interface.

The IFU interface can take in account the mechanical backlash of the motorization, keeping the positioning always from the same direction.

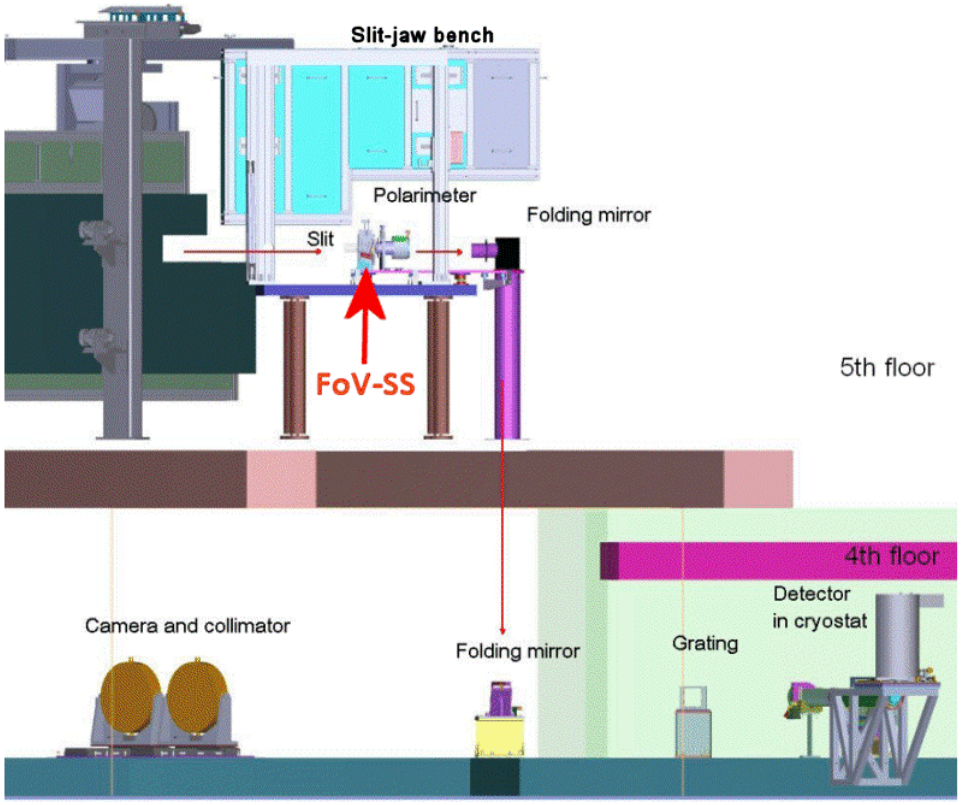
In an effort to achieve faster motorization movements, the positioning motor commands are "parallelized".

Smart motorization homing is implemented in the interface, for efficiency.

It also includes a graphical view of the FoV-SS displacement.

5 Motorization location

The IFU instrument is located under the Slit-Jaw bench, at the 5th floor of the GREGOR telescope building. It is interchangeable with the SlitScanner instrument and mechanically fixed with a precision centering mount, for repeatability.



6 Software

The IFU interface, as virtual instrument (VI), has been developed in the LabVIEW15/64bits environment, on the CentOS7 Linux operating system.

The software has to manage events coming from the user GUI and remote commands through the DCP protocol from client instruments, Conductor, GRIS, etc.

It controls the motorization for referencing and positioning, through the serial communication protocol, connecting on the instrumental network to Xports modules (TCP/IP to RS232), the CoSM client, then the CoSM servers with their respective motor drivers (MCDC3006 Faulhaber).

It uses a configuration file for the network and motorization setup. The software integrates special options in function of the user needs.

It also allows to use "LabVIEW remote panel" connection, from a remote computer, such as GREGOR Flight Stations.

6.1 Installation

The LabVIEW15/64bits IDE is used to compile the source as an executable application.

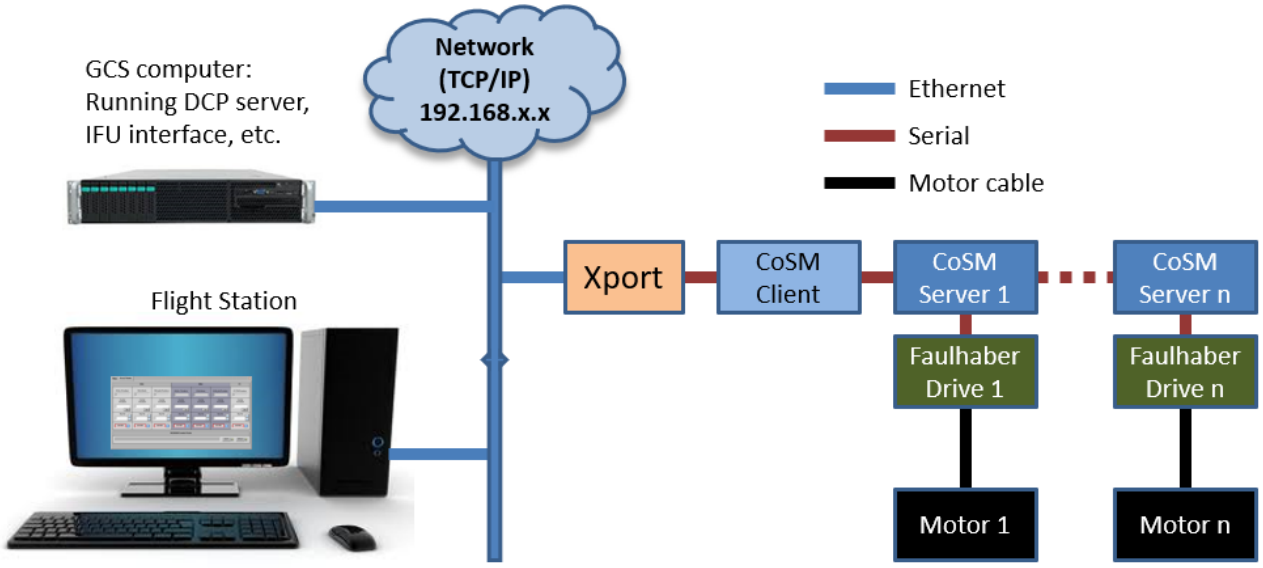


Figure 1 - Complete system diagram

It should be installed on the GCS computer, at the "/opt/G_Control/IFU/" directory, with two folders:

- "log" for errors and position storage (in the "motors" subfolder).
- "config" containing the configuration file for the communication, motorization and general setting.

The executable file (IFU) has to be copied in its directory, with the other previously generated files: "[executableName].aliases", "[executableName].conf" and "niwebserver64.conf".

The last source version is uploaded after an update and is available at the KIS-GitLab website (https://gitlab.leibniz-kis.de/ot/labview/).



6.2 Smart homing

This feature is integrated in the motor referencing function. It offers a quick referencing sequence (software only) when a motor is already powered & referenced, …after a restart of the interface, for example. (Thanks to a trick that detects if the Faulhaber driver had a power loss).

To validate the state of a motor driver, it is needed to click on its respective "Home" button. The "Smart Homing" is now available in all motorization interfaces, as it gives the freedom to close and restart the interface without the need of referencing with movements all the controlled motors. The resulting advantages are a gain of time (instantaneous validation), no loss of the current position, reliability and no stress!

If the referencing with movement is required, for example when a driver has been powered down (power voltage << 24V), or if the "Force Homing" option is checked,
the motorization will do the referencing,
by running the stage to find its "zero" end-switch position.

This can last for various tens of seconds to minutes, depending of the travel range of the motor axis.

A repositioning of the motor after a hard referencing
(setting back its former position),
may not bring it to the precise position as before,
even if the position numbers are the same!

Please, refer to the Optical Lab responsible,
before referencing any critical motorization with movement.

For the IFU in particular, this "hard referencing" will reference the X, Y and Z motors with a high accuracy, due to the driver hardware implemented, to take in account an encoder index position detection.

6.3 Startup & use

The IFU and SlitScanner interfaces software are using both, the Focus compensation of the Slit-jaw motorization. In any case, both interfaces have to be executed at the same time on the GCS computer, to avoid a communication overlapping. The issue is not arming anything but only causing a connection conflict. Be sure before starting the IFU interface to close properly the SlitScanner. Once running, in rare cases, it is needed to restart the interface, unless a new version is implemented, the configuration file has been modified, OS failure, computer shut down, etc.

To avoid any problem, it is advised to start and stop the interfaces properly.



Figure 2 - Loading the interface...

Startup

Please, verify that the IFU interface is not currently running on the system.

On the ICS interface (Gregor Instrument Control) of the GCS computer, double-click on the IFU item in the explorer menu on the left side…

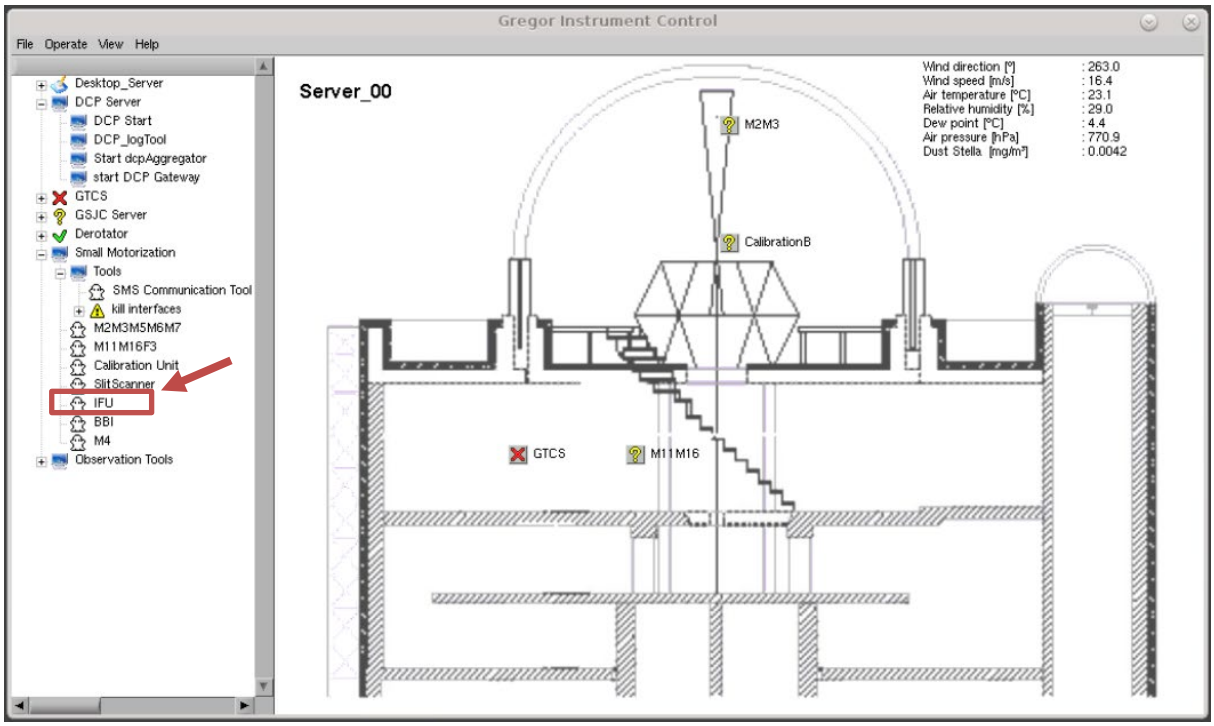


Figure 3 - ICS interface – Starting the IFU interface

Only one instance of the interface can be running; any attempt to start more will generate an error message, as the communication ports for remote panel, the DCP client name at the GCS DCP server is already used and the motorization Xport are already opened by the first one.

At startup, the GUI appears, loads the parameters and shows the main panel;
verify that the DCP and Xport indicators are connected (in green), meaning that the interface registered correctly on the DCP server, ready to receive commands, and it is also connected to the Xport allowing the dialog with the motorization.

At this point, he motorization is ready to be referenced.
In a normal use, if all the motorization of the interface has to be referenced, after a restart for example, go to the "MAIN" panel, verify that the "Force homing" is **not checked**, then click the "Home All" button. => All the motorization is then "Soft" referenced instantly.

The motorization is ready for use. Get more details, refering to the "Smart homing" section.

A remote panel of the interface is also available on the Flight Station (FS).
The following steps are required to use the IFU interface remotely:

- Be sure that the IFU interface is correctly running on the GCS computer.
- Verify that the IFU interface is not running on the FS; otherwise, use it.
- On the FS, access the ICS interface (similar to the GCS ICS interface).
- Double-click on the IFU item, left side explorer menu, then the front panel opens.
- Use the interface.

Close

Depending of which interface instance is used, the closing procedure differs, creating a difference between the main instance and the remote panel instance:

- Main instance (on GCS computer): Always use the "Stop" button, that will start the closing sequence step by step, to properly quit all connections of the interface with the external world.



  Do not use the "X" button, on normal closing. In some case of irresponsive or frozen interface, this option can be tried. In any case, it may take a few seconds.



Figure 4 - Closing screen

- Remote panel (on Flight Stations): The case is different as it is only a virtual window that can be closed by the "X" button. The window closes immediately.
  On the remote panel, the "Stop" button is inactive.

6.4 Configuration file

It is recommended to not modify any parameter of the configuration file, without the express clearance of the responsible. Here is bellow, the text file of the current state:

```
[General Settings]
IFUxPortIP = 192.168.90.103
IFUxPortRemotePort = 10001
FM1yAxisCosmServerAdress = #22
FM1xAxisCosmServerAdress = #23
FM1zAxisCosmServerAdress = #24
FM1fAxisCosmServerAdress = #26
FM1pAxisCosmServerAdress = #21
GreCoServerHostAdress = localhost
GreCoServerHostRemotePort = 2001
IFUGreCoAdress = IFU
LogFilePath = XoptXG_ControlXIFUXlogX
DequeueElementsTimeout = 1111
IFUGreCoCommunicationQueueName = IFUGreCoCommunicationQueueName
IFUcommandQueueName = IFUcommandQueueName
IFUerrorLogQueueName = IFUerrorLogQueueName
WaitMs = 0
FM1fExclude = 0
BacklashStep = 30

[Limit & Home Positions]
FM1xMinimumPosition = 0
FM1xMaximumPosition = 39300
FM1yMinimumPosition = 0
FM1yMaximumPosition = 26800
FM1zMinimumPosition = 0
FM1zMaximumPosition = 39700
FM1fMinimumPosition = 0
FM1fMaximumPosition = 52000
FM1xHomePosition = 19650
FM1yHomePosition = 12900
FM1zHomePosition = 18741
FM1fHomePosition = 36934
FM1xCenterPosition = 20452
FM1yCenterPosition = 12154
FM1zCenterPosition = 14406
FM1fCenterPosition = 25455
FM1xDir&Scale = 1
FM1yDir&Scale = -1
FM1zDir&Scale = 1
FM1fDir&Scale = -0.536
FM1zXcompFactor = 1
FM1zYcompFactor = 2

[FM1 x Motor Controller Settings]
>>> CoSM 23 <<< VERTICAL AXIS >>>
Baud Rate = BAUD9600
Mode = CONTMOD
Input Level = SETTTL
Diprog = DIPROG
Refin = REFIN
Answer Mode = ANSW1
Power On Homesequence = POHOSEQ0
Motor Resistance = RM5780
KN = KN276
Positive Position Limit = LL39400
Negative Position Limit = LL-10
Encoder Resolution = ENCRES2000
Velocity Proportional Term = POR5
Velocity Integral Term = I17
Peak Current = LPC1000
Continuous Current = LCC800
Acceleration = AC30000
Deceleration = DEC30000
Speed = SP100
Position Proportional Term = PP48
```

Position D-Term = PD70
I-term Current = CI80
Sampling Rate = SR1
Homing Speed = HOSP-100
Velocity Source = SOR0
Hard Blocking = HB24
Hard Polarity = HP7
Preset Direction = HD16
Home Harming = SHA0
Hard Limit = SHL8

[FM1 y Motor Controller Settings]
>>> CoSM 22 <<< HORIZONTAL AXIS >>> Positive > xxxxx
Baud Rate = BAUD9600
Mode = CONTMOD
Input Level = SETTTL
Diprog = DIPROG
Refin = REFIN
Answer Mode = ANSW1
Power On Homesequence = POHOSEQ0
Motor Resistance = RM1630
KN = KN253
Positive Position Limit = LL26900
Negative Position Limit = LL-10
Encoder Resolution = ENCRES2000
Velocity Proportional Term = POR5
Velocity Integral Term = I17
Peak Current = LPC1000
Continuous Current = LCC800
Acceleration = AC30000
Deceleration = DEC30000
Speed = SP100
Position Proportional Term = PP48
Position D-Term = PD60
I-term Current = CI50
Sampling Rate = SR1
Homing Speed = HOSP-100
Velocity Source = SOR0
Hard Blocking = HB24
Hard Polarity = HP7
Preset Direction = HD16
Home Harming = SHA0
Hard Limit = SHL8

[FM1 z Motor Controller Settings]
>>> CoSM 24 <<< Z CORRECTION >>>
Baud Rate = BAUD9600
Mode = CONTMOD
Input Level = SETTTL
Diprog = DIPROG
Refin = REFIN
Answer Mode = ANSW1
Power On Homesequence = POHOSEQ0
Motor Resistance = RM5780
KN = KN276
Positive Position Limit = LL39800
Negative Position Limit = LL-10
Encoder Resolution = ENCRES2000
Velocity Proportional Term = POR13
Velocity Integral Term = I30
Peak Current = LPC1000
Continuous Current = LCC800
Acceleration = AC30000
Deceleration = DEC30000
Speed = SP100
Position Proportional Term = PP15
Position D-Term = PD60
I-term Current = CI89
Sampling Rate = SR1
Homing Speed = HOSP-100
Velocity Source = SOR0
Hard Blocking = HB24
Hard Polarity = HP7
Preset Direction = HD16

Home Harming = SHA0
Hard Limit = SHL8

[FM1 f Motor Controller Settings]
>>> CoSM 26 <<< FOCUS >>>
Baud Rate = BAUD9600
Mode = CONTMOD
Diprog = DIPROG
Refin = REFIN
Answer Mode = ANSW1
Power On Homesequence = POHOSEQ0
Motor Resistance = RM5780
KN = KN276
Positive Position Limit = LL52150
Negative Position Limit = LL-600
Encoder Resolution = ENCRES2000
Velocity Proportional Term = POR7
Velocity Integral Term = I8
Peak Current = LPC600
Continuous Current = LCC580
Acceleration = AC30
Speed = SP300
Position Proportional Term = PP17
Position D-Term = PD35
I-term Current = CI90
Sampling Rate = SR1
Homing Speed = HOSP-100
Velocity Source = SOR0
Hard Blocking = HB6
Hard Polarity = HP6
Preset Direction = HD4
Home Harming = SHA2
Hard Limit = SHL2

[FM1 p Motor Controller Settings]
>>> CoSM 21 <<< POLARIMETER >>>
Move TimeOut = 30000
Polling Timeloop = 2000

6.5 Using the interface

The IFU interface can be started remotely, from the ICS interface of the Flight Stations, having started previously the main interface running on the GCS computer. Please, be sure that no other session of the interface has been already started; have first a review of existing interfaces on the desktop and at the task bar, too. Close or use the existing one. The ICS interface provides a list of interfaces to start. Double click the “IFU” item and wait for the interface to load.

At a second step, the user must validate the state of the motorization drivers, clicking the “Home” button and checking that the indicator turns to “Referenced”, for all the used motors, if it is not already done. (See “Smart Homing” information).

The interface is ready to receive DCP or manual commands.

6.5.1 Main panel



Position & Timing

- **Sliders:** A pointer slide indicates graphically the current position of each axis. (It is not a control.)
- **Timing indicator:** shows the time of the last movement in ms.
- **Position:** Current position value of the slider.

Settings

- **Force homing:** If checked and a “Home” is sent, a referencing movement will be executed to find the zero position. Read the “Smart homing” paragraph for details.
- **Referenced/Warning/NOT REF:** Indicator of the "INIT ALL" status.
  If not motor is referenced the "Not referenced" notification in red, is visible.
  If all motors are referenced, the "Referenced" notification in green is visible.
  If not all motors are referenced, the "Warning" notification in yellow, is visible
- **Wait:** this control gives the user a possibility to introduce a delay, in millisecond, to wait after the positioning. Should be set to 0 for fastest operation.

Status

See further “All panels” paragraph.

6.5.2 Axis/Status panel



Absolute Position

Shows a value of the current axis position.

Absolute Movement

Enter a value into the respective control and click the “Set” button to move the motor to the desired position. Movement is executed. Its “Referenced” indicator should be green.

Step Size

To move the motor by steps, enter the step size in to the respective control. The movement is executed using the up & down arrows. If the destination position is out of range, the movement is not done. From DCP, an error message is returned.

Motorization status

This indicator has 3 states as:

- NOT REF When the motorization state is unknown at start up or when an error happened. Motorization needs to perform a referencing to be valid.
- Warning The motorization is moving to the referenced "0″ position.
- referenced The motorization has referenced and is ready for position movements.

Home

Button for referencing and to validate the motor.
In the normal use, the "Home" buttons are individually disabled, as the whole motorization used to be referenced with the "INIT ALL" button of the Main panel.

Tip: To enable "Home" buttons individually, push and maintain the right [Ctrl] and [Shift] keys on the keyboard while clicking the " Home" button. The motor is then ready for an individual referencing.

The "Home" buttons will return all to a disabled state, after the referencing of a motor, any remote command or changing to other panel.

The driver is disabled after referencing.

Set Mid

This button sends the 4 axes to the "middle" default position, set in the configuration file.

The "middle" does not mean the half range of the motorization, but a default position, set up during the tuning of the IFU bench, before the observation campaign.

Driver disabled

This indicator shows the status of the driver; after referencing (smart homing or not), the driver is disabled, meaning that no current is passing through the motor to maintain its position (light ON). As soon as a command to move is sent, the driver turns on, to guaranty the good position (light OFF).

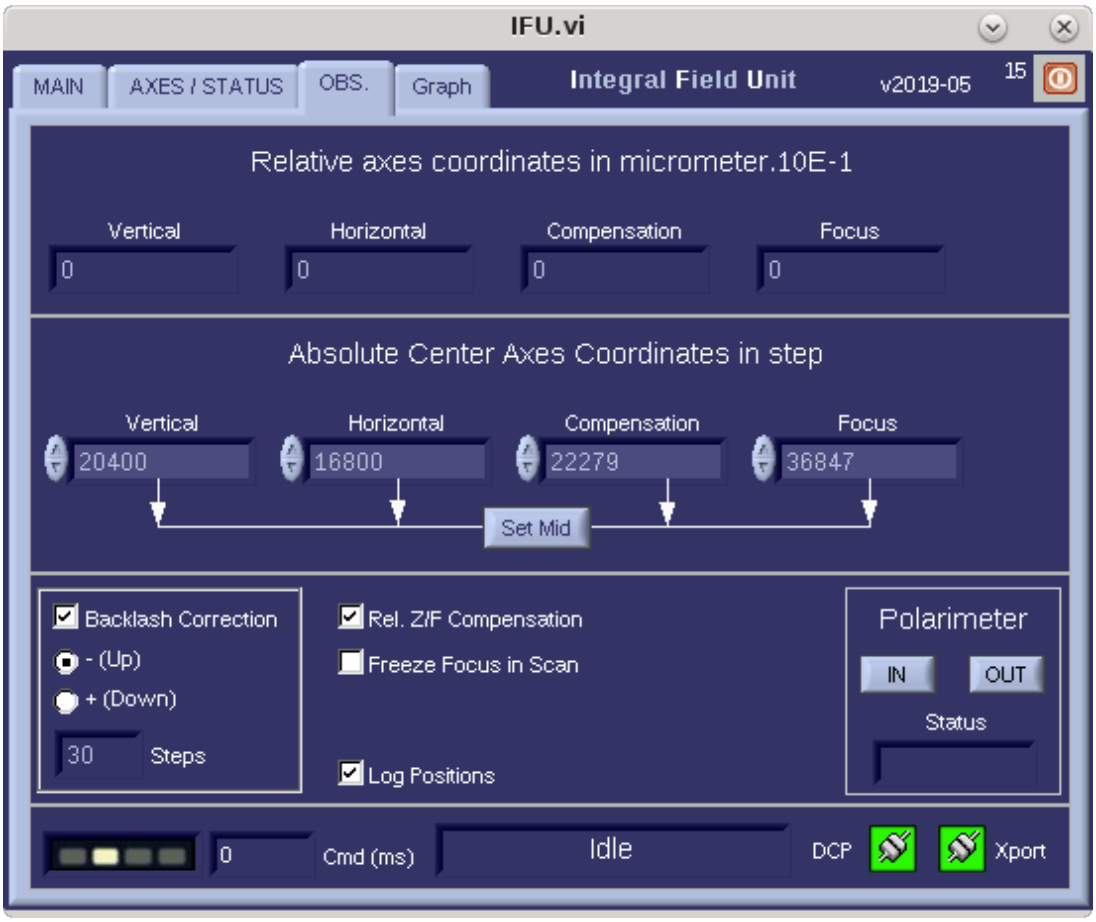
It is convenient after the observations to disable the driver, by doing a “Home“, on all motors.

This will avoid useless heating due to motor consumption.

Status

- **Last command:** This indicator shows the last action done, DCP or manual mode. (internal parameters displayed)
- **Other indicators:** See further “All panels” paragraph.

6.5.3 OBS panel



This panel is mainly used before starting a scan, to configure and control the behavior.

Relative axes coordinates in micrometer .10E $^{-1}$

The 4 indicators show the relative positions, in 10th of micrometer, result of the motor step conversion of each axis, for a DCP command of relative movement, where the Compensation and Focus are calculated according to the relative step values of X and Y axes.
Parameters to adjust the scales and axis direction are set up in the configuration file, under the [Limit & Home Positions] section.

Absolute Center Axes Coordinates in step

The 4 indicator/control boxes show the "middle" position value in step of each axis.
It is possible to modify the coordinates of this positioning, by entering a new value in desired box. At this point, the modification will remain in memory until a restart of the interface.
A "Save" red button will appear after the box modification, allowing the user to **save** the new "middle" positioning in the configuration file. We recommend the user, not to modify the current setting, unless the user received the approval of the responsible person of the instrument.

The "Set Mid" button sends the motorization to the "middle" positioning, coming from the above 4 boxes.

Backlash Correction

The "Backlash Correction" option box selected, allows on each movement of the vertical axis, to go to the destination position, always from the same direction, selected in the selector control below "-(Up)" and "+(Down)". The "Step" indicator shows the number of steps to perform (set in the configuration file).

Rel. Z-F compensation

The Relative Z axis and Focus compensation option box selected, allows to calculate the Z axis and Focus position values according to X,Y new values for a relative positioning DCP command. (X,Y only needed)

Otherwise, the position values of Z and F are taken from the DCP command parameters received for the relative movement. (X,Y,Z and F parameters needed)

Freeze Focus in scan

This option box set to ON, prevents to move the Slit-jaw Focus lens.

This will accelerate the scanning, but resulting in unsharp images taken at the Slit-jaw cameras.

Log Position

This option box set to ON, allows to keep a trace of all axes position, in a log file

stored in the "/opt/G_Control/IFU/log/motors/" directory.

The file named as " IFU_YYYYMMDD_HHmmSS.txt, is automatically created.
YYYY, MM, DD, HH, mm, SS characters are respectively the year, month, day, hour, minutes and seconds.

The option box is always checked at startup of the GUI.

Polarimeter

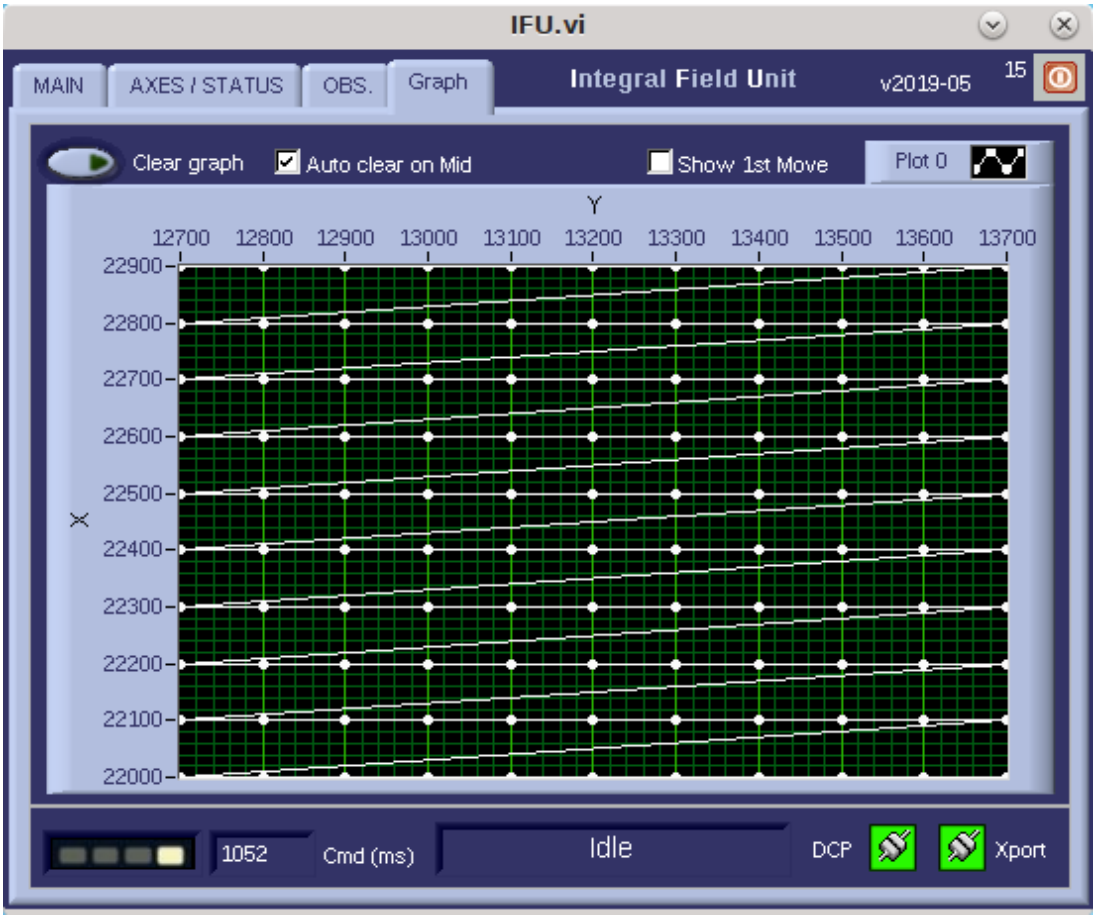
The "IN" and "OUT" buttons allow to insert or extract the Polarimeter from the beam path leading to the spectrograph. The "Status" indicates the operation process state;

"Unknown", "IN" (1), "OUT" (0).

Currently (2023/10), the motorization has not been implemented on the instrument and probably continue to be operated manually for the insertion/extraction.

Other indicators: See further “All panels” paragraph.

6.5.4 Graph panel



On this panel, the steps of the scanning are represented by white dots (location of the image acquisition), while the lines are the path between them. It is a visualisation of the scanned area during the process.

Clear graph

Click on the "Clear graph" button, when the graph needs to be cleared When clicking the button, the button led shows a green flash and get in memory the petition. The action is not immediate and will only happen the next scan to start or DCP positioning command to be sent.

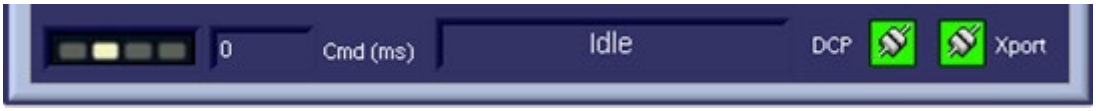
Auto clear on Mid

If this option box is checked ON, the graph will be automatically cleared when a "Set Mid" command is executed.

Show 1st move

If this option box is checked ON, the graph will show as first dot, the last position recorded before starting the scan. This option is useful to display multiple scans in different zones.

6.5.5 All panels



- **4 LEDs bar:** Display showing that a command has been executed, by a step change.

- **DCP Command timing:** shows the whole time for the DCP command execution.
  CMD (ms)

- **Idle/Busy:** Interface activity; waiting for command or doing some movement… The "NOT READY" message is flashing when a DCP or Xport connection is not opened or the motorization is not referenced. The motorization can also be used manually if the DCP server is not connected.
  Status**:** No Error/Not Ready/Idle/...Busy... while waiting for command or moving.

- **Communication status:** Both DCP & Xport must be green for a normal function.

- **Exit Button:** Located in the upper/right location of the interface.
  When clicked, the interface closes the network connections and exit.
  It could last for a few seconds; wait for the operation. The window should close…

7 Technical data

7.1 Motor limits/home/center

Current position limits *(2021-07)*

- FM1xMinimumPosition = 0
- FM1xMaximumPosition = 39300
- FM1yMinimumPosition = 0
- FM1yMaximumPosition = 26800
- FM1zMinimumPosition = 0
- FM1zMaximumPosition = 39700
- FM1fMinimumPosition = 0
- FM1fMaximumPosition = 52000
- FM1xHomePosition = 19650
- FM1yHomePosition = 12900
- FM1zHomePosition = 18741
- FM1fHomePosition = 36934
- FM1xCenterPosition = 20452
- FM1yCenterPosition = 12154
- FM1zCenterPosition = 14406
- FM1fCenterPosition = 25455

The "….HomePosition" is used for referencing.

The "….CenterPosition" is used for the "Set Mid" function.

7.2 Scales and directions

Step

- X step = 0.5 µm → 0.001875 arcsec
- Y step = 1.0 µm → 0.003750 arcsec
- Z step = 0.5 µm
- F step = 1.0 µm

Range

- Total X travel = 19,65 mm
- Total Y travel = 26.80 mm
- Total Z travel = 19,85 mm
- Total Focus travel = 26,00 mm

Parameters

- FM1xDir&Scale = 1
- FM1yDir&Scale = -1
- FM1zDir&Scale = 1
- FM1fDir&Scale = -0.536
- FM1zXcompFactor = 1
- FM1zYcompFactor = 2

Formulas and coefficients

For an X,Y axes relative movement, the corresponding Z Compensation axis movement, to maintain the beam path length, is calculated applying the following formula:

- Zrel = [FM1zDir&Scale] * (-[FM1xDir&Scale] * Xrel * [FM1zXcompFactor] + [FM1yDir&Scale] * Yrel * [FM1zYcompFactor]) / 2;

For an X axis relative movement, the corresponding Focus axis movement, to maintain focusing, is calculated applying a coefficient K = 2 * tang(15º) = 0,536

- Frel = Xrel * [FM1xDir&Scale] * [FM1fDir&Scale]

7.3 CoSM modules – daisy chain configuration

IP: 192.168.90.103

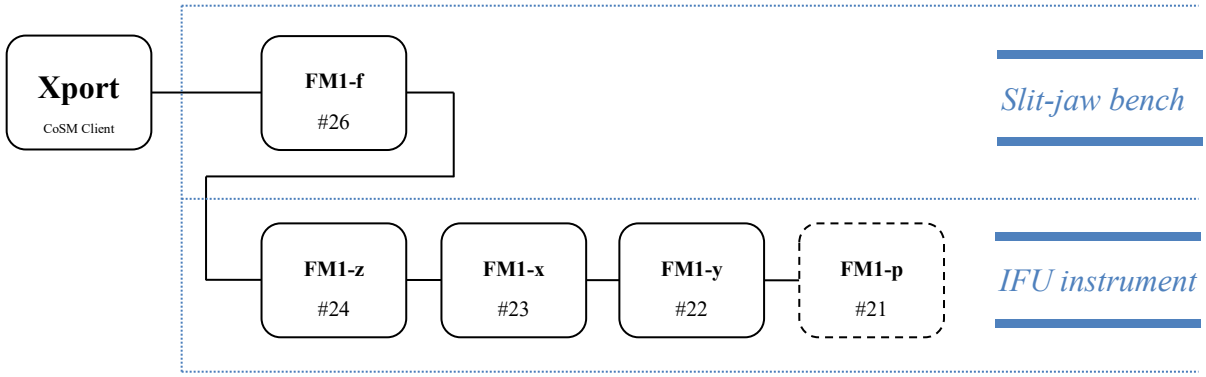


Figure 5 - CoSM modules - daisy chain configuration

- The CoSM module addresses are #26, #24, #23, #22, #21.
- The Xport module is mounted near the upper cable rail, over the AO DM/Tip-tilt location, with its 24V power supply.
- The CoSM cable coming from the FM1-f (Focus lens @ Slit-jaw bench) has to be connected to the first motor driver CoSM module of the IFU instrument, ie. FM1-z.
- The FM1-p (Polarizer in/out motor) is not present, currently. So, the termination resistor (end of transmission line load) is set on CoSM #22.

8 DCP commands

DCP device name: IFU

IFU device name : FM1 [value] where value = {0, 1, 2, 3, 4, 5}

Commands:

- Set nop
- set config soft
- set position abs
- set position rel
- set position def
- set position mid
- get position abs
- get position def

For detailed information and parameters, please refer to the specific last updated version of the DCP documentation, available in the blog at:

IFU – DCP Commands-Rev3 – (2019-05-17)

9 What's new

(2025-01-17)

"OBS." pane:

- Set "Log Positions" option box always checked at startup

(2019-09-04)

"OBS." pane:

- Added "Log Positions" option box

(2018-10-02)

Polarimeter Motorization implementation

- Added Polarimeter insertion control to “OBS.” Pane:
  - “IN” button to insert the Polarimeter into the beam.
  - “OUT” button to extract the Polarimeter into the beam.
  - “STATUS” indicator shows messages.
- Added Polarimeter Motorization IFU DCP command:
  - set position def FM1 5 a (a = position 0 or 1)
  - get position def FM1 5

Main pane

- Added an “INIT ALL” Button

AXES/STATUS pane

- Added a “Set Mid” button

(2017-07-07)

Major update to improve compatibility with SlitScanner observation software, integrating compensations calculation according to specifics parameters in the IFU configuration file.

- Added “” Pane:
  - “Relative axes coordinate in micrometer.10e-1” indicators for DCP steps commands.
  - “Absolute Center Axes Coordinate in steps”, Center coordinate positions can be modified and saved to the configuration file. A “Save” button appears when a modification is made. A “Set Mid” button sends the field of view to his compensate position.

  - "Backlash correction" option, with application direction. The backlash step size, reported on the indicator, has to be set in configuration file
  - "Relative Z/F compensation" option to execute internally the calculation of the compensation for z axis and Slit-jaw focus axis.
  - "Freeze Focus in Scan" option is used to disable the Slit-jaw focus positioning during scan to improve speed performances.
- Added "Graph" Pane:
  - Auto- sizeable graph to display the field of view window positioning and path.
  - "Clear graph button" set allows removing manually the current plots, only when the next movement is done.
  - "Auto Clear on Mid" option set allows removing the current plot when "Set Mid" button is pressed or the "set position mid" DCP command is sent, and only next movement is done.
  - "Show 1st move" option set, allows to display the first relative displacement.
- Added new DCP commands:
  - "set position mid"
  - "set position rel FM1 0 x,y,z,f", where z,f positions can be optional.
  - "set config soft b b b b" where b is "0" or "1" to configure the interface respectively to "Relative Z/F compensation", "Freeze Focus in Scan", "Backlash Correction" and "Up/Down" options.
- Added "Limit detected" message is shown in case of DCP command with parameter that exceed the software axis limits.
- Removed "Neg Relative Comp." option from main panel.

(2016-11-16)

- Added for test purpose, a "Neg Relative Comp." (Negative Relative Compensation) option box that allow reversing the axis direction movements in relative movements for parallel motor commands.
- Focus motor can be excluded from the configuration file. In this case, command to motor does not affects other.