# EUROPEAN SOUTHERN OBSERVATORY

## VLT INSTRUMENTATION

## PARANAL SCIENCE OPERATIONS

**FLAMES Calibration Plan**

**Doc. No. VLT-PLA-ESO-13700-3248**

**Issue 1.0, Date 26/07/03**

Prepared . . . . . A. Kaufer 26/07/03 . . . . . .
Date Signature

Approved . . . . . .
Date Signature

Released . . . . . .
Date Signature

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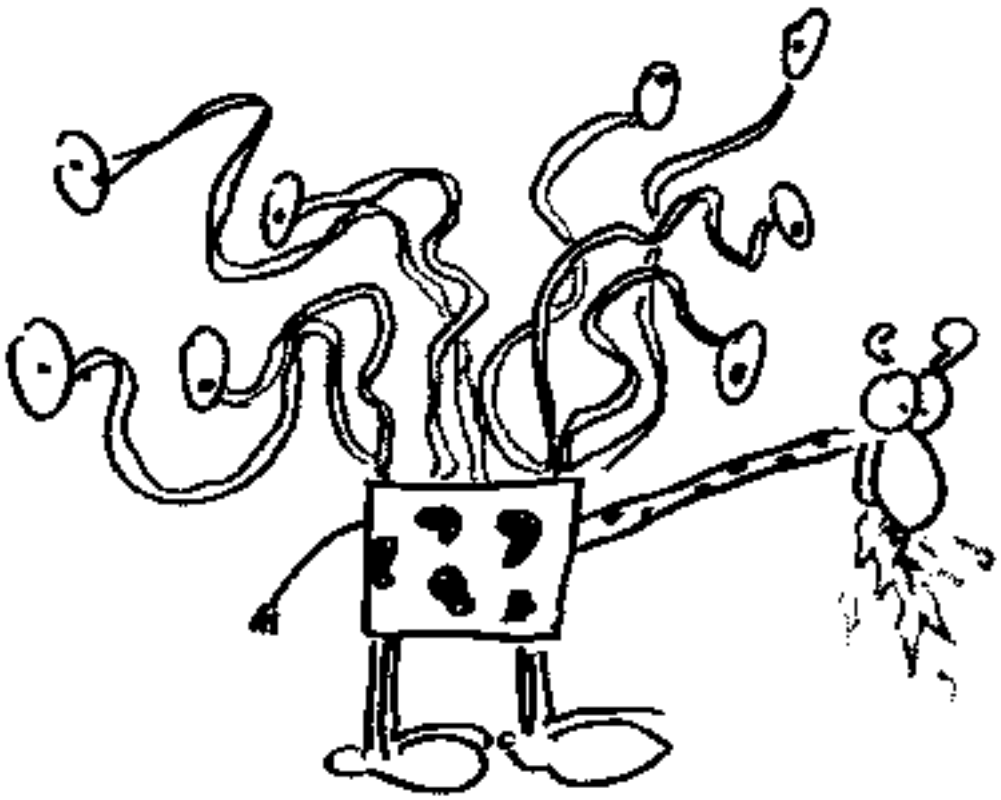

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# Contents

# 1 Glossary

**Acquisition:** Accurate positioning of the telescope in order to center the target on the spectrograph slit.

**BIAS frame:** Read-out of the CCD detector of zero integration time with shutter closed. The registered number of electrons per pixel has to be subtracted from a science exposure, because these were not created by photons from the source.

**Calibration:** Procedures to remove the instrumental signature from the scientific data (e.g. by subtracting BIAS frames and by dividing through by the flatfield).

**Day/Nighttime Calibrations:** Usually calibrations are done on daytime following the night of observations ("Daytime Calibrations"). This invokes a typical time delay between Science observations and Daytime calibrations of a few hours. Upon request, Nighttime Calibration can be provided in form of so-called "Attached Calibrations" for high-precision observations. Their execution time is charged to the time allocation of the science program.

**Flatfield:** Spectrum obtained from light source with a flat (i.e. without spectral features) energy distribution, e.g. a tungsten lamp. The registered signal provides information about the response of the detector, allowing a determination of the variation in sensitivity from pixel to pixel, the echelle order shape, the presence of bad columns on the detector, etc.

**Observation Block:** A logical unit of exposures needed to obtain a coherent set of data. Encompasses all relevant information for a successful data acquisition on a target. It consists of target information, a set of templates, parameter files for the templates, conditions, requirements and comments concerning the specified observations. It represents the entity the short-term scheduler deals with. Constructing Observation Blocks is part of the Phase II Proposal Preparation Process.

**Standard Setting:** A pre-defined setting of the instrument facilitating the preparation of the observations. The Observatory provides the relevant calibration files when a Standard Setting is used. Standard Settings for FLAMES are defined in the User's Manual [1].

**Template** A set of instructions for the performance of a standard operation on an instrument, the instrument and detector setups. The templates represent specially devised sequences for often used instrument operations and calibrations.

**Template Signature File:** This is a description of a Template and its parameters. It contains information about the type and allowed ranges of the parameters; some of the parameters have to be set by the observer.

**Wavelength calibration:** Spectrum obtained from an emission-line source. The wavelengths of the (many) emission lines are accurately known and are used to transform pixel space into wavelength space.

# 2 List of acronyms and abbreviations

**AT** Acquisition Template
**CT** Calibration Template
**OB** Observation Block
**OS** Observation Software
**OT** Observation Template
**P2PP** Phase II Proposal Preparation

# 3 Introduction

This document describes the calibration procedures for the FLAMES instrument at the VLT (cf. [1]).

In general there are two possible strategies for calibrations. To calibrate *science data* requires a set of calibrations, taken in due time, covering the specific instrument setup used in the science observation. To calibrate the *instrument* requires a large set of calibrations covering all offered setups but at a lower rate. In practice, for instruments like UVES and GIRAFFE which offer many standard setups, both strategies are compromised. The science data are calibrated during daytime after acquisition. In addition, a selected set of calibrations is regularly (typically daily) measured for the purpose of instrument "health checks".

For each calibration task this document defines the:

- **Responsible** group to carry out the calibrations,
- **Phase**, i.e., when the calibrations have to be carried out (day or nighttime),
- **Frequency**, i.e., how often the calibration task has to be carried out; expressed in $1/N$ days,
- **Purpose** of this calibration task,
- **Procedure**, i.e., the way how the calibration task is carried out,
- **Outputs**, i.e., the Pipeline data products, the Quality Control (QC) parameters, and/or the keywords entered into the VLT engineering data stream ("FITSLOG") produced by the calibration task,
- **Prepared OBs**, i.e., the pre-prepared (impex) OBs to carry out the task (and the corresponding **OT queues**),
- **Prepared Templates**, i.e., templates to carry out the task (if not composed in a OB)
- **Pipeline Support**, i.e., if and what support is given by the data reduction pipeline for the calibration task,
- **Duration**, i.e., an estimate of the required time to execute the calibration task,
- **Prerequisites**, i.e., possible dependencies on instrumental or sky conditions or other calibration tasks are given.

Tasks which still need implementation on the level of e.g. OB preparation, pipeline support, etc., are marked with the "under construction" logo on the page margin.

In the appendix of the document an estimate of the expected typical daily calibration times of FLAMES is given.

The technical details of the automatic execution of the daily calibration plan is implemented on Paranal in the configuration files of the automatic calibration OB tool (cmm modules `calob`, `flocal`, and `uvocal`) (cf. [2]). Therefore the main configuration files are shown in the appendix of this document.

# 4 References

[1] *FLAMES User Manual*, VLT-MAN-ESO-13700-2994, Version 1.1, 21/07/03, A. Kaufer, L. Pasquini, M. Zoccali, H. Dekker, N. Cretton

[2] *Calibration OB Tool User Manual*, VLT-MAN-ESO-17240-2264, Version 1.1, 15/09/00, R. Schmutzer

[3] *UVES Calibration Plan*, VLT-MAN-ESO-13200-1123, Issue 1.3, 05/07/2002, A. Kaufer, R. Hanuschik

# 5 SCIENTIFIC DATA CALIBRATION

This section of the FLAMES calibration plan describes which FLAMES calibration data has to be collected with which frequency to allow one to

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from the scientific data.

If possible/applicable, an estimate for the accuracy of the calibration products is given.

## 5.1 FLAMES – UVES Flatfield Calibrations

### 5.1.1 Fibre Flatfield Calibration

Responsible: Science Operations

Phase: Daytime

Frequency: Daily; in Service Mode 1 / 1 days per plate, fibre mode (8, 7+1, 6), and wavelength setting used in science data

Purpose: Provide high SNR flatfield exposures (exposure level 20000 ADU) for the purpose of
- correction of pixel-to-pixel sensitivity variations,
- determination of relative fibre-to-fibre transmission,
- fibre localisation,
- fibre spatial PSF modelling,
- echelle blaze correction.

Procedure: 1 Halogen lamp spectrum per standard wavelength setting, fibre mode and plate is taken with a level of 20000 ADU on all UVES fibres.

The UVES fibre buttons are placed on the plate in a spiral. While the CCD shutter is open, the robot sweeps over the fibres with a fibre projector fed by a tungsten lamp. The illumination level is determined by the number of sweeps over the fibre. The exposure time is determined by the number of sweeps to achieve the required intensity levels.

The flatfields of the UVES fibres are split in three different exposures distinguished by the respective UVES fibres placed on the spiral. The sequence is ODD - EVEN - ALL. The ODD and EVEN exposures are used to determine the spatial profile of the individual UVES fibres, while ALL fibres measures the relative throughput of the fibres.

Outputs: pipeline products:
- master flatfield
- fibre-order table

QC parameters:
from fibre-order table:
- number of orders found; order_min, order_max
- number of fibres analyzed
- residuals: mean, rms
- shifts against physical model

from fibre efficiency products:
- relative transmission per fibre (averaged across orders)

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_uves_plate<plate>_flat.obx` with `<plate> = 1, 2`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`flames_cal_prep_sff_ofpos`

Duration:

Prerequisites:

See also:

### 5.1.2 Slit Flatfield Calibration

Responsible: Science Operations

Phase: Daytime

Frequency: Daily; in Service Mode 1 / 7 days per wavelength setting used in science data

Purpose: Provide high SNR slit flatfield exposures to determine the CCD's pixel-to-pixel sensitivity variations independent of the fibre flatfields described in 5.1.1 and to determine the structure of the slit noise.

Procedure: For UVES, 3 long slit halogen lamp spectra per standard wavelength setting are taken with a level of 20000 ADU at 3 different slit positions. A slit width of 1 arsec is used, the slit is shifted by $-4\ 0\ +4$ arsec along its long side between the three exposures to cover all possible fibres.

These slit flatfields are taken with the UVES internal calibration unit and the UVES red slit. The same slit flatfields are used for the calibration of plate 1 and plate 2 fibre spectra.

Outputs: pipeline products:
∘ high SNR master slit flatfields (exposure level 2x(3x20000) ADU in the overlapping regions of the shifted spectra)
QC parameters:
from master slit flats:
∘ lamp efficiency
∘ slit noise (amplitude)
∘ fixed-pattern noise (amplitude)
∘ fringing amplitude (860 only)
∘ effective slit height

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_uves_sflat.obx`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`flames_cal_mkmaster`

Duration:

Prerequisites: Availability of UVES preslit calibration system.

See also:

#### 5.1.3 Attached Flatfield Calibrations

Responsible: Science Operations: Instrument Operator

Phase: Nighttime

Frequency:

SM: if accurate measurement of the fibre-to-fibre transmission is required; OB has to be prepared accordingly

VM: On request, OB to be prepared accordingly

Purpose: Provide high SNR flatfields (exposure level 20000 ADU) for the purpose of
- accurate determination of fibre-to-fibre transmission,
- correction of pixel-to-pixel sensitivity variations.

Procedure: Halogen lamp spectra can be attached as a calibration template to the science OB which allows one to take a Nasmyth screen flatfield calibration exposure in exactly the same fibre/plate and instrument configuration as used in the science exposure.

However, the telescope is moved to zenith to allow to close the Nasmyth shutter which is used as the Nasmyth screen. The rotator is stopped at the position at the end of the science exposure.

Outputs: as in 5.1.1

Templates: `FLAMES_uves_cal_flatatt.tsf`
`FLAMES_comb_cal_flatatt.tsf`

Pipeline Support: needed:
`flames_fibre_order_tables`

Duration:

Prerequisites:

See also:

### 5.2 FLAMES – UVES Wavelength Calibration

#### 5.2.1 Standard Calibrations

Responsible: Science Operations

Phase: Daytime

Frequency: Daily per plate, fibre mode (8, 7+1, 6) and wavelength setting used in science data.

Purpose: Acquire Thorium-Argon emission-line lamp spectra to determine
- 2D (pixel-order) dispersion solutions for each fibre,
- Resolving power for each fibre.

Procedure: Take Thorium-Argon calibration lamp spectra through the fibres:

The UVES fibre buttons are placed on the plate in a spiral. While the CCD shutter is open, the robot visits each fibre button with a fibre projector fed by a Thorium-Argon lamp. The illumination level is determined by the time the illuminator stays above each fibre. The exposure time is determined by the number of fibres to visit and the visit time per fibre.

The exposure levels have been adjusted via the visit time to similar values as used for the UVES slit wavelength calibrations.

In case of the UVES fibre configuration with the simultaneous calibration fibre (7+1), the simultaneous calibration fibre is illuminated by the simultaneous calibration ThAr lamp. Due to the neutral density filter in front of this lamp, the exposure time is set to a minimum of 300sec.

Outputs: pipeline products:
- fibre line tables

QC parameters:
from fibre-linetable:
- number of lines found per fibre and total
- minimum/maximum order number detected
- number of lines accepted per fibre and total
- mean and sigma of fit residuals
- FWHM of emission line width in X and Y direction: mean/median/sigma per fibre/all fibres
- resolving power: mean/median/sigma per fibre/all fibres

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_uves_plate<plate>_wave.obx`
with `<plate> = 1, 2`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support:

Duration:

Prerequisites: needed:
`flames_cal_wavcal`

See also:

### 5.2.2 Simultaneous Calibration

Responsible: User

Phase: Nighttime

Frequency: For each science spectrum if requested (fibre mode 7+1)

Purpose: Record Thorium-Argon lamp spectra during the science exposure to provide very precise wavelength calibrations

Procedure: 1 fibre of the UVES slit, the so-called “simultaneous calibration fibre” is illuminated by a Thorium-Argon calibration lamp during the science exposure to monitor drifts of the spectrograph. This mode is only offered in combination with the standard 580 setting.

Outputs: pipeline products:
- TBD

QC parameters:
- TBD

Pipeline Support: needed: TBD

## 5.3 FLAMES – UVES Pipeline Calibrations

### 5.3.1 Order Definition (with Simultaneous Fibre)

Responsible: Science Operations

Phase: Daytime

Frequency: Daily per plate and wavelength setting used in science data.

Purpose: Record tracings of the echelle orders to define the order and interorder background positions For the first guess of the order definitions it is sufficient to expose the simultaneous calibration fibre only from which the position of all other fibres is guessed.

Procedure: take flatfield exposures with the simultaneous calibration fibre

Outputs: pipeline products:
- order definition table (first guess)
- background table.

QC parameters:
from order guess table:
- number of orders found, order_min, order_max
- fit residuals: mean, rms, minimum, maximum
- number of fit positions: found and selected

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_uves_plate<plate>_ordef.obx`
with `<plate> = 1, 2`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`flames_cal_orderpos`

Duration:

Prerequisites:

See also:

### 5.3.2 Format Check (Simultaneous Fibre)

Responsible: Science Operations

Phase: Daytime

Frequency: Daily per plate and wavelength setting used in science data.

Purpose: Record emission lines of known wavelengths to adjust the physical model of the spectrograph and to find a first guess for the dispersion solution.

Procedure: take Thorium-Argon exposures with the simultaneous calibration fibre and fit the line positions as predicted by the physical model.

Outputs: pipeline products:
- guess solution for wavelength calibration.

QC parameters:
from line guess table:
- number of lines found, selected
- minimum/maximum wavelength

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_uves_plate<plate>_fmtchk.obx` with `<plate> = 1, 2`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`flames_cal_predict`

Duration:

Prerequisites:

See also:

## 5.4 FLAMES – UVES Detector Calibration

### 5.4.1 Bias frames

Responsible: Science Operations

Phase: Daytime

Frequency: 1 / 7

Purpose: Create a master bias frame and determine the CCD Bias characteristics

Procedure: Take 5 bias frames for the standard CCD mode `225kHz,1x1,low`

Outputs: pipeline products:
- Master bias frame

QC parameters:
- Bias level: mean/median/rms
- Readout Noise: mean/median/rms
- structure parameters in X and Y

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_uves_bias.obx`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`uves_cal_mkmaster`

Duration:

Prerequisites:

See also: [3]

### 5.4.2 Dark frames

Responsible: Science Operations

Phase: Daytime

Frequency: 1 / 30

Purpose: Create a master dark frame and determine the CCD dark current and the rate of cosmic hits

Procedure: Take 3 x 1 hour dark frames for the standard CCD mode `225kHz,1x1,low`

Outputs: pipeline products:
- master dark

QC parameters:
- (mean) dark current
- cosmic hit rate

Prepared OBs: `impex/UVES/Maintenance/UVES_tec_dark.obx`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`flames_cal_mkmaster`

Duration: 3 hours

Prerequisites: CCD must have been online for $> 6$ h, better 12 or 24 h (otherwise gradients across the CCD might be present).

See also: [3], darks with closed and open shutter (parasitic light) are taken also as part of the UVES calibration plan in 2x2 readout mode.

## 5.5 FLAMES – GIRAFFE Flatfield Calibration

### 5.5.1 Standard Flatfield Calibration

Responsible: Science Operations

Phase: Daytime

Frequency: Daily; in Service Mode 1 / 1 days per plate, fibre type, and spectrograph setting used in science data

Purpose: Provide high SNR flatfield exposures (exposure level 20000 ADU) for the purpose of
- correction of pixel-to-pixel sensitivity variations,
- determination of relative fibre-to-fibre transmission,
- fibre localisation,
- fibre spatial PSF modelling (TBC),
- echelle blaze correction.

Procedure: 3 Halogen lamp spectra per standard wavelength setting and plate are taken with a level of 20000 ADU. For blue settings (central wavelength $< 400$ nm) 3 times 3 exposures of a 5000 ADU level are taken not to exceed an exposure time of 300 sec per exposure.

For each fibre type the fibre buttons are placed on the plate in a spiral. While the CCD shutter is open, the robot sweeps over the fibres with a fibre projector fed by a tungsten lamp. The illumination level is determined by the number of sweeps over the fibre. The exposure time is determined by the number of sweeps to achieve the required intensity levels. The number of sweeps depends on the fibre type used and the spectrograph wavelength.

Outputs: pipeline products:
- master flatfield
- localization master

QC parameters:
from master flat:
- fixed-pattern noise (across fibres)
- relative transmission: mean/rms
- absolute transmission per fibre (averaged across order, as counts per sec)

from localization master:
- fibre positions (relative distance, inclination against Y)
- fibre PSF (mean/rms)

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_giraf_<mode><plate>_HR_flat.obx`
`impex/FLAMES/DaytimeCalibration/FLAMES_giraf_<mode><plate>_LR_flat.obx`
with `<mode> = medusa, ifu` and `<plate> = 1, 2` or
with `<mode> = argus` and `<plate> = 2`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`[locMast]`

Duration:

Prerequisites:

See also:

### 5.5.2 Attached Flatfield Calibrations

Responsible: Science Operations: Instrument Operator

Phase: Nighttime

Frequency:

SM: if accurate measurement of the fibre-to-fibre transmission is required; OB has to be prepared accordingly

VM: On request, OB to be prepared accordingly

Purpose: Provide high SNR flatfields (exposure level 20000 ADU) for the purpose of
- accurate determination of fibre-to-fibre transmission,
- correction of pixel-to-pixel sensitivity variations.

Procedure: Halogen lamp spectra can be attached as a calibration template to the science OB which allows one to take a Nasmyth screen flatfield calibration exposure in exactly the same fibre/plate and instrument configuration as used in the science exposure.

However, the telescope is moved to the zenith to allow to close the Nasmyth shutter which is used as the Nasmyth screen. The rotator is stopped at the position at the end of the science exposure.

Outputs: pipeline products:
as in 5.5.1
QC parameters:
as in 5.5.1

Templates: `FLAMES_giraf_cal_flatatt.tsf`
`FLAMES_comb_cal_flatatt.tsf`

Pipeline Support: needed; as in 5.5.1

Duration:

Prerequisites:

See also:

## 5.6 FLAMES – GIRAFFE Wavelength Calibration

### 5.6.1 Standard Calibrations

Responsible: Science Operations

Phase: Daytime

Frequency: Daily per plate, fibre type, and spectrograph setting used in science data.

Purpose: Acquire Thorium-Argon emission-line lamp spectra to determine
- 2D (pixel-order) dispersion solutions for each fibre,
- Resolving power for each fibre,
- slit geometry for each slit.

Procedure: take Thorium-Argon calibration lamp spectra through the fibres:

For each fibre type the fibre buttons are placed on the plate in a spiral. While the CCD shutter is open, the robot sweeps over the fibres with a fibre projector fed by a Thorium-Argon lamp. The illumination level is determined by the number of sweeps over the fibre. The exposure time is determined by the number of sweeps to achieve the required intensity levels. The number of sweep is highly dependent on the fibre type used and the spectrograph wavelength.

Outputs: pipeline products:
∘ dispersion coefficients, line table
QC parameters:
from the line table:
∘ mean and rms of residuals
∘ dispersion coefficients
∘ number of lines found/used
∘ resolving power (also 6.10): mean/median/rms (averaged and per fibre)
∘ line width in X (also 6.11) and Y: mean/median/rms (averaged and per fibre)

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_giraf_<mode><plate>_HR_wave.obx`
`impex/FLAMES/DaytimeCalibration/FLAMES_giraf_<mode><plate>_LR_wave.obx`
with `<mode> = medusa, ifu` and `<plate> = 1, 2` or
with `<mode> = argus` and `<plate> = 2`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`[extract, wcal]`

Duration:

Prerequisites:

See also:

### 5.6.2 Simultaneous Calibrations

Responsible: User

Phase: Nighttime

Frequency: For each science spectrum if requested (SIMFLAG “ON”)

Purpose: Record Thorium-Argon lamp spectra during the science exposure to provide very precise wavelength calibrations

Procedure: 5 fibres in each Giraffe slit, the so-called “simultaneous calibration fibres” are illuminated by a Thorium-Argon calibration lamp during the science exposure to monitor drifts of the spectrograph.

Outputs: pipeline products:
∘ accuracte radial velocities.
QC parameters:
as in 5.6.1 plus:
∘ second order correction of dispersion coefficients

Pipeline Support: needed

## 5.7 FLAMES – GIRAFFE Detector Calibration

### 5.7.1 Bias frames

Responsible: Science Operations

Phase: Daytime

Frequency: 1 / 7

Purpose: Create a master bias frame and determine the CCD Bias characteristics

Procedure: Take 5 bias frames for the standard CCD mode `225kHz,1x1,low`

Outputs: pipeline products:
- Master bias frame

QC parameters:
- Bias level: mean/median/rms
- Readout Noise: mean/median/rms
- structure parameters in X and Y

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_giraffe_bias.obx`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`[biasMast]`

Duration:

Prerequisites:

See also:

### 5.7.2 Dark frames

Responsible: Science Operations

Phase: Daytime

Frequency: 1 / 30

Purpose: Create a master dark frame and determine the CCD dark current and the rate of cosmic hits

Procedure: Take 3 x 1 hour dark frames for the standard CCD mode `225kHz,1x1,low`

Outputs: pipeline products:
- master dark

QC parameters:
- (mean) dark current
- cosmic hit rate

Prepared OBs: `impex/FLAMES/DaytimeCalibration/FLAMES_giraffe_dark.obx`

OT queue: `FLAMES.Daytime.Calibration`

Pipeline Support: needed:
`[biasMast]`

Duration: 3 hours

Prerequisites: CCD must have been online for $> 6$ h, better 12 or 24 h (otherwise gradients across the CCD might be present).

See also:

## 5.8 FLAMES – GIRAFFE Flux Calibration

### 5.8.1 IFU and ARGUS flux standards

Responsible: Science Operations: Instrument Operator

Phase: Nighttime / Twilight

Frequency:
VM: once per run, plate and spectrograph settings used in science data (if requested by user)
SM: if OBs provided by the user

Purpose: Measure the response function to allow flux calibration of the science data

Procedure: Observe spectrophotometric standard stars with IFUs and/or ARGUS plus an attached flatfield.

For IFUs, only one IFU will be assigned to the spectrophotometric standard star. The other IFUs and the IFU sky fibres will be placed in a circle of the same radius to be illuminated after the standard star observation via the Nasmyth screen.

For ARGUS, the spectrophotometric standard star is centered on the ARGUS IFU. The other ARGUS Sky fibres will be placed in a circle of the small radius to be illuminated after the standard star observation via the Nasmyth screen.

The attached flatfields will be used to correct for the relative transmission of the IFUs, IFU Sky fibres, and the ARGUS sky fibres.

Outputs: pipeline products:
∘ response function for flux calibration
QC parameters:
∘ response function
∘ efficiency curves

Prepared OBs: `impex/FLAMES/ArgusSpecPhotStd/FLAMES_argstd_1_1_<target>.obx`
`impex/FLAMES/ArgusSpecPhotStd/FLAMES_argstd_1_1.67_<target>.obx`
`impex/FLAMES/IfuSpecPhotStd/FLAMES_ifustd_<target>.obx`

with `<target>` equal to the name of the specphot standard

OT queues: `FLAMES.ARGUS.SpecPhotStd, FLAMES.IFU.SpecPhotStd`

Pipeline Support: needed

Duration:

Prerequisites: Good astrometry on specphot standard star fields,

Spectrophotometric extinction tables for Paranal (at the moment La Silla tables are used). Flux tables for `target` (currently the Midas fluxtable is used).

See also:

### 5.9 Summary: Science Data Calibrations

Table to be distributed in the FLAMES User Manual.
Data to be distributed to the user.

**FLAMES – UVES Science Data Calibration Plan**
(per instrument setting, i.e. plate, fibre mode, and central wavelength)

| Calibration | number | frequency [1/days] | purpose |
|---|---|---|---|
| Fibre Flatfields | 3 | 1 / 1 | pixel-to-pixel sensitivity variations<br>fibre-to-fibre transmission<br>fibre localisation<br>fibre PSF modelling<br>blaze correction |
| Slit Flatfields | 3 | 1 / 7 | pixel-to-pixel sensitivity variations |
| attached Fibre Flatfields | $n$ | o.r. | high-precision flatfielding |
| Wavelength | 1 | 1 / 1 | dispersion solution<br>resolving power |
| Sim. Fibre Order Definition | 1 | 1 / 1 | order and background definition |
| Sim. Fibre Format Check | 1 | 1 / 1 | dispersion guess solution |
| Bias | 5 | 1 / 7 | master biases, bias characteristics |
| Dark | 3 | 1 / 30 | master darks, dark current, cosmics rate |

**FLAMES – GIRAFFE Science Data Calibration Plan**
(per instrument setting, i.e., plate, fibre mode, resolution and central wavelength)

| Calibration | number | frequency [1/days] | purpose |
|---|---|---|---|
| Flatfields | 1 | 1 / 1 | pixel-to-pixel sensitivity variations<br>fibre-to-fibre transmission<br>fibre(=spectra) localisation |
| attached Flatfields | $n$ | o.r. | high-precision flatfielding |
| Wavelength | 1 | 1 / 1 | dispersion solution<br>resolving power<br>slit geometry |
| Bias | 5 | 1 / 7 | master biases, bias characteristics |
| Dark | 3 | 1 / 30 | master darks, dark current, cosmics rate |
| IFU: Flux Standard | $n$ | o.r. | response correction, flux calibration |
| + attached Flats | $n$ | o.r. | rel. trans. IFU array / Sky fibres |
| ARGUS: Flux Standard | 1 | 1 / 1 | response correction, flux calibration |
| + attached Flats | 3 | 1 / 1 | rel. trans. ARGUS array / Sky fibres |

o.r. = on request only, corresponding OBs to be provided by user
$n$ = number to be defined by user

# 6 INSTRUMENT MONITORING

This section of the FLAMES calibration plan describes which FLAMES system data has to be collected with which frequency to allow trend analysis of the instrument health and to initiate preventive maintenance. Furthermore, data to further characterise the instrument is taken.

## 6.1 FLAMES – UVES Fibre Transmission Characterisation

Responsible: Science Operations

Phase: Daytime

Frequency: Daily; per plate and wavelength setting

Purpose: Determine the absolute fibre transmission as function of plate, fibre number and wavelength (within the limits of the stability of the OzPoz flatfield lamp and calibration system)

Procedure: as described in 5.1.1

Outputs: pipeline products:
- fibre efficiency files

QC parameters:
- absolute transmission per fibre (averaged across orders, as counts per sec)

Prepared OBs: as in 5.1.1

OT queue: as in 5.1.1

Pipeline Support: needed: TBD

Duration:

Prerequisites:

See also:

## 6.2 FLAMES – UVES Fibre Projector Stability Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Daily for both slits using the 580 wavelength setting

Purpose: Characterise the mechanical stability of the fibre projector. Measure the shifts of the fibre projector along (x direction) and perpendicular (y direction) to the slit

Procedure: as described in 5.3.2

in addition the shift of the positions of the ThAr lines has to be measured with respect to a master reference format check frame.

the measured shift is a superposition of the shifts of the fibre projector and the shifts in the spectrograph. The latter are measured by the UVES calibration plan using slit formatchecks. Therefore, the true shifts of the fibre projector can be determined.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ X and Y shifts against physical model and against reference frame
- ∘ by comparison to UVES echelle trended X and Y shifts: X and Y shifts of positioner

Prepared OBs: as in 5.3.2

OT queue: as in 5.3.2

Pipeline Support: needed

Duration:

Prerequisites:

See also:

### 6.3 FLAMES – UVES Simultaneous Calibration Fibre Intensity Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Weekly for both slits using the 580 wavelength setting

Purpose: Monitor the intensities of the simultaneous Thorium-Argon calibration lamp to allow preventive exchange before it fails.

Procedure: as described in 5.6.1

in addition the intensities of the ThAr lines in the simultaneous calibration fibres have to be measured with respect to a master reference frame; the relative intensities are computed.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ relative line intensities as function of time

Prepared OBs: as in 5.3.2

OT queue: as in 5.3.2

Pipeline Support: needed

Duration:

Prerequisites:

See also:

### 6.4 FLAMES – UVES Resolving Power Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Weekly for both slits and the 520, 580, 860 wavelength settings

Purpose: Measure the average resolving power per wavelength setting

Procedure: as described in 5.3.2
in addition the resolving power is measured from the ThAr lines

Outputs: pipeline products:
∘
QC parameters:
∘ resolving power: mean/median/sigma per fibre/all fibres
∘ FWHM of emission line width in X and Y direction: mean/median/sigma per fibre/all fibres

Prepared OBs: as in 5.3.2

OT queue: as in 5.3.2

Pipeline Support: needed

Duration:

Prerequisites:

See also:

### 6.5 FLAMES – UVES CCD Characterisation

Responsible: Science Operations

Phase: Daytime

Frequency: Monthly

Purpose: Characterise the CCD via the following parameters:

- Bias level
- Gain
- RON
- Dark current
- Bad pixel/columns map
- Linearity
- Shutter error
- Relative Contamination

Procedure: Take a series of UVES CCD lamp flats, 1h darks, and biases for the standard CCD mode

`225kHz,1x1,low`

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ Bias level
- ∘ Gain
- ∘ RON
- ∘ Dark current
- ∘ Bad pixel/columns map
- ∘ Linearity
- ∘ Shutter error
- ∘ Relative Contamination

Prepared OBs: `impex/UVES/Maintenance/UVES_red_ccdtest.obx`

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration:

Prerequisites: CCD must have been online for $>$ 6 h, better 12 or 24 h (otherwise gradients across the CCD might be present).

See also: [3]

### 6.6 FLAMES – UVES CCD Shutter Performance

Responsible: Engineering

Phase: Day- and Nighttime

Frequency: Every CCD exposure

Purpose: Monitor the performance of the UVES Red CCD shutter

Procedure: Record the opening and closing time of the CCD shutter. Tend the measured times over time. A increase in the times indicate mechanical wearout of the shutter mechanics.

Outputs: FITSLOG keywords:

| | |
|---|---|
| `DET SHUT TMOPEN` | Time to open shutter [s]. |
| `DET SHUT TMCLOS` | Time to close shutter [s]. |

Pipeline support: not needed

Prerequisites:

See also: [3]

### 6.7 FLAMES – UVES Instrument throughput / ETC Verification

Responsible: Science Operations

Phase: Nighttime

Frequency: Monthly

Purpose: Measure the instrument throughput by comparing the observed fluxes with the ETC predicted fluxes as function of wavelength

Procedure: On both plates configure and observe with a 3x3 raster of 0.4" stepsize ("jitter") in the three standard wavelength settings an astrometric field with targets of known brightness and spectral type.

Extract the measured flux at the center of the raster as function of wavelength.

Compare the results with the ETC predictions taking into account atmospheric conditions and the airmass of the observation.

Outputs: pipeline products:
- 

QC parameters:
- 

Prepared OBs: `impex/FLAMES/Maintenance/FLAMES_uves_raster520_<field>.obx`
`impex/FLAMES/Maintenance/FLAMES_uves_raster580_<field>.obx`
`impex/FLAMES/Maintenance/FLAMES_uves_raster860_<field>.obx`

with `<field>` the name of the astrometric field. Fixed fields to cover the whole year are available.

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration:

Prerequisites: Photometric, dark sky, seeing $< 1.2$".

See also:

### 6.8 FLAMES – UVES Radial Velocity Accuracy Characterisation

Responsible: Science Operations

Phase: Twilight / Nighttime

Frequency: Monthly

Purpose: Determine long-term radial velocity accuracy by repeated observation of the same field.

Procedure: On both plates configure and observe in the 580 setting using the simultaneous calibration fibre an astrometric field with targets of known radial velocities.

As target field, old open clusters preferred to have low-rotation and low-activity solar type stars

Determine the radial velocities of the individual stars making use of the simultaneous calibration fibre.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘

Prepared OBs: `impex/FLAMES/Maintenance/FLAMES_uves_radvel_<field>.obx`
with `<field>` the name of the astrometric field. Fixed fields to cover the whole year are available.

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration:

Prerequisites: Clear sky, no moon restrictions, seeing $< 1.6$".

See also:

### 6.9 FLAMES – UVES Motor Currents

Responsible: Engineering

Phase: Daytime

Frequency: Monthly

Purpose: Detect trends in the motor currents of the different functions to allow preventive maintenance

Procedure: Record UVES motor currents over the full encoder range and both senses of motion

Outputs: FITSLOG keywords:
- ∘ Sample file,
- ∘ Min/Max/Average currents of all motorized functions

Prepared OBs: `impex/UVES/Maintenance/MotorCurTest.obx`

OT queue: `UVES.Maintenance`

Pipeline Support:

Duration:

Prerequisites:

See also: [3]

### 6.10 FLAMES – GIRAFFE Fibre Transmission Characterisation

Responsible: Science Operations

Phase: Daytime

Frequency: Daily; per plate and wavelength setting

Purpose: Determine the absolute fibre transmission as function of plate, fibre number and wavelength (within the limits of the stability of the OzPoz flatfield lamp and calibration system)

Procedure: as described in 5.5.1

Outputs: pipeline products:
as in 5.5.1
QC parameters:
as described in 5.5.1 plus
◦ numbers for absolute transmission as function of fibre number and wavelength

Prepared OBs: as in 5.5.1

OT queue: as in 5.5.1

Pipeline Support: needed

Duration:

Prerequisites:

See also:

### 6.11 FLAMES – GIRAFFE Spectrograph Stability Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Daily for Argus and both IFU and MEDUSA slits using the HR9 wavelength setting

Purpose: Determine the spectral shifts along and perpendicular to the dispersion direction for all simultaneous fibres

Procedure: Take spectra with the simultaneous ThAr calibration lamp on.

Measure the shift of the positions of the ThAr lines with respect to a master reference frame for each individual simultaneous fibre spectrum; the average shifts over all fibres are computed.

Outputs: pipeline products:
◦
QC parameters:
◦ spectral shifts in X and Y relative to reference frames

Prepared OBs: `impex/FLAMES/Maintenance/GIRAF_tec_stability.obx`

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration: 15 min

Prerequisites:

See also:

### 6.12 FLAMES – GIRAFFE Simultaneous Calibration Lamp Intensity Monitori

Responsible: Science Operations

Phase: Daytime

Frequency: Weekly for Argus and both IFU and MEDUSA slits using the HR9 wavelength setting

Purpose: Monitor the intensities of the simultaneous Thorium-Argon calibration lamp to allow preventive exchange before it fails.

Procedure: as described in 6.11

in addition the intensities of the ThAr lines in the simultaneous calibration fibres have to be measured with respect to a master reference frame; the relative intensities are computed.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ relative line intensities as function of time

Prepared OBs: as in 6.11

OT queue: as in 6.11

Pipeline Support: needed

Duration:

Prerequisites: as in 6.11

See also:

### 6.13 FLAMES – GIRAFFE Resolving Power Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Weekly for Argus and both IFU and MEDUSA slits using the HR2,9,14 and LR1,4,7 wavelength settings

Purpose: Determine the resolving power per wavelength setting averaged over all fibres

Procedure: Take spectra with the simultaneous ThAr calibration lamp on.

Mesure the average resolving power for each individual fibre spectrum; the average resolution over all fibres per wavelength setting is computed.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ Resolving power as function of temperature

Prepared OBs: `impex/FLAMES/Maintenance/GIRAF_tec_resolution.obx`

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration: 60 min

Prerequisites:

See also:

### 6.14 FLAMES – GIRAFFE Spatial Resolution Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Weekly for Argus and both IFU and MEDUSA slits using the HR2,9,14 and LR1,4,7 wavelength settings

Purpose: Determine the spatial resolution (i.e., the width of the spectra perpendicular to the dispersion direction) per wavelength setting averaged over all simultaneous fibres

Procedure: as described in 6.13

in addition the average spatial resolution is measured for each individual fibre spectrum; the average resolution over all fibres per wavelength setting is computed.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ Spatial Resolution power as function of temperature
- ∘ Spatial Resolution versus Resolving power

Prepared OBs: as in 6.13

OT queue: as in 6.13

Pipeline Support: needed

Duration: as in 6.13

Prerequisites:

See also:

### 6.15 FLAMES – GIRAFFE Spectrograph Focus Monitoring

Responsible: Science Operations

Phase: Daytime

Frequency: Bi-monthly for Argus and both IFU and MEDUSA slits using the HR2,9,14 and LR1,4,7 wavelength settings

Purpose: Determine the slit focus value for different slits and wavelength settings for the temperature under which the test was carried out

Procedure: Take spectra with the simultaneous ThAr calibration lamp on. Measure the fwhm of the simultaneous ThAr lines and determine the best focus value.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ focus value as function of slit, wavelength setting, and temperature

Prepared OBs: `impex/FLAMES/Maintenance/GIRAF_tec_focus.obx`

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration: 3 hrs

Prerequisites:

See also:

### 6.16 FLAMES – GIRAFFE CCD Characterisation

Responsible: Science Operations

Phase: Daytime

Frequency: Monthly

Purpose: Characterise the CCD via the following parameters:

- Bias level
- Gain
- RON
- Dark current
- Bad pixel/columns map
- Linearity
- Shutter error
- Relative Contamination

Procedure: Take a series of GIRAFFE CCD lamp flats, 1h darks, and biases for the standard CCD mode

`225kHz,1x1,low`

Outputs: pipeline products:
- ∘

QC parameters:
- ∘ Bias level
- ∘ Gain
- ∘ RON
- ∘ Dark current
- ∘ Bad pixel/columns map
- ∘ Linearity
- ∘ Shutter error
- ∘ Relative Contamination

Prepared OBs: `impex/FLAMES/Maintenance/GIRAF_tec_ccdtest.obx`
`impex/FLAMES/Maintenance/GIRAF_tec_dark.obx`

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration: 1 hr + 3 hrs for darks

Prerequisites: CCD must have been online for $>$ 6 h, better 12 or 24 h (otherwise gradients across the CCD might be present).

See also:

### 6.17 FLAMES – GIRAFFE CCD Shutter Performance

Responsible: Engineering

Phase: Day- and Nighttime

Frequency: Every CCD exposure

Purpose: Monitor the performance of the GIRAFFE CCD shutter

Procedure: Record the opening and closing time of the CCD shutter. Tend the measured times over time. A increase in the times indicate mechanical wearout of the shutter mechanics.

Outputs: FITSLOG keywords:

| | |
|---|---|
| `DET SHUT TMOPEN` | Time to open shutter [s]. |
| `DET SHUT TMCLOS` | Time to close shutter [s]. |

Pipeline support: not needed

Prerequisites:

See also:

## 6.18 FLAMES – GIRAFFE Instrument throughput / ETC Verification

### 6.18.1 FLAMES – GIRAFFE + MEDUSA rasters

Responsible: Science Operations

Phase: Nighttime

Frequency: Monthly

Purpose: Measure the instrument throughput by comparing the observed fluxes with the ETC predicted fluxes as function of wavelength

Procedure: On both plates configure and observe with a 3x3 raster of 0.4" stepsize in the L1, L4, L8 wavelength settings an astrometric field with targets of known brightness and spectral type.

Extract the measured flux at the center of the raster as function of wavelength.

Compare the results with the ETC predictions taking into account atmospheric conditions and the airmass of the observation.

Outputs: pipeline products:
- ∘

QC parameters:
- ∘

Prepared OBs: `impex/FLAMES/Maintenance/FLAMES_giraf_rasterL1_<field>.obx`
`impex/FLAMES/Maintenance/FLAMES_giraf_rasterL4_<field>.obx`
`impex/FLAMES/Maintenance/FLAMES_giraf_rasterL8_<field>.obx`

with `<field>` the name of the astrometric field. Fixed fields to cover the whole year are available.

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration:

Prerequisites: Photometric, dark sky, seeing $< 1.2$".

See also:

### 6.18.2 FLAMES – GIRAFFE + IFU pointings

Responsible: Science Operations

Phase: Nighttime

Frequency: Monthly

Purpose: Measure the instrument throughput by comparing the observed fluxes with the ETC predicted fluxes as function of wavelength

Procedure: On both plates configure and observe with IFUs in the L1, L4, L8 wavelength settings an astrometric field with stars of known brightness and spectral type

reconstruct the stellar images from the IFU spectra

measure the total flux for each target

Compare the results with the ETC predictions taking into account atmospheric conditions and the airmass of the observation.

Outputs: pipeline products:
- QC parameters:
-

Prepared OBs: `impex/FLAMES/Maintenance/FLAMES_giraf_ifuL1_<field>.obx`
`impex/FLAMES/Maintenance/FLAMES_giraf_ifuL4_<field>.obx`
`impex/FLAMES/Maintenance/FLAMES_giraf_ifuL8_<field>.obx`

with `<field>` the name of the astrometric field. Fixed fields to cover the whole year are available.

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration:

Prerequisites: Photometric, dark sky, seeing $< 1.8$".

See also:

### 6.19 FLAMES – GIRAFFE Radial Velocity Accuracy Characterisation

Responsible: Science Operations

Phase: Twilight / Nighttime

Frequency: Monthly

Purpose: Determine long-term radial velocity accuracy by repeated observation of the same field.

Procedure: On both plates configure and observe in the H10 setting using the simultaneous calibration fibre an astrometric field with targets of known radial velocities.

Determine the radial velocities of the individual stars making use of the simultaneous calibration fibre.

Outputs: pipeline products:
- QC parameters:
- RV precision: mean/rms

Prepared OBs: `impex/FLAMES/Maintenance/FLAMES_giraf_radvel_<field>.obx`

with `<field>` the name of the astrometric field. Fixed fields to cover the whole year are available.

OT queue: `FLAMES.Maintenance`

Pipeline Support: needed

Duration:

Prerequisites: Clear sky, no moon restrictions, seeing $< 1.6$”.

See also:

### 6.20 FLAMES – GIRAFFE Motor Currents

Responsible: Engineering

Phase: Daytime

Frequency: Monthly

Purpose: Detect trends in the motor currents of the different functions to allow preventive maintenance

Procedure: Record GIRAFFE motor currents over the full encoder range and both senses of motion

Outputs: FITSLOG keywords:
- Sample file,
- Min/Max/Average currents of all motorized functions

Prepared OBs: `impex/FLAMES/Maintenance/GIARF_tec_motorcurr.obx`

OT queue: `FLAMES.Maintenance`

Pipeline Support: none

Duration: 30 min

Prerequisites:

See also:

## 6.21 FLAMES – OZPOZ Astrometric Model Verification

### 6.21.1 FLAMES – GIRAFFE + MEDUSA rasters

Responsible: Science Operations

Phase: Nighttime

Frequency: Monthly

Purpose: Check the accuracy of the astrometric model

Procedure: take data as described in 6.18.1

reconstruct the stellar images from the raster
determine the RA and DEC centroid of the stars
determine the RA and DEC offsets w.r.t. the nominal positions
fit an astrometric model to the offsets

Outputs: pipeline products:
∘
QC parameters:
new model parameters:
∘ center plate RA offset
∘ center plate DEC offset
∘ scale change
∘ additional rotation

Prepared OBs: same as in 6.18.1

OT queue: same as in 6.18.1

Pipeline Support:

Duration:

Prerequisites:

See also:

### 6.21.2 FLAMES – GIRAFFE + IFU pointings

Responsible: Science Operations

Phase: Nighttime

Frequency: Monthly

Purpose: Check the accuracy of the astrometric model

Procedure: take data as described in 6.18.2

reconstruct the stellar images from the IFU spectra
determine the RA and DEC centroid of the stars
determine the RA and DEC offsets w.r.t. the nominal positions
fit an astrometric model to the offsets

Outputs: pipeline products:
- ∘

QC parameters:
new model parameters:
- ∘ center plate RA offset
- ∘ center plate DEC offset
- ∘ scale change
- ∘ additional rotation

Prepared OBs: same as in 6.18.2

OT queue: same as in 6.18.2

Pipeline Support: needed

Duration:

Prerequisites:

See also:

### 6.22 FLAMES – OZPOZ Fibre Configuration Performance

Responsible: Science Operations

Phase: Day- and Nighttime

Frequency: N/A

Purpose: Monitor the performance of the fibre positioner

Procedure: At the end of any fibre configuration performance parameters are recorded.

Outputs: FITSLOG keywords:

| | |
|---|---|
| `INS PCC TIMTOT` | Total configuration time [s]. |
| `INS PCC NUMMOVE` | Number of moves in the configuration. |
| `INS PCC NUMFIB` | Number of fibres in the configuration. |
| `INS PCC MPERF` | Average number of moves per fibre. |
| `INS PCC TIMFIB` | Average time per fibre in configuration [s]. |
| `INS PCC TIMMOVE` | Average time per move in configuration [s]. |
| `INS PCC PPERM` | Average number of placements per move. |

Pipeline support: not needed

Prerequisites:

See also:

### 6.23 FLAMES – OZPOZ FACB Sensitivity

Responsible: Science Operations

Phase: Nighttime

Frequency: 1 / 90

Purpose: Monitor the sensitivity of the FACBs

Procedure: Observe with FACBs fiducial stars of known magnitude and determine countrates for gives magnitude.

Every time a FACB image is saved, the brightness of the stars is determined and logged together with the magnitude of the stars to the FITSLOG.

The countrate then is scaled to a magnitude of 15.

Outputs: FITSLOG keywords:

| | |
|---|---|
| `INS FACBi CNTS` | FACB countrate [ADU/sec] |
| `INS FACBi MAG` | FACB R magnitude [mag] |
| `INS FACBi SENS` | FACB sensitivity [ADU/sec @ 15mag] |

Pipeline support: not needed

Prerequisites:

See also:

## 6.24 Summary: Instrument Monitoring

Monitoring data to be made available as QC parameters through QC webpages and FITSLOG keywords throught the Paranal Autrep database with standard plots created on a daily basis.
The data for the following instrument monitoring tasks might already be available from the science data calibrations.
Some of the monitoring tasks are already covered by the UVES calibration plan.

**FLAMES – UVES Instrument Monitoring Plan**

| Calibration | number | frequency [1/days] | purpose |
|---|---|---|---|
| Fibre Flatfields | 3 | 1 / 1 | absolute fibre transmission |
| Sim. Fibre Format Check | 1 | 1 / 1 | fibre projector stability |
| | | 1 / 7 | resolving power monitoring |
| | | 1 / 7 | sim. ThAr lamp intensity monitoring |
| CCD flats + biases | $seq$ | 1 / 30 | CCD characterization |
| | | | CCD contamination |
| UVES rasters on astrometric fields | 3x3x$v$ | 1 / 30 | instrument throughput / ETC verification |
| RV Standard field | 1 | 1 / 30 | long-term RV accuracy |

**FLAMES – GIRAFFE Instrument Monitoring Plan**

| Calibration | number | frequency [1/days] | purpose |
|---|---|---|---|
| Flatfields | 1 | 1 / 1 | absolute fibre transmission |
| Wavelength | 1 | 1 / 1 | spectrograph stability |
| | | 1 / 7 | resolving power monitoring |
| | | 1 / 7 | spatial resolution monitoring |
| | | 1 / 7 | sim. ThAr lamp intensity monitoring |
| CCD flats + biases | $seq$ | 1 / 30 | CCD characterization |
| | | | CCD contamination |
| MEDUSA rasters on astrometric fields | 3x3x$w$ | 1 / 30 | instrument throughput / ETC verification |
| IFU pointings on astrometric fields | 1x$w$ | 1 / 30 | instrument throughput / ETC verification |
| RV standard field | 1 | 1 / 30 | long-term RV accuracy |

**FLAMES – OZPOZ Instrument Monitoring Plan**

| Calibration | number | frequency [1/days] | purpose |
|---|---|---|---|
| MEDUSA rasters on astrometric fields | 3x3x$w$ | 1 / 30 | verification of astrometric model |
| IFU pointings on astrometric fields | 1x$w$ | 1 / 30 | verification of astrometric model |
| Any fibre configuration | | | fibre configuration performance |
| FACB images | | 1 / 90 | FACB sensitivity |

$v$ = 3 = number of wavelength settings := 520, 580, 860

$w$ = 3 = number of wavelength settings := LR1, LR4, LR8

$seq$ = special sequence: 5 biases + 10 flatfield pairs of equal exposure time covering the dynamic range

# A Calibration Time Estimates

Typical calibration times were recorded during commissioning. More detailed estimates for this section expected from experience collected during the dry run.

# B calobBuild configuration files

The daily calibration plan is coded with the help of the Calibration OB tool (`calob`). See [2] for details and the configuration syntax.

Since the configuration files are still frequently changing we refer for the moment directly to the cmm modules

```
flocal          last version: 1.9
uvocal          last version: 1.31
calob           last version: 1.24
```

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