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Very Large Telescope
Paranal Science Operations
AMBER Template Manual

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1 INTRODUCTION

1.1 Scope

This document describes the **templates** for AMBER, the **A**stronomical **M**ulti-**BE**am **R**ecombiner, of the VLT Interferometer. Like for all the VLT instruments, observations with AMBER are carried out with **observation blocks** (OBs). The OBs must be written by the user during Phase-2 preparation with the P2PP tool. An OB consists of a set of information and several templates that describe the target acquisition and the observation sequence. For some templates, the user has to indicate the values of **keywords** (parameters).

This manual requires the user to already have an insight in the AMBER operation, as described in the "AMBER User Manual", that can be downloaded from:

`http://www.eso.org/instruments/amber/doc`

For the installation of the P2PP tool, see:

`http://www.eso.org/observing/p2pp`

Note: the AMBER specific templates will be downloaded by the P2PP tool.

For service mode observations, it is important to read the AMBER-specific service mode instructions given on the web page:

`http://www.eso.org/observing/p2pp/AMBER/AMBER-P2PP.html`

This page gives suggestions for OB edition with P2PP (name, constraint set), as well as the requirements for the "readme" file and for the finding charts.

There is also an AMBER P2PP specific web page with a step by step tutorial at:

`http://www.eso.org/observing/p2pp/tutorials/tut_amber.html`

1.2 Contact information

In case of questions or suggestions related to Phase-2 preparation, please contact the ESO User Support Department (`usd-help@eso.org`).

1.3 Period of validity of this manual

This manual only applies for observations with AMBER in ESO Period 92, starting April 1st, 2010 and ending October 1st, 2010.

1.4 Acknowledgments

The Editor would like to thank Stan Stefl and Markus Wittkowski for comments and suggestions of improvements to the manual.

1.5 Glossary

- **Constrain Set (CS)**
  Listq of requirements for the conditions of the observation that is given inside an OB. OBs are only executed under this set of minimum conditions.

- **Observation Block (OB)**
  An Observation Block is the smallest schedulable entity for the VLT. It consists of a sequence of Templates. Usually, one Observation Block include one target acquisition and up to three exposure templates.

- **Observation Description (OD)**
  A sequence of templates used to specify the observing sequences within one or more OBs.

- **Observation Toolkit (OT)**
  Tool used to create queues of OBs for later scheduling and possible execution (service mode).

- **Proposal Preparation and Submission (Phase-I)**
  The Phase-I begins right after the CfP (Call-for-Proposals) and ends at the deadline for CfP. During this period the potential users are invited to prepare and submit scientific proposals. For more information, see:

  `http://www.eso.org/observing/proposals.index.html`

- **Phase-2 Proposal Preparation (P2PP)**
  Once proposals have been approved by the ESO Observation Program Committee (OPC), users are notified and the Phase-2 begins. In this phase, users are requested to prepare their accepted proposals in the form of OBs, and to submit them by Internet (in case of service mode). The software tool used to build OBs is called the P2PP tool. It is distributed by ESO and can be installed on the personal computer of the user. See:

  `http://www.eso.org/observing/p2pp`.

- **Service Mode (SM)**
  In service mode (opposite of the "Visitor-Mode"), the observations are carried out by the ESO Paranal Science-Operation staff (PSO) alone. Observations can be done at any time during the period, depending on the CS given by the user. OBs are put into a queue schedule in OT which later sends OBs to the instrument.

- **Template**
  A template is a sequence of operations to be executed by the instrument. The observation software of an instrument dispatches commands written in templates not only to instrument modules that control its motors and the detector, but also to the telescopes and VLTI sub-systems.

- **Template signature file (TSF)**
  File which contains template input parameters.

- **Visitor Mode (VM)**
  The classic observation mode. The user is on-site to supervise his/her program execution.

1.6 Modifications for P92

There are modifications to table 2.

2 AMBER TEMPLATES

2.1 Observing modes

As indicated in the "AMBER web pages" found at:
`http://www.eso.org/instruments/amber/inst/index.html`
the following setups of AMBER will be offered for P92:

- 18 spectral modes available:
  1. Low Resolution JHK using IRIS, where 30% of K is always sent to IRIS.
  2. Medium Resolution K-band, center wavelength 2.1μm.
  3. Medium Resolution K-band, center wavelength 2.3μm.
  4. Medium Resolution H-band, center wavelength 1.65μm.
  5. High Resolution K-band, with 14 central wavelengths (see Table 1).
- Table 2 gives a summary of the possible DITs that can be used depending on telescopes, FINITO, and/or differential mode. The user can also check the latest on line information at:
  `http://www.eso.org/instruments/amber/inst`
  as this information supersedes any numbers presented in this manual.
- Coudé guiding on the science target or a guide star. It should be noted that without MACAO the flux will be severely time dependent and will not reach the magnitude limits given in this document or in the CfP. For proper AMBER observations Coudé guiding must be used. For proper MACAO operation the SCIENCE target or the guide star must be suitable for guiding (see section 2.2.2). Similar constraints for the STRAP are given in section 2.2.3.
- Only baselines with three UTs or three ATs (3T template).
- Only one read-out mode (1 row) on the detector.
- External fringe tracker (FINITO) is available both on the ATs and the UTs. See section 2.3.4 for the constraints that must be fulfilled for FINITO fringe tracking. Note that starting in P92 FINITO is standard for MR and HR modes. OBs in MR or HR requiring FINITO not to be used should be submitted with a waiver.

Hence, the number of templates for P92 is minimal: one template for the preset, acquisition and fringe search, and one template for fringe observation. Moreover, because of the policy adopted by ESO for observations with AMBER in service mode (one calibrated visibility point every 70 minutes), the number of keywords to be set by the user is very limited.

2.2 The acquisition template

According to P2PP rules, the first template in an OB must be an acquisition template. In the case of AMBER, the name of this template is: *AMBER_3Tstd_acq*.

The sequence of this template starts by a "preset": the target coordinates (α, δ) are sent to the telescopes and the delay lines, so they can slew to the position corresponding to the target coordinate at preset time. Once the telescopes are tracking and Coudé-guiding, the target should be seen on the *Image Alignment Sensor*, currently IRIS. To ensure that the beams are injected properly to AMBER the *Image Alignment Sensor* is used to align the object to the VLTI reference points ("image optimization"). To ensure that maximum flux is injected an "injection adjustment" is done. This is done by sending offsets to the telescopes to maximize the flux injected into the AMBER fibers.

2.2.1 Proper motion

In particular in Low resolution mode it is critical to have the information on the observed proper motion of the object as a proper motion larger than 50 mas/year can slow down or impede the fringe search. For an effective use of the allocated time we strongly suggest that the user puts the measured proper motion into the P2PP.

2.2.2 Coudé guiding with the UTs

It is possible to have an object different from the science target as a guide star at the Coudé focus. The requirements are:

- The guide star must be brighter than $V = 17$ (MACAO is used for Coudé guiding). Note that the Strehl drops significantly in K with a Coudé guide star fainter than the 13-14th magnitude (approximately 1 magnitude) and that by magnitude 16th the magnitude limits for the science object drops by more than 2 magnitudes.

- The guide star must be within a radius of 57.5 arcsec from the science target. Note that the Strehl drops with distance from the science target, so it is recommended that the user chooses a Coudé guide star as close as possible. If at distances larger than a few tens of arcseconds from the science target more than 1 magnitude can be lost. A rule of thumb is that the magnitude limits drops by 1 magnitude for every 15 arcseconds from the science object. Note that when using FINITO the allowed distance is severely restricted, see section 2.3.4. Note that the magnitude limit is changed when using FINITO, see section 2.3.4.

- The guide star must be fainter than $V = 1$.

- It is requested that the faintest (if variable) V magnitude of the Coudé guide star is given in the keyword `TEL.COU.MAG`.

- There are a few additional weather condition constraints for proper MACAO performance, which are also important even though the SCIENCE object is used for the Coudé guiding:

  - Seeing should be better than 1.5 arc sec.
  - τ_0 >1.5 ms
  - Airmass <2.

  These constraints do not affect Service observations as OBs are only classified as A or B if MACAO has been performing within the tolerances. The constraints are given here for Visitor mode observations to give the user the conditions under which MACAO will perform as expected. Thus during non ideal weather conditions outside the MACAO performance ranges the user could ameliorate the effects to some degree by only using bright guide stars and only observing at a high elevation.

Note: The magnitude limits are identical for Coudè guiding on the `SCIENCE` target, and are different from the limiting magnitudes for the AMBER instrument. **Note:** A plot of the expected Strehl as function of guide star magnitude, distance and weather conditions is shown in Figure 1

Note: To inject light into AMBER a Coudé guide star must be used. It is not possible under any weather conditions to perform AMBER observations not using MACAO on the UTs.

2.2.3 STRAP guiding with the ATs

Note: To inject light into AMBER a guide star must be used with STRAP. It is not possible under any weather conditions to perform AMBER observations not using STRAP on the ATs. The requirements for successful STRAP guiding are:

- The guide star must be brighter than $V = 13$. Note that the tip tilt correction drops significantly in K with a STRAP guide star fainter than the 11th magnitude and that by magnitude 13th the magnitude limits for the science object drops by more than 1 magnitude.
- The guide star must be within a radius of <60 arcseconds from the science target. Note that the effective tip-tilt correction drops with distance from the science target, so it is recommended that the user chooses a guide star as close as possible. If at distances larger than a few tens of arcseconds from the science target more than 1 magnitude can be lost. A rule of thumb is that the magnitude limits drops by 1 magnitude for every 15 arcseconds from the science object. Note that with FINITO operation the distance is severely limited, see section 2.3.4.
- It is requested that the faintest (if variable) V magnitude of the guide star is given in the keyword `TEL.COU.MAG`. This is true for all cases when STRAP is used.

2.2.4 Source K and H magnitudes

The `SEQ.SOURCE.HMAG` and `SEQ.SOURCE.KMAG` keywords should be used to specify the uncorrelated H and K band fluxes of the science target.

2.2.5 Source K and H Visibilities

The `SEQ.SOURCE.HVIS` and `SEQ.SOURCE.KVIS` keywords should be used to specify the **minimum** visibility on the two shortest baselines for the science target in the requested LST range. It is critical that these numbers are correct as possible since they are used to configure FINITO and in particular too optimistic numbers can impede proper FINITO operation. It is safer to underestimate the Visibility as the FINITO operation can adapt to higher Visibilities than expected (although with possible reduced performance).

The final step in the Acquisition template is to search for fringes ("fringe search"). If FINITO is used then the fringe search will be performed by FINITO and if not selected then it is done by AMBER by doing a saw tooth search around the nominal fringe position. Note that there are no user keywords available for this step.

2.3 The observation template

This template is the second and the last one (although see section 2.3.7 and section 2.3.8) in any AMBER OB description for P92. It is used to record the photometric beams and the dispersed fringes. There is currently only one template:

1. 3T exposures using 1 readout row on the detector, *AMBER_3Tstd_obs_1row*.

Each exposure consists of one dispersed photometric spectrum for each telescope and one dispersed fringe spectrum. The standard observation template takes 7 exposures, one dark (DARK), five on source exposures (OBJECT), and, one off-source exposure (SKY).

The `TEL.OFFS.ALPHA` and `TEL.OFFS.DELTA` are used to select the location of the off target exposure. These offsets will move the telescopes in the directions given.

2.3.1 Integration time

If the object is too faint/resolved/high Airmass for FINITO operation the integration times with AMBER will have to be short to minimize atmospheric turbulence. It is foreseen to use a DIT of 0.025 s (0.05 and 0.1 s available on the ATs) for all observations. The exception to this rule is the use of differential phase observations and High Resolution K observations. In these cases it is possible to use a DIT twice the standard DIT, *i.e* 0.05 s on the UTs and 0.1 s on the ATs. **Note:** The DIT of the Science and Calibrator targets **must** be identical to avoid biasing the data.
Note II: As a consequence the magnitude of the Calibrator is strongly suggested to be within $\pm$0.5-1 (uncorrelated) magnitude of the science target.
Both the issues above are to avoid the biasing that is caused by having different detector read-out levels on the Science and Calibrator.

2.3.2 Using IRIS for Lab guiding

IRIS is always used for lab guiding. This ensures that the slow tunnel tip-tilt effects are corrected. The H flux is sent undiminished to AMBER while 30% of the K band flux is used for the IRIS guiding. This magnitude loss is included in the given magnitude limits.

2.3.3 Selecting the spectral band

There are 17 available spectral configurations available for AMBER. The low resolution (LR) covers the full spectral band of the instrument with R$\sim$35, while the medium resolution grating (MR, with R$\sim$1500) can currently be configured for two wavelength ranges in the K-band and the high resolution grating (HR, with R$\sim$12000) can currently be configured for 14 wavelength ranges. The user should select the proper spectrograph configuration depending on the desired observing wavelength (see table 2.3.3). The final constraints in the spectral configuration are the upper and lower limits of the spectral range. Currently due to the fixed `DIT` (if FINITO is **NOT** used) of 0.025 s (or 0.05 s for differential phase observations, see "AMBER User Manual" for a description of this mode) the total spectral range is 0.04 μm in MRK and 0.008 μm in HR and twice that for DIT=50 ms). These are set by the keywords:
`OCS.DET.ROW0.WLENMAX` and `OCS.DET.ROW0.WLENMIN` in the
`AMBER_3Tstd_obs_1row.tsf` template.

Table 1: Allowed spectral configurations and spectral ranges. The maximum $\Delta\lambda$, should be used to determine the WLENMIN/MAX for the observing template. The numbers are all given for DIT=0.025 s and should be scaled accordingly if DIT is increased *i.e* DIT=0.05s allows twice the $\Delta\lambda$ so that in MR would be 0.08 μm.

Spectral Configuration	Covered wavelength range [μm]	Maximum $\Delta\lambda$ [μm]
Low_JHK	1.027–2.54 μm	*Full range*
Medium_K_1_2.1	1.926-2.275 μm	0.04 μm
Medium_K_1_2.3	2.126-2.474 μm	0.04 μm
Medium_H_1_1.65	1.540-1.822 μm	0.032 μm
High_K_1_1.979	1.955-2.003 μm	0.008 μm
High_K_1_2.018	1.994-2.042 μm	0.008 μm
High_K_1_2.056	2.032-2.079 μm	0.008 μm
High_K_1_2.095	2.071-2.118 μm	0.008 μm
High_K_1_2.133	2.110-2.156 μm	0.008 μm
High_K_1_2.172	2.149-2.195 μm	0.008 μm
High_K_1_2.211	2.187-2.235 μm	0.008 μm
High_K_1_2.249	2.226-2.272 μm	0.008 μm
High_K_1_2.288	2.265-2.311 μm	0.008 μm
High_K_1_2.326	2.303-2.348 μm	0.008 μm
High_K_1_2.365	2.342-2.387 μm	0.008 μm
High_K_1_2.403	2.381-2.425 μm	0.008 μm
High_K_1_2.442	2.420-2.464 μm	0.008 μm
High_K_1_2.481	2.459-2.503 μm	0.008 μm

An example of the proper setting of the keywords for a template observing with *Medium_K_1_2.1*, centered around $\lambda 2.16\mu$m would be:

- *DET1.DIT* = 0.025
- *OCS.DET.ROW0.WLENMAX* = 2.18
- *OCS.DET.ROW0.WLENMIN* = 2.14

Note: Using FINITO in MR or HR the full spectral range can be used in all cases.

2.3.4 FINITO

FINITO is offered on the Auxiliary Telescopes (ATs) and on the Unit Telescopes (UTs). FINITO scans the center of the fringe packet in H band with high speed and sends a co-phasing signal to the VLTI Delay Lines via a dedicated high speed link. Due to the short individual exposure times (between 0.5ms and 2ms) and the need to measure the fringe in every individual scan, the sensitivity of FINITO is somewhat worse than for AMBER in Low Resolution mode that slowly records the fringe and can reject some data. FINITO operates on two channels, i.e. tracks three baselines. Note that if FINITO is used then it takes either 70% or 100% of the H-band flux. This will only affect the LR-JHK and MR-H modes, as in MR-K or HR-K the 100% dichroic is used and for LR-JHK the 70% one is used, thus loosing 1.3 magnitudes in the H-band. The observer should take this loss into account when setting the DIT in the template.

The full potential of FINITO comes with AMBER using higher spectral resolution *i.e* Medium and High Resolution. Since the fringes are "frozen" in OPD space, AMBER can integrate longer and/or one can stack the individual fringes during post processing.

Currently, FINITO operations are feasible under the following conditions:

- Seeing below 1.2 arcseconds on the ATs and below or equal to 0.8 arcseconds on the UTs.
- The transparency should be CLR or better.
- τ_0 above 2.5ms
- Airmass less than 1.5.
- The limiting correlated magnitude for FINITO is H=5 on the ATs and H=8 on the UTs in LR or MR. In HR, the limits are H=5 on the ATs and H=7 on the UTs (see here) for limiting magnitudes in various set conditions).
- The minimum visibility in the H band is 15% on the ATs and 10% on the UTs.
- The limiting V magnitude for the Coude guide star is severely reduced when using FINITO. It is V=11 on the ATs and V=13 on the UTs.
- The distance to the Coude guide star (if different from the Science object) is severely limited when using FINITO. For both the UTs and the ATs the maximum distance is 15 arcseconds.

These numbers were determined with a seeing less than 1.2 arcseconds and τ_0 above 2.5ms.

The usage of FINITO is set by the `TEL.DEL.FTSENSOR` keyword in the ACQ template. To use it the keyword value should be changed from the default `NONE` to `FINITO`.

FINITO should always be used in HR and MR, since the limiting factor is then AMBER. Moreover, using FINITO thus allows AMBER to:

- Read-out the full spectral range in Medium and High Resolution: The user should thus specify the full spectral range using:
  - `OCS.DET.ROW0.WLENMAX` = 9999
  - `OCS.DET.ROW0.WLENMIN` = 0
- Use longer than normal DITs (up to 12 s). Note though that the DIT **must** be the same on the Calibrator as on the Science object.
- See here) for limiting magnitudes in various set conditions.
- Stabilize the fringes in the low resolution, so that higher quality data can be recorded.

2.3.5 AMBER DITs with FINITO

With the use of FINITO on the ATs longer than normal DITs are feasible. The DIT of AMBER depends on the K magnitude of the object and is given in table 2.

2.3.6 Summary Table

Table 2 summarizes the current AMBER/AMBER+FINITO limits and possible configurations assuming nominal weather conditions.

2.3.7 Additional spectral bands

It is possible to obtain visibility measurements at several spectral positions inside the range allowed by each configuration, *ie*, to obtain calibrated visibilities on a line and the surrounding continuum. In this case the user adds one *AMBER_3Tstd_obs_1row* template after the last observation template.

Note: This is **only** possible if the same spectral configuration is kept, and is limited to two additional observation templates, *ie*, a total of three observing templates in the same OB. It should also be stressed that the same observing configuration should be used for the calibrator.

2.3.8 High SNR spectral calibration

In the two MRK modes an added high SNR observation will be performed at the end of the final observing template. Its purpose is to allow later correction of the spectra by the user in the offline data reduction. This observation covers the full MRK band in question and is delivered automatically and requires no user input.

Table 2: Summary of available spectral configurations, telescopes (Tel), limiting K and H correlated magnitudes (K_c and H_c), limiting K and H visibilities (K_{Vis} and H_{Vis}), limiting Airmass (AM), DITs and maximum $\Delta\lambda$. Note that the DIT for the calibrator **must** be the same as for the science object. Thus to avoid systematic errors a calibrator should ideally be within 0.5 magnitudes of the science object. Also, for better than normal weather conditions K and H magnitudes 4 and 5 can be reached on the ATs. The DITs to be used in these cases are then the same as the DIT for a K=3 object. Performances are seeing dependent, the following numbers are given for 0.8 arcsecond on the UTs, and 0.6 arcsecond for the ATs. Please consult the AMBER web page for updated numbers for degraded seeing conditions.

Mode	Tel	FINITO	K_c	H_c	K_{Vis}	H_{Vis}	AM	$\Delta\lambda$ [μm]	DIT [s]
LR	UT	no	$K_c \leq 7.5$	$H_c \leq 7.5$	≥ 0.1	≥ 0.1	≤ 2.0	Full	0.025,0.05
LR	UT	yes	$K_c \leq 7$	$H_c \leq 7$	≥ 0.1	≥ 0.1	≤ 1.5	Full	0.05
MRH	UT	yes	NA	$H_c \leq 3$	NA	≥ 0.1	≤ 1.5	Full	0.2
MRH	UT	yes	NA	$3 < H_c \leq 5.5$	NA	≥ 0.1	≤ 1.5	Full	0.5
MRK	UT	yes	$K_c \leq 6$	$H_c \leq 7$	≥ 0.1	≥ 0.1	≤ 1.5	Full	0.2
MRK	UT	yes	$6 < K_c \leq 7$	$H_c \leq 7$	≥ 0.1	≥ 0.1	≤ 1.5	Full	0.5
HRK	UT	yes	$K_c \leq 2$	$H_c \leq 6$	≥ 0.1	≥ 0.1	≤ 1.5	Full	0.2
HRK	UT	yes	$2 < K_c \leq 3$	$H_c \leq 6$	≥ 0.1	≥ 0.1	≤ 1.5	Full	0.5
HRK	UT	yes	$3 < K_c \leq 4$	$H_c \leq 6$	≥ 0.1	≥ 0.1	≤ 1.5	Full	1.0
HRK	UT	yes	$4 < K_c \leq 5$	$H_c \leq 6$	≥ 0.1	≥ 0.1	≤ 1.5	Full	3.0
HRK	UT	yes	$5 < K_c \leq 6$	$H_c \leq 6$	≥ 0.1	≥ 0.1	≤ 1.5	Full	6.0
LR	AT	no	$K_c \leq 3.6$	$H_c \leq 4.0$	≥ 0.05	≥ 0.05	≤ 2.0	Full	0.025
LR	AT	no	$3.6 < K_c \leq 4.4$	$4.0 < H_c \leq 4.8$	≥ 0.05	≥ 0.05	≤ 2.0	Full	0.05
LR	AT	no	$4.4 < K_c \leq 6.0$	$4.8 < H_c \leq 6.0$	≥ 0.05	≥ 0.05	≤ 2.0	Full	0.1
LR	AT	yes	$K_c \leq 5.5$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	0.05
MRH	AT	yes	NA	$H_c \leq 0$	NA	≥ 0.15	≤ 1.5	Full	0.2
MRH	AT	yes	NA	$0 < H_c \leq 2$	NA	≥ 0.15	≤ 1.5	Full	0.5
MRH	AT	yes	NA	$2 < H_c \leq 4.5$	NA	≥ 0.15	≤ 1.5	Full	1.0
MRK	AT	yes	$K_c \leq 1$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	0.2
MRK	AT	yes	$1 < K_c \leq 2$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	0.5
MRK	AT	yes	$2 < K_c \leq 5.5$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	1.0
HRK	AT	yes	$K_c \leq 0$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	1.0
HRK	AT	yes	$0 < K_c \leq 1$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	3.0
HRK	AT	yes	$1 < K_c \leq 2$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	6.0
HRK	AT	yes	$2 < K_c \leq 5.5$	$H_c \leq 5$	≥ 0.05	≥ 0.15	≤ 1.5	Full	12.0

2.3.9 Execution time

The execution time for one uncalibrated visibility is fixed to 30 minutes. Users interested in obtaining visibility measurements at several spectral positions inside the range allowed by each configuration should add 10 minutes for each additional spectral band. Each band will be defined by its minimum and maximum wavelength, with a span of 0.04μm in MRK, 0.032μm in MRH and 0.008μm in HR. A maximum of 3 bands can be accommodated within one observation *ie* at total execution time of 100 minutes for both `SCIENCE` and `CALIBRATOR`. Each change of configuration, or a number of bands exceeding 3, will require a new acquisition, *ie*, 20 minutes per uncalibrated visibility.

The execution time can be detailed at template level, where the *AMBER_3Tstd_acq_1row* takes 20 minutes, and the *AMBER_3Tstd_obs_1row* takes 10 minutes. Thus the total execution time for an OB with one acquisition template and one observing template takes 30 minutes.

Note: The calibrator has to be observed with the same configuration and thus the total execution time for one calibrated visibility spectrum is 60 minutes for one calibrated visibility. If for example the user has two spectral bands the total time for one SCIENCE OB and one CALIB OB is 80 minutes.

2.4 User keywords

In the following tables, we give for each template the keywords that have to be set by the user with the P2PP tool.

2.4.1 AMBER_3Tstd_acq.tsf

Parameter	Range *(Default)*	Label
SEQ.SOURCE.HMAG	-5...30 *(0)*	Source uncorrelated H magnitude
SEQ.SOURCE.HVIS	0...1 *(0.7)*	Source minimum H Visibility for the requested LST range
SEQ.SOURCE.KMAG	-5...30 *(0)*	Source uncorrelated K magnitude
SEQ.SOURCE.KVIS	0...1 *(0.7)*	Source minimum K Visibility for the requested LST range
TEL.DEL.FTSENSOR	NONE FINITO *(NONE)*	Using FINITO as external fringe tracker or not.
TEL.TARG.ADDVELALPHA	-15...15 *(0)*	Differential RA tracking in arcsec/sec.
TEL.TARG.ADDVELDELTA	-15...15 *(0)*	Differential DEC tracking in arcsec/sec.
TEL.COU.ALPHA	RA *(0.)*	RA of a guide star.
TEL.COU.DELTA	DEC *(0.)*	DEC of a guide star.
TEL.COU.GSSOURCE	SETUPFILE SCIENCE *(SCIENCE)*	Coudé guide star, this can be either the science object (SCIENCE), a guide star (SETUPFILE), or no Coudé guiding (NONE). See section 2.2.2.
TEL.COU.MAG	0...25 *(0.)*	Guide star magnitude in V. This must be supplied and in the case of a variable star the maximum magnitude should be given.
DPR.CATG	SCIENCE CALIB *(SCIENCE)*	Science or calibrator OB.
OCS.OBS.SPECCONF	Low_JHK Medium_K_1_2.1 Medium_K_1_2.3 Medium_H_1_1.65 *(NODEFAULT)*	Spectral configuration

Below follows a more detailed description of the keywords in the acquisition template:

- `SEQ.SOURCE.HMAG` and `SEQ.SOURCE.KMAG` are the uncorrelated H and K band magnitudes of the target, the light of which is sent to the AMBER fibers. **When using medium resolution H band, please enter the actual Kmag**, since it will be used for the IRIS lab guiding (see VLTI user manual).

- `SEQ.SOURCE.HVIS` and `SEQ.SOURCE.KVIS` keywords should be used to specify the **minimum** visibility on the two shortest baselines for the science target in the OA requested LST range. It is critical that these numbers are correct as possible since they are used to configure FINITO and in particular too optimistic numbers can impeded proper FINITO operation. It is safer to be underestimating the Visibility as the FINITO operation can adapt to higher Visibilities than expected (although with possible reduced performance). When using medium resolution H band, please enter `KVIS=0.7`, which is the default value.

- `TEL.DEL.FTSENSOR`: By changing this from the default `NONE` to `FINITO` the user will use FINITO as an external fringe tracker allowing stabilized fringes and thus longer DITs.

- `TEL.TARG.ADDVELALPHA/DELTA`: These keywords should be used for object moving on the sky with a large differential motion, as e.g. asteroids or comets. For the objects with normal proper motion (a few arcseconds/year) should fill in the field `proper motion RA/DEC` (units are in arcsec/year) in the bottom right of the P2PP window.
- `TEL.COU.ALPHA/DELTA`: Coordinates of the Coudé guide star. These keywords should only be specified if the keyword `TEL.COU.GSSOURCE` is set to `SETUPFILE`. Otherwise they should be `0.0` as the Coudé Guiding will use the science target to guide on.
- `TEL.COU.GSSOURCE`: This keyword is used to tell the system if Coudé guiding or STRAP guiding is to be used. Note that without Coudé/STRAP guiding and thus without MACAO/STRAP AMBER cannot be operated. The keyword can have the following values :
  - `NONE`: No Coudé guiding and thus NO MACAO (AMBER requires a working MACAO to perform within specifications).
  - `SCIENCE`: Coudé guiding on the science object. The coordinates are those given in the `RA/DEC` fields in P2PP.
  - `SETUPFILE`: Coudé guiding on a guide star. The coordinates are those given in the `TEL.COU.ALPHA/DELTA` fields in P2PP. Please note the constraints for MACAO guide star in section 2.2.2 and that these constraints are also pertinent if Coudé guiding are attempted on the `SCIENCE` object.
- `TEL.COU.MAG`: Coudé guide star Visual magnitude. This should **always** be specified. **In the case of a variable star the maximum magnitude should be given.**
- `DPR.CATG`: This keyword is used to specify whether this is a Science OB (`SCIENCE`) or Calibrator OB (`CALIB`). This should conform with the labeling of the OB (see AMBER Specific P2PP info on the ESO P2PP pages).
- `OCS.OBS.SPECCONF`: This keyword sets the desired spectral configuration. It can be:
  - `Low_JHK`: Low resolution observations covering bands J, H, and K.
  - `Medium_H_1_1.65`: Medium resolution observations in H with the central wavelength 1.65 μm.
  - `Medium_K_1_2.1`: Medium resolution observations in K with the central wavelength 2.1 μm.
  - `Medium_K_1_2.3` Medium resolution observations in K with the central wavelength 2.3 μm.
  - `High_K_1_X.XXX` High resolution observations in K with the central wavelength taken from the table 1.

2.4.2 AMBER_3Tstd_obs_1row.tsf

Parameter	Range *(Default)*	Label
SEQ.SOURCE.HMAG	-5...30 *(0)*	Source uncorrelated H magnitude
SEQ.SOURCE.HVIS	0...1 *(0.7)*	Source minimum H Visibility for the requested LST range
SEQ.SOURCE.KVIS	0...1 *(0.7)*	Source minimum K Visibility for the requested LST range
SEQ.SOURCE.KMAG	-5...30 *(0)*	Source uncorrelated K magnitude
DET1.DIT	0.025 0.050 *(0.025)*	Frame integration time (DIT in s)
TEL.OFFS.ALPHA	-999...999 *(0)*	Telescope sky offset in RA (arcsec).
TEL.OFFS.DELTA	-999...999 *(30)*	Telescope sky offset in DEC (arcsec).
OCS.DET.ROW0.WLENMAX	0.0...9999.0 *(NODEFAULT)*	Row 1:max wavelength (in μm).
OCS.DET.ROW0.WLENMIN	0.0...9999.0 *(NODEFAULT)*	Row 1:min wavelength (in μm).

A detailed explanation of the keywords in the observing template follows:

- `DET1.DIT`: Frame integration time in seconds.
- `TEL.OFFS.ALPHA/DELTA`: Telescope sky offset in RA/DEC (arcsec), these offsets are used for taking the sky exposure. These offsets will move the telescopes in the given directions.
- `OCS.DET.ROW0.WLENMAX`: Upper limit of the desired wavelength range in μm. For ranges see section 2.3.3. If the number `9999` is used then the upper limit will be set to the maximum value for the desired spectral configuration.
- `OCS.DET.ROW0.WLENMIN`: Lower limit of the desired wavelength range in μm. For ranges see section 2.3.3. If the number `0` is used then the lower limit will be set to the minimum value for the desired spectral configuration.

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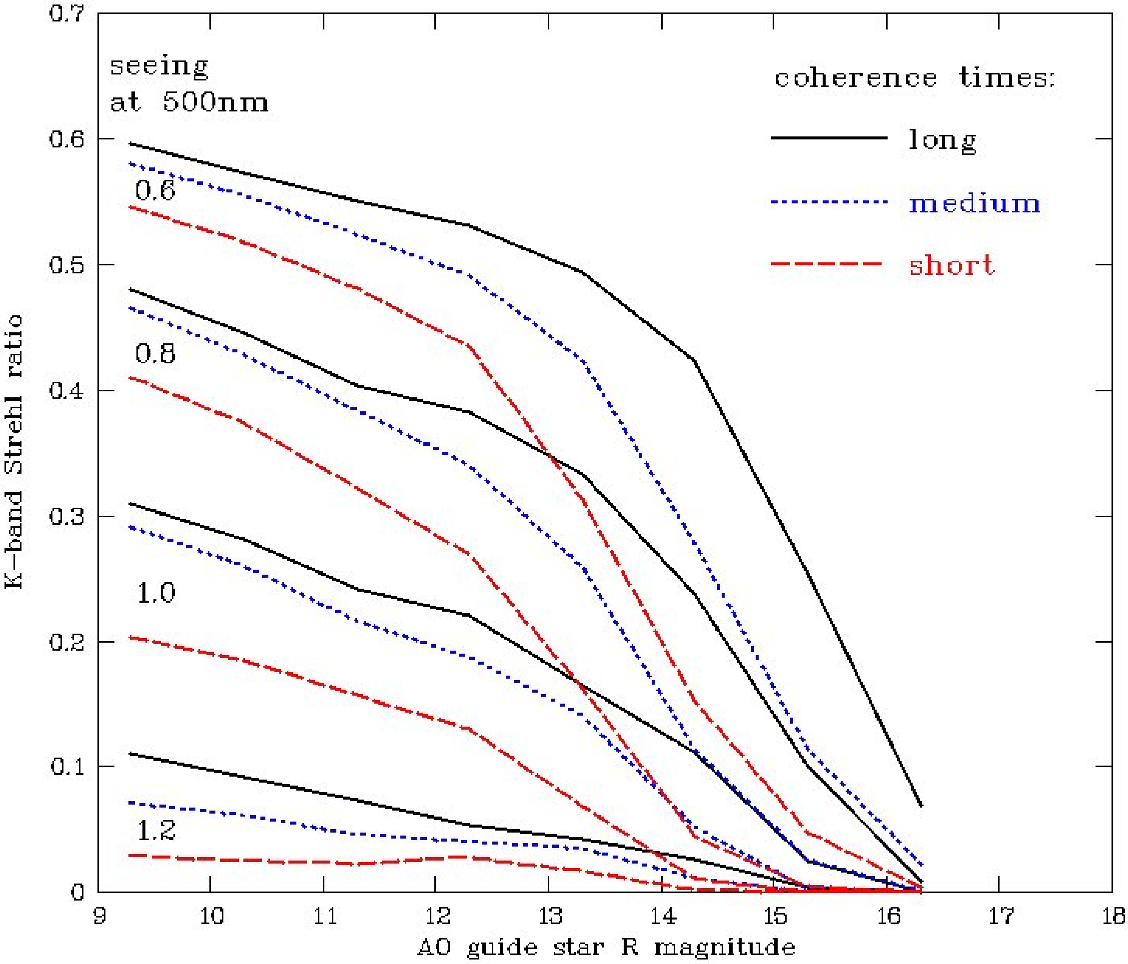

Figure 1: The predicted Strehl performance in K band is shown on the following figure for some seeing cases (0.6 to 1.2" at 500nm) and high altitude wind speeds of 11m/s (long), 22m/s (medium) and 33m/s (short):
The main uncertainty in the conversion between optical seeing and IR Strehl ratios is the undefined coherence time of the atmosphere. An example one would read from the figure that the Strehl ratio at seeing of 0.8" may vary between 0.16 and 0.33 for a 14th magnitude AO guide star for different coherence times!
An estimate of the high altitude wind speed for the coming week can be obtained from the Long term predictions for Paranal. In the figure above a high altitude wind speed of 33m/s was used to obtain the graph for the short coherence times.