Details on MIDI and its instrumental modes can be found on the **MIDI web page**.

The raw accuracy of the visibility measurements is typically better than 20%. The highest accuracy for calibrated visibilities can be obtained in SCI_PHOT mode, provided target and calibrator are both brighter than 15Jy for UTs and 200Jy for ATs. The visibility of the Science source is absolutely calibrated by observing a Calibration Source. We offer two calibration modes, either Science-Calibration (SCI-CAL) for normal accuracy requirements, or Calibration-Science-Calibration (CAL-SCI-CAL) for high accuracy requirements.

A proposal can consist of different observations of the same target with different baselines and/or hour angles in which case the observing time to be requested is simply computed as the number of required time-slots multiplied by the duration of one slot as given in Table 19. Time constrained observations (*e.g.* variable objects) can further be requested in the appropriate section of the proposal.

6.13 AMBER, Astronomical Multi-BEam combineR

AMBER is a near-infrared, multi-beam interferometric instrument, combining up to 3 telescopes simultaneously. In Period 87, AMBER can be used with UTs or ATs. For specifications of the UT and AT performances see Sect. 4.2.2 and Sect. 4.2.5. All possible triplets of UTs are available, and a number of selected AT combinations. For the telescope positions and baseline lengths of the different AT and UT baselines, please refer to **the VLTI baseline page**.

Because of the limited availability of UTs for AMBER, any scientific programme on the UTs should be designed so that scientifically meaningful results can be achieved in a single night.

6.13.1 Spectral Modes and Coverage

The following spectral modes are offered: the Low Resolution H+K bands (LR-HK), Medium Resolution K band (MR-K), High Resolution K band (HR-K) and Medium Resolution H Band (MR-H). For central wavelengths and wavelength coverages for LR-HK, MR-K, MR-H and HR-K see **the AMBER web page.**

The high readout speed required to record fringes implies that individual exposure time must be short (<180 ms, in medium or high resolution, and <25ms in low resolution), which can only be done if the detector is windowed therefore limiting the spectral range recorded in a single observation. Users interested in obtaining visibility measurements at several spectral positions inside the range allowed by each configuration can add up to two additional spectral bands.

6.13.2 Integration times, DIT

External fringe tracking with FINITO is available on both the UTs and the ATs. The use of FINITO allows the entire AMBER detector to be read, maximizing simultaneous spectral coverage. It also allows the AMBER DITs to be adjusted to yield sufficient signal-to-noise ratio per frame in the fringes. However, the DIT has to remain small since, even with the help of the fringe tracker, interferometric fringes get significantly blurred after integrations lasting seconds. Note that medium and high resolution are only offered with external fringe-tracking as standard setup.

If no fringe tracker is used (*i.e.*, faint and/or extended objects, or airmass too high) the integration times with AMBER will have to be short to minimise the blurring caused by the atmospheric turbulence. In Low Resolution, without external fringe tracking, the maximum authorized DITs are set to 100ms on the ATs and 50ms on the UTs. If *absolute visibility* measurements is the goal, the shortest authorized DITs are recommended (see table 2. in the Template manual); if *closure-phase* and *wavelength differential-mode* are the quantities of interest, the maximum recommended DIT should be used.

Special Modes: Special programs may require a different combination of modes and DITs. This is the case when using MR or HR without external fringe-tracking. A shorter DIT strongly reduces the limiting magnitude. It also reduces the spectral coverage that can be read (see Sect. 6.13.1). Any proposal requiring a non-standard DIT should carefully detail the justification and the technical feasibility. It will be scheduled in Visitor Mode.

In service mode the AMBER DITs ought to be chosen while preparing the Phase II. The AMBER template manual, available on **the AMBER documentation page**, provides the recommended DITs for all offered configurations.

6.13.3 Limiting magnitudes

AMBER and the VLTI have limitations in magnitude (V-band, H-band and K-band), fringe contrast (H-band and K-band), airmass and seeing. The details of these limitations can be found on **the AMBER web page:**, as well as the most updated values on Visibility accuracy and Closure phase accuracy.

The limiting magnitudes are estimates on the basis of at least 50% of the frames being successfully processed by the AMBER pipeline. If a lower yield rate is accepted, an increase of up to 0.5 in the limiting magnitude can be achieved. In this case, the user should account for additional integration in the same spectral band (see Sect. 6.13.5) to obtain more frames.

The limiting correlated magnitude depends on the AMBER spectral resolution, the FINITO tracking mode (No-Tracking, Group-Tracking or Fringe-Tracking), and the seeing conditions. The main interest of FINITO Group-Tracking on faint magnitude is to enhance the SNR on the AMBER closure-phase, but reducing the flux in the H-band.

In order to be observable with FINITO, the target should have:

- Hmag: −2...5 (ATs) −1...7 (UTs)
- Visibility in H: > 15% (ATs) >10% (UTs)

6.13.4 Calibration strategies

AMBER requires frequent calibration on-sky, using calibrator stars. We offer two calibration modes: "CAL-SCI-CAL" and "CAL-SCI". The first one is the standard mode which should be used in most cases, in particular when *absolute calibration* is required for best accuracy. Absolute calibration is required in most program, but for some programs, *wavelength differential quantities* provide the astrophysical information. In that case, "CAL-SCI" (or indifferently "SCI-CAL") is sufficient.

The choice of on-sky calibration strategy should be specified in the "calibration request" section of the proposal. **That strategy will be reviewed particularly carefully during the technical feasibility. Proper justification must be provided in case one wants to use "CAL-SCI" instead of the standard "CAL-SCI-CAL".**

6.13.5 Execution times

For each Observing Block (OB), either SCI or CAL:

- Acquisition requires 15min in HR or MR, 10 minutes in LR, including the spectrograph setup and the recording of the calibration fringes (so called P2VM).
- Integration requires 15min. A maximum of 3 integrations is allowed per OB, which could consist in repeating 3 times the same integration or covering 3 different wavelength ranges within the same spectral setup.

Hence a normal "CAL-SCI-CAL" sequence requires 90min in MR or HR, 75min in LR.

When observing targets close to the limiting magnitude in MR or HR, it is recommended to double or triple the integration, and to focus on *wavelength differential quantities*. Hence a "SCI-CAL" sequence with triple integration requires 2x1h=2h.

Using non-standard DIT (below 200ms in MR and HR, or below 25ms in LR, see Sect. 6.13.2) can strongly reduce the spectral coverage available within one integration. To obtain measurements at different position within the range of the spectrograph setup, the user can use 2 or 3 integrations with different central wavelengths (see Sec. 6.13.1).

6.14 VIRCAM, VISTA InfraRed CAMera

VISTA (see Sec. 4.2.6) is equipped with the near infrared camera VISTA InfraRed CAMera (VIRCAM), which covers a 1.65 degree diameter field of view with a loosely packed detector mosaic totalling ≈ 67 million pixels of mean size 0.339″. The point spread function (PSF) of the telescope+camera system (including pixels) is measured to have a full width at half maximum (FHWM) of 0.51″.

6.14.1 Filters

The only moving part in the camera is the filter wheel. In addition to the sets of filters listed in Table 17, it also includes one available position that can hold a further set of 16 filters (1 per detector). This filter slot is planned to be available for ”visitor” filters in the future (cf. below). Due to the complexity of the cryogenic VIRCAM instrument and the VISTA facility possible filter exchange will be linked to instrument and telescope maintenance intervals. Regular instrument maintenance is expected to be scheduled about every two years.

The list of the currently offered filters is given in Tab. 17. All filters are used in the approved public surveys.

Table 17: VISTA filters

Filter	Wavelength [μm]	FWHM [μm]	Comment
Z	0.88	0.12	required by public surveys
Y	1.02	0.10	required by public surveys
J	1.25	0.18	required by public surveys
H	1.65	0.30	required by public surveys
Ks	2.15	0.30	required by public surveys
NB1.18	1.18	0.01	required by public surveys
NB980/NB990	0.98/0.99	0.01	2 sets of filters in one slot; require instrument rotation for complete observations

6.14.2 Focal plane geometry

The sixteen 2048×2048 pixel IR detectors (Raytheon VIRGO HgCdTe $0.84 - 2.5\mu$m) in the camera are not buttable and are arranged as shown in Fig. 8. The diagram shows the focal plane as it would be seen looking directly down the camera body (down the Z-axis which on the telescope points towards the sky). On the sky (in the default instrument rotator position) +Y corresponds to N, and +X to West.

A single integration of length DIT secs (or a co-added series of these known as an Exposure) produces a sparsely sampled image of the sky known as a *Pawprint*. The area of sky covered by the pixels of a pawprint is 0.6 deg^2. Full almost uniform sky coverage of a *Tile* of 1.501 deg^2can be achieved with six pawprints, offset by ±47.5% in y at two respective x-positions offset by 95% of the detector size. Any sky position of a tile will fall at least on two of these six pawprints.

6.14.3 Instrument performance

Table 18 summarizes the instrument performance as established during commissioning. The instrument performance can be further evaluated from the publicly available Science Verification data sets