MIDI Combines Light from the VLTI: the Start of 10 μm Interferometry at ESO

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When at the beginning of November 2002 the MIDI containers were opened up in Paranal and the team members together with ESO personnel started to assemble the instrument in the VLTI interferometric laboratory, nobody could be completely sure that their ambitious goal could actually be achieved: to bring together for the first time two beams of light from distant giant telescopes at the wavelength of 10 microns and obtaining stable, repeatable and accurate interference fringes. Although the instrument had been designed and built with the utmost care and all laboratory tests in Europe indicated that all specifications were met, going to the sky was another matter. The thermal infrared covers the wavelength range around the peak of the natural emission of a black body with a temperature about 300 K. This is close to the ambient temperature of the telescope mirrors and structure, of the two dozens of mirrors (in each arm) needed to bring the light into the tunnel and the interferometric lab, of all the mechanic structures, and of course of the sky. Therefore, at the wavelengths to which MIDI is sensitive, everything glows brightly! There is no distinction between day and night, and even the brightest stars are just tiny speckles of light in an overwhelmingly bright background. For this reason, previous attempts to perform interferometry in the thermal infrared had to find other ways to combine the light (for example, like Bester et al. (1990), in the style of radiointerferometers, thereby however sacrificing sensitivity), or never achieved a real routine operation. Even the ambitious efforts being carried out at the Keck Interferometer, in spite of having started earlier than at ESO, are so far still confronted with difficulties in this special area.

It was indeed a big satisfaction when, after a few weeks of integration, MIDI achieved first fringes on the small siderostat telescopes first, and on the large Unit Telescopes immediately afterwards. This encouraging result was immediately reported in an ESO Press Release (25-02) and a press release by the MPIA in Heidelberg (02-12-19). After that, a First Commissioning run has also been completed in February 2003, with fringes being obtained routinely and reliably on several stars. This success might give the impression that things were relatively simple. In reality, it was quite the opposite.

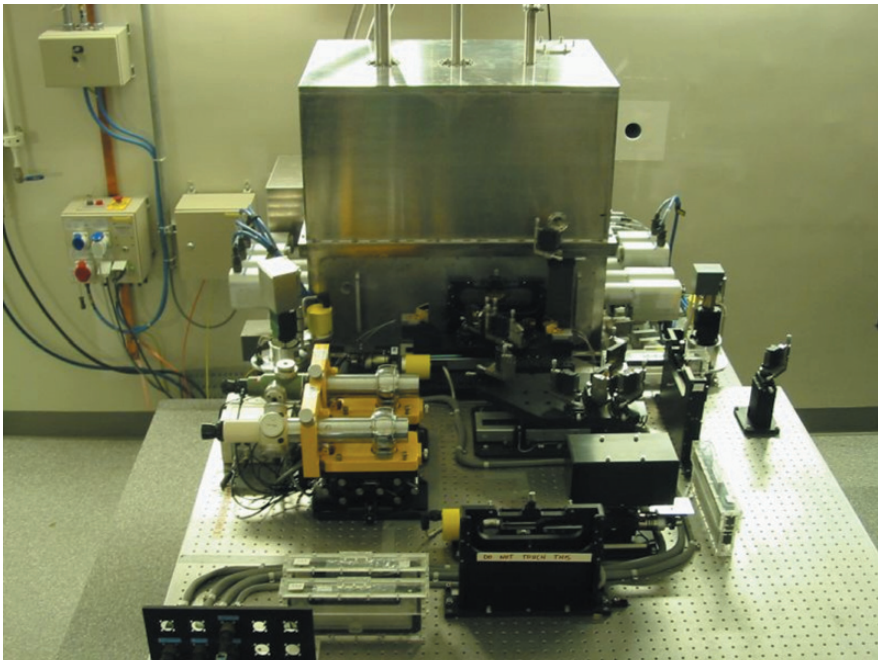


Figure 1: The fully assembled MIDI instrument in the interferometric laboratory on Paranal during commissioning in February.

Some history

When in January 1997 scientists at the Max-Planck-Institut für Astronomie in Heidelberg (MPIA) were sitting together to think about how to react to ESO's call for proposing interferometric instrumentation for the VLTI, it was not clear for which wavelength range they should propose to build an instrument. The near-infrared range around a wavelength of 2 μm had the advantage of being a proven high-quality observing method with detector arrays on many telescopes. Observing in the wavelength region around 10 μm, the main mid-infrared atmospheric transmission window, at first view appears laden with disadvantages: the thermal emission of the room temperature surroundings is at its maximum, about 10 W/m^2/sr/μm, by many orders of magnitude higher than the expected typical signal from a star, and the long wavelength of 10 μm will limit the spatial resolution achievable on the VLT Interferometer - and given by the ratio of λ/baseline - to a value five times smaller than for near-infrared wavelengths. On the other hand, the mid-infrared wavelength range has its attractive sides, too. It is a tracer of material at temperatures of a few hundred K, at which 10 μm radiation is emitted most efficiently. Such material is intimately connected to young stars in the form of discs or circumstellar envelopes, to giant stars in dust shells formed from expulsion of surface layers and in Active Galactic Nuclei as tori confining the space around the central massive black holes - all of them areas of high current research interest. The higher penetrating power of the longer wavelength is an additional advantage in studying these often rather dense clouds of material. And a 10 μm interferometric instrument using the full available atmospheric transmission window from 8 μm to 12 μm would have been the first of its kind worldwide. In the end, the enthusiasm for a totally new field of observations won over the risks and challenges, and the acronym

"MIDI" (Mid-infrared Interferometric instrument) carries with it the chosen wavelength range.

Looking back, those days now seem history. MIDI was transported to Paranal in October 2002, packed in 34 boxes with a total weight of nearly 8 tons. The assembly and installation began on November 4, and from November 15 to 27, they were followed by an extensive alignment and verification phase in the interferometric laboratory. Finally MIDI went to the sky. After several nights of testing with the 40 cm siderostats MIDI eventually was connected to the Coudé beams of ANTU and MELIPAL and in the second of two nights, the 15th of December, MIDI detected its first fringes with the VLT telescopes.

This moment was full of emotion for the people present and all their colleagues back in Europe: it culminated an effort of over 5 years. Indeed, the first solid step of planning a mid-infrared instrument for the VLTI began at MPIA in summer 1997: it was the beginning of a road which led to the "Preliminary Acceptance Europe" (PAE) in September 2002.

Besides the MPIA, which is leading the effort with a PI team (project scientist and project manager) and providing cryogenics, mechanics, control and system software, detector including read-out electronics and associated software, major and important contributions came from the Netherlands, France, and other German institutes:

– the cold optics from ASTRON (Dwingeloo), the near-real-time software, the templates to run the instrument and the software management from NEVEC (Sterrewacht Leiden) as Dutch contributions,

– the data reduction software, management of the instrument science group (OCA, Nice) and efforts to provide MIDI with a 10 micron monomode fibre as spatial filter (Observatoire de Paris) from France,

– the warm optics from the Kiepenheuer-Institut für Sonnenphysik (Freiburg) and preparation of interferometric calibrators from the Thüringer Landessternwarte (Tautenburg).

Last but not least one should emphasize the crucial collaboration with ESO personnel both in Garching and Paranal in all areas of the project.

The work carried out by the consortium covered a very wide range of topics, from the design and realisation of optical and mechanical concepts, to the demanding task of providing the complex software needed to run the instrument as integral part of the VLTI. The importance and size of this software work, not further described here, can hardly be overestimated. Mostly hidden to the outside and requiring intense cooperation between the instrument and the VLTI software teams, the development of specialized software is at the heart of the MIDI project.

It should be noted here that MIDI started off as a specialised PI-instrument and only after Concept Design Review was changed to a fully compliant VLT instrument, following ESO standards as far as possible and with the ambitious goal to be operated in a routine and user-friendly fashion like any other instrument on Paranal. This is a bold goal for an interferometric instrument. As a result of this history, unlike all other first generation ESO VLT instruments, in the MIDI project essentially all of the hardware was paid for by the MIDI consortium. ESO also developed and provided specialized hardware needed to integrate MIDI into the VLTI. The total cost of MIDI born by the consortium - not counting the necessary matching efforts on ESO's side - is of the order of 6 million Euros. Of this, 1.8 million Euros are for equipment, materials and optical parts, with the remaining for salaries during the extensive planning, construction and testing.

The instrument

Principle of measurement

The optical concept of the instrument is shown in Figure 2. From the left, the afocal beams from two telescopes of the VLTI are approaching the instrument. Their nominal diameter is 80 mm, and they are reduced to 18 mm diameter by a beam compressor provided as part of the VLTI infrastructure, represented here for simplicity by two lenses.

After the four folding mirrors of a small internal delay line, the compressed beams enter the cryostat ("Cold box") through the entrance window ("Dewar window"). The telescope pupil is imaged by the VLTI delay line optics onto a cold pupil stop to provide the needed suppression of thermal emission from outside the beams. Next, an intermediate focus is formed, where different slits or diaphragms (i.e. spatial filters) can be introduced for additional suppression of unwanted radiation. If no spatial filters are used, the detector pixels, which are much smaller than the Airy disc, still provide an alternative way to limit the spatial region admitted for the measurement. Then the beams are recollimated (again, reflective optics is represented by a lens for simplicity) and move on to combine on the surface of a 50-50 beam splitter, situated close to the reimaged pupil plane. The active coating is indicated in the Figure on the lower half of the back side of the ZnSe plate. This is the heart of the instrument.

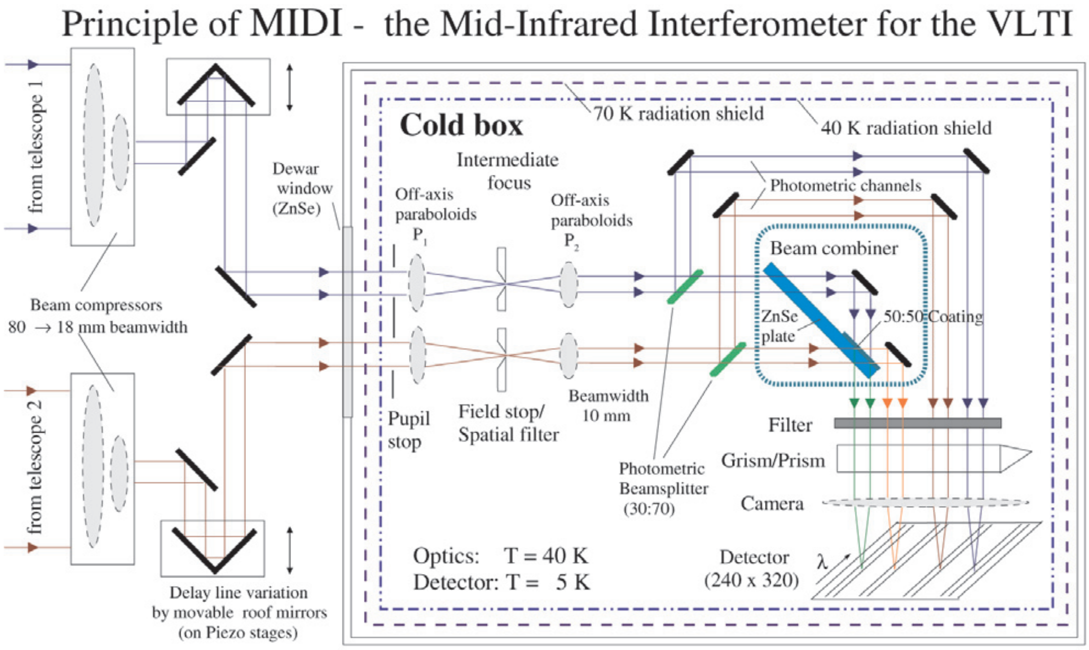
From the beam combiner onwards, the two interfering beams have a common optical axis. Actually, there are two such overlaid beams, one outgoing to each side of the beam combiner. These two outputs are modulated in flux depending on the optical path difference of the interfering beams, but with opposite sense because of energy conservation. Next, an image of the sky is formed for each of the two combined beams on the detector. Spectral information can be obtained by inserting filters or by spectrally dispersing the image using a prism for low or a grism for intermediate spectral resolution. If it is required to monitor the flux in the incoming telescope beams for high precision measurements, beam splitters can be inserted in front of the beamcombiner unit. The resulting additional monitoring beams are imaged onto the same detector.

MIDI measures the degree of coherence between the interfering beams (i.e. the object visibility at the actual baseline setting) by artificially stepping the optical path difference between the two input beams rapidly over at least one wavelength within the coherence time of ~ 0.1 s. This is done with help of the piezo-driven roof mirrors forming part of the small delay lines just outside the cryostat. The result in both channels is a signal modulated with time ("temporal fringe"), from which the fringe amplitude can be determined. The large

Table 1: Basic parameters of the instrument

Wavelength coverage	N band (8 - 13 μm)	expandable to Q (17 - 26 μm)
Resolution (λ/B for 100 m)	20 milli-arcsec	
Spectral resolution	up to 300	(prism, grism)
Airy disc (FWHM) at 10 μm	0.26″ (for UTs) 1.14″ (for ATs)	(FOV = 2″)
Sampling time for fringe motion	100 ms ... 1 sec	average ... best conditions
Atmospheric stability for chopping	200 ms	
Detector	50 microns 320 x 240 pixels 2×10^7 electrons 800 electrons	pixel size dimensions full well read noise
Background noise from sky from VLTI (at UT in Airy disc)	1.6×10^{10} photons/sec 1.23×10^{11} photons/sec	
Limiting N-magnitude (without/with external fringe tracking)	 at UTs 3-4 mag (1-2.5 Jy) at ATs 0-1 mag	 /7-9 mag (0.1-0.6 Jy) /4-6 mag

Figure 2: Schematic diagram of the instrument. For explanation, see text.



and not precisely known thermal background forces us to determine the total flux separately by a chopped measurement, chopping between the object and an empty region of the sky, and determining the source flux by subtraction. The raw normalised visibility is obtained by dividing the fringe amplitude by the total flux. As in standard interferometric practice, the calibrated visibility is obtained by dividing the raw visibility of an object by that of a known star.

Critical points and basic features

In the planning phase of MIDI three major technical fields were identified that could at the end turn out to become a show-stopper or at least create some constraints for the technical development of MIDI: vibrations, detector readout, and alignment.

Vibrations are a natural consequence of the fact that MIDI had to apply a closed cycle cooler for cooling the optics to below 40 K and the detector to below 10 K. At the time when MIDI was planned this was the only option to guarantee the necessary cooling power. Over more than two years extensive tests were carried out with several dewar set-ups to find possibilities to damp these vibrations both in the MIDI instrument itself and in the environment where we had to avoid disturbing neighbouring instruments. Finally we ended up with a design that concentrates on a very heavy (650 kg) separate mount for the cold head and we connected it to the MIDI vacuum by a metallic bellow selected for its damping properties. Naturally, a number of additional technical measures such as special damping feet had to be applied until we came up with a solution where the internal jitter on the detector would not exceed 0.04 pixel.

Another critical point for MIDI concerns the necessary fast read-out times introduced by the very high and variable background at 10 µm (see Table 1). With such a high background resulting mainly from all the warm optical elements in the VLTI chain the detector pixels would be saturated very quickly after several milliseconds. So, only dispersing of the signal over a number of pixels prevents saturation. The typical integration times for MIDI therefore are in the range of one to several hundreds of milliseconds. It is clear that this could lead to a very high data rate of up to some tens of Mbytes/sec. By windowing the frames during detector read-out the most important operating modes will not exceed a pure read-out time of 3 msec and a final data rate of 3 Mbyte/sec which is compliant with the current capabilities of the ESO archiving system. Developing this detector readout system with the real-time synchronisation capabilities needed for self-fringe tracking was one of the major tasks of instrument development (see Ligori et al. 2003).

Normally with instruments working in the mid-infrared regime the variability of the high background is corrected for by chopping of the telescope and thus subtracting the background. This also holds for interferometry where the knowledge of the two beam intensities is needed for the accurate calculation of the object's visibility. In MIDI the two photometric channels (see Figure 2) were foreseen for delivering this information. However, when the external fringetracker and the adaptive optics are in operation, chopping will impose significant losses in time efficiency and additional synchronization constraints. This mode remains to be tested extensively in the next commissioning runs.

A third major concern was the accuracy of the alignment, and in particular how the alignment of the cold optical elements, which can only be performed in the warm when the devices are accessible for adjustment, is maintained during cooling. Two major steps have been taken to overcome this difficulty. First: the whole cold optical bench including its mountings have all been made out of parts of one single block of aluminium

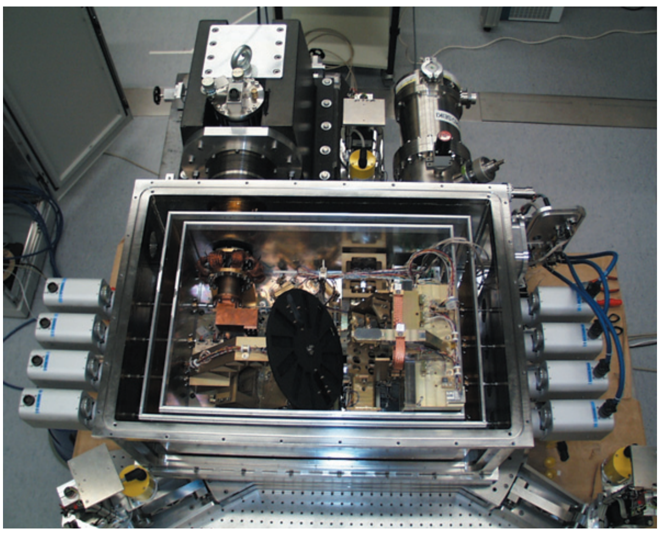


Figure 3: MIDI's Cold Optical Bench (COB) inside the open dewar. The two radiation shields are visible around the optical setup which is cooled down with the Closed Cycle Cooler (on the left side in the background) to a temperature of 40 K. The filter wheel (black), focus and other parts can be moved with the eight motors at the sides of the instrument.

alloy, and they were designed in a way that the shrinking of the material of 0.42% which comes from cooling down from 300 to 40 K is nearly homologous and should keep the optical characteristics (see Glazenborg-Kluttig et al. 2003). Second: A dewar mount was constructed which is movable around five of its six axes and thus provides for an accurate adjustment of the heavy (230 kg) MIDI dewar. During the integration and the first commissioning we were very glad to find the concept of the MIDI alignment to be fully confirmed. A view into the cold optics in the open dewar is given in Figure 3.

The outcome of all of these phases of planning, design and development has been presented recently (Leinert, Graser et al. 2003a, 2003b, Przygodda et al. 2003). Here is a summary description of the main characteristics of the instrument (see also Table 1):

– Two beam pupil-plane interferometer at mid-IR-wavelengths (8–13 μm)

– Principle of measurement: The beams from two telescopes meet on a beam-combining beam splitter, where their pupils are superimposed “on axis”.

– The intensity of the two complementary outputs is modulated by stepping the optical path difference through one or more wavelengths by means of an internal piezo-driven delay line.

– a grism and a prism provide a spectral resolution up to 300.

– phase measurement will occur eventually by external referencing (when the dual beam capabilities of PRIMA become available on the VLTI).

MIDI on Paranal: first results and scientific programme

Currently the MIDI instrument is in a phase of extensive tests during the first commissioning runs at Paranal to verify the function of the instrument in all operating modes. At present, the first commissioning has been completed and already encouraging results can be presented.

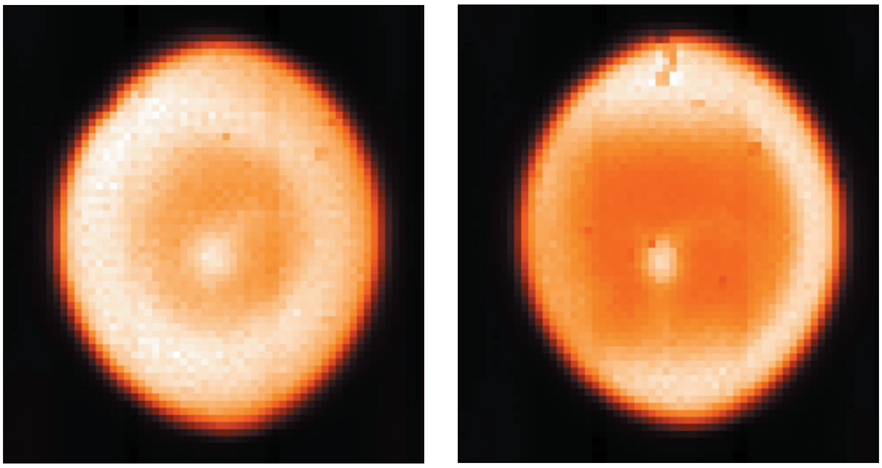


Figure 4: Raw images of the very bright infrared object η Car during telescope pointing. Left: beam from UT1, right: beam from UT3. On the detector the two beams are at top and at bottom, separated by unexposed parts of the array. In these exposures, no field limitation has been introduced except that given by the mechanical openings in the instrument. The outer, bright ring is thermal emission from the VLTI tunnel and outside the field-of-view. The field-of-view through the VLTI to the colder sky (about 2″) is seen as the darker inner circular structure. It is less pronounced for the beam from UT1 because at the time of this exposure there was some vignetting, increasing the contribution of unwanted thermal emission. η Car is bright enough to be seen already in these raw images.

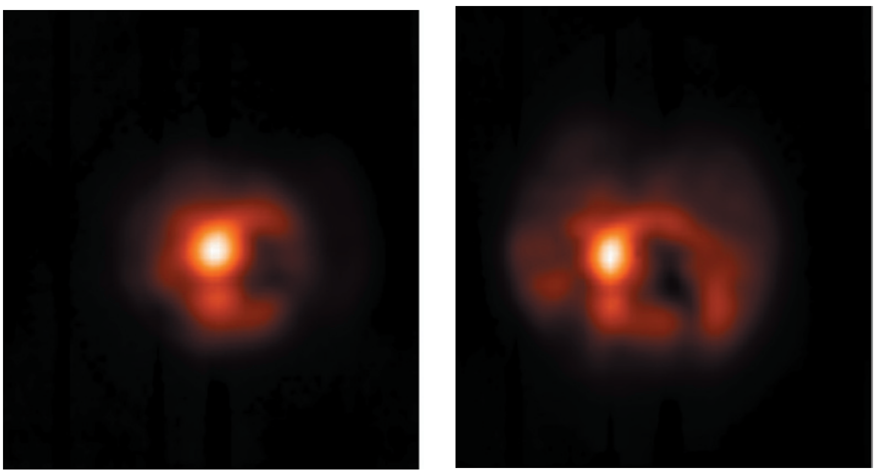


Figure 5: Chopped images of η Car obtained during the centring process. Left: beam from UT1, right: beam from UT3. The size of the blobs is close to the diffraction limit for 8-m telescopes, about 0.25″. Note the good optical quality.

Figure 4 shows the signals of the two interferometric output channels obtained during an observation of Eta Carinae using the VLT unit telescopes ANTU and MELIPAL (UT1 and UT3). The circular fields are dominated by background radiation from the sky and the VLTI tunnels. Only because the object is very bright (flux more than 5000 Jy in the core, one of the brightest in the sky at 10 μm) is it identifiable in MIDI’s FOV of 2 arcsec. Usually an object becomes distinguishable only after the background is subtracted by chopping and nodding procedures. Chopping is performed by a modulation of the secondary mirror with a frequency of about 2 Hz and an amplitude of 3 arcsec. The resulting image in case of the observation of Eta Carinae is shown in Figure 5. One can clearly identify the complex structure of the object. The image, rivalling in sharpness the best mid-infrared images obtained with dedicated imaging instruments on Mauna Kea, demonstrates the excellent imaging capabilities of MIDI and the whole VLTI infrastructure which sends the light via 31 mirrors and 5 transmissive elements until it reaches the detector.

When searching for the fringe signal, the large delay line of the VLTI infrastructure is moved in steps of 30 micron over a range of a few millimetres, while MIDIs internal piezo-driven delay line is performing additionally a few scans of 60 micron each at each of those steps. At the position where the optical path difference (OPD) between the two interferometric arms is almost zero, the fringe signal from the object becomes detectable in the subtraction of the two interferometric output channels. As an example, Figure 6 shows the superposition of five consecutively measured fringe packets, showing that fringe motion can be quite small under good seeing conditions. Fringe detection was performed also on a 9 Jansky source without problems, but finally the limiting magnitude of the instrument in self fringe tracking mode is not expected to be better than 1 Jansky, due to the fluctuations in the very strong background radiation. To increase the sensitivity it is necessary to apply external fringe tracking. This possibility will be given by FINITO, which will be installed on Paranal later this year. Together with the adaptive optics system MACAO, it is expected to dramatically increase MIDI’s sensitivity.

The scientific potential of MIDI has been discussed by the instrument science group and presented by Lopez et al. (2000). Further discussions led to a guaranteed time programme to fill the 300 hours of guaranteed observing time available to the instrument

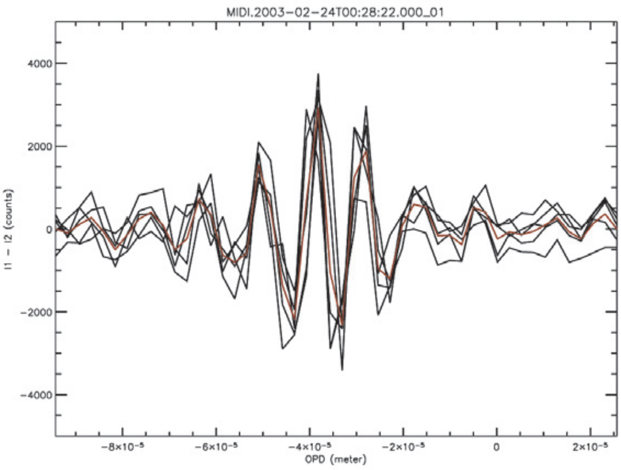


Figure 6: The superposition of five fringe packets, measured at intervals of ~ 0.3 s and their average plotted against the optical path difference (OPD). Here, the packets were obtained in the fringe searching mode. The fringe tracking mode allows one to adjust the delay lines automatically in order to compensate the atmospheric OPD variations. Then, the object visibility can be obtained with high accuracy by averaging the amplitude of hundreds of packets.

team on the UTs, which is shown in Table 2. This list gives an impression of what may be feasible to observe with the MIDI instrument. It has to be kept in mind that the objective of direct planet detection is atypical. It tries to detect the very small shift with wavelength of the centre of the combined image of star and planet. Requiring a differential accuracy of 10^{-4}, not guaranteed to be attainable by the instrument, it is a programme of extremely high risk for possibly high reward.

When planning observations with MIDI, a few constraints have to be kept in mind. For self-fringe tracking, not only must the source be bright enough but there must be sufficient flux in a very compact (<0.1″) central region, to which the interferometric measurements will refer. In general, the visual brightness should be at least 16 mag, in order to allow the operation of the tip-tilt and MACAO adaptive optics system. For observations with external fringe tracking, the *H*-band brightness should be at least 11 mag in order to drive the fringe tracker. In addition, one has to consider that interferometry with two telescopes of the VLTI will provide only a few measured points of visibility, in a reasonable time of several hours, i.e. only a few points where the Fourier transform of the object image is determined. The scientific programme has to be checked in advance as to whether its main questions can be answered on this basis (e.g. to determine the diameter of a star one does not need to construct an image of its surface). As an example Figure 7 shows a prediction for the close young binary Z CMa. Here, the existence of circumstellar discs around the two components will show in a strong reduction with telescope separation of the sinusoidal visibility variations typical for a binary source. Such a signature can be clearly identified with a limited set of VLTI observations.

The near future

Now that MIDI is approaching routine observations as a science instrument on Paranal, have we exhausted the potential of 10 μm interferometry? Quite certainly not. A year from now, external fringe stabilisation by the fringe tracker FINITO should increase the sensitivity of the highly background-limited instrument MIDI by at least a factor of 10 – even a factor of 80–100 appears possible. This will increase dramatically the number of interesting objects to be studied. Next, a proposal has been submitted to the funding agencies to allow an extension of MIDI operation into the 20 μm wavelength range. Also, the possibility is being studied to inject beams from more than two telescopes simultaneously into the MIDI instrument by means of an additional special external optics rearranging the geometry of the input beams (Lopez et al. 2003). This would allow one to derive from the interferometric measurements the so-called "closure phases" and thus enable the reconstruction of images. An alternative way for image reconstruction may open two years from now, when the VLTI will have installed the PRIMA "dual-beam" facility which will allow one to freeze the fringe motion at a particular position such that the phases necessary for image reconstruction can be obtained even in normal operation of MIDI with two-beam combination. Mid-infrared interferometry promises to become a field with much wider applications during the next decade. But the most exciting time for those having been involved in the instrument development is now: the first steps into new territory.

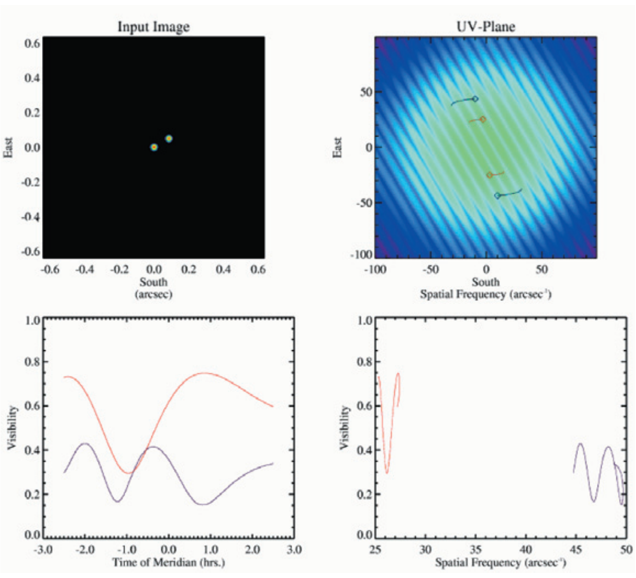


Figure 7: Simulation of an observation of the young binary Z CMa. The binary has been represented by two point sources at the observed separation of 0.1″ at P.A. 300°, each surrounded by a circular disc with Gaussian brightness distribution and FWHM of 10 mas. From upper left to lower right we see: the image of the object; its Fourier transform and the tracks covered by the telescope pairs UT1-UT3 (outer lines) and UT1-UT2; the observed visibility as function of time (left) and of spatial frequency. Here, the curves with the lower visibility values correspond to the longer baseline UT1-UT3.

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The dedicated efforts of a large number of colleagues from the institutes involved were necessary to bring the instrument MIDI to its present state of completion, in addition to the few who are honoured as authors of this article. We very much want to thank all of those for their important work and helpful cooperation and apologise if someone's name should be missing in the following list of contributing persons:

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- from Observatoire de Paris Meudon:

Table 2: Proposed guaranteed time programme

Topic	Telescopes UTs	ATs
Dust Tori in Nearby Active Galactic Nuclei	65 h	–
Inner discs of low-mass young stellar objects	65 h	90 h
Inner discs around intermediate-mass young and Vega-type stars	62.5 h	100 h
Massive young stars	52.5 h	305 h
The dusty environment of hot stars	2 h	68 h
Cool Late Type Stars and related objects	25 h	450 h
Extra-solar planets and brown dwarfs	25 h	–

J. Bonmartin, G. Chagnon, V. Coude du Foresto, M. Nafati (now Nice)
- from Observatoire de la Côte d'Azur Nice: P. de Laverny, G. Niccolini
- from Laboratoire d'Astrophysique Grenoble: A. Dutrey
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References

M. Bester, W. C. Danchi, and C. H. Townes, "Long baseline interferometer for the mid-infrared" SPIE 1237, 40 - 48, 1990.

A. W. Glazenborg-Kluttig, F. Przygodda, H. Hanenburg, S. Morel, J.-W. Pel, "Realization of the MIDI cold optics", SPIE 4838, 1171-1181, 2003

C. Leinert, U. Graser et al., "Ten-micron instrument MIDI - getting ready for observations on the VLTI", SPIE 4838, 893-904, 2003a

Ch. Leinert, U. Graser et al., "MIDI - the 10 μm instrument on the VLTI", Conf. Proc., 11th EAS Meeting: "JENAM 2002: The Unsolved Universe", Porto, Portugal, Astrophys. Space Sci. 2003b

S. Ligori, U. Graser, B. Grimm, R. Klein, "Experiences with the Raethyon Si: As IBC detector arrays for mid-IR interferometric observations", SPIE 4838, 774-785, 2003

B. Lopez, Ch. Leinert, U. Graser et al., "The astrophysical potentials of the MIDI VLTI instrument", SPIE 4006, 54 - 67, 2000.

B. Lopez, Ph. Mathias, D. M'ekarnia et al., "APres-MIDI, APerture Synthesis in the MID-Infrared with the VLTI", SPIE 4838, 1011 - 1015, 2003.

F. Przygodda, O. Chesneau, U. Graser, Ch. Leinert, S. Morel, "Interferometric observations at mid-infrared wavelengths with MIDI", Conf. Proc., 11th EAS Meeting: "JENAM 2002: The Unsolved Universe", Porto, Portugal, Astrophys. Space Sci. (2003)

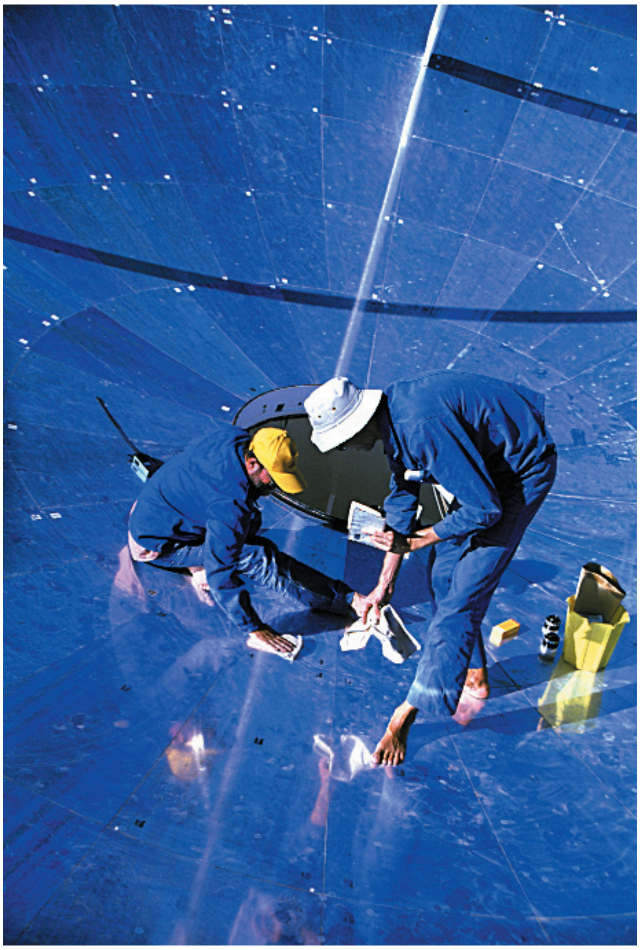
NEWS FROM THE LA SILLA SITE

L. GERMANY, SciOps

Danish 1.54m Handover

On September 30, 2002, ESO stopped offering the Danish 1.54 m telescope to its community. The Danish 1.54 m is now only available to the Danish community, and ESO continues to perform the maintenance of the telescope. The main repository of information regarding that telescope is now the "Ground-Based Astronomical Instrument Centre" (IJAF) at the CUO (http://www.astro.ku.dk/ijaf/).

Final Dishwalk at the SEST



Lars-Ake Nyman and Mikael Lerner make the final dishwalk on the SEST. Photo by Lauri Haikala.

March saw us witness the last ever dishwalk at the SEST telescope before its closure later this year. The SEST dish is inspected once a year for damage to the teflon coating. This may be caused by pebbles flying around in high wind (which cause small holes in the coating), high humidity, and from the coating peeling off at the edges of the panels. This damage is "fixed" by sticking small plastic patches over the affected area.

To do the inspection, the dish has to be pointed close to zenith (since only aliens can defy gravity to walk on the dish when it is at low elevations). The work has to be done bare foot (so as not to damage the delicate surface), and usually in the Chilean autumn, since the sun is high in the sky during summer and the SEST has a 50 degree Sun avoidance zone. Pointing too close to the Sun will fry the secondary (as happened back in the 80's), and walking around with bare feet on a metal surface in the middle of summer is also probably going to fry the inspectors!