The *Mid*-Infrared
*I*nterferometric
Instrument for the
Very Large Telescope
Interferometer

# MIDI

**–**

## MIDI Guaranteed Time Observations
## Abstracts and Source List for October 2008 - Period 83

Date 06 August 2008

## Summary of the guaranteed time programme for MIDI

| Coordinator | Topic | Obs. Time UTs | Obs. Time ATs | Page |
|---|---|---|---|---|
| Klaus Meisenheimer | Dust Tori in Nearby Active Galactic Nuclei | 65 h | – | **done** |
| Christoph Leinert | Studying the inner disks of low-mass young stellar objects | 65 h | 90 h | 1 |
| Anne Dutrey | Studying Inner Disks around Intermediate-mass Pre-Main-Sequence and Vega-type stars | 62.5 h | 100 h | 3 |
| Markus Feldt | A detailed study of massive young stars | 52.5 h | 305 h | 5 |
| Olivier Chesneau | The dusty circumstellar environment of Hot Stars | 2 h | 68 h | 7 |
| Andreas Quirrenbach | Cool Late Type Stars and related objects | 25 h | 450 h | 9 |
| Bruno Lopez | Extra-solar planets and brown dwarfs | 25 h | – | 11 |
| | Allowance for rounding errors | 3 h | | |
| | **TOTAL** | **300 h** | **110 n** | |

**MIDI guaranteed time observations –**

**Abstract and source list**

# Studying the inner disks of low-mass young stellar objects

Authors: Ch. Leinert (coordinator), A. Dutrey, Th. Henning, T. Herbst, S. Ligori, B. Lopez, I. Pascucci, F. Przygodda, G.Niccolini, Th. Ratzka, H. Zinnecker

## 1 Abstract

Using the spatial resolution of MIDI on the VLTI, about 2 AU at the 150 pc distance of nearby star forming regions, we want to perform a **direct** study of the properties of disks around T Tauri stars. The immediate outcome of these observations should be 10 $\mu$m size, geometry and orientation of these disks, supplemented for the brighter objects by some information on chemical composition of dust and on physical structure and pecularities in spatial distribution of circumstellar material. The latter effect may point to dust destruction or to depletion as it might result from gravitational interaction with an orbiting companion or planet. The results are relevant for the formation, structure and evolution of circumstellar disks which connect the formation of low-mass stars to the possible formation of planets.

For this study, the proposal contains a number of classical T Tauri stars of different mass and age. Binary stars are included: they allow us to look for differential effects and to study the results of dynamical interaction. Object groups known for particular accretion activity, like FUORs and binaries containing so-called infrared companions, are well represented on purpose – the emphasis is on the earlier phases of circumstellar disk evolution.

Total observing time : **65 hours on UTs - used up**
**90 hours on ATs**

## 2 Source list

⟹ **these eight objects are protected for AT observing only**

| apparently single stars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| target name | coordinates (α,δ) (J2000) | | | | | | telescopes | priority[a] |
| RY Tau | 04 | 21 | 57.4 | +28 | 26 | 35 | ATs | *** |
| DG Tau | 04 | 27 | 04.7 | +26 | 06 | 17 | ATs | *** |

[a]highest priority is indicated by ***

| multiple stars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| target name | coordinates (α,δ) (J2000) | | | | | | telescopes | priority[a] |
| T Tau | 04 | 21 | 59.4 | +19 | 32 | 06 | ATs | *** |
| Haro 6-10 | 04 | 29 | 24.4 | +24 | 33 | 02 | ATs | *** |
| Z Cma | 05 | 45 | 22.6 | +09 | 04 | 12 | ATs | *** |
| Glass I | 11 | 08 | 16.0 | −77 | 33 | 47 | ATs | *** |
| AS 205 | 16 | 11 | 31.4 | −18 | 38 | 25 | ATs | ** |
| VV CrA | 19 | 03 | 06.7 | −37 | 12 | 51 | ATs | *** |

[a]highest priority is indicated by ***

**MIDI guaranteed time observations –**

**Abstract and source list**

# Studying Inner Disks around Intermediate-mass YSOs and Vega-type stars

Authors: Anne Dutrey (coordinator, Grenoble), Roy van Boekel (Amsterdam), Thomas Henning (Heidelberg), Christoph Leinert (Heidelberg), Bruno Lopez (Nice), Gilles Niccolini (Nice), Bringfried Stecklum (Tautenburg), Rens Waters (Amsterdam)

## 1 Abstract

We propose to use MIDI at the VLTI to observe the dust disks surrounding nearby isolated Herbig Ae/Be stars and Vega-type stars (D$\leq$ 450 pc). **The spatial resolution achieved by MIDI (about 2 AU at 150 pc) will allow us to study *in-situ* the size at 10 $\mu$m and structure of the inner regions of the proto-planetary disks surrounding Herbig Ae/Be stars and to search for warm dust in Vega-type systems**. These observations will put strong constrains on the models of disks surrounding intermediate mass young stars ($2-5\,M_\odot$). The immediate outcome should be the 10$\mu$m size, geometry, and orientation of disks. For a few bright objects, we also expect information on the spatial distribution of the carbonaceous and silicate dust components, that show strong spectral features in the 10$\mu$m region. The sample contains a number of stars of different mass and age. We have included single stars and binaries to study the effect of multiplicity on disk structure; the sample also contains some main sequence stars with dust shells, which allow us to investigate the evolution from gas-rich accretion disks towards gas-poor collisionally evolving systems.

This proposal should be considered as the intermediate-mass counterpart of the proposal on TTauri disks.

Total observing time : **62.5 hours on UTs – used up**
**100 hours on ATs**

## 2 Source list

$\Longrightarrow$ **these seven objects are protected for AT observing only**

| apparently single stars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| target name | coordinates (α,δ) (J2000) | | | | | | telescopes | priority |
| HD 97048 | 11 | 08 | 04.6 | −77 | 39 | 17 | ATs | ** |
| HD 100546 | 11 | 33 | 25.64 | −70 | 11 | 41.6 | ATs | *** |
| HD 104237 | 12 | 00 | 05.54 | −78 | 11 | 32.5 | ATs | *** |
| HD 142527 | 15 | 56 | 41.86 | −42 | 19 | 21.5 | ATs | *** |
| HD 163296 | 17 | 56 | 21.26 | −21 | 57 | 19.5 | ATs | *** |

| multiple stars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| target name | coordinates (α,δ) (J2000) | | | | | | telescopes | priority |
| HD 150193 | 16 | 40 | 17.83 | −23 | 53 | 44.1 | ATs | *** (1.”07 - 2p) |
| TY CRA | 19 | 01 | 40.83 | −36 | 52 | 33.9 | ATs | ** (eclip/sb2 - 1p) |

“2p” means separate pointings for the two components, “1p” means one combined pointing

**MIDI guaranteed time observations –**

**Abstract and source list**

# A detailed study of massive young stars

M. Feldt[1] (coordinator), Th. Henning[1], L. Kaper[2], Ch. Leinert[1], H. Linz[3], I. Pascucci[1], M. Robberto[4], B. Stecklum[3], R. Waters[2], H. Zinnecker[5]

[1] Max–Planck–Institut für Astronomie (MPIA) Heidelberg
[2] Astronomical Institute, University of Amsterdam
[3] Thüringer Landessternwarte Tautenburg
[4] ESA–Space Telescope Science Institute (STScI) Baltimore
[5] Astrophysikalisches Institut Postdam

## 1 Abstract

We propose to use MIDI to spatially resolve the circumstellar environment of prominent high-mass protostars and young stars. The dust distribution in the immediate stellar surroundings will allow us to constrain the evolutionary status of the sources. According to the standard scenario, the mid-IR emission is expected to be roughly symmetric in the early radial infall phases, asymmetric in the main disk-accretion phases, absent in the final stages with an established wind-cleared cavity and compact HII region. An enhanced fraction of close companions would provide support to the alternative hypothesis that massive stars form by coalescence of lower mass objects in the densest parts of young clusters.

| | | |
|---|---|---|
| Total observing time : | **52.5** | **hours on UTs** |
| | **305** | **hours on ATs** |

## 2 Source list

**⟹ six of the following objects are planned for UT observing, twelve are planned for observations on ATs, and four are planned for observations with both, UTs and ATs (see column "UT/AT" in the table)**

| Target | R.A. (J2000) | Dec. (J2000) | Age group / question class[a] | UT/AT |
|---|---|---|---|---|
| G045.45+00.06 MIR | 19 14 21.17 | +11 09 15.6 | 0 | UT |
| G010.8399−02.5922 | 18 19 12.12 | −20 47 29.7 | I | UT |
| G284.01−0.85 #1 | 10 20 15.09 | −58 03 39 | I | UT + AT[b] |
| G268.4217−00.8486 | 09 01 54.4 | −47 44 11 | I | UT + AT[b] |
| Mon R2−IRS 2 | 06 07 45.8 | −06 22 53.7 | I | AT |
| Mon R2−IRS 3 NE | 06 07 47.8 | −06 22 55.7 | I | UT |
| Mon R2−IRS 3 SW | 06 07 47.8 | −06 22 56.6 | I | AT |
| M 8E IR | 18 04 53.3 | −24 26 42 | I | AT |
| AFGL 4176 | 13 43 02.1 | −62 08 52 | I | AT |
| G345.0080+01.7946 | 16 56 47.6 | −40 14 25 | 0/I | UT |
| G305.2017+00.2071 | 13 11 10.5 | −62 34 39 | I | AT |
| AFGL 2136 | 18 22 26.5 | −13 30 12 | I | UT + AT[b] |
| G203.3167+02.0560 | 06 41 10.10 | +09 29 34.0 | I | AT |
| G324.2+0.12 | 15 32 54.0 | −55 55 00 | I | UT |
| G318.9491−00.1967 | 15 00 55.4 | −58 58 54 | 0 | UT |
| Orion BN | 05 35 14.5 | −05 22 22.0 | I | UT + AT[b] |
| IRAS15411-5352 | 15 44 59.503 | −54 02 19.22 | I | AT |
| IRAS17149−3916 | 17 18 23.9 | −39 19 10 | I | AT |
| IRAS17216−3801 | 17 25 06.3 | −38 04 02 | I/II | AT |
| IRAS18060−2005 | 18 08 58.3 | −20 05 14 | I | AT |
| IRAS18064−2020 | 18 09 21.0 | −20 19 31 | I | AT |
| M17SW IRS1 | 18 20 19.7 | −16 13 31 | I | AT |

[a] See abstract for introduction.

[b] Snapshot with UTs, subsequent detailed studies at ATs.

Table 1: Target list sorted by decreasing science priority.

**MIDI guaranteed time observations –**

**Abstract and source list**

# The dusty circumstellar environment of Hot Stars

**Authors:** O. Chesneau (coordinator), L.B.F.M. Waters, B. Lopez, M. Robberto, F. Vakili,
E. Bakker, A. Glazenborg-Kluttig, J. de Jong, S.Ligori

## 1 Abstract

The stellar winds of hot stars strongly affect the galactic interstellar medium, by many aspects of these winds are still poorly known. The winds of massive hot stars are driven by the strong radiation field, whose interaction with matter has been modeled in 1975 by Castor, Abbott and Klein in the frame of an isotropic and homogeneous wind. Since then, however, many observations have demonstrated that most of these winds are rather time variable, asymmetric, and/or clumpy. The combined effects of rotation, magnetic fields, pulsations and binarity certainly complicate the picture. Most remarkable is the fact that several classes of hot stars have large amounts of circumstellar dust.

It is likely that the presence of a dusty environment is closely related to the stellar wind. The conditions that lead to dust formation in that somewhat hostile environment are not well understood and require the knowledge of the dust spatial distribution. MIDI at the VLT Interferometer will be able to resolve the location and geometry of the dusty circumstellar environments of some bright hot stars ($N<1$), and to reveal the innermost regions where dust survives ($\succeq 100R_*$). This proposal addresses three topics related to hot stars with poorly understood circumstellar dust. The effects of binarity and stellar rotation on the presence of dust near hot stars will also be addressed.

The first two proposals deal with dust and gas in the very dense winds of evolved, very massive stars: (i) the enigmatic LBV η Car, and (ii) the hydrogen-poor Wolf-Rayet (WR) stars. In each case, binarity is suspected to be at the origin of the unexplained level of hot dust around these systems. The third project addresses the circumstellar environment of the B[e] stars. These are hot stars with large amounts of circumstellar gas and dust, whose origin, composition and geometry are poorly understood, but may be related to rapid rotation of the central star.

Titles of the subproposals:

- **’The geometry of the core of the η Carinae system’**
- **’Hostile environnement around WC stars’**
- **’B[e] stars dusty environnement’**

Total observing time : **2 hours on UTs - used up**
**68 hours on ATs**

# 2 Source list

⟹ **these six objects are protected for observations on ATs only**

| Object name | Priority | α(2000) | δ(2000) | IRAS 12 μm in Jy | Sp. Type | Telescopes |
|---|---|---|---|---|---|---|
| WR 98a | 1 | 17 41 13.3 | -30 32 33 | 51.6 | WC8+? | ATs |
| HD 45677 | 1 | 06 28 17.42 | -13 03 11.1 | 146 | unclB[e] | ATs |
| HD 50138 | 1 | 06 51 33.40 | -06 57 59.4 | 70.3 | unclB[e] | ATs |
| HD 62623 | 1 | 07 43 48.47 | -28 57 17.4 | 258 | A2Iabe | ATs |
| MWC 300 | 2 | 18 29 25.68 | -06 04 37.2 | 100.6 | unclB[e] | ATs |
| CPD -42 11721 | 3 | 16 59 06.9 | -42 42 08 | 95 | unclB[e] | ATs |

**Note:** Priorities range from 1 (high) to 3 (low)

**MIDI guaranteed time observations –**

**Abstract and source list**

# Cool Late Type Stars and related objects

Authors: A. Quirrenbach (coordinator), B. Lopez, E. Bakker, O. Chesneau, W.D. Cotton,
Ch. Leinert, J. Meisner, J.-L. Menut, G. Niccolini, G. Perrin, P. Schuller,
R. Tubbs, L.B.F.M. Waters

## 1 Abstract

We propose to use MIDI at the VLTI to study mass loss in a sample of Asymptotic Giant Branch (AGB) stars, Red Supergiants (RSG), and related cool evolved objects with a dusty circumstellar environment. Both AGB stars and RSG are characterized by a dense, dusty stellar wind which is probably driven by stellar pulsations in combination with radiation pressure on dust. We wish to investigate the structure of these winds, in particular the location of the dust formation layer, and its dependence on pulsation cycle, mass loss rate and chemistry. Spectrally resolved interferometry in the 10 $\mu$m window will allow a measurement of the stellar radius and/or the warm molecular layer (even in stars with high mass loss rates), and of the location of the different types of dust that condense in AGB outflows. Deviations from spherical symmetry in the inner regions of the wind and the effects of binarity on the geometry of the envelope will be investigated.

Total observing time : **25 hours on UTs - used up**
**450 hours on ATs**

## 2 Source list

$\Longrightarrow$ **all these 28 objects are protected for observations on ATs only**

| target name | coordinates $(\alpha,\delta)$ (J2000) | | telescopes | comments |
|---|---|---|---|---|
| IK Tau | 03 53 28.6 | +11 24 20 | ATs | M6e |
| SW Vir | 13 14 04.38 | -02 48 25.1 | ATs | M |
| R Hya | 13 29 42.78 | -23 16 52.8 | ATs | Me |
| IRC+20326 | 17 31 55.0 | +17 45 20 | ATs | M2 |
| U Her | 16 25 47.47 | +18 53 32.86 | ATs | O-rich LPV |
| R Dor | 04 36 45.59 | -62 04 37.8 | ATs | O-rich AGB low $\dot{M}$ |
| Mira | 02 19 20.79 | -02 58 39.5 | ATs | O-rich AGB moderate $\dot{M}$ |
| R Leo | 09 47 33.49 | +11 25 43.6 | ATs | O-rich AGB moderate $\dot{M}$ |
| AFGL 5259 | 09 45 15.2 | -22 01 45 | ATs | O-rich AGB |
| R Aql | 19 06 22.25 | +08 13 48.0 | ATs | Me |
| R Aqr | 23 43 49.46 | -15 17 04.20 | ATs | Me+, Symbiotic LPV |
| W Hya | 13 49 02.00 | -28 22 03.5 | ATs | O-rich AGB low $\dot{M}$ |
| $\pi$ 1 Gru | 22 22 44.21 | -45 56 52.6 | ATs | S, Tc |
| V Aql | 19 04 24.16 | -05 41 05.4 | ATs | C |
| U Hya | 10 37 33.27 | -13 23 04.35 | ATs | C-rich LPV |
| R Lep | 04 59 36.35 | -14 48 22.5 | ATs | CIIe |
| V Hya | 10 51 37.25 | -21 15 00.3 | ATs | C |
| T Sgr | 19 16 14.44 | -16 58 17.06 | ATs | C and Li rich LPV |
| R Scl | 01 26 58.09 | -32 32 35.5 | ATs | C-rich AGB low $\dot{M}$ |
| IRC +10 216 | 09 47 57.3 | +13 16 44 | ATs | C-rich AGB high $\dot{M}$ |
| IRAS 15194-5115 | 15 23 05.0 | -51 25 59 | ATs | C-rich AGB high $\dot{M}$ |
| IRAS 09116-2439 | 09 13 54.1 | -24 51 21 | ATs | (SiC) |
| VX Sgr | 18 08 04.04 | -22 13 26.61 | ATs | RSG with disk |
| VY CMa | 07 22 58.33 | -25 46 03.2 | ATs | RSG |
| $\alpha$ Ori | 05 55 10.31 | +07 24 25.4 | ATs | RSG |
| Red Rectangle | 06 19 58.22 | -10 38 14.7 | ATs | Binary post-AGB star |
| HR 4049 | 10 18 07.59 | -28 59 31.2 | ATs | Binary post-AGB star |
| RY Sgr | 19 16 33 | -33 31 20 | ATs | R CrB star |

**MIDI guaranteed time observations –**

**Abstract and source list**

# Extra-solar planets and brown dwarfs

Authors: Bruno Lopez (coordinator), Thomas Henning, Christoph Leinert,
Jeffrey Meisner, Peter Schuller, Martin Vannier
– in coordination with Romain Petrov, representing the AMBER programme

## 1 Abstract

Since the first detection of a hot giant planet orbiting around the star 51 Peg, several very exciting results have been obtained in detecting planets outside our solar system. We propose to observe, within the guaranteed time of VLTI/MIDI, two extrasolar planets (known hot Jupiter-like sources) and two brown dwarfs. The aim of the observations is to directly detect planet and brown dwarf radiation and to deduce spectral information of their atmospheres. Acquisitions of calibrated visibility curves and differential interferometry methods will be performed for reaching the best accuracy in the observations.

The observations of brown dwarfs will be compared to the observations of ATsthe Jupiter-like planets. One of our goals, for instance, will be to verify that the companion of GL86 is indeed a planet and not a brown dwarf itself.

Total observing time : **25 hours on UTs**

## 2 Source list

⟹ **these three objects are protected for UT observing only**

| Object | α | δ | Sp. Type | V | N | Dist. | Msin(i) |
|---|---|---|---|---|---|---|---|
| GL 86 | 02 10 14.4 | -50 50 00.5 | F6 | 6.17 | 4 | 10.9 pc | 4. $M_{Jup}$ |
| GL 876 | 22 53 16 | -14 15 44.3 | M4 | 10.1 | 4.7 | 4.7 pc | 0.5 $M_{Jup}$ |
| HD 217580 | 23 01 51.54 | -03 50 55.4 | K4v | 7.46 | 4.8 | 16.9 pc | 60 $M_{Jup}$ |