

Observing Proposals for the possible utilization of part of the Italian GTO time on VLT1

facility VISA for ESO Period P80  
(Sent to INAF for internal review)

L. Corcione, M. Delbo, M. Gai, M.G. Lattanzi, S. Ligori, A. Sozzetti  
INAF-OATo

Pino Torinese, 6 Feb 2007

A) PROPOSALS

A1) Asteroids

PROPOSAL NAME: 'Direct determination of asteroid sizes with VLT1'

i) The interest in interferometric observations of asteroids stems in possibility of obtaining a direct determination of the sizes of these bodies. This is crucial to study interesting cases and to assess the reliability of thermal infrared, polarimetric and radar models, the major sources of information on asteroid sizes (see Delbo et al., 2006).

Our group has measured, for the first time, interferometric fringes of asteroids with MIDI at the VLT1. Data were obtained on 234 Barbara and 951 Gaspra. A paper based on these observations is in preparation. In this work, we were able to better constrain the physical properties of 234 Barbara, which is an object with very peculiar surface characteristics (Cellino et al. 2006) never observed before.

ii) We propose to continue on this work by measuring the sizes and the thermal properties of three asteroids using the ATs. Note that this would be the first time that the ATs will be utilized for asteroid observations. Our targets are:

41 Daphne

This is a rather large asteroid ~200 km, for which we still have some ambiguity in the albedo. The radiometric albedo is 0.09, whereas the polarimetric one is 0.06. This ambiguity leads to a large diameter ranging from 170 to 220 km than we seek to better constrain by means of VLT1. Moreover, the 3D model of this asteroid, obtained by lightcurve inversion, reveals distinct an asymmetric shape, globally very different from equilibrium-like figures, indicating contact-binary structure.

8 Flora

8 Flora is the largest member of the Flora family, which is not clear whether it is a random superposition of groups of asteroids having similar proper orbital elements, or a real dynamical family with a common collisional origin.

12 Victoria

This object with a rotational period of 8.662 hours, has a lightcurve amplitude of 0.33 mag. It is very interesting from the spectroscopic/taxonomic point of view: it's the largest asteroid of type L, a new subclass of S-types. These objects are poorly known. The L class include 234 Barbara, that has a very peculiar polarimetric behavior and that we have already studied with MIDI at the VLT1.

-Requested time: 3 visibility points; 3 h

-Instrument + configuration: MIDI + FINITO (better if available)

## -Targets:

Number	Designation	RA (2000)	DEC(2000)	V MAG	J	H	K	N	Obs. Window
8	Flora	03 20 00	+12 00 30	9.05	-	-	7.1	-0.4	(Jan-Feb 2008)
12	Victoria	00 25 17	+11 32 42	9.90	-	-	7.90	+0.27	(Oct-Nov 2007)
41	Daphne	13 46 54	-02 45 36.7	9.80	-	-	7.80	-0.91	(Mar 2008)

Note: Asteroids are moving targets. Coordinates and magnitudes are calculated at the center of the observing window.

## A2) Stars with planets

PROPOSAL NAME: ''Planets, brown dwarfs, and dusty debris disks.''

i) We seek to learn more about the hot dust distribution around the bright, nearby, planet-harboring K dwarf HD 69830. This star is orbited by three Neptune-mass planets within 0.5 AU (Lovis et al. 2006). It exhibits a strong mid-IR excess (Beichman et al. 2005), interpreted as a massive asteroid belt-like structure at ~1 AU (Lisse et al. 2007).

Given the age of the star (~3 Gyr), this feature is likely due to a transient, very recent event such as the disruption of an asteroidal body in a low-eccentricity orbit in resonance with the outermost Neptune-sized planet in the system.

By taking advantage of the spatial resolution of MIDI on the VLTI, we can improve on our knowledge of the size (@8-10  $\mu\text{m}$ ), geometry, and orientation of the putative asteroid belt, possibly supplemented by information on dust chemical composition, physical structure, and peculiarities on the spatial distribution of the material. Second, we can rule out the possibility that the dusty structure resides in dynamically stable regions within 1 AU. Our results will then crucially complement the higher-sensitivity, but lower-resolution, Spitzer observations.

ii) We propose to use MIDI/VLTI to directly detect radiation and acquire spectral information on the atmosphere of the putative brown dwarf companion of the bright, nearby G sub-giant HD 38529. This star is orbited by a system of two Doppler-detected sub-stellar companions (Fischer et al. 2002). A recent combined astrometric+spectroscopic solution (Reffert & Quirrenbach 2006) would recognize the outer companion as a L/T dwarf, albeit with large uncertainties in the actual mass. Our observations will permit to better constrain the actual mass of the companion, by comparison with structural models of L & T dwarfs. Finally, according to Spitzer data, HD 38529 has IR excess emission @70  $\mu\text{m}$  (Moro-Martín et al. 2007) implying the presence of cold dusty debris, thus our results will allow us to improve our knowledge of the role of massive sub-stellar companions in the evolution of debris disks.

-Instrument + configuration: MIDI + FINITO (Possibility of doing them without FINITO at the UT's...Just in case!)

## -Targets:

HD NUMBER	RA (2000)	DEC(2000)	V MAG	J MAG	H MAG	K MAG	N MAG
69830	08 18 23	-12 37 55	5.95	4.953	4.364	4.165	3.90
38529	05 46 34	+01 10 05	5.94	4.905	4.384	4.211	4.00

-Requested time: 2 h

## A3) Mira-type stars

PROPOSAL NAME: ''Size and shape variations of specially selected Mira-type variables''.

In this program, where sensitivity is more important than resolution (i.e., low visibility but very high photon flux), we will utilize the VLTI to measure, at

oato\_i tal i an\_gto\_vi sa\_p80\_to\_i naf\_6dec07-1. txt

different wavelengths and with unprecedented accuracy, angular sizes, shapes, and possibly surface brightness distributions of selected carbon- and oxygen-rich Mira-type variables.

Observations at visible wavelengths with the FGS interferometer aboard the HST discovered that large asymmetries in the atmosphere of Mira-type stars are most likely the norm rather than the exception (Lattanzi et al. 1997), and that such asymmetries do vary with pulsation cycle (Guglielmetti et al. 2001). The causes of these asymmetries are still unknown.

They are the major limitation to the determination of the photospheric diameter, a crucial parameter for establishing the effective temperature scale and the mode of pulsation of Mira-type stars. The determination of the photospheric diameter requires, besides detailed model atmosphere calculations, very accurate measurements of the angular diameter as function of wavelength and pulsation phase (Karovska 1997), an almost ideal task for FINITO (which should be able to fringe-track even with low Visibility, say above 0.15) and AMBER in high spectral resolution (Medium Res mode acceptable).

-Instrument + configuration: AMBER (High Res) + FINITO (better if available)

-Target: W Hya (TBC)

HD NUMBER	RA (2000)	DEC(2000)	V MAG	J MAG	H MAG	K MAG	N MAG
120285	13 49 02.0	-28 22 03	8.0 var	-1.7	-2.7	-3.3	-

-Requested time: 6 h (for three visits)

B) TOTAL TIME REQUESTED FOR TARGETS ABOVE.

Given the current constraints on implementing interferometric observations (with little or no dependence on VISA or UT usage, TBC) time appears dominated by overheads: 1 h with MIDI per visit and 2 h with AMBER per visit.

Therefore, giving the informations provided above, the total time requested is approximately 11 hours, including the three visits, at different pulsation phases within P80, for the mira.

C) OBSERVING MODE.

Service mode acceptable (or should we say 'preferred!').