European Southern Observatory

E-ELT Site Monitoring Stations Assembly Guidelines

Station La Chira – Paranal

V02.9

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1 ASTELCO Tower erection

Figure 1: The tower can be erected without need of a crane

Figure 2: dome and mount are lifted by means of a removable crane

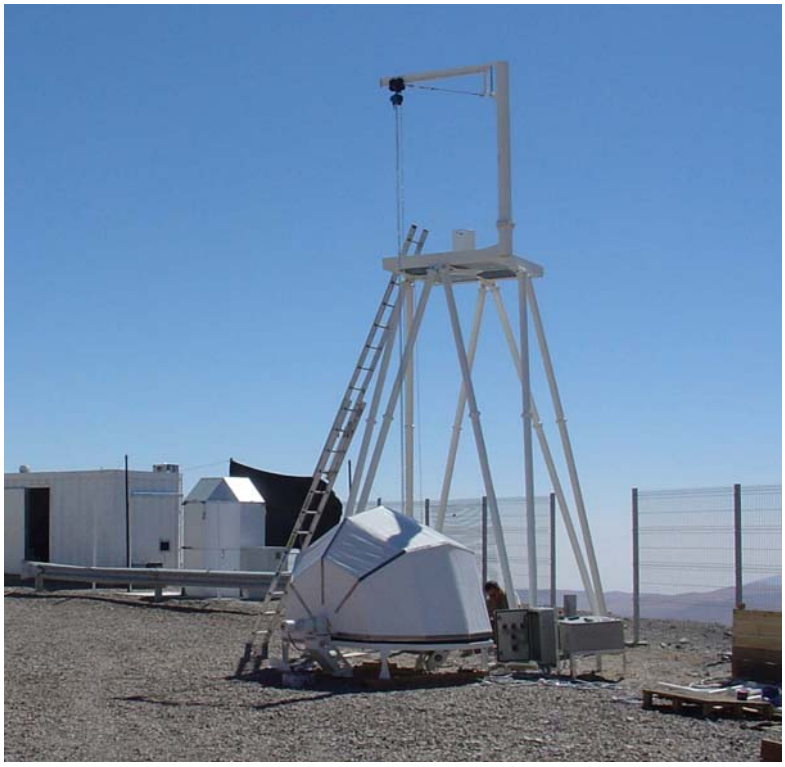


Figure 3: The dome is delivered ready to install

Figure 4: tensing wires are added to increase the stiffness

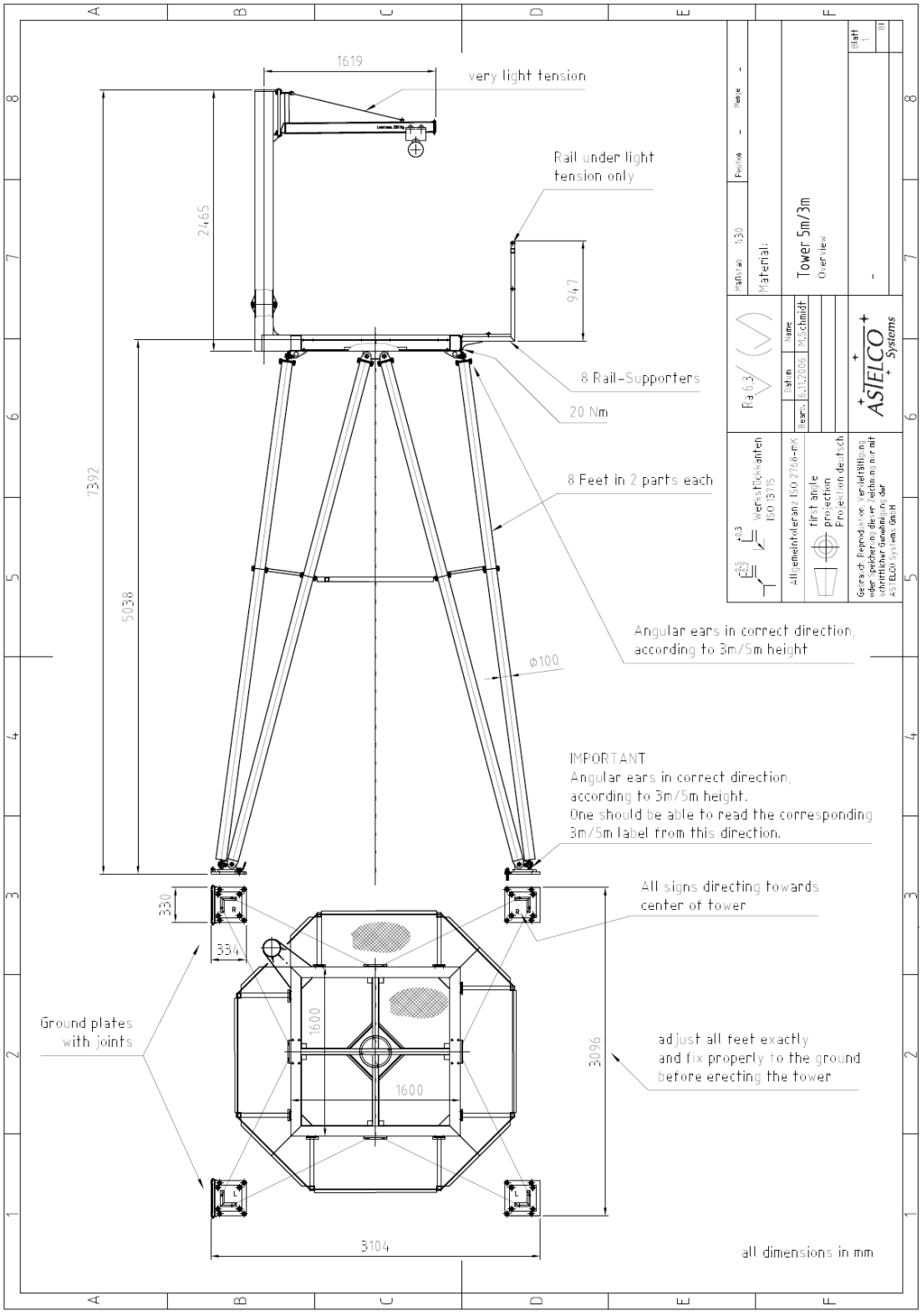


Figure 5: the ASTELCO tower requires minimum foundations of 4 concrete blocks, each 40cm x 40cm, 60cm deep, with a leveling accuracy of ±5mm over a distance of 2m. The total weight, with the enclosure is 1.4 tons. The tower can be assembled by 3 persons with one car, one tackle, ropes and small tools.

2 ASTELCO Dome

2.1 Control

The dome control is either manual from the front panel of the control cabinet or remote though the mount TCS.
The dome motion can be stopped at any time from below using the safety knob. A slight pressure on the dome rubber edge also stops the dome motion.

2.2 Cabling

The cables from the mount and dome control cabinet are running inside weather proof flexible tubes up the tower legs.

3 ASTELCO Mount

3.1 Adjusting the mount in equatorial mode

The tower concrete base must have 2 sides oriented the along N/S direction. The 4 concrete pads are leveled within 1 degree. By construction, the tower will then provide a sufficiently horizontal interface for the telescope mount. Orientate the mount along N/S after releasing the azimuth fixation screws, using a compass (and correcting for local magnetic declination) such as the upper part of the RA axis points to the south in the southern hemisphere, to the north in the Northern hemisphere. Then adjust the latitude angle within one degree. A better adjustment can be achieved using a conventional alignment procedure (e.g. Scheiner or Bigourdon methods in the southern hemisphere).

3.2 Balancing the mount in equatorial mode

The telescope tube is installed with the mount dovetail in the horizontal position (Figure 6). Before releasing the brake, the counter-weight should be moved towards the extremity of the bar so as to prevent the mount to flip over. Warning: **the pneumatic brake is released on both axes simultaneously** when pushing the brake button during a few seconds (Figure 7). First balance the mount in DEC by sliding the tube inside the profile (Figure 8), fasten the screw firmly when finished. Then balance in RA by adjusting the counterweight position (Figure 9).

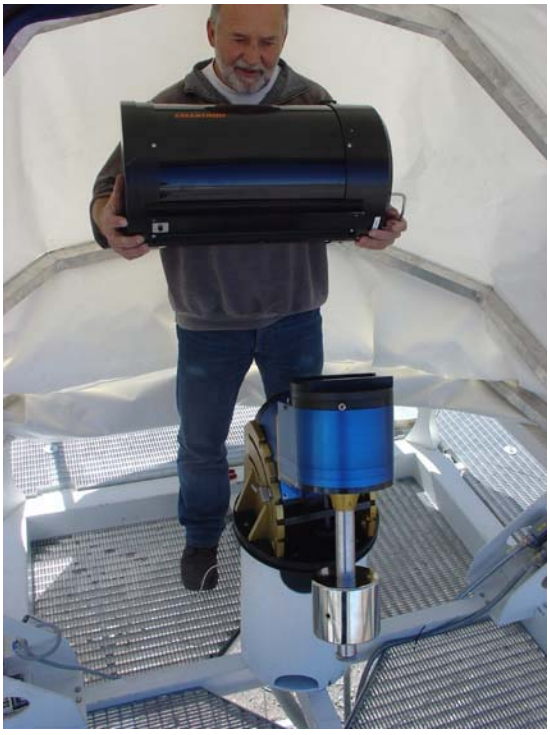


Figure 6: telescope tube installation

Figure 7: releasing the pneumatic brake (on both axes simultaneously)

Figure 8: sliding the optics along the dovetail to balance the mount in DEC

Figure 9: balancing the mount in RA

4 Power Supply

4.1 Power requirements

Subsystems (% of time on in clear sky):

Meteo station: (0%, has its own solar power supply)
Telescope mount (50%, night only - Slewing 1%, Tracking 99%)
Tower enclosure (20s motor operation about 10 times per night)
TCS pc (50%, because can be switched of during daytime)
DIMM pc (50%, because can be switched of during daytime)
MASS pc (100%, gateway to Paranal)
WIFI link (100%)
Cabinet fan (can be thermally controlled)
Ethernet router

The 24h measurement of the TCS with automatic run of the MASS-DIMM (without DIMM unit) between 19:36 and 5:21 gives a power consumption of 3.381 kWh/24h.
The measurement during a night of observation between 19:35 (aperture of the dome) and 5:20 (closure of the dome) gives 1.415 kWh/24h.
The maximum instantaneous consumption during enclosure opening is 234 W and during enclosure closing: 257 W.
The DIMM PC + camera (to be provided by IAC) power consumption is less than 150 W.

Figure 10: La Chira solar panel assembly

4.2 Power plant specification

Peak output: 2.2kW
Maximum AC power (220V~, 50Hz): 4.2kW
Energy storage computed for 5 hour of sun per day = 12kwh, for a consumption of

500W, 24h/day.
Battery assembly: 48V, 50Ah = 24 batteries of 2.4 V
Solar panel assembly: 14 modules

Solar plant charge controller and inverter

4.3 Power plant performance

The solar power system considered has the following capabilities:
Maximum instant power: 4.5kVA, single phase
Maximum energy per day: 6.7kWh
Energy deliverable after last sun on panels: 26kWh, with new batteries (about half as much after three years of operation).
Recovery time of exhausted batteries: at zero load, four days of bright sun.

5 Software configuration

5.1 Set the ip address for the controller

logon to the mount by ssh root@oldIPaddress

In /etc/sysconfig/network, a file ifcfg-eth0 which contains the configuration for the network interface. Either use:
BOOTPROTO='dhcp'
or
BOOTPROTO='static'
BROADCAST='192.168.123.255'

IPADDR='192.168.123.123'
NETMASK='255.255.255.0'
NETWORK='192.168.123.0'
if you use static, you might also need to change ifroute-eth0
0.0.0.0 192.168.123.254 0.0.0.0
where 192.168.123.254 is the gateway address

5.2 Windows based software

The Astelco NTM mount telescope control interface (TCI) uses a proprietary communication protocol (TPL=transfer protocol language). Connecting to the mount is done via sockets from a telnet window:

Start connection with ip and port nr, e.g: telnet 192.168.123.123 65432
Stop connection: DISCONNECT.

A specific TPL interface (TPL explorer) can be used. An additional software interface (StarGrabber) is delivered which allows communicating with “The Sky”, a software tools commonly used by amateur astronomer.

5.2.1 Access NTM mount with The Sky 5

a) Install TCI translator "StarGrabber.exe" in the same directory as VMWare-WinXP.rar package.
b) Start StarGrabber and configure options:
-input type
-send type ETCI
-output type Pilar 3
-settings: enter IP address of mount telescope control computer (TCC, see 6.1, or localhost when using putty sessions)
-autosave
-save now
c) Start The Sky
-set site location & time zone
-set date to use computer clock and daylight saving to local country
-set computer clock time zone to local TZ
-check sidereal time <TOOLS><COMPUTER TIME>

5.2.2 Access NTM mount with TPL explorer

a) Options
-settings TPL server 134.171.188.90:65432 (simulator), or localhost:65432 with putty (6.2.2)
-record TCP log
-autoget on set
-autosave
b) Explorer
-uncheck clear tree on connect
c) <timeout=4000> if needed
d) <connect> "assumes TCS computer is online"
e) <explore parallel> "reads the server tree structure"

Note: for debugging using regedit: TPLExplorer settings are stored in HKEY_CURRENT_USER\Software\VB and VBA Program Settings\TPLExplorer

5.3 LINUX based software

Communication with the mount from a LINUX pc is currently possible by sending individual commands (e.g. using perl and telnet) following the TPL protocol described in [1].

5.4 Example of command sequence

In this example a simple sequence of commands is shown, for observing an object of known coordinates. Initial and final state is dome closed, mount powered off.

5.4.1 Starting observations

- **cabinet/power/set**

[NN SET CABINET.POWER=1]
wait XX seconds for reply: [NN DATA OK CABINET.POWER]
if timeout then read error list
[NN+ GET CABINET.STATUS.LIST]
wait XX seconds for reply:
[NN+ DATA INLINE CABINET.STATUS.LIST="err-string"]
clear the error after problem solving:
[NN+ SET CABINET.STATUS.CLEAR=1]
else read power status:
[NN+ GET CABINET.POWER_STATE]
wait XX seconds for reply: [NN+1 DATA INLINE CABINET.POWER_STATE=1.0]

- **dome/targetpos/set**

[NN SET DOME.TARGETPOS=180]
wait YY seconds for reply: [NN DATA OK DOME.TARGETPOS]

- ***pointing/pointingparams/loadfile***

SET <9>.<3>.<8>=/log/pm_20062406-045012.dat #load an old set of measurements
SET <9>.<3>.<10>=1 #calculate
SET <9>.<3>.<13>="Paranal-1"
SET <9>.<3>.<13>="" #will be loaded as default

- **pointing/target/ra/set**

[NN SET POINTING.TARGET.RA=23.99] #forbidden zone +/-5degrees from meridian
wait ZZ seconds for reply: [NN DATA OK POINTING.TARGET.RA]

- **pointing/target/dec/set**

[NN SET POINTING.TARGET.DEC=-89.99]

wait ZZ seconds for reply: [NN DATA OK POINTING.TARGET.DEC]

- **pointing/track/set**

[NN SET POINTING.TRACK=2]

5.4.2 Monitoring observation

- **ha/trajectory/runtime/get**

In equatorial mode, for mechanical reason the tracking direction has to be reversed close to the meridian. [GET HA.TRAJECTORY.RUNTIME] checks the remaining time before hitting the software limit. The fixed limits for each axis can be readout as [GET HA/DEC.REALPOS!MIN] – [GET HA/DEC.REALPOS!MAX].
The original dead zone of about 5 degrees in HA has been removed early 2007 with the adjunction of an interface plate on the mount base. The limits have been set to
`DEC MIN = -58 - DEC MAX = 258 (default) and`
`HA MIN = 185 - HA MAX = -5, which allows an overlap of 5 degrees in HA on both axes.`

- **pointing/targetdistance/get**

[NN+ GET POINTING.TARGETDISTANCE]
wait XX seconds for reply: [NN+1 DATA INLINE POINTING.TARGETDISTANCE= 0.0??]
repeat command permanently during tracking and check target distance stability
check status POINTING.TRACK equal to 1 or 3 (not 0)

5.4.3 Stopping observations

Parking pointing to the pole (setting new target position stops current tracking)

- **ha/targetpos/set**

[NN SET HA.TARGETPOS=90 SET POINTING.TARGET.RA=]
wait YY seconds for reply: [NN DATA OK HA.TARGETPOS]

- **dec/targetpos/set**

[NN SET DEC.TARGETPOS=90]
wait YY seconds for reply: [NN DATA OK DEC.TARGETPOS]

- **dome/targetpos/set**

[NN SET DOME.TARGETPOS=0]
wait YY seconds for reply: [NN DATA OK DOME.TARGETPOS]
Note: starting from new release TCI 2.0 (Feb.07): replace DOME by DOME[1]

- **cabinet/power/set**

[NN SET CABINET.POWER=0]
wait XX seconds for reply: [NN DATA OK CABINET.POWER]

6 Network

6.1 IP addresses

6.1.1 La Chira Station IP configuration

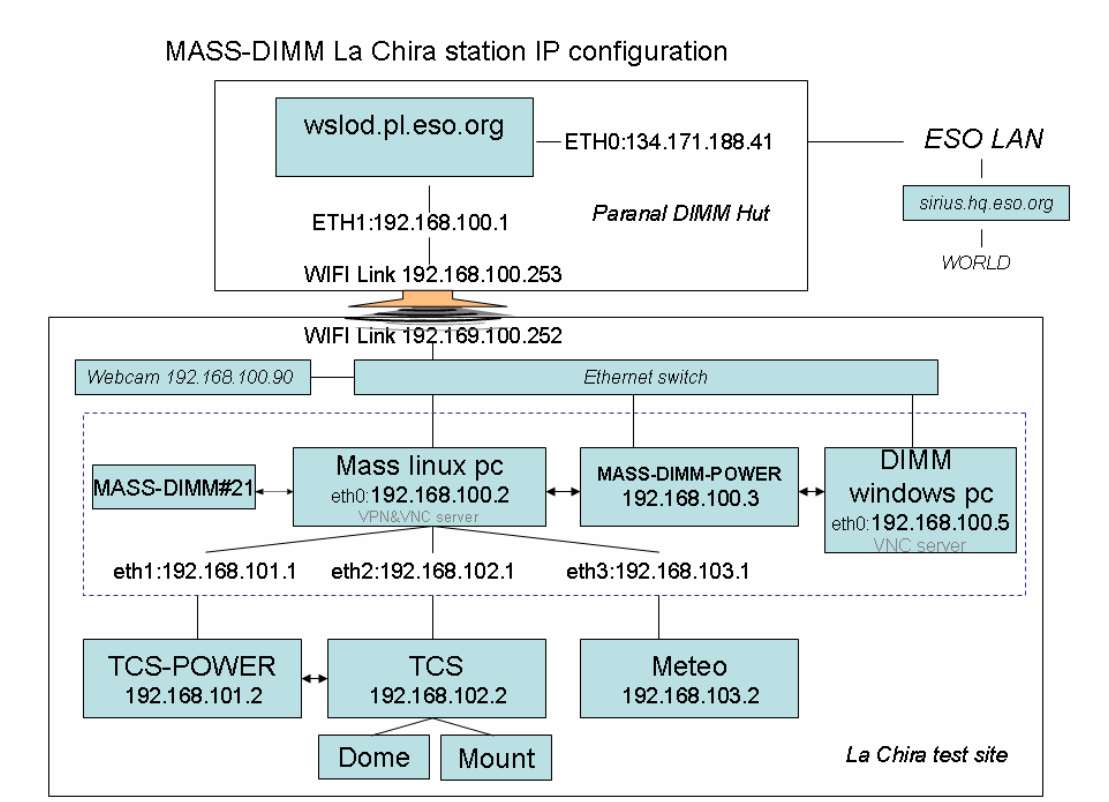


Figure 11: La Chira Station IP configuration (note that MASS-DIMM instrument is powered from the mount 12V auxiliary power supply)

Two Stealth Computer little pcs are used for mass and dimm measurements. They are stored on top of the mount control cabinet. A damping material reduces the vibrations of the TCS brake air pump.

6.2 Remote access

6.2.1 Open a VNC session from Windows on to MASS linux pc

It is possible to remotely service and operate the station subsystems from inside the ESO domain using ssh port forwarding. For example, an ssh session could be opened

on wslod.pl.eso.org port 22 which includes a tunnel to the MASS linux PC port 5801& 5901 (vnc ports with display number 1) where a VNC server is running:
In PuTTY, add the related tunnels
L5801 192.168.100.2:5801
L5901 192.168.100.2:5901
As long as the PuTTY window is opened, a VNC call to localhost:5901 (use password set by supervisor) will be automatically re-directed to the MASS linux pc.

6.2.2 Open an ssh session from an ESO computer to the mount TCS

From windows, start a PuTTY session to wslod as user supervisor which includes a tunnel from port 65432 (openTPL port) to localhost:65432.

From linux, create an ssh connection to wslod which includes a tunnel to localhost:65432:
ssh -L 65432:localhost:65432 supervisor@wslod.pl.eso.org

In both cases:
On wslod, create an ssh connection to MASS linux PC which includes a tunnel from wslod to the ASTELCO mount (port 65432):
ssh -L 65432:192.168.102.2:65432 supervisor@192.168.100.2

6.2.3 Open an ssh session from outside ESO firewall to the mount TCS

From windows, start a PuTTY session to sirius.eso.org as user mass which includes a tunnel from port 65432 (openTPL port) to localhost:65432.

From linux, create an ssh connection to sirius.eso.org as user mass which includes a tunnel from port 65432 (openTPL port) to localhost:65432,
ssh -L 65432:localhost:65432 mass@sirius.eso.org

In both cases:
On sirius, create an ssh connection to wslod which includes a tunnel from sirius to localhost:65432:
ssh -L 65432:localhost:65432 supervisor@wslod.pl.eso.org

On wslod, create an ssh connection to MASS linux PC which includes a tunnel from wslod to the ASTELCO mount (port 65432):
ssh -L 65432:192.168.102.2:65432 supervisor@192.168.100.2

7 WIFI Link to Paranal

7.1 Setup

The antenna is a directional parabola with an 8° beam-width and it is located and pointed away to the observatory with 28.5 dBm in antenna. The front to back ratio of the antenna is 24 dB so only 4.5 dBm are radiated toward the observatory (less than 3mW). The signal coming from the remote site it is less than -76 dBm in 2.4 GHz ISM Band. The power (500mW) is under the normal power of almost any RF link and the frequency (2.4 Ghz) is reserved for WiFi devices.

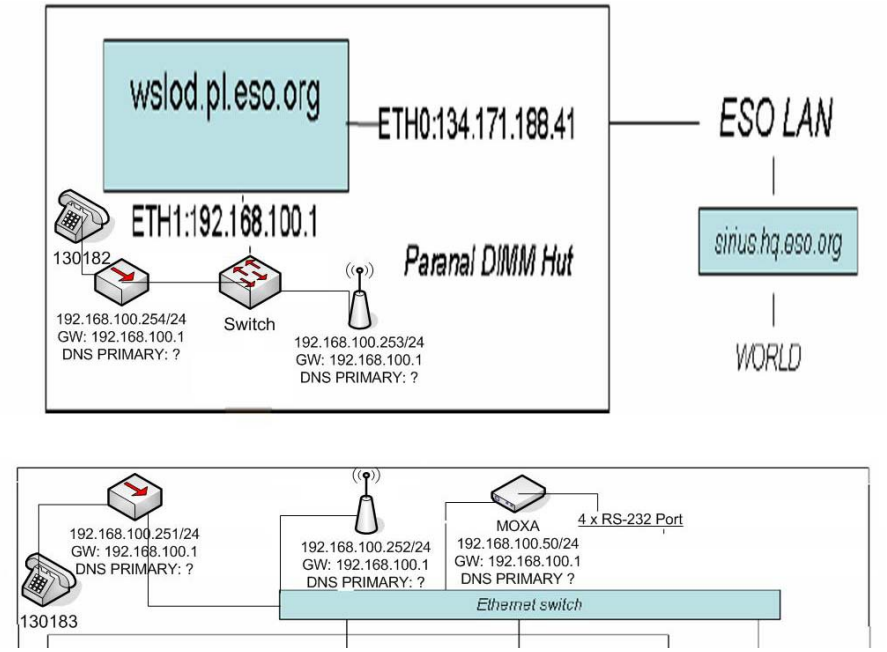


Figure 12: Paranal-La Chira wireless link configuration

7.2 Maintenance

Check link quality between wslod and mass-dimm linux pc:

- Packet loss: from wslod extract with (>netstat | more) the port number of your own connexion (eg. 37558) and exclude it from the check. From mass-dimm linux as root (su -): #tcpdump –n –I eth0 ! port 37558
- Transfer speed: on wslod create a big file (dd if=/dev/zero of=testfile bs=1M count=50), and copy it to mass-dimm (scp testfile 192.168.100.2)
- An account “chiralink” has been created on wslod for maintenance purposes

8 Meteorological environment monitoring

8.1 Station description

Vaisala station during the tests at Paranal

A Vaisala system MAWS100 with WXT510 weather transmitter is installed at La Chira the top of a 10m high mast.

The Automatic Weather Station MAWS100 is configured to measure with the following sensors:

Sensor name and identifier	Sensor type	MAWS channel	Measuring range	interval
Wind Speed (WS)	WXT510	COM 1	0...60 m/s	1 s
Wind Direction (WD)	WXT510	COM 1	1...360 °	1 s
Air Temperature (TA)	WXT510	COM 1	-52...+60 °C	60 s
Relative Humidity (RH)	WXT510	COM 1	0...100 %	60 s
Air Pressure (PA)	WXT510	COM 1	600…1100 hPa	60 s
Precipitation (PR)	WXT510	COM 1	0…200 mm	60 s

The serial port 1 of the communication module (DSU232_0_0) is dedicated to send messages via DXE421 Ethernet Module. The line parameters are: RS232, 9600 baud, 8 data bits, 1 stop bit and No parity.

8.2 Meteo station Ethernet module configuration

This is a complement of the VAISALA COM Server Unit DXE421 USER'S GUIDE (M210608EN-A).

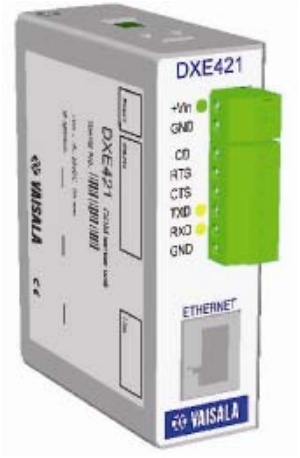
Material required:

- 1 laptop with RS-232 serial port (9 pins)
- 1 electrical cable with one RS-232 plug on one side and stripped wires on the other side (3 wires needed only)

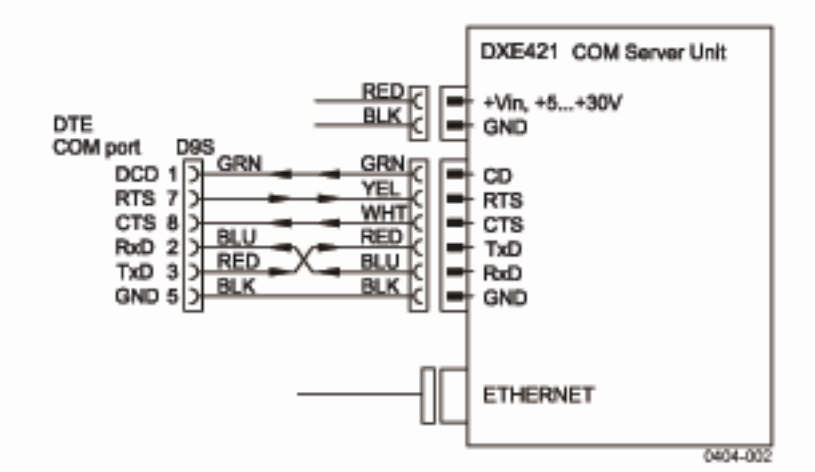
Method:

8.2.1 Access to the Vaisala DXE421

Open the door of the VAISALA DXE421 station (one screw manually unscrewed).



8.2.2 Connection of the RS-232 serial cable



Disconnect the 3 wires TxD, RxD and GND from the DTE COM port (the connector is fixed to the opened door).
Connect the RS-232 plug of the serial cable to the RS-232 serial port of the laptop (DB9 male).
Connect the 3 following streapped wires of the serial cable to the 3 disconnected wires of the DXE421COM Server Unit:

Serial cable	DXE241 unit
Received Data (pin 2) ->	TxD
Transmitted Data (pin 3) ->	RxD
Signal Ground (pin 5) ->	GND

Note that in the case of a DB9 female RS-232 serial port on the laptop, the Transmitted Data is on pin 2 and the Received Data on pin 3.
There is no need to connect the other pins.

8.2.3 Enter to the setup mode

Open a terminal on the laptop (Windows).
The serial port configuration by default is displayed: Baudrate 9600, I/F mode 4C (RS-232C, 8-bit, no parity, 1 stop bit).

Switch off the power of the DXE421 (disconnect the +Vin wire of the DXE421 if no switch is found).
In the same time, hold down the X key of the keyboard of the laptop and switch on the power of the DXE421 (reconnect the +Vin wire of the DXE421: be careful to connect correctly the wire inside the pins of the DXE421).

Hold down the X key until the following text appears on the screen of the laptop:

MAC address 00204A806000
Software version 01.6 (040308) XPTE
Press Enter to go into Setup Mode

Press ENTER on the laptop to proceed.

The following menu is displayed:

Change Setup:

0 Server configuration
1 Channel 1 configuration
3 E-mail settings
5 Expert settings
6 Security
7 Factory defaults
8 Exit without save
9 Save and exit Your choice ? 0

8.2.4 Change of IP configuration of the Meteo Unit

Press ENTER to select 0 for changing the server configuration.
Give the following IP settings:

IP Address : 192.168.103.2
Set Gateway IP Address (Y) N
Netmask: Number of Bits for Host Part (0=default) 8
Change telnet config password (N) N

Exit the setup menu:
Select 9 (Save and exit) in the setup menu to exit the menu.

8.2.5 Reconfiguration

Disconnect the RS-232 serial cable from the DXE421 COM Server Unit.
Reconnect the 3 wires to the DTE COM port with the correct affectation.
Close the door of the VAISALA DXE421 station. Do not screw it completely in order to not damage the wire which is inside.
Disconnect the RS-232 serial cable from the laptop.

Check of the link through internet

Log on to an Xterminal.

Type: > ssh supervisor@134.171.188.41 to connect to wslod, the gateway.
Type the script: > ./tunnel-ssh to connect to the Mass linux pc.
Then telnet to the Meteo Unit:
Type the command: telnet 192.168.103.2 9999 to configure the setup.
Type the command: telnet 192.168.103.2 10001 to get the data from the Meteo Unit.

8.3 Meteo data structure

The internet port allows receiving the data messages by opening a telnet session on port 10001 (9999 to change setup) from mass-dimm#21:

>telnet 192.168.103.2 10001 (CTRL] to exit)

Two types of reports are available, in single line or in a table.
Single Line:

```
2006-10-10 15:42:02 LACHIRA 0 17.6 17.5 18.0 17.0 0 7 6 7 5 -18.9 -20.5 -18.9 -
21.9 0 747.2 747.3 747.4 747.2 0 4.0 3.7 5.7 1.5 3.9 6.5 1.1 0 293 293 347 268 292
347 241 0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0 14.672
```

Formatted table:

MAWS Total Report 2006-10-10 15:42:02 Station: LACHIRA

		STATUS	INST	AVE(1H)	MAX(1H)	MIN(1H)
AIR TEMPERATURE	°C:	0	17.6	17.5	18.0	17.0
RELATIVE HUMIDITY	%:	0	7	6	7	5
DEWPOINT TEMPERATURE	°C:		-18.9	-20.5	-18.9	-21.9
AIR PRESSURE	hPa:	0	747.2	747.3	747.4	747.2
WIND SPEED	2M m/s:	0	4.0	3.7	5.7	1.5
	10M m/s:			3.9	6.5	1.1
WIND DIRECTION	2M deg:	0	293	293	347	268
	10M deg:			292	347	241
PRECIPITATION	mm:	0	0.00			
Floating Sum, Hour/day	mm:		0.00	0.00		
Cumul. Sum, Current/Previous Hour	mm:		0.00	0.00		
Cumul. Sum, Current/Previous Day	mm:		0.00	0.00		
OPERATING VOLTAGE	Vdc:	0	142			

9 Performing a pointing model

9.1 Method

The pointing model should be performed with a fully balanced mount with the focal instrument attached to the tube.
A preliminary model can be achieved in daytime using about 7 stars bright enough to be visible with the eyepiece (with cross-hair). The azimuth and latitude offsets delivered by the pointing model must be minimized (below 0.1 degree) by further mechanical adjustment to cancel field rotation.
The rough pointing model is used as a finder for a smaller field webcam. A new model is then redone on about 20 stars evenly chosen within the useful sky.

9.2 Software

Use “The Sky” to select the stars and slew the mount, then use TPL Explorer to apply the offsets and compute the coefficients.
From windows: start PuTTY session on wslod as supervisor
Start ./tunnel.sh on wslod
Start StarGrabber.exe on windows
Start TPLExplorer.exe on windows
Connect
<Special><TCI:Offsets> #starts offset panel
To append the new objects to an earlier set of measurements:
SET<POINTING><POINTINGPARAMS><LOADFILE>=”/log/pm_ date-time”; (e.g. pm_20060108-074422.dat), same format as <DUMPFILE>
To start a new set of measurements, clear existing points (if needed)
SET<POINTING><POINTINGPARAMS><RECORDCOUNT>=0
Start TheSky.exe on windows
select object
copy to clipboard (lower 2nd icon on object information panel)
popup appears, wait until <S> icon turns to <T> in offset panel
if no start, start spiral search (30”)
center star, <add> in offset panel
<calculate> (after at least 7 measurements)
Save the pointing model SET <POINTING><POINTINGPARAMS><SAVE>=”” (will be default at next startup), or e.g. “lachira”

10 Running MASS measurements

10.1 Manual mode

Open an X session on mass linux pc (from wslod: ssh –X <ip address>, or run the script */home/supervisor/ssh-mass-dimm-21*)
Enter: "turbina &"

[tools][initialization]
[file][select star]
[measurements][select scenario] ; set in [config][operation][scenario]
e.g. 10*(60*N) for 10 series of 60mn
[measurements][run scenario]

10.2 Supervisor mode

10.2.1 Starting the Supervisor

The La Chira station runs currently at Paranal, close to the VLT-ASM DIMM. As the station is not yet equipped with a meteorological monitoring system, the supervisor has been configured to mimic VLT-ASM DIMM activity, i.e. observe only when DIMM. Also for cross-comparison purposes, the telescope shall point to the same star as the VLT-ASM DIMM.
The supervisor can be started remotely by executing as user supervisor the script

/home/supervisor/sv/mass-dimm-supervisor_start.sh

from the mass-dimm linux pc. For this purpose, Open an X session on mass-dimm linux pc (from wslod: ssh –X <ip address>, or run the script */home/supervisor/ssh-mass-dimm-21*). To open the supervisor gui on your display rather than on the mass-linux pc, accept "run with local display" when prompted. Note that any previously running supervisor session should be killed before starting a new one, execute */home/supervisor/sv/mass-dimm-supervisor_stop.sh* for this purpose.

10.2.2 Supervisor operation

10.2.2.1 Semi-robotic mode

When weather circumstances are not available, the supervisor mimics the VLT-ASM DIMM behavior contained in the file /pub/general/mass/asmdimm.log, uploaded by wasm via wslod.
In the current scenario (*obs_massdimm_chira.tcs*), turbina stays in init mode, the dome remains closed and the telescope parked as long as DIMM is not producing seeing data. This status is also achieved by pushing the <stop operations> button.
When operation is allowed, as soon as DIMM produces a data while pointing at a star which belongs to the MASS catalogue, the dome opens, the telescope slews to thetarget and MASS measurements start (note that the time needed to refresh DIMM data depends on the link speed, 30s are necessary of the scp through the wifi link when another VNC session is running, 15s when only sv runs).
A change of star by DIMM will also be detected (with some delay ~2mn), operation will stop (i.e. dome closes and telescope parks) and re-start if the chosen star belongs to the MASS catalogue.

Operation is authorized by the circumstance monitor (e.g. calculating sun position) according to the limit operating conditions stored in the configuration file *sv.vltasm.cfg.*

10.2.2.2 Full robotic mode

tbd

10.2.3 Stopping the Supervisor

To close dome and park telescope, activate the <stop operation> button before stopping the supervisor. The supervisor and all running subsystems can be stopped by executing the command

```
/home/supervisor/sv/mass-dimm-supervisor_stop.sh
```

10.3 MASS data structure

The mass data files are stored in the mass-dimm linux pc at /opt/turbina/data/out
See MASS documentation for further info.

11 Running DIMM measurements

11.1 Turbina DIMM

11.1.1 Turdimm setup

The developer of MASS provides since mid-2007 a linux-based software for DIMM measurements based on IEEE1394-based digital cameras such as Prosilica EC650 Camera (at La Chira: Serial number 02-1065B-05044, software id Hex number 0x00f31000000755c). The resolution is 659 × 493, the readout noise at gain=0 is 12.2 e-, Conversion factor is 2.09 e-/adu, 0.66 arcsec/px, 7.5 micron pixel at f=2348mm. The camera is typically read at a frame rate of 30Hz with 5ms exposure time. Seeing data are produced every 1mn with intermediate values every 10s based on 280 images.

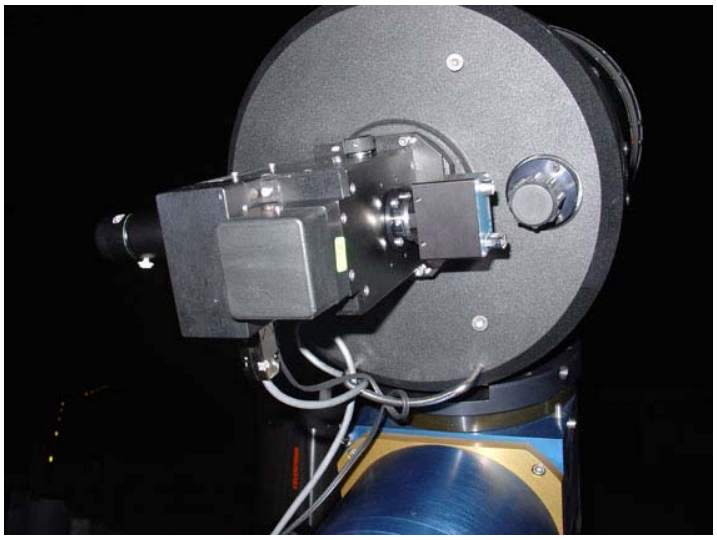


Figure 13: the camera is installed such as the X axis is parallel to the pupil segmentators separation (here vertical)

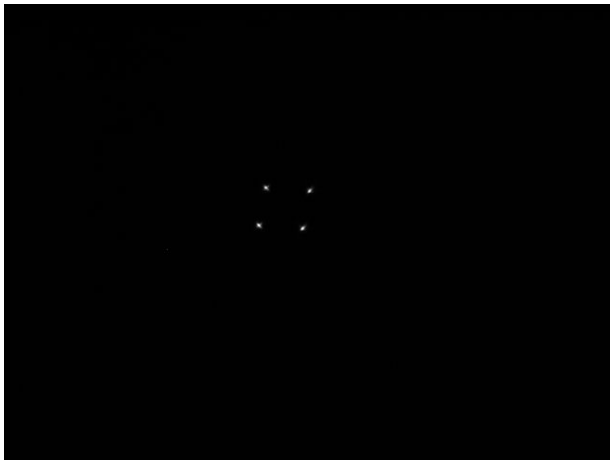


Figure 14: MD#21 plate scale calibration on the double star HD2884/2885 (Bet Tuc, 00 31 32.5, -62 57 29) of separation 26.6": the pixel size is 0.66".

Figure 15: Wind shake of tower/mount assembly for a north wind of velocity 15m/s. The horizontal motion amplitude is about 50" (exposure time 0.1s).

11.1.2 Turdimm operation

The program `/opt/dimm/dimm` is started from the supervisor. Running manually DIMM measurements is possible from any telnet session, typically:
`telnet localhost 16200`

```
10 init
20 run center
30 set scenario="100*(c+10*n)"
40 run scenario
50 stop
60 park
70 quit
```

The full command line includes redirecting dimm output to preat utility:
`/opt/dimm/dimm -i 192.168.100.5 -p 16200 | /opt/dimm/preat > /home/supervisor/turdimm/data/turdimm.log &`
Preat allows to calculate seeing and Strehl and adds these values to the standard output. The telnet session is `telnet 192.168.100.5 16200`
The star information is needed to compute airmass correction:

```
29 set object="8728 Alp_Psa 22 57 39 -29 37 20 a55 1.16  0.09"
29 set object="99 Alp_Phe 0 26 17 -42 18 22 k03 2.39 1.09"
```

Note that the syntax is similar to Turbina but not identical. The filter files are in /opt/dimm/etc.
During the measurements it is possible to recenter the object in the DIMM field, for example:
`./TCS_offset.sh tcs 65432 0.005 0` for dx=-15 px
`./TCS_offset.sh tcs 65432 0 0.005` for dy=-15 px

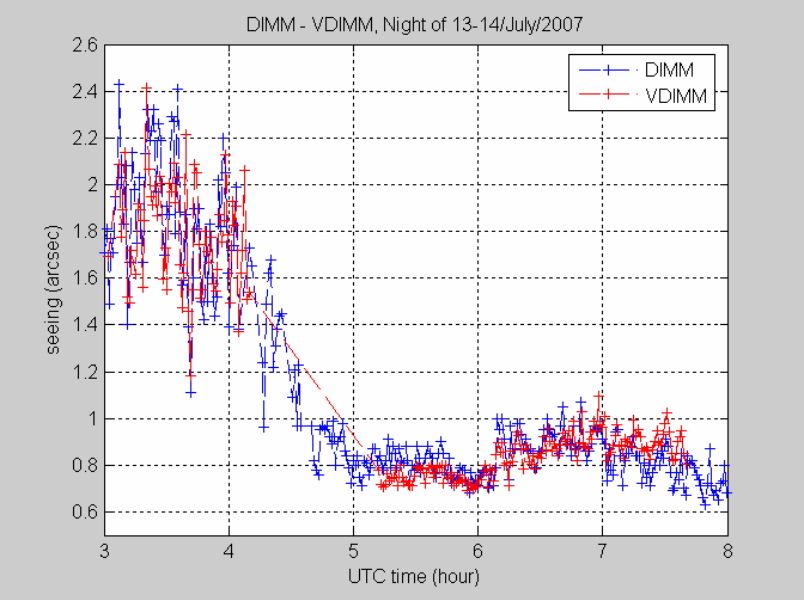


Figure 16: The Turbina DIMM (at 2m above ground, red) was compared at Paranal to the ESO DIMM (at 6m, blue) in July 2007.

11.1.3 Image display

For alignment purposes and when turdimm is stopped, it is possible to display the focal images using “coriander” under linux.

11.2 IAC DIMM

Establish a VNC connection (password dimm) to IAC-DIMM-I port 5900 (localhost:0 when the following putty tunnel is created: L5900 192.168.100.5:5900).
Enter at the prompt the username and password for DIMM software (administrador & 123).

11.3 WEBCAM DIMM

11.3.1 DIMM program setup

The webcam is attached to the DIMM channel of the MASS-DIMM on the C11 telescope. Two pupils of 89mm diameter, 195mm apart, are provided by the MASS-DIMM instrument with a plate scale of 0.493” per 5.6 micron pixel of the detector.

Set wslod.pl.eso.org as time server for dimm-mass windows pc (same as for mass-dimm linux pc).
Disable windows automatic updates.
In case other webcams are connected, disable them: right click on “my computer” <manage> <device manager> <imaging devices>, right click on the device <disable>.

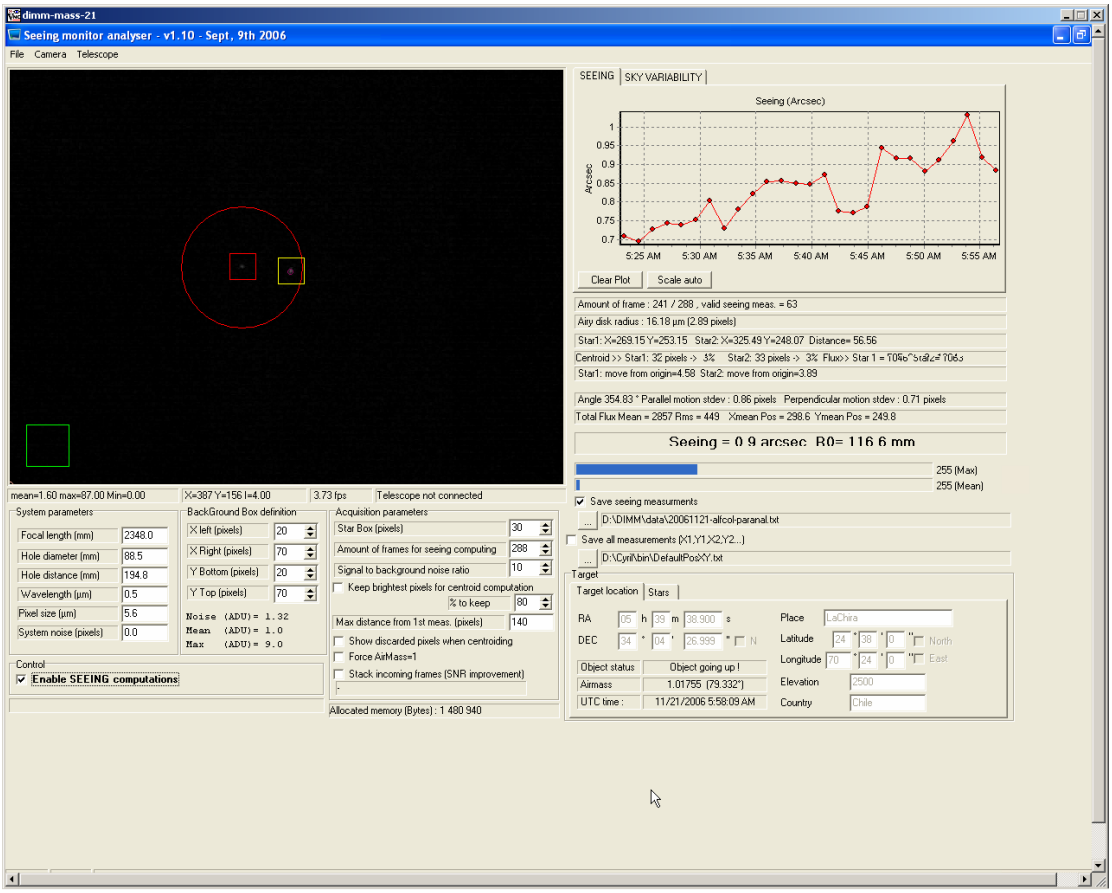


Figure 17: The DIMM software used for the preliminary operation is a window based shareware developed by Cyril Cavadore. The detector is a Phillips SPC900NC ToUCam III webcam set at 5ms exposure time. The frame rate was 8.5Hz with real time determination of the centroids.

11.3.2 Dimm-mass PC display export for remote control

on dimm-mass pc:
-install tightVNC server (autostart at reboot & register as system service)
set passwd, set fixed display 0
-open the firewall in windows for the VNC server
in control panel/ firewall/Exceptions/Add Program/launchTightVNC Server

11.3.3 DIMM data file sharing

Share D:\DIMM directory from dimm-mass pc:
- enable “file & printer sharing for Microsoft network” on the relevant network connection
- disable simple file sharing: tools/folder/View/untick use simple file sharing
- right click on folder/sharing&Security/share this folder/permission/full Control for everybody and network

To access DIMM folder from mass-dimm21, mount it as root:
Add an entry “*192.168.100.5 dimm*” in /etc/hosts (note that a bug in samba redhat 9 prevents using long names), then
mount -t smbfs -o username=admin,password=xxxx,uid=supervisor,gid=mass //dimm/DIMM /home/supervisor/DIMM,

or include the following command in /etc/fstab so that mount can be done by any user:
//dimm/DIMM /home/supervisor/DIMM smbfs user,username=admin,password=xxxx,uid=supervisor,gid=mass 0 0
and chmod u+s /usr/bin/smbmnt, chmod u+s /usr/bin/smbumount

The user on mass-dimm-21 can then
-smbumount /home/supervisor/DIMM
-mount /home/supervisor/DIMM

```
#post dimm-mass file
set lastcamdimm = `ls /home/supervisor/DIMM/data | tail -1`
#cp /home/supervisor/DIMM/data/$lastcamdimm /var/ftp/pub/dimm/camdimm.log
```

11.3.4 Remote control of the DIMM measurements

- Open a VNC session from a remote computer:

from localhost, start a putty session on wslod including a tunnel to ports 5800 & 5900 (vnc ports with display number 0),
L5800 192.168.100.5:5800
L5900 192.168.100.5:5900,
then open a VNC server session on localhost:0

- Open a Remote Desktop Connection from another windows pc:

from localhost, start a putty session on wslod including a tunnel to port 3389
L4000 192.168.100.5:3389
Then open a RDC on localhost:4000 (programs/accessories/communication), configure rdc to share disk drive to be able to drag and drop files from the remote directories to the local pc.

12 Data transfer to ESO Domain

12.1 Real time transfer

wslod, the gateway to the ESO domain collects runs every 5mn the cronjob /home/supervisor/sv-wslod/copy-mass-dimm-files.csh to download data to wslod:

```
#post mass-dimm file from mass-dimm pc
/pub/general/mass/mass.log to /var/ftp/pub/mass/mass.log
#post dimm-mass file from dimm-mass pc
/home/supervisor/turdimm/data/turdimm.log to /var/ftp/pub/dimm/turdimm.log
#post error logs
TPL-lasterr.log  to /var/ftp/pub/mass/
#post meteo data
/home/supervisor/vaisala/data/meteo.log to /var/ftp/pub/meteo/meteo.log
```

Note: scp is used without password query. To configure it, run *ssh-keygen -t dsa*
And append the public key to the authorized user files on the server:

```
scp id_dsa.pub supervisor@192.168.100.5:/tmp
cat /tmp/id_dsa.pub >> .ssh/authorized_keys
```

12.2 Daily transfer

Mass-dimm linux pc posts daily at 11h20UT on wslod the data and log directories by running the cronjob /home/supervisor/sv/put_massdimm_log.csh:

```
#MASS-DIMM files to /var/ftp/pub/mass/data/out
#DIMM-MASS files to /var/ftp/pub/dimm/data/out
#ASTELCO TCS error log to /var/ftp/pub/mass/TPL-err.log
#VAISALA METEO files to /var/ftp/pub/meteo/data/out
```

13 Station Remote Startup & Shutdown

13.1 Cold Startup

Dome and TCS cabinets are not powered.
Switch on MASS-DIMM linux PC power from Expert Power Control NET by executing, from wslod:

```
/home/supervisor/iBoot/epc_control.pl --host=192.168.100.3 -on
```

Switch on TCS cabinet power from Expert Power Control NET by executing, from MASS-DIMM pc:

```
/home/supervisor/iBoot/epc_control.pl --host=192.168.101.2 -on
```

Wait until TCS computer boots and switch on TCS following the warm startup procedure.
Both previous actions can also be achieved using a browser pointing at the above ip addresses.

13.2 Warm Startup

Cabinet power is on, TCS is off (i.e. mount [but not mass-dimm instrument] power is off).
Logon MASS-DIMM pc from wslod as supervisor by running the script:

```
/home/supervisor/tunnel.sh
```

Switch on TCS:

```
/home/supervisor/sv/TCS_on.sh tcs
```

Reset mount error if needed and switch on TCS again:

```
/home/supervisor/sv/TCS_reset_errors.sh tcs
/home/supervisor/sv/TCS_on.sh tcs
```

All the previous actions can be executed with a single script:

```
/home/supervisor/sv/TCS_begnight_startup.sh tcs
```

Open dome:

```
/home/supervisor/sv/TCS_opendome.sh tcs
```

```
Note: the knob on the MASS instrument should be turned away from the
ocular position to be able to get the starlight on the detectors.
```

13.3 Partial shutdown (end of night)

A single script is available:

```
/home/supervisor/sv/TCS_system_off.sh tcs
```

which performs the following actions:

-Move telescope to parking position (ra,dec=90,90):
call `./TCS_park.sh`

-Close dome (target position=0)
call `./TCS_closedome.sh tcs`

-Switch off TCS:

13.4 Total shutdown

From mass-linux pc, switch off TCS cabinet power using Expert Power Control NET:

```
/home/supervisor/iBoot/epc_control.pl --host=192.168.101.2 –off
```

Note that any turbina session should be closed before shutting down TCS cabinet power (use */home/supervisor/sv/mass-dimm-supervisor_stop.sh)*

All the previous actions can be executed with a single script:

```
/home/supervisor/sv/TCS_endnight_shutdown.sh tcs
```

Shut down other external computer (e.g. mass linux pc) and switch off mass-linux pc power from from wslod using Expert Power Control Net:

```
/home/supervisor/iBoot/epc_control.pl --host=192.168.100.3 –off
```

Switch off Dome cabinet main power switch
Unplug external power cords.

14 Recommendations

-Check the reference number written in the cables when connecting the mount to the TCS computer (encoder and motor correspondence).
-Rebalance the mount carefully after any change of focal plane instrumentation
-Check the cable path for all positions of the mount: release the brake and move the telescope by hand to any possible position in the sky.
-Caution: the 12V outlet on the mount front plate remains active after the motors are powered down. It is disabled only by switching off the TCS computer.

15 Troubleshooting and recovery procedures

-After power cycling the cabinet computer or after software power down, the mount returns an error to the “power on” command (did not find the right phase). Reset the error in the TCS computer (one time) and the mount will chose the other direction.

-If the mount hits an obstacle during slewing or tracking, a current limit will stop it automatically. Reset the error in the TCS computer before re-pointing (repeat the operation once more if not successful).

-In absence of power in the cabinet, the mount cannot be moved by hand because the brake cannot be released (air pump off).

-After activation of the dome emergency switch: push the reset button on the dome control panel, or reset the error in the TCS computer. Note: the reset light on the dome control panel should turn permanent red when the emergency switch has been activated, however due to a software bug, it blinks at 2.5 s intervals.

-After activation of the enclosure safety rubber switch: push the reset button on the dome control panel, or reset the error in the TCS computer.

-Should the TCS computer have to be rebooted remotely,
access EPC NET 220V outlet ip-adress from MASS linux-pc by running the delivered script `/home/supervisor/iBoot/epc_control.pl --host=192.168.101.2 –off`

or open a browser at http://192.168.101.2

-Turning on/off the mount power should not happen when mass turbina program is running: the voltage peak freezes the rs485 line and the mass-dimm linux pc has to be rebooted. Should the MASS-DIMM computer have to be rebooted remotely, access EPC NET 220V outlet ip-adress from supervisor@wslod by running the delivered script:

```
/home/supervisor/iBoot/epc_control.pl --host=192.168.100.3 –off
/home/supervisor/iBoot/epc_control.pl --host=192.168.100.3 –on
```

or open a browser at http://192.168.100.3

-The clock of the TCS computer is synchronized on the GPS receiver. The GPS receiver looses its configuration data when the NTM is disconnected from power for a while. This issue will be fixed in the next NTM software update. Meanwhile, the clock probably needs to be set by hand:

```
ssh root@192.168.102.2
date -u "010709152007.00" (07.01.2007 09:15:00)
```

-When starting Turbina, the lpt and parport drivers are removed to be replaced by rs485lpt (as root: /sbin rmmod lp parport). However, a user logging in using "remote desktop" windows application in which the local resources "printers" are not disabled will start automatically the lp and parport drivers (/sbin/lsmod to see a list of loaded drivers). These drivers enter in conflict with our MASS instrument rs485lpt driver and cause the computer to hang-up. Solution: the lp and parport drivers have been renamed "xx-renamed" so that no application can start them.

16 References

[1] 4PI-DOC-03-008-01-1; Transfer Protocol Language, V2, 7 March 2006

[2] TT-DOC AS-TCI; Telescope control interface, V2 rev24, 23 June 2006

[3] 4PI-DOC-03-008-02-3; OpenTCI, V2.3 rev296, 07 March 2006, updated to V2.5 Rev358, 20 February 2007

[4] E-ELT Site Monitoring Stations Assembly Guidelines, ESO, 28 June 2006

[5] ASTELCO Enclosure - Control System V 1.01 (EN), 02 May 2006