

The Innsbruck 60 cm RC Telescope



S. Kimeswenger
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this version replaces all previous ones.

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1 Introduction

That 60 cm Cassegrain telescope of the Institute of Astrophysics (former Institute of Astronomy) of the Leopold Franzens Universität Innsbruck was taken into test operation in October 1995. The planning of the telescope and the building of the telescope mounting was carried out by the engineers from the workshop of the Institute for Astronomy of the University Vienna under the guidance of Mr. Pressberger. The blanks for the two mirrors made of ZERODUR come from SCHOTT in Mainz. The mirrors were dragged by Mr E. Aeppli (company Astro Optik, Adlicon, Switzerland). The control electronics and software was planned and built by Mr. Kimeswenger (Institute of Astrophysics, Innsbruck).

The telescope and therefore too this manual are advanced constantly. For this reason, always convince themselves that you read the currently current version of the manual and all complement leaves. If you run by use of this manual into mistakes OR have propositions for changes if please, register you this with red pencil into the specimen in the dome (please, you also indicate your initials and the date).

Position of the telescope:

$11^{\circ}20'34'' = 00^{\text{h}}45^{\text{m}}22.26^{\text{s}}$	east of Greenwich
$47^{\circ}15'50''$	northern latitude
617 m	above sea level

Contact:

Any requests have to be organized/channeled, as far as not explicitly indicated different in one of the next sections, by Mr. Saurer.

2 Access Policy

The staff meeting of the institute decided on the 14.12.1999 on the following policy.

Access policy (in this order):

- Events in the task of the executive board (*Tag der offenen Tür / day of the open door*; Führungen / guided tours)
- Lectures and Praktika for the time where the appropriate instrument is mounted up to 2/3 of the time within the instrument slot:
 - ◆ Praktische Astronomie – Ocular and direct imaging CCD
 - ◆ Beobachtungspraktikum für Diplomanden u. Dissertanten – direct imaging CCD and Spectrograph. The “Mittelbau Meeting” have to be informed about those plans to avoid collisions with projects (see below).
- Scientific projects which have to be applied for at the “Mittelbau” (currently one session each Tuesday) and in case of ToO the head of the institute.

The “Mittelbau” also sets the project priorities.

It is on the behalf of the project to avoid collision with higher priority projects, but it not has to take care about the information of lower priority projects.
- Access by staff and persons in the direct task of an employee within the framework of projects.
- No observing of single persons except staff
- No company through third parties

3 Overview of the Instruments

For observations at the 60 cm telescope a CCD- and a plate camera is available. The CCD camera can also be used in connection with a slit spectrograph. This section only gives a quick look overview. The instruments have a dedicated manual each.

3.1 Instrument Change Policy

The staff meeting of the institute decided on the 14.12.1999 the following policy to reduce the overhead for the staff and to preserve the quality of the instruments and their usage:

- Instrument changes only by means of “instrument slots”:
 - ◆ 1st Monday of month – **Ocular Set**
 - ◆ following Thursday – **CCD direct imaging camera** - 2.5 weeks
 - ◆ 4th Monday of the month – **The Spectrograph**

Additional changes: On demand for target of opportunity (ToO) and in special cases where the lectures using the instrument are extremely short in time – **but never within the night.**
The changes may be done only by authorized personal:

Currently (25.1.2000) S. Kimeswenger, W. Saurer

3.2 The Ocular Set

The ocular set is designed for test purpose only. Thus it is not like a „stable“ configuration. Although it is usable for simple guiding on the sky. The Ocular set contains as central unit the “knee” of the Zeiss 15 cm Telescope from Hötting. Thus all oculars from there are usable. Additionally a intersection unit for a set of MEADE wide angle oculars (40 mm focal length Pössel style) and for a guider/measurement ocular ($f = 12.5$ mm) is available.

3.3 The Plate Camera

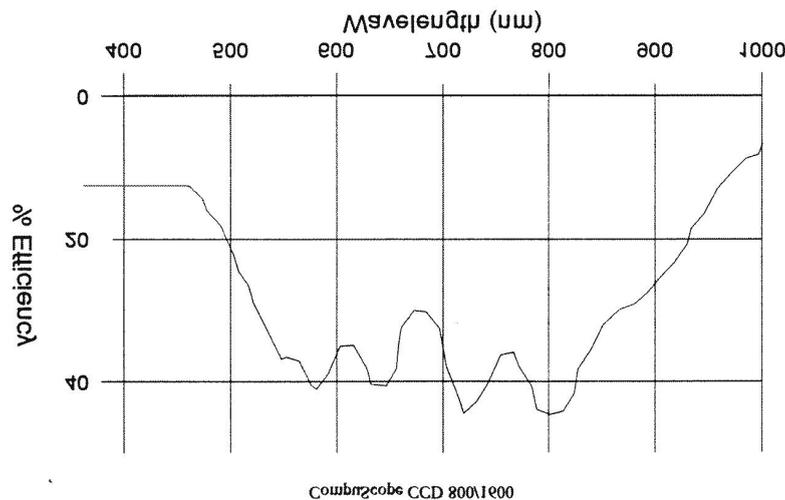
The plate camera is designed for plates of the size 9x9 cm. However, normal flat films, panned flat on a special aluminum plate, also may be used (e.g. Kodak Technical Pan, TRI-X PAN or T-maximal). One may insert color photographs 120 spool films (e.g. Kodak Gold Pro 400), the however have to be cutted and panned flat some days before their use The development undertakes the company Miller optics, Meraner Straße 3, Innsbruck.

The circular field of sight of the plate camera has nearly exactly a diameter of 1 degree.

The plate camera was used only by Thomas Köberl and by Mr. Pressberger. There is no one available at the institute to introduce to this instrument. Anyone, who intends to use it stands for his own. It will be mounted only on special demand.

3.4 The CompuScope/Kodak CCD Kamera

The CompuScope¹ CCD camera (purchased 1994) includes a Kodak KAF0400 chip (front side illuminated) with 786 x 520 pixels, where the part of the defective pixels is about 2 percent. The individual pixels are 9 x 9 μm in size, resulting in a chip active area of 7.1 x 4.6 mm. The chip reaches its maximum quantum efficiency at 725 nm with 45 % and is coated with Metachrome II to provide a QE of at least 10% even in the UV.



¹ The company CompuScope Precision Instrumentation and Software 3463 State Street, Suite 431, Santa Barbara, California 93105 seems to exist no longer, but at nearly the same address with the same products exists named ISI Systems 3463 State Street Suite Santa Barbara, Ca 805-692-2390 Tel <http://www.imagingsystems.com>

Saturation level is between 100 000 and 140 000 electrons per pixels. The chip is cooled by means of Peltier thermoelectric unit on an unchangeable temperature of -10°C , what results in a dark current of about one electron per second and pixel. The "charge transfer efficiency" (CTE) conducts in worst case 0.99997 i.e. from 100 000 electrons those are shifted into the neighbor pixel while reading out, at the most three are left (numbers given by vendor). On account of the 14 bit analog/digital converters (A/D), the signal is quantized in 16384 levels (analog digital units – ADU), what gives a gain of about 7 electrons per ADU. Read-out of the entire CCD lasts about 22 seconds. The readout noise is about 10 ADU (have to be improved) and the BIAS is about 120 (stable within 0.15 ADU/night) and a constant for the chip.

For the filter wheel, which is included in the camera Johnson UBVR filters, an $\text{H}\alpha$ (FWHM 10nm), an $\text{H}\beta$ (FWHM 3nm), an OIII (500.1 nm, FWHM 10nm), an SII (762.0nm, FWHM 10nm) and an RG9 IR filter (giving a wide I band) are available. Additionally a clear glass plate of the same thickness is available. The RG9 glass is thinner and thus have a different focus !

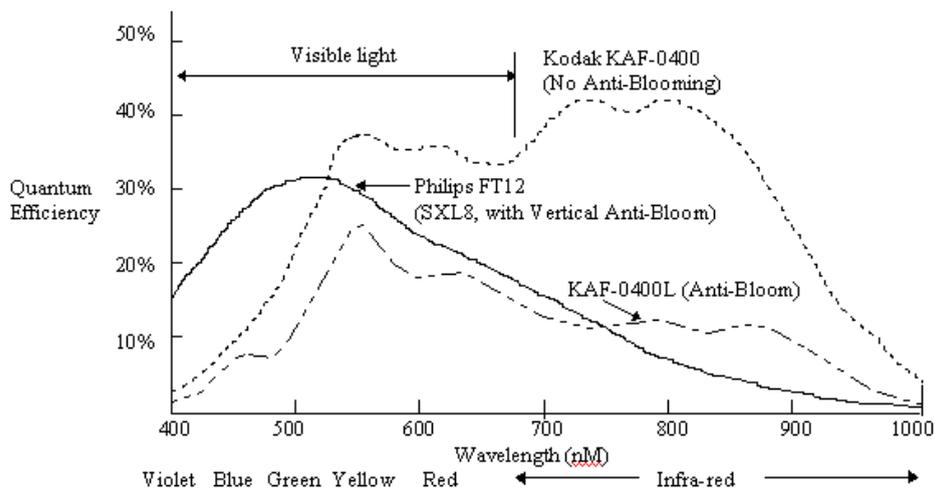
The camera normally is foreseen to be attached to the Spectrograph, but also direct imaging configuration is used currently on the 60 cm telescope. In direct imaging mode, the field of view (FOV) at the prime Cassegrain focus of the 60cm is 4.7 x 3.1 arcminutes and 0.368 arcsec/pixel – this is drastically oversampled for our typical seeing.

Warnings :

1. At short exposure times and with bright objects (where the shutter time makes a significant portion of the total time) a reflection at the edge of the moving shutter makes a “comet tail” to any bright object !
2. The mechanical shutter is not accurate better than about 0.1 second !

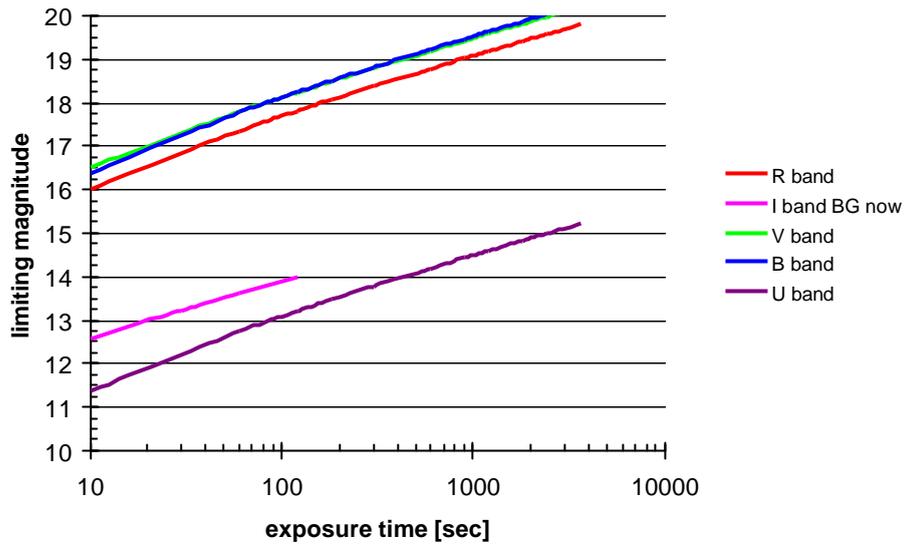
3.5 The Starlight-Xpress/Phillips SXL8 CCD Kamera

This new camera was purchased from Venturescope² in September 1999. It has a Phillips FT12 chip. This chip has 510 x 512 pixels 15x15 μ m each. This results to 0.614 arcseconds per pixel and a 5.2 x 5.2 arcminute FOV. The Peltier cooling works to up to 40° below ambient and is stabilized at a maximum of -23.0°C. The full well capacity is about 5 times larger than that of the Kodak chip. The readout noise is about 1.2 ADUs at full cooling (for detailed tests see camera manual). The AD converter has only 12 bits resulting to 4096 ADU values. The gain is about 16 electrons per ADU. The bigger pixels give a much better sampling of the point spread function (PSF) but result in a much higher dark current (about 0.5 ADU per second). Thus this camera is not well suited for the Spectrograph but well suited for the direct imaging. At the moment it is foreseen for the Coude telescope on the old observatory in Hötting.

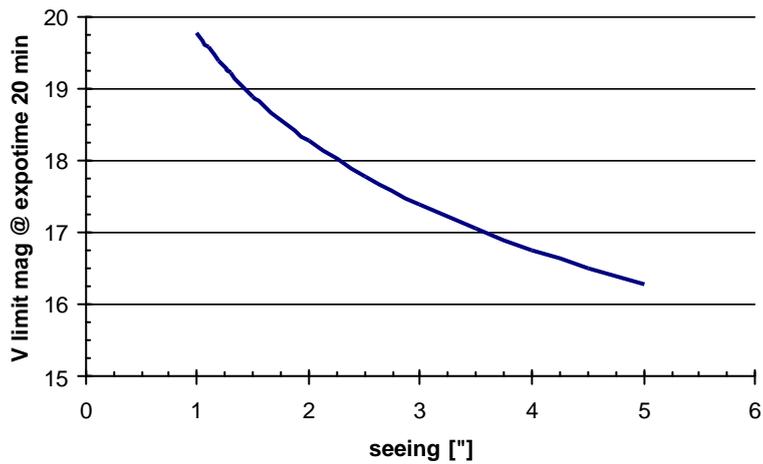


The BIAS and the DARK have real structures – thus simple using mean values for the correction is not sufficient. The camera has a electronic “shutter”. This allows much more accurate exposure times down to 0.01 seconds (better than 5% reliable) and down to 0.002 seconds (up to 25% inaccurate). This allows “speckle limited” exposures of bright objects to avoid seeing effects. The main disadvantage of this feature is, that does not allow to take real darks without special additional mechanisms (currently one filter well position has to be a blank). The filter wheel is not included in the camera head.

² Venturescope 18 The Wren Centre, Westbourne Road, Emsworth, Hants. PO10 7RN. U.K.
<http://www.venturescope.co.uk>



The sensitivity above is for a seeing of 1.5 arcseconds. Any imaging system degrades rapidly with the seeing.



3.6 The FW1 filter wheel unit

As the SXL8 camera has no own filter wheel unit, a dedicated unit has been purchased in June 1999 (from ISI Systems³). The unit is very similar to that attached internally to the Kodak CCD camera. It contains the same type of filters. There are no additional filters available, but just the filters may be exchanged from one to the other system.

³ ISI Systems 3463 State Street Suite Santa Barbara, Ca 805-692-2390 Tel <http://www.imagingsystems.com>

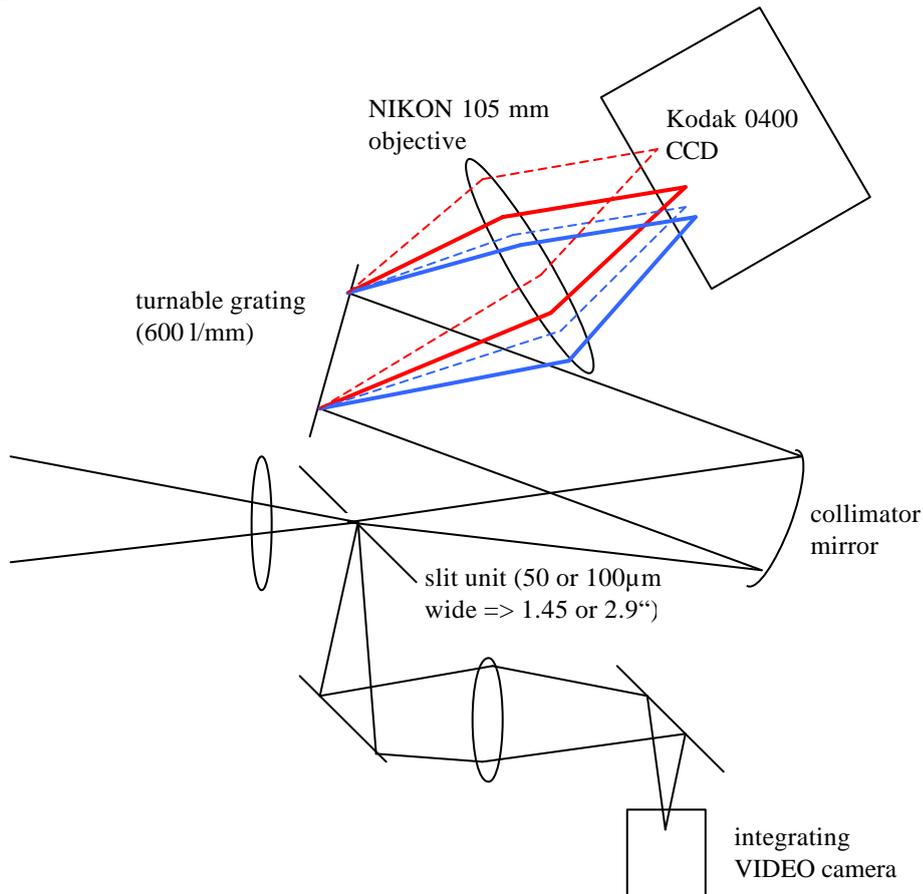
3.7 The Spindler & Hoyer integrating Video

This unit, originally purchased from S&H⁴ in 1998, was foreseen for the slit preview of the spectrograph only. It is a Video camera head with the capability to integrate up to a few minutes. As the system is not cooled specially, really meaningful values will not be above a few seconds. The system is able to drive 2 video screens simultaneously, were currently one is mounted in the dome room and one is in the control room downstairs. A 5.5 magnitude star saturates (using the slit preview) already at 80 to 100 milliseconds exposure time. Thus with 5 seconds exposure time stars down to 14.5^m should be well visible. Although 5 seconds are a problem for guiding (too slow for major changes). An 10-11 mag point like object is well visible after 1.5 to 2 seconds. As this is also the limit for the spectrograph, this will give the limit normally. A mount to be able to attach this camera to ocular and giuder positions to be used as guiding camera for direct imaging is in preparation.

⁴ Spindler & Hoyer, Königsallee 23, D-37081 Göttingen, <http://www.spindlerhoyer.de>

3.8 The Spectrograph 10C

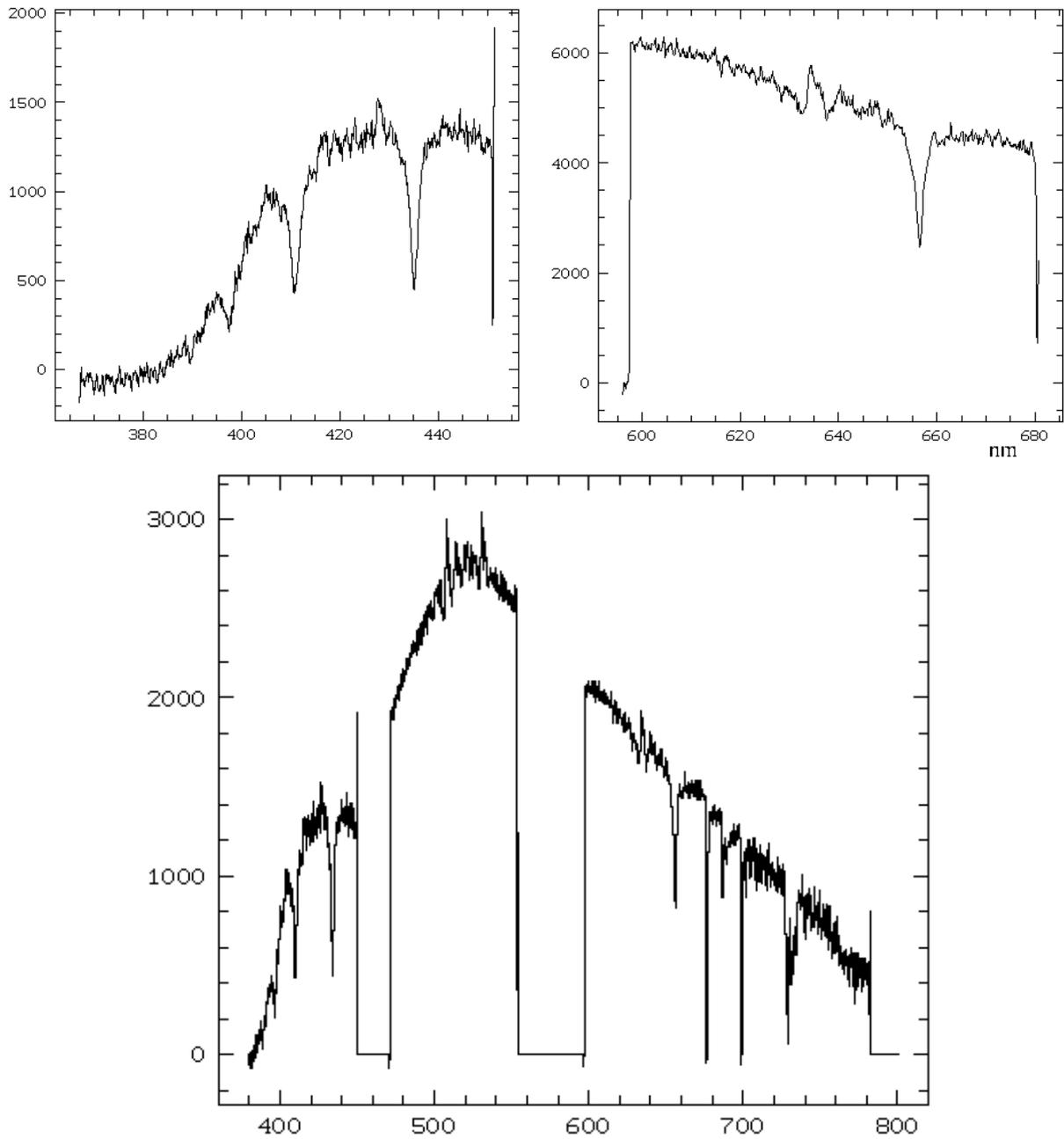
The spectrograph is a classical slit spectrograph similar (but much smaller) to the well known Boller & Chivens systems (e.g. Asiago, ESO 1.5m, ...). It was purchased from Optomechanics Research Inc.⁵ and needs to be tested in further details. With the Kodak camera we have a dispersion of about 0.11 nm/pixel. The real resolution seem to be 0.2 to 0.3nm (have to be investigated).



Sketch of the spectrograph unit

⁵ Optomechanics Research Inc., P.O. Box 87, Vail AZ. 85641 NOW in P.O. Box 87 Tucson Arizona 85641 (520) 647-3332 tel., <http://www.primenet.com/~ronomr/index.htm>

Spectrum of a 5.3^m A0V star



Quick look results for the expected sensitivity ($S/N \sim 10$) are:

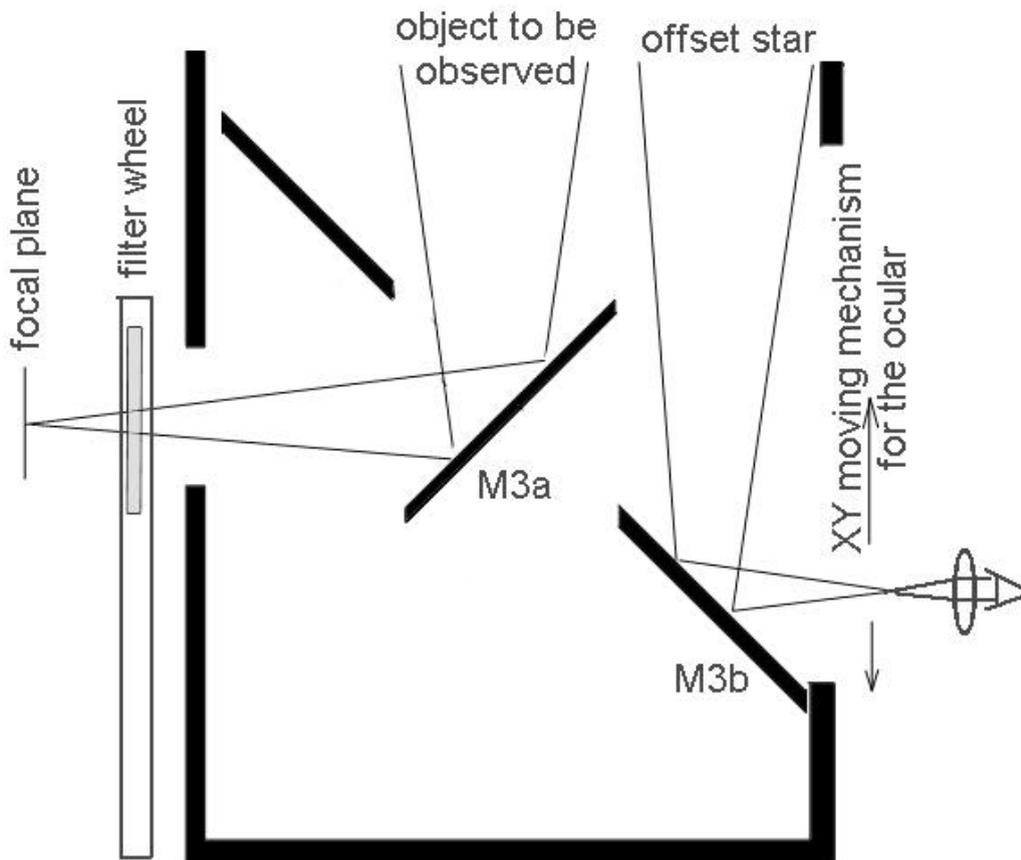
- 11^m after 30 minutes exposure @ dispersion of $\sim 1\text{\AA}/\text{pixel}$
- change to a $2.5\text{\AA}/\text{pixel}$ grating \rightarrow gain 1^m
- emission line dominated object $\sim 18\text{-}19\text{m}$

3.9 The MEADE Pictor 201 CCD-Autoguider

The camera was purchased 1996 from Astrocom⁶. This unit is foreseen to work as full autoguider as soon as all mechanical details/problems of the telescope are known. First tests are undergoing, but it will be not fully operational before end of 2000.

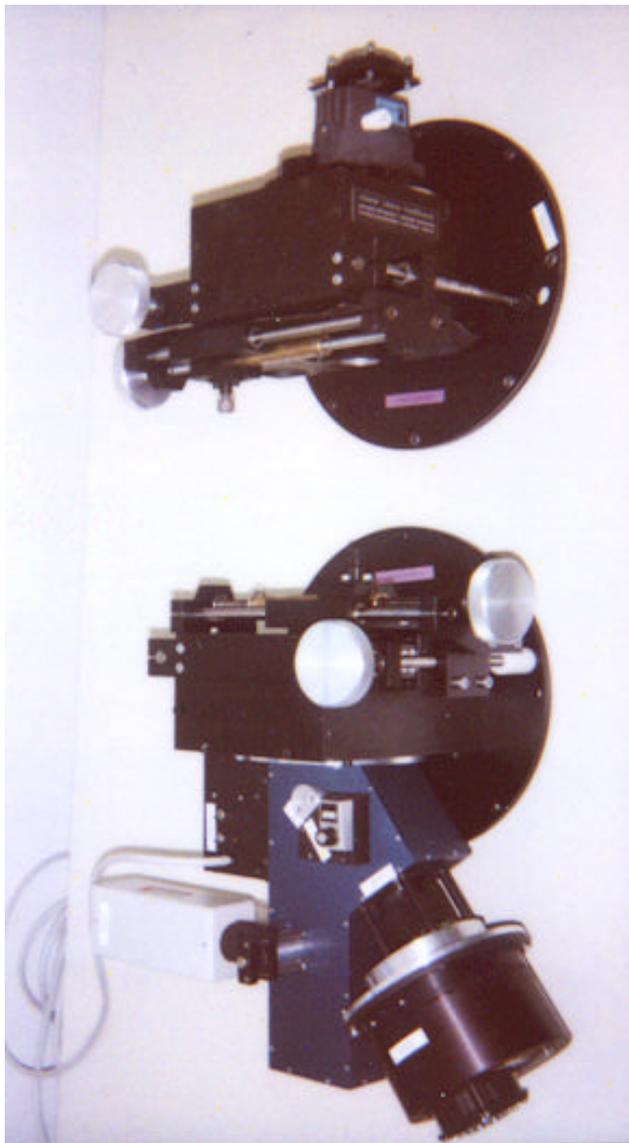
3.10 The Offset units

To be able to attach the direct imaging CCDs and the Spectrograph to the telescope, 2 offset units were designed by the HTL school and built for us by the trainee workshop of the company Oberhofer here in Innsbruck. They contain a third mirror in the optical path of the total system. This is “spliced” into the mirror M3a folding the central part of the FOV to the main instrument and to the mirror M3b allowing to observe simultaneously the surrounding area. The main disadvantage of this design is the fact, that the central position (= object) is never viewable by the oculars on the one side.



⁶ Astrocom GmbH, Altost. 110, D-81249 München

- Advantages:
 - no loss of flux due to the offset
 - compact – thus large instruments possible
 - Guiding object selectable in a rather large field
 - $0.7 \times 0.7^\circ \rightarrow 0.42$ square degrees after subtracting the central obscuration of 15 % →
 - ~ 2 *: $m < 8^m$ / field
 - ~ 60 *: $m < 10.5^m$ / field
- Disadvantages:
 - mirror M3a limits the field
 - central position (= object) never viewable
 - focal plane only about 3 cm outside the offset



The SXL8 CCD camera in direct imaging mode (upper) and the spectrograph with the Compuscope Kodak CCD (lower) attached to the offset units. The XY moving mechanism is clearly visible at the opposite side to the instruments each.

Remark: Normally the SXL8 will be in Hötting and the CompuScope/Kodak is mounted instead.

4 Initiation of the Telescope

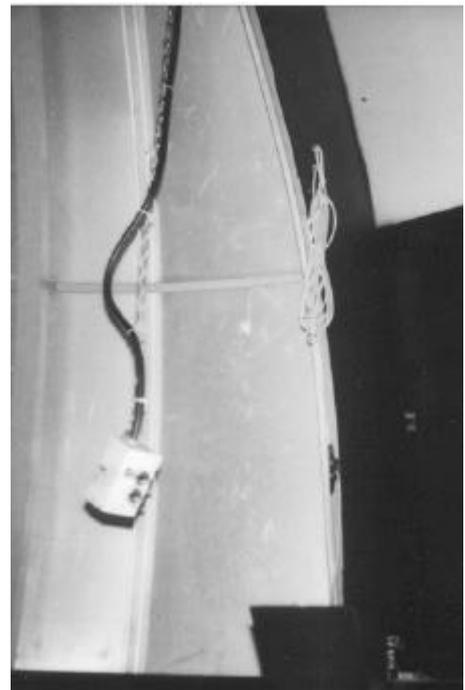
4.1 The Dome

The dome slit should be opened about two hours before observation beginning so that an equalization of temperature can occur between inside and outside air. If the wind rate is greater than 15 m s^{-1} OR the relative humidity is higher than 90 percent outside of the dome, the slit must not be opened. In the case of snow situation, it is absolutely required to free completely the dome before opening. Also an area of about **1 meter** (needed for the lower part of the dome slit when opened) around the dome at the flat roof have to be free of snow (down to about 5 cm thickness).

The slit may be opened and/or closed on principle only then if the optics of the telescope is covered. As a result, one prevents, that the mirrors are contaminated by dust, oil or water from the dome mechanics.

The dome is opened and closed using the unit shown in the (right) figure and hanging from the roof directly beside the slit. The upper knob is used to move the main slit. You may keep the motors on until it is opened/closed completely. End switched turn off the power automatically. It is not possible to close it without closing the lower part (called "Tauklappe") before !

The lower knob switches the winder for the lower part of the slit. Again end switches are operational. Be aware, that this lower part enlarges the turning size of the dome significantly (nothing should be within 1.2 meter around the dome on the roof) !



The dome movement is controlled from the big light gray box beside the computer. This box has 3 switches. The middle one (key) is the main power for the dome movement. The right hand switch selects between manual (HAND) and automatic computer controlled (AUTO). As the computer control is still experimental, the manual mode have to be used now. Only in case of the manual mode, the left switch allow to move the dome left (LINKS) and right

(RECHTS). At some positions the dome is known to hang sometimes. In this case one have either to go back and retry or turn around in the opposite way.

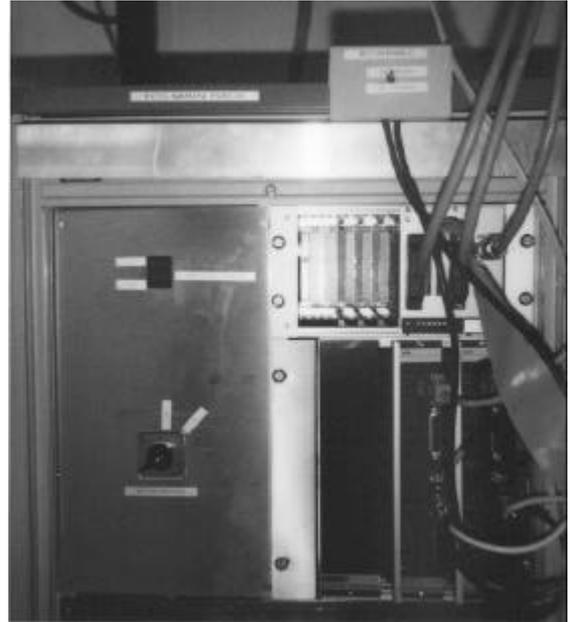


4.2 The Control Rack and Base Control Computer – Starting the System

The control units for the telescope hardware is located in the room 9/07 below the telescope (called further 9/07u). The motor control unit (see figure below) has two sections. The lower section (black unit) contains the drivers for the motors themselves (MOTOR DRIVERS). They have to be switched on first of all. The switch is located at the same level left of the black rack. Each motor driver has a small number digit field in the upper part. During normal operations only the dot should be lit. Any number indicates a (severe) hardware problem. If this unit is on, additionally to the small dot, a buzzing sound should indicate the operations. If this is not the case, the main power supply may be down. It is located at the pillar in the center of the room (a set of a red and a green button and a 3 phase fuse). Before power on, the motors should be disabled from operations. This is done by the switch at the top of the rack (MOTORS ENABLE/DISABLE)



The room 9/07u



The zoom of the control rack.

Above this unit a silver shining unit is dedicated to read the motor encoder positional information and the mechanical handset for manual operations of the telescope (ENCODER DRIVERS). Again here the power switch is located left from the unit. Once operational, each line (right ascension and declination axis of the telescope) should indicate by 24 LED lamps the binary positional information.

Next to power on of those units, the computer (PC) right to the rack should be powered on. Since February 2000 this should normally not be necessary as the computer (*ast-t3.uibk.ac.at*) should be operational all the time.

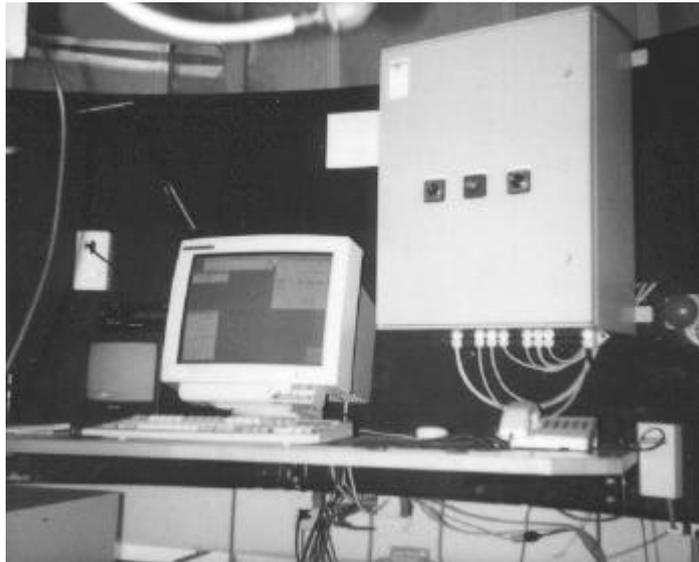
Now the whole system have to be thermalised for a minimum of 30 minutes. As best the thermalising should be done with the dome open (to get the real ambient temperature).

After this step the motor drivers have to be calibrated to the ambient temperature. This is done by enabling the motors (MOTORS ENABLE at top of the rack) and then turning at the two potentiometers at the lower end of the black motor drivers until the 24 bit position display does not indicate any movement of the axis. This step may be done only with the computer ast-t3 being on and booted, but the software not working. During nights with strong changes

in ambient temperature it may be necessary to redo this step by first stopping the software on ast-t3 and then recalibrating.

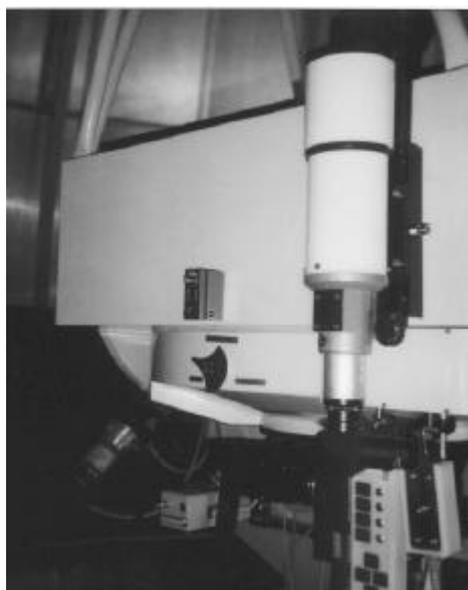
Now one may logon at the computer ast-t3 (keyboard and screen in room 9/07u) as user **run** with the password **run**.

Then you may walk up to the telescope (room 9/07o) and logon on the computer (ast-t2) there on your own account. This will start the software for the telescope use automatically.



The working area in the dome room (ast-t2)

BEFORE moving the telescope you have to fix the main mirror with the red turnable knob at the center of the mirror cell (visible in the middle of the image below).



Summary: Starting the telescope system

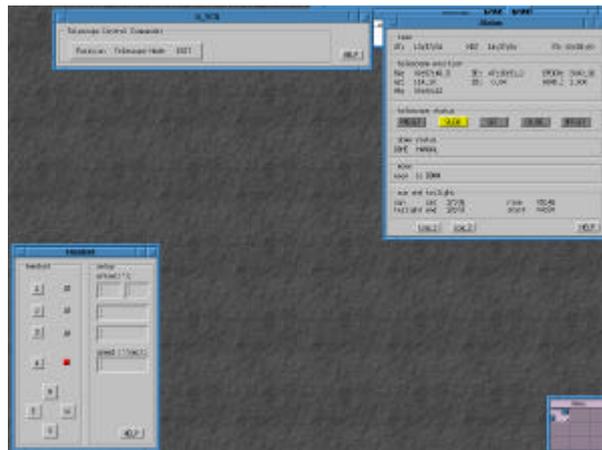
1. Open the **dome**
2. Go to room 9/07u (below the telescope)
3. Motors disabled (switch at top of the rack to **MOTORS DISABLE**)
4. Power on for the **MOTOR DRIVERS**
5. Power on for the **ENCODER DRIVERS**
6. If necessary power on and boot the computer **ast-t3**
7. Push **Strg-Alt-F1** on the console of ast-t3
8. **Wait** for thermalising for a minimum of **30 minutes** (best with dome open)
9. Enable the motors (**MOTORS ENABLE**)
10. Calibrate the drift of the motor system (**CALIBRATE**)
11. Logon to ast-t3 as user run – password run
12. Go to room 9/07o
13. Lock the main mirror by using the red turnable button at the main mirror cell (northern side)
14. Login on ast-t2 using your account – the remaining software should be started automatically on the screen.
15. Test the link between the computers by pushing different speed buttons on the handset. The change of the LED lamps should be indicated immediately on the screen display too.
16. Move the telescope to “*Maintenance position south*” and remove the mirror covers.

Summary: Stopping the telescope system

1. Move the telescope to “*Maintenance position south*” and cover the mirrors. This always have to be done **before closing the dome** to avoid garbage from the dome mechanics to enter the mirror cell.
2. Close the **dome**
3. Move the telescope to *zenith*
4. Unlock (loosen) the main mirror in the mirror cell (red turnable button at the northern side of the mirror cell).
5. Exit the control software by using the exit button of the pulldown menus (Never use the logout option of the window manager !)
6. Go down to room 9/07u
7. **DISABLE** the motors
8. Stop the software at ast-t3 by pushing Strg-Alt-FN simultaneously (FN is one of the function keys F1 to F6) until a login prompt appears to the screen (Normally Strg-Alt-F2 should work). Then logon as user **stop** with the password **s**.
9. Switch of the **ENCODER DRIVERS** and the **MOTOR DRIVERS**.

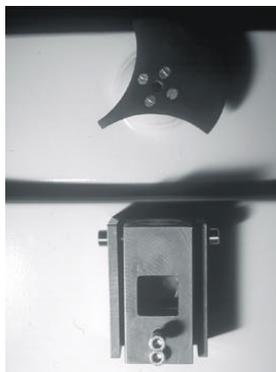
4.3 The Telescope Control Software

The software is started automatically during login at the console of ast-t2. It contains 3 primary windows – the upper left window contains a pulldown menu where the telescope commands are given – the upper right window displays the telescope status – the lower left window controls the settings for the handset paddle.



Warnings:

1. Please do not move the telescope from zenith before fixing the mirror !



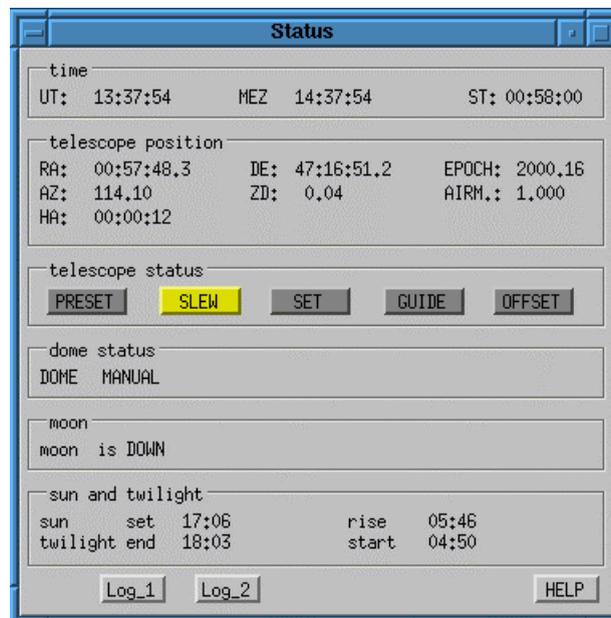
Do not forget to release it at the end of the observations !

2. Never logout from ast-t2 using the window manager menu (as it is used at normal UNIX workstations). Always use the EXIT command at the upper left window of the telescope control software !

If it happens by chance, try to restart the window manager by the command “fvwm2 - display :0” in any xterm window or remotely from an other computer if you have no access to terminal windows anymore

3. Please exit all control software for CCD cameras etc. before the logout/EXIT mentioned above. As this software works physically on an other CPU it may hang in an undefined state.

The upper right window gives the status of the telescope. It displays the timing information on top (always us the sidereal time from there if there are discrepancies between the clock beside the computer and this display). The second box displays the coordinates. Check after logon, if they are (near) zenith – otherwise the network link to ast-t3 may be broken. In this case you have to logout, stop the software on ast-t3 and start from the beginning.



The next box gives you the current working status. At the moment you will have only:

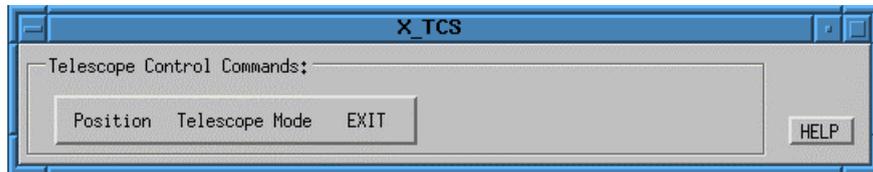
- ◆ SLEW: The telescope is at a given position and the tracking to compensate earth movement is switched off.
- ◆ GUIDE: The telescope follows the sky (normal operation during observation)
- ◆ PRESET: The telescope moves to a new destination – you have given some command and it is still working on it.

The following box gives the dome status – at the moment only manual mode is supported.

Finally two boxes are giving the moon status (position and current distance to the telescope) and the sun status (rise and set and twilight in UT !).

The two buttons (Log_1 and Log_2) at the lower end are dedicated for creating a pointing model only.

The upper left window has 3 main pulldowns. The left one is dedicated to the movement and control of coordinates in normal operations. The middle one is for special technical purposes. It is not needed at normal operations. The right one contains the EXIT button only.



The menu structure now is:

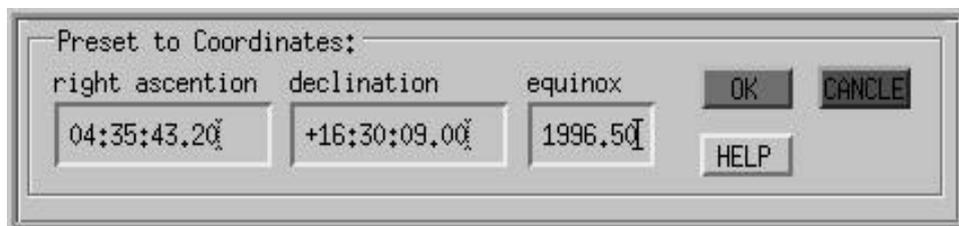
Move to position >	manually given coordinates	
	Zenith	
	maintenance position south	
	dome flatfield position	
	Catalogue >	Standard stars
		User catalogue
Correct Coordinates >	back to last pointing	
	Coordinates given manually	
	Coordinates from Standard Star Catalogue	
	Coordinates from User Catalogue	
Tracking >	ON	
	OFF	

◆ Move to position

is dedicated to move the telescope.

There are 3 fixed positions – namely the zenith, a position to the south to be able to remove the mirror covers and a position above the halogen lamp to the south-west for flatfielding. After moving to one of those positions, the telescope goes always to SLEW mode.

To observe object the user may insert coordinates manually. A box appears, where he may insert the values.



The coordinates have to be given completely (including leading zeros and leading sign even if it is positive) until minutes. A Space may be used instead of the “:” too. Pushing RETURN fills the remaining field with zeros. In case of RETURN on an empty equinox causes to set 2000.00 .

Pointing by using a catalogue displays the standard catalogue (containing the brighter HR stars – the file is ~tcs/KATALOGE/Standard.cat) or the user catalogue (file

~/KATALOGE/User.cat – copy ~/tcs/KATALOGE/User.cat as sample. You may edit it with any text editor. The columns for the coordinates have to be on that very fixed positions) in a separate window. You may select a star there by double-click. Finally you may move (back) to that position, where the last pointing by catalogue or manual coordinates was.

◆ Correct Coordinates

is foreseen to correct for displacements due to mechanical errors in the system. You select a bright star near your target object and then center it to your instrument (camera or spectrograph slit). Then you call these commands here. This will cause the current position to be set to the given value (sources as above). This will shift the whole coordinate system for the next pointing. Corrections like this are lost after logout/restart of the software (for fixing it see below).

◆ Tracking

ON/OFF switches the tracking to follow the sky on/off just at the current telescope position.

Reset control software	
Set Telescope Mode >	StopControl
	StartControl
Set current to be ZENITH	

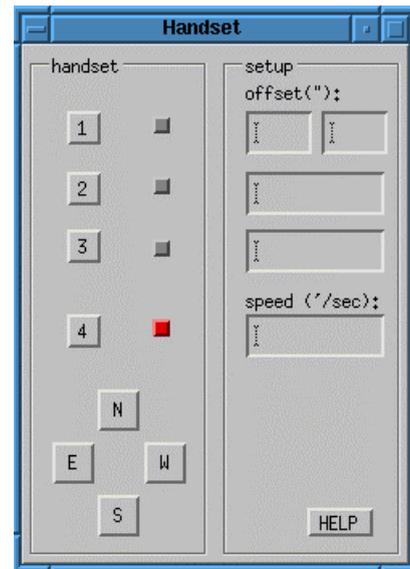
◆ The first entries are not for normal users – ignore them

◆ Set current to be ZENITH

stores the current position as zenith to the harddisk. This should be done only if you are absolutely sure what you are doing. It should be done normally only after a *Correct Coordinates* on a star near zenith and then calling to *move to zenith*. If You are not sure please keep your fingers off.

Finally the exit menu contains the EXIT button itself and a CANCEL position.

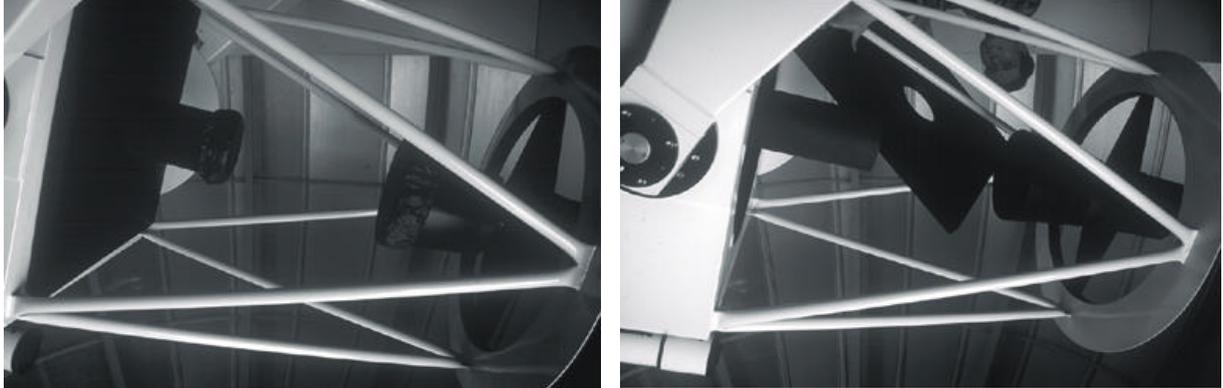
The Window in the lower left corner is dedicated to control the handset paddle of the telescope. The red “lamps” should indicate the same status as on the physical handset. The input windows beside them are for setting the values connected to the 4 different modi. The upper three modi are giving an offset. Thus the value is given in units of arcsec. Pushing a button (independent of the time you stay in the button) will cause the telescope to do one of these steps. The upper most setup allows different values for α and δ . The 4th mode is a speed mode, where the duration pushing the button gives the distance. The speed given here is the maximum for this operations.



As the telescope has to start slowly (ramp up) it reaches it after a certain time (up to 10 seconds if you select a very high speed). The maximum value is 270"/sec (4.5 degrees/sec or 20 seconds from pole to equator). A typical value for guiding will be 0.3 to 0.5 . Be aware, that at high speed the telescope will not stop immediately after releasing the button, but needs up to 5 seconds to ramp down the speed. In the offset modi (1-3) it is possible to move the telescope by pushing the direction buttons (N-E-S-W) on the screen with the mouse too.

The Telescope control may be using a secondary display downstairs on ast-t1. This is started by logon there under the SAME USER as on ast-2 and AFTER starting the software on ast-2. And calling the command `Control2` there. This then displays there the same operation windows. This may be used especially for guiding at the spectrograph video from downstairs. But be aware, that the dome is not moving automatically yet. You may get vigneting during tracking operations !

The observation starts by moving the telescope to the “maintenance position south”. There you may remove the 3 covers of the mirrors. **To avoid garbage falling to the optics never open the telescope covers before opening the dome.**



After those actions you may start observing. It will start with a coordinate check near zenith on a bright star (and the Correct Coordinates for it). Then you move near to the object to a bright star and correct the coordinates there again. If it is far from zenith it might be necessary to go via a star with a position in-between.

At the end of your run you move to the southern position to cover the telescope, then back to zenith – loosen the mirror – logout. Now you may close the dome and you do the reverse operations downstairs.

4.4 The Logbook and the Meteo information

Any observation or technical test/change (also those during daytime) have to be inserted to the logbook. The logbook is placed on the desk near the computer ast-t3. Observers always should note information on the weather conditions to the logbook. The ambient conditions are measured by a meteo station, having sensors in the dome and outside the dome. They measure temperature, humidity, atmospheric pressure (including the tendency indicated by an arrow), and wind speed (outside only). The display is placed in the dome at the north-west wall.



The meteo station display

Pushing the buttons for temperature or humidity multiple times changes the display from INSIDE to OUTSIDE and vice versa. The wind speed and direction is always indicated on the left side of the display. Normally the units should be in SI system, but after a power failure US units are indicated. This may be changed easily by pushing the button UNITS. The button DEW changes the display to that of a (calculated) DEW point. This is the temperature where at the current humidity fog will build. This should be (as minimum) 2-3 degrees from the real temperature.

Meteorological Limits:

Limits where the dome have to be closed during observations:

Wind 14 m/s

Humidity 95 % (outside)

Limits where it is allowed to (re)open the dome:

Wind < 11 m/s

Humidity < 90 % (outside)

The values for Temperature, Humidity and Wind should be indicated at least at the beginning and at the end of each observation. If the values are near the limits the observer has to monitor the values throughout the whole night !