Wise Observatory
C18 Telescope
Manual

Shai Kaspi and Saar Niv

School of Physics and Astronomy and the Wise Observatory
The Raymond and Beverly Sackler Faculty of Exact Sciences
Tel-Aviv University, Tel-Aviv 69978, Israel

Updated: April 4, 2023

ABSTRACT

The Wise Observatory of Tel-Aviv University has been operating since 1971. Currently it operates a 40 inch telescope, a Centurion 18 inch telescope (C18), and a Centurion 28 inch telescope (C28). This document describes the operation of the C18 which was purchased in 2003 and commissioned during 2004.

The operating systems include programs to set the telescope to objects, automated guider, automated observations, operation of the CCD and instruments, remote observing, and various other tasks. Since 2015 the telescope is a robotic telescope which accepts targets list during the day and carry out the observations robotically during the night.

The purpose of this manual is to describe the use of the C18. The aim is to help the observer to operate the instruments properly and to avoid mistakes so that the observing time will be fully and properly used.

The C18 is described in a paper by Brosch et al. 2008, Ap&SS, 314, 163 available through the Wise Observatory manual web page mentioned below.

Since the Wise Observatory is in constant development this manual will hopefully be updated according to the developments. This document is available via the WWW at http://wise-obs.tau.ac.il/observations/Man/

General information about the Wise Observatory is available at http://wise-obs.tau.ac.il/

Information about the Department of Astronomy and Astrophysics of Tel-Aviv University is available at http://www.astro.tau.ac.il/

DISCLAIMER

This document is provided "as is" without warranty of any kind. Neither The Wise Observatory nor the authors of this manual nor any other parties providing it warrant, guarantee, or make any representations regarding the use of, or the results of the use of, this manual, in terms of correctness, accuracy, reliability, currentness, or otherwise.

In no event will The Wise Observatory or anyone else who has been involved in the creation, production, or delivery of this manual be liable for any direct, indirect, consequential, or incidental damage arising out of the use, the results of use, or inability to use this manual (including but not limited to loss of data or data being rendered inaccurate or losses sustained by third parties), even if The Wise Observatory, or any individuals involved in the creation, production, or delivery of this manual, have been advised of the possibility of such damages or claim.

Contents

Chapter 1

Introduction

The Wise Observatory, named in honor of Florence and George Wise, the first president of Tel-Aviv University and his lady, was dedicated in October 1971. The observatory is owned and operated by Tel-Aviv University (TAU), Israel, and is dedicated to research in observational optical astronomy. It is located on a high plateau in the central part of the Negev desert (longitude $34°45'48''$ E, latitude $30°35'45''$ N, altitude 875 m, time zone –2 hours relative to Universal Time). New Israel coordinates are 177040, 500876). The observatory code given by the International Astronomical Union is 097. The site is about 5 km west of the town of Mitzpe Ramon. 200 km south of Tel-Aviv and 86 km south of Beersheva. The town of Mitzpe Ramon has a population of about 6000 and offers facilities in housing, schools and basic medical services. The town management had cooperated with the observatory in controlling and shielding street lights and outside illumination to minimize the additional light background, but in the last few years together with a large development of the town, the light pollution from the town has increased considerably.

The characteristics of the site, prior to the establishing of an astronomical observatory on it, were described by Vidal and Feldman (1974). The number of clear nights (zero cloudiness) is about 170 a year. The number of useful nights is about 240. The best season, when practically no clouds are observed, is June to August, while the highest chance for clouds are in the period January to April. Winds are usually moderate mainly from NE and N. Storm wind velocities (greater than 40 km/h) occur, but rarely. The wind speed tends to decrease during the night. Temperature gradients are small and fairly moderate. After 23:00 LT, the gradient is usually 0.2°C/h the year round. The average relative humidity is quite high, with a tendency to decline during the night from April to August. The average seeing is about 2–3 seconds of arc. A few good nights have seeing of $1''$ or less while some show seeing larger than $5''$. Typical extinction coefficients, in mag/airmass, are: $k_V = 0.24$, $k_{U-B} = 0.22$, $k_{B-V} = 0.14$, $k_{V-R} = 0.05$, and $k_{R-I} = 0.07$. These are median values for the 1990s decade. A review of the observing conditions at the Wise Observatory is given in Brosch 1992 Q.J.R.astr.Soc., 33, 27–32.

The 0.46-m Centurion 18 (C18) was installed in 2005. The telescope operates from a small dome and is equipped with a large format CCD camera - currently a OSI 683. Observations are performed remotely, either from the Observatory main building, from Tel-Aviv University, from home, or from abroad.

Research activities include: imaging and photometry of asteroids, binary stars, extra solar planets candidates, quasars and active galactic nuclei.

The Wise Observatory E-mail address is: admin@wise.tau.ac.il. The FAX number is: +972-3-6408179 and the phone numbers of the Tel-Aviv headquarters, on the campus of TAU, are +972-3-6408729 or +972-3-6409279. The phone number of the Mitzpe Ramon site is +972-7-6588133 and FAX at +972-7-6588303. There is an Internet connection to the observatory site which allows access to almost all computers at the observatory.

The purpose of this manual is to describe the C18 and its operation. The aim is to help the observer operate the instrument properly and avoid mistakes, so that the observing time will be fully and properly used.

1.1 Observing Time Policy and Procedure

Policy

The equipment and facilities of the Wise Observatory are constructed and maintained for the use of the general scientific community. Available observing time on the Wise Observatory telescope will be shared between staff members, students and visitors, and will be allotted on the basis of scientific merit and suitability of instruments. The final responsibility for all time allocation shall be the director's.

Procedure

1. Requests for observing time are submitted to the observatory office using the standard Observing Time Request Form. Tex and postscript files of the Time Request Form are available over the Internet at http://wise-obs.tau.ac.il/observations/forms/.

2. Requests for observing time should be made for the six month periods October 1 - March 31 or April 1 - September 30, and should be submitted prior to the preceding August 1 and February 1 respectively. Late requests will be granted only in exceptional cases at the discretion of the director.

3. Graduate students must submit an endorsement from their faculty advisor along with the form. The endorsement must contain statements concerning the student's academic standing, the acceptability of the proposed research to the department, and the capability of the student to perform the proposed work.

4. Requests will be reviewed by a scheduling committee appointed by the director.

5. Any applicant who feels that the decision on the telescope allocation has been unfair may appeal directly to the observatory director for reconsideration.

6. Once telescope allocations have been made, revisions in schedules must be negotiated through the director.

1.2 Guidelines for Visiting Astronomers

The Observatory staff have put together a few guidelines with a view to making your stay a more efficient and pleasant one. If there are any questions or we can help in any way, please do not hesitate to contact us.

Our headquarters are situated on the university campus in Ramat-Aviv, a suburb of Tel-Aviv north of the city center. The Observatory site itself is about 200 km south of Tel-Aviv.

Prior to departing for the site, the astronomer is encouraged to visit the TAU office for briefing and discussions with the Observatory staff. It is therefore advisable to plan to be in Tel-Aviv at least one day earlier than the commencement date of the observing run.

Likewise, if the observer should need some assistance in transferring data or reduction, a day or two in Tel-Aviv will be required at the end of the run.

N.B. The visitor must take into consideration that Tel-Aviv University, as most public institutions in Israel, is closed on Friday, Saturday and religious or national holidays. Sunday is a working day in Israel.

1.2.1 Transportation

a. To and from Ben-Gurion International Airport:
Ben-Gurion International Airport is about 20 km from Tel-Aviv. There are taxicab, buses, and a train line between the airport and Tel-Aviv.

b. To and from Mitzpe Ramon:
The Wise Observatory is situated 5 km west of the township of Mitzpe Ramon. Buses run regularly every 15-20 minutes from the Central Bus Station of Tel-Aviv, or every 30 minutes from Tel-Aviv North (Arlozorov) Railway Station, to Beersheva (roughly 3/5 of the way to Mitzpe Ramon), and then somewhat less frequently (about every hour, depending on the time of day) from Beersheva to Mitzpe Ramon. There is also train line with a frequency of every half hour between Tel-Aviv and Beersheva. The trip takes all in all three and a half to four hours.

N.B. Buses and trains do not run on the Sabbath, from Friday afternoon to Saturday evening and the same applies from the afternoon before until the evening after official holidays.

Cars can be hired at the airport or in Tel-Aviv. At peak season it might be advisable to reserve in advance.

The observer should coordinate his arrival in Mitzpe Ramon with the Observatory staff in regard to time and meeting place.

c. At the site:

At Mitzpe Ramon there is a utility car, driven by the technical assistant, for traveling to and from the site. The utility car may not be used outside Mitzpe Ramon and the site, except in cases of emergency.

In order to drive the car there is a need for a special permit from the University authorities. Please consult with the Observatory technical manager regarding issuing this permit (it is a lengthly procedure which is not easy to complete).

1.2.2 Accommodation

a. In Tel-Aviv:

It is advisable to reserve accommodation in Tel-Aviv a few weeks in advance through a reliable travel agency. We shall be glad to assist in making reservations for accommodation in Tel-Aviv (at the visiting astronomer's expense) if the following details are provided a few weeks in advance: arrival date and time, airline and flight number, room requirements (single or double accommodation) and duration of stay.

Likewise accommodation can be arranged for the end of the run, if we are advised of the visitor's requirements.

b. In Mitzpe Ramon:

In the town of Mizpe Ramon there are several places to stay (hotel, youth hostel, etc.). Please consult the local site manager regarding the options. Observers may stay at one of the two furnished rooms in the observatory for the duration of the observing run; these rooms offer very basic accommodation. In such a case the observer's sleep will probably be interfered by the noise during the daily maintenance work.

Meals are obtainable at one of the few restaurants in the town of Mizpe Ramon, but can also be self-prepared in the observatory where basic cooking facilities and utensils are available. It must be noted that no restaurants or shops are open in Mitzpe Ramon from Friday afternoon to Sunday morning. The same applies to official holidays.

Observers who wish to be accompanied by members of their families, students or other guests, should first obtain the consent of the director.

There are sets of keys for the observatory. Please consult the site manager in order to obtain the keys. THE KEYS MUST BE RETURNED AT THE END OF YOUR RUN.

1.2.3   The Observatory: Operating Procedures & Briefings

As in every scientific laboratory, the basic rules are "if you are not sure, then don't" and "if something unexpected occurs, stop everything and call for help". For safety reasons no one is allowed to work at night alone.

1. Whenever a night assistant is assigned to an observer, the responsibility of the Observatory and the operation of the telescope rests with the night assistant.

2. Astronomers who receive permission from the director to work at the site without a night assistant must be thoroughly instructed by the site manager before the beginning of the observing run. It is the responsibility of the observer to see to it that he is properly instructed. Astronomers must strictly follow the local staff instructions and adhere to any written instructions that are supplied.

3. First-time visitors, or astronomers who have not been at the Observatory for more than 6 months, should plan to be at the site at least 6 hours before the actual run starts, in order to familiarize themselves with the Observatory, the safety procedures and the instruments.

4. Instruments will be changed only during the daytime shift, excluding Saturdays and official holidays.

5. Astronomers who plan to take away their data, should bring their own media. We currently use writable CD-ROMs and DVDs recorded on a PC platform.

6. The telephone +972-7-6588133 is a wireless one with an extension in the dome. It is to be used for work only, as every call outside Mitzpe Ramon is billed as a long distance call. No international calls are permitted, unless authorized by the director.

1.2.4   Publications and Acknowledgment

It is expected that visiting astronomers will utilize the observations they obtain at the Wise Observatory for the preparation of publications describing their research activity.

Publications by non-staff astronomers of such research should carry the following credit lines: an asterisk by the author(s) name to refer to a footnote stating, "Visiting astronomer, the Florence & George Wise Observatory, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel-Aviv University, Israel". The paper should carry the following acknowledgment: "This paper is [partly] based on observations collected at the Wise Observatory with the C18 telescope. The C18 telescope and most of its equipment were acquired with a grant from the Israel Space Agency (ISA) to operate a Near-Earth Asteroid Knowledge Center at Tel Aviv University."

Also, a reference to the C18 paper (Brosch et al. 2008, Ap&SS, 314, 163) should be placed in the paper.

Notification of any papers published for which the Wise Observatory is given a credit line would help keep the Observatory publication records accurate and current.

1.3   Image backup and the permanent archive

All observations of the C18 until the end of 2013 were backed up on DVD. A user copy is available in room 503 at the Wise Observatory University Tel-Aviv office. If, for any reason, a required disk cannot be found at Tel-Aviv, a complete disk backup set is also kept at the observatory. Upon request, files can be transferred to a machine at the University using the network link.

Since the beginning of 2014 the permanent archive is done onto two external USB disks. One is at the observatory and one is at Tel-Aviv university.

The procedure of backuping the files, is done on the wo-neo computer with the Total Commander window using the pre-defined tabs for the working directories.

On the right side of the Total Commander window there is a tab called "images" which is connected to the C:\Users\mizpe\Documents\ACP Astronomy\images\ directory on the wo-neo computer and lists subdirectories with the name yyyymmddc18 which each has the images from that specific night.

On the left side of the Total Commander window there is a tab called "mizpe-bck-backup" which connects to the directory /home/mizpe-bck/C18backup/ on the wise-bck computer at TAU (that also has a link to it from the wise-gate computer).

At the end of the night you need to copy the yyyymmddc18 directory from the images directory to the "mizpe-bck-backup" directory and it will have the same name of yyyymmddc18. Simply go to the "mizpe-bck-backup" tab on the left side of the Total Commander window and to the "images" tab on the right side and copy the yyyymmddc18 directory.

A second backup is done to the mizpe-cdr computer that is at the observatory to the directory e:\C18backup\ . Simply go to the "mizpe-cdr-backup" tab on the left side of the Total Commander window and to the "images" tab on the left side and copy the yyyymmddc18 directory.

You can put these copy procedure in the background so that you can continue to use the Total Commander window while copying.

Once the transfer is completed you need to check that the files were transferred correctly. The simple check is to check that their sizes are identical to their original sizes in the original directory. One can check the number of files and the total bits number in each panel of the Total Commander window and see if there is a discrepancy. If some of the sizes are different then something was wrong during the transfer and the procedure of transferring should be repeated. If all files were transferred well the numbers will be the same.

It is the night's Principal Investigator responsibility to make sure that the files were transferred correctly and fully - otherwise he will lose valuable data.

1.4 Safety Instructions

1. When moving the telescope, you must ensure that it does not run below the horizon.

2. Check the humidity at least once every 2 hours, and more frequently when humidity is higher than 80%. You must close the dome if water condensation begins to form (around humidity of 90%).

3. Do not attempt to make any repair whatsoever to the telescope measuring instruments, or dome on your own. Call a member of the staff in any event or breakdown.

4. Always lock the doors of the building and carry the distress button.

5. Always use a torch when moving in darkness.

6. Make sure you know the telephone numbers of the emergency services in Mitzpe-Ramon and those of the local staff members.

7. When leaving the C18 dome make sure to close tightly and correctly the door with the two secure locks.

Telephone Numbers:

Dan Maoz, Observatory Director	W: 03-6408538
Ezra Mashal, Technical Director	H: 03-5400633 or 052-3529230
Sami Ben-Gigi, Site Manager	H: 08-6588829 or 052-2703382
Shai Kaspi, Electronics and Software	H: 09-7405648 or 054-7236295
Nachliel Levy, housekeeping	H: 08-6588705 or 052-8809342
Tel-Aviv Office	03-6408729 or 6409279
Tel-Aviv Office FAX	03-6408179
Site numbers	08-6588133 (FAX: 08-6588303)
Emergency mobile-telephone*	050-5075945

*This telephone is in the site computer's room and is to be used ONLY for emergency, when none of the regular lines are available.

Emergency Services:

Police	**100**
Red Magen David (ambulance & medical service)	**6588569**
Civil Guard	**6588333**

1.4.1 Security at the Observatory Site

1. A list of emergency telephone numbers is posted in the office of the site manager, in the control room, and in the dome room. The observer should familiarize himself with the location of this list.

2. A document of "Security and Safety Rules" for the Wise Observatory is available at the observatory and through the Internet at:

   http://wise-obs.tau.ac.il/observatory/pakam_avtacha.pdf

   The document is in Hebrew and cover different aspects of security and safety at the observatory. Any person working or observing at the observatory has to read and be familiar with these rules and has to sign at the observatory that he has read them and understood them.

3. The site manager, or, in his absence, the day/night assistant is in charge of all security measures, and observers are expressly requested to comply with his instructions.

4. The gate of the compound and the doors of the building must be kept locked.

5. During observation, every person in the dome room must be equipped with at least a red flash-light. It is forbidden to walk around without a flash-light.

6. The observatory is equipped with a "distress button" ("Lachtzan Metzuka"). This is a small black device (like a car key remote control) with two blue buttons that once a person press on it, it sends a signal to a control box which in turn dials to predefined numbers and send a distress signal.

   The observers/workers at Wise have to carry this device on them while staying/working at the observatory. In case there is an emergency or an injury which prevents you from using the phone to call for help, you should immediately press one of the blue buttons (does not matter which, their operation is identical). You should carry the distress button at all times. It is equipped with a blue band so you can carry it on your neck.

   The control box is placed in the observatory office, on the shelf near the big flashlight charger. The distress button is placed on the control box. Whenever you come to the observatory please take it from there and carry it, use it in an emergency, and return it to that place when you leave the observatory.

   Currently, the control box dials to TAU security office, Sami, and Shai. When they will get the distress signal they will check first with the observatory if the button was not pressed by mistake, and will call for help in case no contact is made. The security

department of the university, which has a 24 hour manned station, is getting the first call from the observatory and act accordingly.

7. The whatcam (see http://132.66.65.17/) can be used to monitor the observatory yard.

8. There are 5 projectors on the observatory walls which light the surroundings of the observatory. In case there is something suspicious the projectors can be turned on. To turn the projectors on one can use a software on mizpe-cdr desktop which is call "Projectors" and has an icon of a lightening. When you run the program a window is opened with a button. when you hit the button its background will turn yellow and the projectors around the observatory will start to work. It take them a few minutes to get to their maximum illumination. The projectors can be turned on also using a switch in the main electricity board in the electricity/generator room. The switch is located on the left side of the main new electricity board, and is labeled as "outside light switch" and it is near switch number 54 (which is labeled "outside light"). Pay attention not to turn these projectors on when you are exposing an image as the light will ruin your observation.

Chapter 2

C18 Camera

2.1 CCD

The C18 telescope is now working with a QSI 683 CCD (image sensor KAF-8300) at the prime focus. This CCD has 3326×2504 pixels of size 5.4 micron square and the pixel scale on the C18 is 0.882 arcsec/pix which gives a field of view of 48.9×36.8 arcmin (0.815×0.613 degrees, which gives an area of 0.5 square degree). In the unbinned mode the readout noise is about 8 electrons RMS, the gain at the option of Hige Gain is 0.476 e-/ADU, the bias level is around 580 and the saturation level is 65536. There are different options of preflash to the CCD; usualy the one used is normal, which adds about a 1 sec deadtime to each image.

2.2 Filters

The QSI 683 CCD has in it a filter wheel with 8 positions for 1.25" filters. There is also an external 8 positions XAGYL filter wheel for 1.25" filters. connected to that CCD. Each filter wheel has one clear position to enable the use of the other filter wheel and thus there are 14 places that are used for narrow band filters that span over all the optical range.

The NB5200 filter used by the ACP as the default filter for focus and pointing updates. The filters are accessible from the "Expose" tab of the MaximDL's "Camera Control" window. Every plan made, must include which filter (or filters) to use in each exposure. ACP will automatically tells MaximDL, which filter to set for the next exposure. The focus position of the NB5200 filter is around 1000.

The NB filters have different focus position than the NB5200 filter. If we determine the NB5200 focus position as 0, then a "−" direction means "in" from the focus of the NB5200 position, and a "+" direction means "out" from the NB5200 position.

ACP reads the different focus offsets, for each filter, from a file named: C:\Users\Public\Documents\ACP Config\FilterInfo.txt, so it automatically commands FocusMax to set the correct focus po-

sition, with each filter change. The FocusMax program controls the RoboFocus program, which moves the focuser. The position of the focus also appears on the FocusMax window. However, when one moves the focus from the RoboFocus window the numbers in the FocusMax window do not get updated. To get the correct number of the focus position one needs to click on the "config" button of the RoboFocus window and in the window that will be opened one will see the current position of the focus in the upper right side of the window. This position will also get updated when one moves the focus from the RoboFocus. This is the number one needs to record as the focus position.

2.3 Telescope Motion Limits

The C18 motion limits are as in the following table. In most cases the telescope can reach below airmass of 2.9 in these limits so it is safe to point the telescope to any available object in the sky above altitude of 20. The ACP limit is set to altitude of 25 degrees and it will not let to point the telescope to altitude lower then 25 degrees.

NOTE: Due to the installation of the optical gates for the special calibration (sec. 2.7) the telescope cannot go to HA above 05:20 to the east, i.e., below −05:20 in the table below.

Declination degrees	East HA hours	West HA hours	Alt degrees
−30	−03:10	03:05	15
−15	−04:00	04:00	17
00	−04:30	04:35	20
+15	−05:05	05:05	20
+30	−05:40	05:35	20
+45	−06:15	06:15	17
+60	−07:20	07:50	17
+75	−11:15	11:20	16

2.4 ACP Scripts

The ACP (Astronomers Control Program) operates the main operations done with the C18 telescope. It has several scripts which are used to help the observer to do his observations. The scripts are placed in the C:\Program Files (x86)\ACP Obs Control\Scripts\ directory.

A convenient way to reach the above path is by pressing "Select the Script..." Button in the ACP interface. You can open the scripts in a text-editor (Notepad or Wordpad) to see the scripts. Many scripts have some description of how o used them at their beginning. To run a script you need to choose it from the "Select the Script..." Button and then to click

the "Run" button.

Here are a few scripts which are most useful:

1. **AutoFlat_SPECIFIED0** - takes a sequence of flatfields with the filter that is currently in front of the camera in the filter wheel.

2. **AutoFlat_AllFilters** - takes a sequence of flatfields with all the filters that are specified in the script's start.

3. **AutoFlat_Clear** - takes a sequence of flatfields with the Clear filter.

4. **AutoFlat_I** - takes a sequence of flatfields with the I filter.

5. **meridianSync** - Sync the telescope to the meridian.

6. **GateSync** - Sync the telescope to the position of the optical gates on the telescope axes (see section 2.7).

7. **AquireImages** - runs through a sequence of objects in different positions in the sky, different exposures, and different filters, in a predefined program and operates the C18 practically in an automatic mode like a robotic telescope. The plans are at "C:\Users\mizpe\Documents\ACP Astronomy\plans\" and an example of a set of commands is:

#STARTSETNUM 1 ; Added by ACP/AcquireImages.vbs

#INTERVAL 0 ; Bias

#repeat 15

#DARK

#INTERVAL 10 ; Dark, set exp time here

#repeat 5

#DARK

#INTERVAL 20 ; Dark, set exp time here

#repeat 5

#DARK

;#INTERVAL 25 ; Dark, set exp time here

;#repeat 10

;#DARK

#INTERVAL 300 ; 300 second exposures

#Filter C #REPEAT 999

Seneca 23 50 23.3 +02 15 07

#STARTSETNUM 2 ; Added by ACP/AcquireImages.vbs

#INTERVAL 150 ; 150 second exposures

#Filter C

#REPEAT 999

Balam 21 11 42 -12 46 01

#STARTSETNUM 2 ; Added by ACP/AcquireImages.vbs
#INTERVAL 50 ; 50 second exposures
#REPEAT 3
2002EZ11_060522 10 13 13 +11 34 06
#INTERVAL 20 ; 20 second exposures
#DITHER 5
ngc7331 22:37:04.2 +34:24:58.5
m31 00:42:44.3 +41:16:09.4

No empty lines are allowed in the plan.txt file., between the name of the object and its right ascension one needs to use tab and also between the RA and Dec.

8. **CloseTelescope** - sends the telescope to sidereal time + 1 hour, close the cover and the dome. It is writing a file to close the cover. In case the script stops in the middle the file will stay there and will cause a close of the mirror every time one will try to open it. To fix this one needs to deleter the file C:\C18controlfiles\Covercommand.txt

2.5 Robotic Operation

On March 2015, the C18 started to operate in a fully robotic mode. The program which accounts for the robotic work is the 'ACP Scheduler' (yellow gear icon on the desktop). The Scheduler consists of three programs: the Schedule Browser, the Scheduler itself and the VOEvent Receiver. The heart of the package is the Scheduler. It does all the work of sending observing requests to ACP Observatory Control Software. The browser is a general purpose editor for observing requests in the Scheduler's relational database. The VOEvent Receiver connects to the VOEvent network and listens for alerts on transient events. If one of interest (customizable) arrives, it can automatically generate an observing request, interrupt the Scheduler, and have the observations taken right then. The user can also add manually, any other request and defines it as a top priority, so the VOEvent is an option only.

2.5.1 Entering Observing Requests

Before start, you will need to create some requests in the scheduler's database. The Schedule Browser is the graphical tool supplied with Scheduler that lets you browse and enter an observing requests. The observing request can be generated by a RTML (Remote Telescope Markup Language) File, or a simple txt plan file input, which needs to be inserted into the Schedule Browser database. Plans can created easily by using the 'ACP Planner' (see 2.5.5: Creating Plans With ACP Planner), or in any other manner. If you choose to create the

plan without using the ACP Planner, make sure to check it, via "ACP Plan Checker" before you insert it into the Schedule Browser.

When plan is ready, open the 'Schedule Browser'.

1. Choose 'Data' from the top menu, and press: 'Import ACP Plan...'

2. On the new window press: "Compile", then choose the desired plan and press: "Open". Note: Plans are typically located in the C:\Users\mizpe\Documents\ACP Astronomy\Plans\ directory.

3. If the plan is ok, then "Import Plan" button becomes available, press it now.

4. If a plan imported successfully (also if not), you should get an appropriate message on the big white box. If the plan imported successfully, close that window and you should see the project on the Browser's list.

5. When project added to the list, it is disable to avoid unwanted start. You should right-click on it and select "Resubmit Project" to enable it. The project will now appear as a "yellow book" (rather than a red "no parking" sign), indicates target is scheduled.

The science images are stored in: C:\Users\mizpe\Documents\ACP Astronomy\images\ . Every night the Scheduler will create a folder with the current date in a format of yyyym-mddc18 . This folder contains the science images and also the biases, darks, and flat-fields.

2.5.2   Taking flat fields robotically

On Scheduler's main window, you can find two check boxes: "Dusk flats" and "Dawn flats". Checking any one of them, will run a script named: "AutoFlat". The "Dusk flats" calls the script at sunset, while the "Dawn flats" calls the script just before sunrise. The "AutoFlat" script must be in the default "Script" folder of ACP: C:\Program Files (x86)\ACP Obs Control\Scripts\ . You should write an "AutoFlat" script that suits your observing characteristics. It is strongly recommended that you use the "AutoFlat_Sample" script, which locates also in the default "Script" folder. Open the "AutoFlat_Sample" script with Notepad (or WordPad), look for the section: "USER SETUP". Then, edit the filter list, so it contains only the filters you want to take flat fields on. When done, save the file as: "AutoFlat" (replace the current file) in the default folder.

Note: In order to take Dusk flats robotically, the script must be in the default folder, and you must start the Dispatcher at least 35 minutes before sunset. If you start the Dispatcher less than 35 minutes before sunset, the Scheduler won't run the "AuroFlat" script, and will go to "Sleep" mode, in that case (and only in that case) you can manually load and run the "AutoFlat" script from the ACP, without stopping the Dispatcher. This won't damage the robotic work, since "AutoFlat" ends before it is dark enough to start observing.

The flat field images will be at the same folder yyyymmddc28, where your science images are.

2.5.3   Taking calibration frames (bias/dark) robotically

Scheduler has an option to have ACP acquire dark and bias frames (cal frames) after observing completes and (optionally) after automatic dawn flats have been acquired. To do this, Scheduler simply runs an ACP observing plan called "SchedulerCalFrames.txt". If this plan exists in the ACP default plans folder: C:\Users\mizpe\Documents\ACP Astronomy\Plans\ , the specified dark and/or bias frames will be acquired. To activate dawn cal frames, enable the option on the scheduler's main window.

Note: You should check the existing "SchedulerCalFrames.txt" file, and edit it, as you need.

Bias and dark images will be at the same folder yyyymmddc28, where your science images are.

2.5.4   Observing with ACP Scheduler

1. Close any program running on the background, except for Skype. It is very important to make sure that "C18 Control" is OFF; otherwise, it will conflict with Scheduler when the latter tries to control the electrical switches.
2. Connect the Skype to hear what is going on inside the dome. Remember that you cannot turn on the lamp since "C18 Control" is OFF, so you might want to use the "WhatCam" as well.
3. Start the Scheduler. Give it about 30 seconds to initialize. If the Scheduler remains minimized, locate it on the toolbar (yellow gear icon at the bottom of the desktop), then right-click on it and choose: "Restore".
4. Select your current sky condition.
5. Make sure the mode selector is set for Normal (ACP Night Only).

6. When ready, click the Dispatcher Running check box, to start the Scheduler.

7. From this point, Scheduler will do anything necessary to accomplish the projects. If you interest to learn more about how Scheduler operates the observatory, than read section 2.5.6: What's going on when Dispatcher is running?
Note: No need to worry if nothing immediately happens. Your observations will be taken when constraints are met and when time is available for them; this means that there is no way to know exactly which and when a project executes. In other words: We cannot get

an observing timetable from the Scheduler, but keep in mind that Scheduler itself wants to finish the work as soon as possible, so if conditions are good and constraints are met, then Scheduler will do the work as quickly as possible.

8. At any time, you can select View Log in the Scheduler menu to see a journal of the Scheduler's activity or watch the progress via the Schedule Browser.
Alert: It is strongly recommended not to touch anything (e.g., open or close programs on the background) while the Dispatcher is running, as it can cause the Scheduler to crash and most times forces to re-boot the computer. If you have to do something manually, you should first uncheck the Dispatcher Running check box. This will stop Scheduler from running, and prevent any software conflict.

9. Though the scheduler will sleep all day, you may want to stop it in the morning so you can shut down ACP, transfer images and files, or so it will not automatically start observing on the next night.

2.5.5 Creating Plans with ACP Planner

The ACP Planner provides nice and simple interface to create your own plans. When using the ACP Planner, you can be sure that the plan is 100% ok to use by the ACP, you don't need to check it via "ACP Plan Checker" before running.

First you will need to open the ACP Planner (same icon as ACP's but different name), point the mouse cursor on the white box under "Target", right-click the mouse button and then select "Add New Target...". A new window will be opened, name the target as you like (it is suggested to simply call it by its name, e.g.: NGC 3640). Now you can either provide its coordinates or choose it from the "Deep sky catalog". To choose it from the catalog mark the radio button next to "Deep sky catalog lookup", then press "Search Names", enter target's name and press "Search". If the catalog finds your target, it will appear on the shortlist on the right hand side of the searching window, then press "OK". Before you close the "Add Target To Plan" window, make sure to set the minimum altitude to 25 deg (this is only a precaution, as ACP should not allow to slew under elevation 25). Now, confirm with "OK" once more, and the target is added to your plan.

Next, you should set exposure settings. Choose the filters you need, on each filter, set the "Num" (number of repeats on the same filter), set the "Sec" (time of the exposure in seconds), and also the "Bin" (Binning 1,2,3...).

Next, press the 'Update' button at the bottom of the window. You can enter more targets and do the same, but don't forget to press "Update" after each target you finish to set. It

will also give you the total time required to complete the each set.

Now, save your plan under C:\Users\mizpe\Documents\ACP Astronomy\Plans\ , and you're done. The plan you've created can be used to create a project in the Schedule Browser, or if you are not working robotically, you can run it as a regular plan under "AcquireImages" script.

2.5.6   What's going on when Dispatcher is running?

What will happen immediately, after activating the Scheduler, depends on many parameters, such as time, targets, weather, sky condition etc. If Scheduler starts very early before sunset or it doesn't have work to do immediately when sunset, you'll probably see the status changes to "Sleep". It means Scheduler is running and waiting for the right time to wake up. If you start the Scheduler 35 minutes before sunset and it needs to start working as soon as possible (e.g., catching a target before it setting), you will probably shortly see the status: "Open" and the Scheduler will start doing some "startup tasks". If you start the Scheduler 35 minutes before sunset, it will probably take "Dusk Flats" (if enabled and AutoFlats script was found), shortly after observatory has opened.

"Startup tasks" are done when Scheduler needs to open the observatory, e.g., at the beginning of the evening or when weather is safe again after an unsafe period of time. The "Startup tasks" is basically the indicator for ACP to run a script named: "StartupObs". This script has custom made for the C18 and can be used only for C18 operation. It was written by Saar Niv, and does all starting procedures in order to set the telescope, and also the softwares, so they are ready to work. When observatory is ready, Scheduler will start doing observations. The dome will stay open the whole night, even if Scheduler finish its work and has nothing left to do. At sunrise, Scheduler will tell ACP to run the "ShutdownObs" script which will first close the dome and then shuts down the rest, in an organized way.

IMPORTANT: If at some point, weather becomes bad or even unsafe you should disconnect the Scheduler by unchecking the box near "Dispatcher Running" and manually run the "ShutdownObs" script from ACP. The script which can be found at the default path: C:\Program Files (x86)\ACP Obs Control\Scripts\ . This will first close the dome and then shuts down the rest, in an organized way. This emergency procedure is just a temporary solution until we get our new cloud sensor, then the ACP is able to do it by itself without disconnecting the Scheduler.

2.6   Manual Operation

A suggested procedure to operate the C18 is suggested here.

   Initialize

— Start about an hour before sunset so to allow the CCD time to cool.

— Open VNC to wo-neo.tau.ac.il.

— Make sure the time of the clock is current and that the Dimension4 program is running on wo-neo and is updating the UT. Note to close the Dimension4 program by pressing the minimize icon and NOT the close (X) icon.

— Open Skype to "wo.neo1" to see and hear what is going in the C18 dome. If in parallel a Skype window is opened on the wo-neo computer close it to minimize computer resources. Another option is to open the "option" window of skype on wo-neo and to look at the "Video setting" tab.

— Open the "C18 Control" tool.

— Turn on the CCD+Focus by clicking on "CCD+Focus" in the "C18 Control" tool and answering "ok" in the confirmation window.

— Open the ACP program from wo-neo desktop.

— Connect the ACP to the camera using the menu "camera"$\rightarrow$ "connect". MaximDL windows will open and will be connected to the camera.

— In the MaximDL's "Camera Control" window on the "setup" tab click on "coolers" – "on" and cool the camera to about -30 degrees in the winter and about -20 in the summer, making sure that at the stable temperature the "cool power" is about 90%. If the CCD does not goes to the temperature you desire, choose the temperature it reached to as the working temperature and make sure you take the flat-fields, bias, dark and images all with the same CCD temperature. To change the temperature use in the "setup" tab the "cooler" button (in the "Camera 1" area).

— Open "Total Commander", make sure images from previous night were backed up to "mizpe-bck-backup", and to "mizpe-cdr-backup". Images from the different nights are stored in: "C:\Users\mizpe\Documents\ACP Astronomy\Images\".

— You can open the "C18 target commander" to view the times, sun & moon positions, and to check target lists. You can load your target list into "C:\program files\ACP obs control\plans\" ($\bullet$- check this path) so that it will be available to the tool.

Open

— About 15 minutes before sunset:

— In the "C18 Control" window press "Dome" to enable the dome operation.

— In the ACP program prepare the script "meridianSync" by choosing in the script area from "Select the Script..." the script with that name. Do not press the "Run" yet.

— In the "C18 Control" window press "Telescope", then answer "ok" to the question that appears and after 5 seconds go to the "Run" bottom in the ACP window and click on it to synchronize the telescope position with its operation. The ACP will be connected to the telescope and calibrated coordinates will appear on screen. If the operation fails run the script again and again.

— In ACP press the "Dome Control" button to Open the "ACP Dome Control" window. In that window press the "open" button to open the dome. If the "open" button is not active try to press the "home", "park", or "close" buttons until the "open" button" will be active (otherwise you can try to use the DDR program to open the dome). The dome will open and then will follow the telescope.

— Open the telescope cover using the "C18 Control" program and pressing the "cover" button.

— Click on "FocusMax" icon on the desktop. A "FocusMax" and a "RoboFocus" windows will appear.

— Minimize the "FocusMax" window.

— Click on the "A/R" button of the RoboFocus window so that the writing will be black (Absolute) and not red (Relative) and in the window you will see the current position of the focus.

Flat-fields

— When the sun is at about −4 degrees below the horizon take flat fields (for narrow band filters probably best to start on sunset). Make sure that the dome light is off. You can use the script "AutoFlat_F", where F is a filter name (or some filters), can be used to take FF in a certain filter or a sequence of filters. To operate the script choose it from the "Select the Script..." button and then press "Run". If there is no script with the filter you want you can edit the script to have the filters you need. The flat field will take a while - patience is required.

Alternatively, you can use the script "AutoFlat_SPECIFIED0" that will not change the filters and will take the flats with the current filter that is in filter wheel. It will only check for the suitable exposure time and will take images one after the other.

You can also get the flatfield images in a manual operation in which you will take a sequence

of exposures using the "autosave" option in certain filters with a delay between the exposures. During the delay between the exposures the telescope should be moved a bit using the "Nudge Telescope" buttons from the ACP.

Calibration

— Check the telescope calibration by going to a bright star using the ACP window. Press "slew or sync" to send the C18 to a star (best to use the "_BrightStarCatalog.lst" list in the "C18TargetsCommander" tool) and press "go to" . It's best to choose a bright star near the zenith and a bit to the South-East to avoid the wind. Alternatively you can leave the telescope where it is.

— In the ACP program, select the script: "FindLostScope", and run it.

— The camera will then take a short exposure, and the PinPoint program will automatically run and solve the field. This procedure will take a minute or two and at the end of it, the telescope will be synced to the correct coordinates.

— NOTE: It is best to avoid synchronizing the telescope manually, since it is less accurate than automatic procedure.

Focus

To focus the telescope:

— In ACP program, select the script: "AutoFocus", then press run. ACP will ask which filter, you would like to focus on, best to give it the filter you are about to use most durign the night, for example 3 (for the L filter), on the white box above the ACP's console, and confirm with ok.

— The ACP will now manage the autofocus sequence, by controlling: MaximDL, FocusMax and RoboFocus. At the end of the run, the telescope will be focused and ready for work.

— You can do a focus test for the telescope several times a night, since the focus might change with the temperature during the night.

— The telescope is now ready for work.

Observing

— In the ACP program go to your object using "slew or sync" where you enter the coordinates and press "go" . When moving the telescope turn on light in the dome (click "Lamp" in the "C18 Control" tool) and watch the motion using the Skype window.

— Note that the lamp in the dome is turned off from the "C18 Control" tool while observing.

— Operate the MaximDL guider using the "guide" tab in the MaximDL's "Camera Control"

window. Take one exposure by checking the "expose" check mark, enter an exposure time and the declination of the telescope, and press "start".

— Once you get an image choose a star for guiding and click on it. This will put its coordinates in the "X" and "Y" boxes. Check the mark next to "Track", and press "start". The telescope will start to track.

— To see a graph of the guider errors click on the "Graph" button.

— To take an exposure/s go to the "Expose" tab in the "Camera Control" window. Press "Autosave" button and a window of "Autosave Setup" will appear.

— Setup the sequence you want to carry out (check the box next to the line you want, give an image name, the exposure integration time, and the number of exposures). Also change the "AutoSave FileName" into the current date, and when done setting press "ok". To start the observation press "start".

— NOTE: there is a caveat concerning using the "AutoSave" with a sequence of different filters and the guider. Please see the last paragraph of section 2.2 for details.

— When done, stop the guider, go to another object (while turning the dome light on) and so on the entire night.

— An alternative option is to use the "AquireImages" script in which you need to prepare an observing "plan.txt" file for it and then the script will carry out your plan, including moving the telescope, moving filters, moving between objects, etc. Note that the images are written in a subdirectory with the date of the observation.

To operate the script press the "Select the Script..." button and choose the "AquireImages" script. Then press "Run" to run the script. You will be prompt to choose the plan from the list of plans, so choose your "plan.txt" file. Then the script will carry out the observing plan (no need for a second "Run" after choosing the plan).

— During the night you need to take bias and dark frames. In the "Expose" tab in the "Camera Control" window. Press "Autosave" button and a window of "Autosave Setup" will appear. Set up a sequence of about 5 darks with the exposure you have and about 5 bias. Also change the "AutoSave FileName" into the current date, and when done setting press "ok". Then in the "expose" tab press "Start" to take and register the sequence of biases and darks. During this, the dome should be closed and the light be turned off.

Close

— Observations usually continue until the sun is −12 degrees below the horizon at sunrise. When finishing the work for the night you can take a flat field sequence if needed.

— Close the mirror cover using the "C18 Control" window.

— Close the dome using the ACP program (click "Dome"→ "close").

— Move the telescope close to its parking position, i.e, to RA=LST+1 min and Dec=0, using the "slew or sync" button.

— When the LST equals the RA (about 10 seconds before), disconnect the telescope from ACP by choosing from "Telescope" menu the "Disconnect" option and straight away (as close as possible in time) press the "Telescope" button on the "C18 Control" window. This is so as not to create a gap between the telescope halting position and the meridian.

— Close the "FocusMax" window, and the "RoboFocus" windows will also disappear.

— In MaximDL's "Camera Control" window in the "setup" tab press "Warm Up" and wait until the "Cooler Power" will go to zero. Then press "cooler off" and then press "disconnect" to disconnect from the camera.

— In ACP choose from the "Camera" menu the "disconnect" option.

— Exit the ACP program.

— Turn off the CCD+Focus in the "C18 Control" tool and press "ok".

— Turn off the Dome power in the "C18 Control" tool.

— Make sure the lamp is off in the "C18 Control" tool and all the other buttons are off.

— Open "Total Commander". The images were written into a subdirectory named after the date of observations in the "C:\Users\mizpe\Documents\ACP Astronomy\Images\" directory (the "images" tab in the rigth side of the "Total Commander"). Copy that subdirectory to the backup at "mizpe-bck-backup" and "mizpe-cdr-backup" (tabs on the left side of the "Total Commander").

— Verify that the files were copied correctly, i.e. check the sum of image sizes in kb is the same in the original and copied directories.

— It is the responsibility of the principal investigator (PI) of the night to make sure that all files were backed up correctly.

— Fill out the log in: http://wise-obs.tau.ac.il/observatory/log.html?C18

— Close your Skype connection to wo.neo1.

— Go to sleep.

2.7   Special Calibration

It could happen during the night that the telescope loses its position due to an electrical shutdown, or powering the telescope without calibrating it, or if the telescope coordinates are not calibrated and you cannot find your bright star or the field, etc.

If skies are clear, you can try run the "FindLostScope" script, this will sync the telescope

to the correct coordinates. If it also fails, you can follow the next procedure to calibrate the telescope by using its optical gates which are on the telescope.

The optical gates on the C18 are working using the C18control software. Because the declination gate is off by 2 degrees to the South, use the "GateSync" script instead of the "meridianSync" script which is used at the beginning of the night.

The calibration method is as follow:

— Make sure the power to the telescope is on (the Telescope button on the C18control is on). Also, press the "Reset Telescope Power" if needed.

— Make sure ACP is running and connected to the camera (MaximDL) and to the telescope.

- Go to ACP and on the top menu enter "ACP" then "Preferences...", enter "Pointing Corr." tab and uncheck both boxes.

— Check in the Skype window that the telescope is positioned close to the meridian and to Dec of 00:00:00.

— In the ACP operate the "GateSync" script (so ACP will be only approximately calibrated).

— In MaximDL open the "Observatory" window (small observatory icon near the small CCD icon in the MaximDL program) and in the "setup" tab press Telescope "connect" to connect MaximDL to the telescope. Then go to the "Telescope" tab to have the telescope controllers.

DEC calibration:

— Start calibrating the declination first - in the "C18 control" window press "CalDec" button.

— Look at the telescope through the Skype and decide if its North/South to the zero point (DEC=0 deg).

— Through MaximDL's "Observatory" window in the "Telescope" tab choose the amount of degrees you want to move, then press the direction (N or S).

— When the telescope arrives to the optical gate the electricity will shutdown, the telescope will stop, and the CalDec button will turn red.

— In the "C18 Control" window press the "CalDec" button to disable it.

— In the "C18 Control" window press "Reset Telescope Power" and confirm with "ok".

— Wait for the coordinate to disappear from the ACP window (might take a minute).

— load the "GateSync" script in the ACP but do not run it yet. Press "telescope" on "C18 control" window and right after you confirm with the "ok" press the "Run" on the ACP to operate the script.

RA calibration:

— Start calibrating the RA - in the "C18 control" window press the "CalRA" button.

— Look at the telescope through the Skype and decide if its West/East to the zero point (RA=LST).

— Through MaximDL' "Observatory" window in the "Telescope" tab choose the amount of degrees you want to move, then press the direction (E or W).

— When the telescope arrives to the optical gate the electricity will shut down and the telescope will stop and the CalRA button will turn red.

— In the "C18 Control" window press the "CalRA" button to disable it.

— In the "C18 Control" window press "Reset Telescope Power" and confirm with "ok".

— Wait for the coordinate to disappear from the ACP window (might take a minute).

— load the "GateSync" script in the ACP but do not run it yet. Press "telescope" on "C18 control" window and right after you confirm with the "ok" press the "Run" on the ACP to operate the script.

— Return to "ACP"→"Preferences...", enter "Pointing Corr." tab and check back both boxes.

— The telescope is now calibrated and ready for work.

Pay attention that when closing the telescope one should send it to Dec=0, RA=LST, so when opening it at the next night the user should use the meridianSync script. The GateSync script should be used only when using the above procedure.

Note that when fixing the telescope to a position using the telescope axis screws:

1. The RA metal pointer should be in the optical gate position.

2. The Dec metal pointer should NOT be in the optical gate position but about 0.5 cm north to it exactly above the line marked on the telescope.

In this position the telescope is pointed to Dec=0, RA=LST and the meridianSync script should be used. If one puts both metal pointers of both axes in their optical gate position then the telescope is pointing to Dec=-2.5 degrees, RA=LST-1.25 minutes (1.25/60 hours) and the GateSync script should be used.

2.8   Notes

DO NOT CLOSE THE C18 "TELESCOPE" UNLESS THE TELESCOPE IS AT THE MERIDIAN AND AT DEC=0.

WHEN MOVING THE TELESCOPE, OR TO SEE ANYTHING IN THE DOME, TURN ON THE DOME LAMP BY CLICKING ON "LAMP" IN THE "C18 CONTROL" TOOL, BUT DO NOT FORGET TO TURN IT OFF BEFORE STARTING AN EXPO-

SURE.

Observing limit is altitude of 20 degrees which corresponds to airmass of 2.9.

Note that the focus lens position is marked in the "FocusMax" window under "position". The current focus for the clear is around a position of 350 and for the other filters is around 1350. Note that the position is always between 2 and 2544 and do not allow the lens to move in any case beyond those numbers as the lens might get stuck. The farthest it can reach from the CCD is around a value of 2544 and this is a limit that is in the "RoboFocus" program (in the "config" tab, under the "max travel" number). The closest the lens can get to the CCD is a value of 2. This last value is also coded into the software so one should not pass it by accident. Make sure you will not pass it or that you'll cause the lens to get stuck in its housing. Note that you can use the "RoboFocus" window to stop the movement or move the focus in small steps.

One can put in the observer name and the object name in the header by using in MaximDL: File $\rightarrow$ settings $\rightarrow$ FITS header, and choosing the object or observer keyword and editing it. However, note when you finish the observations you have to change it back to blank value, otherwise the next day it will have the same values as you changed it to.

If the ACP is loosing the dome during the night and it is not slaved any more to the telescope, then send the dome to "home" and then do "unhome". this should solve the problem.

If you connect the "focuser" from MaximDL and the FocusMAX is not able to connect then press "disconnect" the focuser from MaximDL and try to connect again. If problem persist then probably the definition of robofocus in FocusMAX is not correctly defined and one need to redefine it in FocusMAX.