

Wise Observatory C18 Telescope Manual

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ABSTRACT

The Wise Observatory of Tel-Aviv University has been operating since 1971. Currently it operates a 40 inch telescope and a Centurion 18 inch telescope (C18). 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.

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/>

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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 $34^{\circ}45'48''$ E, latitude $30^{\circ}35'45''$ 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 $0.2^{\circ}\text{C}/\text{h}$ 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 an STL-6303 of SBIG. 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 lengthy 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 are being 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.

The procedure of backing up 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 left side of the Total Commander window there is a tab called "images" which is connected to the c:\Program Files\ACP Obs Control\Images\ directory on the wo-neo computer and list all the observation files from the current night.

On the right side of the Total Commander window there is a tab called "Observations" which is connected to the c:\Observations\ directory on wo-neo.

At the end of the night you need to copy all the files from the images directory to a subdirectory that you will create in the Observation directory with the name of yyymmddc18. Copy the files by selecting all of them ("Mark→Select All") and copy to the subdirectory. On the right side of the Total Commander window there is also a tab called "C18backup" which connects to the directory /home/mizpe-bck/C18backup/ on the wise-gate computer at TAU.

At the end of the night you also need to copy all the files from the images directory to a subdirectory that you will create in the C18backup directory with the name of yyymmddc18. 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.

The above procedure ensures that two copies of the data are kept (one on mizpe-bck at TAU and one on wo-neo disk at the observatory) until a permanent backup is done on DVDs. The Observatory staff will clear those disks once the relevant CD-ROMs have been created.

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.

The files are transferred to a DVD after 4 Gigabytes of image data have been accumulated. After a DVD and its backup copy are written, the image data subdirectories are removed from the observatory machines.

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.
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 Ezra and Sami. 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. We will work with the

security department of the university, which has a 24 hour manned station, for them to get the first call from the observatory and act accordingly.

7. There are security cameras around the observatory. The cameras' images are displayed on a computer in the control room (called wise-site) and they show the grounds around the observatory. The observer should use this screen to monitor the activity around the observatory.

The whatcam (see <http://wise-obs.tau.ac.il/~yiftah/WC/> or <http://132.66.65.17/>) can also 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 STL-6303E CCD from SBIG at the prime focus. This CCD has 3072×2048 pixels of size 9 micron square and the pixel scale on the C18 is 1.47 arcsec/pix which gives a field of view of 75×50 arcmin (1.25×0.84 degrees, which gives an area of 1 square degree). In the unbinned mode the readout noise is 15 electrons, the gain is 1.38 e-/ADU, the bias level is around 930 and the saturation level is 65536.

2.1.1 Bad Pixels

There are few hot pixels close to the center of the CCD, one of them at $X, Y = 1515, 1035$. This may pose a problem if you want to just point to an object and expose. In addition, column $X=1573$ is a bad column as it shows a clear vertical line across the CCD.

2.2 Filters

The STL-6303E CCD from SBIG has in it a filter wheel with 5 positions. Four Bessell filters are mounted in this filter wheel, B, V, R, and I. The filters are round 50 mm diameter. The fifth position is with no filter (clear - C).

The filters are accessible from the "Expose" tab of the MaximDL's "Camera Control" window. One needs to choose a filter before starting the exposure. It takes few seconds for the filter to change. Another option is to use the "Setup Sequence" in the "Sequence" tab and to set in it the "Light" exposures to be with the required filter. Remember to take sky-ff with the filters you need.

The B, V, R, I has different focus position than the clear position. If we determine the R focus position as 0, then the clear focus is at -950 , the I is at 0, the V is at $+30$, and the B is at $+70$. A $-$ direction means "in" from the focus of the R position, and a $+$ direction

means "out" from the R position. The clear position focus is around 850 and the focus for the filters is around 1850. The focus for the different filters is set up automatically according to the filter position. If you focus in clear then when moving to one of the BVRI filters the focus will move by 950 units "out", and vice versa. However one must remember to connect the MaximDL to the focuser before you make any filter change.

The position of the focus is shown in 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.

A subtle issue concerning the change of the filters and the focus when observing an object is as follows: if one observe an object and use the guider, then when changing filter while continue to guiding the image of the guide star on the guider CCD will shift its position a bit due to the focus change and the movemnet of the focus lense. This will cause the guider to move the telescope a bit after a new image with a new focus is started and the image with the new filter will be smeared a bit. To minimize this effect it is recommanded that (if taking a guide star and not starting the guiding in every filter - as done in the "Autosave" option of MaximDL) the sequesnce of observing in the filters will be: R, I, V, B. This will minimize the move of the guide star. A better way is to avoide this alltogether and to use the script AquireImages (see below in sec. 2.5) and in it to define the object again everytime a filter change is needed. In this way the guider will start from the beginning on each filter and the guider will not smear the image. The downside of this solution is that it waste some time in order to start the guider again every time a filter change is done.

2.3 Telescope Motion Limits

The C18 motion limits are as in the following table. In most cases the telescope can reach above 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 20 degrees and it will not let to point the telescope to altitude lower then 20 degrees.

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 Weather Robot

The Weather Robot is currently not working and this section is currently obsolete.

The Weather Robot was constructed by David Polishook.

If the astronomer cannot attend the telescope while it is observing (the same cycle over and over again), the telescope could be put under the control of the weather robot. The weather robot checks regularly the weather data send by the weather station through the weather-pc, and the clearness of the sky by the clouds radar which is operating through wo-neo.

Pay attention: the robot cannot be operated if the weather socket is not connected and if the clouds radar is not operated.

To operate the weather robot open the weather station window (through the button: Weather Station on the “C18 control” window), connect to the weather station and check on the weather robot check box.

When at least one of the weather parameter is off its limit the weather robot will act. The relevant weather parameters are:

1. Humidity: the limit of too high humidity is 85%.
2. Wind: the limit of too fast wind is 45 km/h.
3. Sky clearness: Rain and heavy clouds are reasons for observatory shut down.
4. If the wind is faster than 20 km/h, the humidity limit jumps to 88% and up.
5. If the clouds radar stops to operate, the weather robot will treat it as heavy clouds and will close the observatory.

The observatory shut down is not immediate; rather the weather robot waits some time to see if the bad weather consists. Waiting time till shut down are:

1. Humidity: 30 minutes after the humidity is off the limit.

2. Wind: 5 minutes after the wind is off the limit.
3. Sky clearness: 10 minutes after heavy clouds.
4. Sky clearness: immediate shut down in case of rain.

Shutting down the observatory includes:

1. Close the telescope cover (by C18control).
2. Stop guiding (By ACP script AquireImages_weatherRobot).
3. Stop exposure (By ACP script AquireImages_weatherRobot).
4. Send the telescope to Dec=0, RA=LST+1h (By ACP script AquireImages_weatherRobot).
5. Home and close the dome (By ACP script AquireImages_weatherRobot))

Pay attention: the tracking of the telescope is not stopped!

Pay attention: the shutting down of the C18 is only possible when the script AquireImages_weatherRobot is run through ACP.

If the weather becomes better, back into the standard limits, the weather robot will "put its hands off" the observatory but no action will be done automatically! This is for the astronomer to re-operate the observatory.

Pay attention: The weather robot does not close the observatory before dawn. The astronomer still holds the full responsibility for these tasks.

In any time you wish the weather robot will stop operating, just check out the check box at the meteorology window. Each time you open the weather robot, the "beginning-time" for bad weather is been initialized.

2.5 ACP Scripts

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

The macros can be reached through the "Browse..." Button in the ACP interface. You can open the macros in a text-editor (notepad or wordpad) to see the macros. Many macros have some description of how o used them at their beginning. To run a macro you need to choose it from the "Browse..." Button and then to click the "Run" button.

Here are a few macros 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 macro'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. **AcquireImages** - 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:\program files\ACP obs control\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. **AquireImages_weatherRobot** - 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. In addition it has connection to the Weather Robot (see section 2.4) and so it can stops the observations when the weather is becoming bad.

9. **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 delete the file c:\C18controlfiles\Covercommand.txt

2.6 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 of the computer is UT one and that the Dimension4 program is running on wo-neo and is updating the UT. Note to close the Dimention4 program by pressing the minimize icon and NOT the close (X) icon.
- Open NetMeeting on wo-neo. Click on the play button to see the image. If this does not work, open the TVR program and then close it. Also minimize the NetMeeting window since it takes many Internet resources and makes the VNC work much slower.
- 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" → "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 go 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 "c:\Observations" and to "wise-gate/mizpe/C18backup", and erase all backed-up images from the writing directory of "c:\program files\ACP obs control\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\" 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 "browse" 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 very fast 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

— Open the dome using the ACP program by choosing from the "Dome" menu the "open" option. 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.

— In MaximDL open the "Observatory" window (small observatory icon near the small CCD icon in the MaximDL program) and in the "setup" tab in the "Telescope" section press "connect" to connect MaximDL to the telescope. Also in the "Focuser 1" section press on "connect" to the Focuser. A "Focus-Max" and a "RoboFocus" windows will appear. Minimize the "Focus-Max" window and close the "Observatory" window.

— Click on the "config" button of the RoboFocus window and in the window that will be opened you will see the current position of the focus.

— Using the MaximDL's "Camera Control" window in the "Expose" tab choose "Single". Then move between the "C" filter and one of the BVRI filters few times and make sure the

focus moves accordingly (press the "Get Current Position" in the "config" window of "Robo Focus". The clear position focus is around 850 and the focus for the other filters is around 1850.

Flat-fields

— When the sun is at about -4 degrees below the horizon take flat fields. 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 "browse" 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 option "move telescope here" that one gets when clicking the right mouse button on the image (when using the AutoFlat scripts the telescope moves automatically between exposures).

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.

— The telescope and dome will move to the position you asked. Make sure the coordinates the telescope has arrived to are the ones you wanted. Sometimes the telescope does not get exactly to where you wanted and you need to send it again using the "slew or sync" button.

— In the MaximDL's "Camera Control" window from the "Expose" tab choose "Single" and take a 1 sec exposure. Check if the star is in the middle of the field. If not, point the mouse to the star and right-click the image and choose "Point Telescope Here". Take another exposure and repeat this until the star is in the middle of the frame. When finished, make sure you have the initial coordinates in the ACP in the "Slew Or Sync Telescope" window, press "Sync" to calibrate the telescope coordinates, and click "yes" to confirm.

Focus

- Focus the telescope using the "RoboFocus" window:
- Take an exposure of a field for three seconds using the "Expose" tab in the "Camera Control" window and using the filter you will mostly use during the night.
- In the "Expose" tab in the "Camera Control" checkmark "Mouse" in the "Subframe" area, and also check mark "Continuous".
- Mark a subframe with a suitable star for focusing on the image by clicking on the left mouse button in the upper-left corner of the subframe you want and dragging the mouse to the lower-right corner of the subframe you want. The subframe will be marked on screen and its parameters will appear in the "Subframe" section in the "Camera Control" window.
- Choose about 3 seconds for an exposure and binning of 1. Then press the "start" button.
- The tool will take continuous exposures of the subframe.
- Enlarge the image using the "+" magnify mark and put the cursor on the star to see its FWHM in the information window.
- On the "Camera Control" window choose from the "Options" menu the "Display large Statistics" option to see the parameters of the star.
- Check the FWHM in a few images. You can use the "FocusAid" excel sheet in order to plot the V-curve of the focus and to choose the best focus place.
- In the "RoboFocus" window change the focus position (by about 20 units) "in" or "out" and measure again the FWHM in several images.
- Repeat this until you'll get the best focus, i.e., the position which will give the minimum in the FWHM.
- To see the focus position click the "config" button in the "RoboFocus" window. In the "configuration" window that will appear you will see the focus position in the upper-right corner. Press "Get Current Position" to get updated position. The current focus for the "C" filter is around a position of 850 and for the other filters is around 1850.
- Note that the position should always be between 2 and 2544. Do not allow the lens to move in any case beyond those numbers as the lens might get stuck. — Remember to write the focus position in the log you'll fill in the morning.
- When done, press "Stop".
- In the "Expose" tab in the "Camera Control" check mark "Single", and in the "Subframe" area un-checkmark the "Mouse" and press the icon with the arrows to reset the subframe into the maximum dimension of the CCD.
- 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 net-meeting window. Remember to minimize the NetMeeting window once done, since it takes many Internet resources and makes the VNC work much slower.

— 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 (note the declination is coming up automatically from the telescope), and press ”start”.

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

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

— An alternative and better 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 “browse” 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.

— Choose the macro "CloseTelescope" and "Run" it. It will carry out the following 4 action (or you can carry them all separately by hand):

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

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

— Move the dome to its parking position using the ACP window and choosing from the "dome" menu the "Home".

— 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.

— In MaximDL open the "Observatory" window (small observatory icon near the small CCD icon in the MaximDL program) and in the "setup" tab press on Focus 1 section "disconnect" to disconnect from the the Focuser. the "Focus-Max" and "RoboFocus" windows will disappear. Close the "Observatory" window.

— 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". If images were written into a subdirectory named after the date of observations in the "c:\program files\ACP obs control\ images\" directory then copy them out of this subdirectory into the images directory and delete the empty subdirectory. Then copy the images from the "c:\program files\ACP obs control\ images\" directory to the backed up at "c:\Observations" and to wise-gate/mizpe/C18backup . 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.
- Later erase all images from the "c:\program files\ACP obs control\ images\" directory so it will be ready for next night.
- Fill out the log in: <http://wise-obs.tau.ac.il/observatory/log.html?C18>
- 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. A procedure to calibrate the telescope in such a case is described below and it uses 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.
- Check in the NetMeeting 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 NetMeeting 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 NetMeeting 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.

— 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 macro 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 EXPOSURE.

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

Note that the focus lens position is marked in the "Focus-Max" window under "position". The current focus for the clear is around a position of 850 and for the other filters is around 1850. 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.

We used to focus the telescope using the "Focus-Max" software and window by clicking the "focus" button and the telescope would have taken an image and would focus on it automatically. However for some reason this is not working properly anymore. Probably the "Focus-Max" need to be adjusted but this is yet to be done and checked.

One can put in the observer name and the object name in the header by using: File → settings → 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.