IAC80 TELESCOPE
FREQUENTLY ASKED QUESTIONS

INDEX

0. GENERAL ISSUES

What is this document?

This document focuses on those issues relevant for a successful observation by answering the typical questions that any observer can pose. **These questions are mostly referred to the telescope and its CCD camera**.

Is this the only documentation available for observer?

No, more information is available in the telescope webpage (http://www.iac.es/telescopes/ten.html) and in the manuals therein. These manuals are also in the telescope control room. All the information contained in this document is discussed in more detail there.

What to do when arriving to the observatory?

The support astronomer should have contacted the observer at least one week before his/her run to discuss the details of the observations and **request for the filter requirements.** The support astronomer will meet the observer at the telescope the afternoon of the first night of his/her observing run. The user will then be introduced to the telescope and instrument. Note that support is only offered for the first night of the run, **then, visiting astronomers are expected to run the telescope and instrument on their own after the introduction**. The night assistant will open and close the telescope and initialize the CCD control software.

What to do in case of problems when observing?

In case of problems, the observer can **contact the support astronomer on duty by phone** (look for her/his name and mobile phone number in the control room). A night assistant is also present on the mountain the whole night and can be contacted in case of problems or questions.

When will the equipment resume its normal operation after a technical failure?

If neither the support astronomer nor the night assistant can solve a technical problem, it will be notified to the day maintenance staff so it is expected that the problem is fixed to the next observing night. However, the IAC80 is a small facility with a small staff so unfortunately no technicians are on duty during weekends and bank holidays.

1. OBSERVING TIME ALLOCATION

Can any astronomer apply for observing time regardless its affiliation?

Yes, everybody can apply for observing time, being equal, regardless his/her nationality or affiliation.

How to apply for regular observing time?

The IAC80 time is allocated by the Spanish time allocation committees (CAT). The A-semester runs from 1st March to 31st August and the B-semester from 1st September to 31st February. Telescope proposals should be submitted directly to the CAT. Proposal submission guidelines and deadlines are given on: http://www.iac.es/cat/pages/cat-nocturno/es/presentaciF3n.php

How to apply for service observing time?

The IAC80 telescope offers an average of two service nights per month. The time devoted to these observations is distributed each semester, and so these nights will appear as "Service" in the schedule of the telescope. Each service programs must not exceed three observing hours per night, although these programs can apply for time in several service nights.

The schedule is on:

http://www.iac.es/telescopes/tening.html

Where the application form is in:

http://www.iac.es/telescopes/peticion_tiempo/form-eng.htm

How to apply for *routine* observing time?

The IAC80 telescope offers time for *routine* programs each night. Every requested *routine* observation must ask for less than an hour of observing time per night. This type of observations is suitable for programs of continuous monitoring. The time can be requested from the same form than is used for service time.

How to apply for *extra* observing time?

Some nights of the telescopes have not been scheduled for observing. These nights have been called as *extra nights* in the telescopes schedules. Astronomers could request these nights for observing their own programs. Just send an e-mail to the *Head of Telescope Operations* (aoscoz AT iac.es) indicating the night, the instrument and a brief explanation of your scientific aims.

How to acknowledge in a paper the observations carried out in the IAC80?

The CAT requests the users to make the corresponding acknowledgement in articles resulting from the observations carried out on the Spanish Observatories. This acknowledgement should be made either with a title foot note or, if the editors do not allow foot notes, by quoting the following text in the corresponding section: "*This article is based on observations made with the IAC80 telescope operated on the island of Tenerife by the Instituto de Astrofísica de Canarais in the Spanish Observatorio del* Teide."

2. THE TELESCOPE

What instruments has the IAC80?

The most frequently used instrument at the IAC80 telescope is **the CCD imager CAMELOT** (acronym of 'Teide Observatory Light Improved Camera' in Spanish). There is also a portable camera optimized for fast readout photometry called TCP (Tromsø CCD Photometer). Furthermore, a spectrograph is expected to be installed in the next future.

Which are the telescope pointing limits?

North:	+84º 00' Dec.	(Z = 56°.0)
South:	-40º 00' Dec.	(Z = 68°.5)
East:	-5h 11m HA.	(Z = 68°.0)
West:	+5h 13m HA.	(Z = 68°.0)

How to proceed if the telescope reaches one of its limits?

It is not expected to happen. First, because, before moving, the system checks if the target is outside the limit and, if so, it aborts the pointing. Second, because the telescope control PC will show a warning if the telescope is near the limit when tracking. The user should also check the field '*Tiempo al límite*' **(time to the limit)** showing the time remaining until the telescope reaches the limit. Anyway, if for one reason the telescope goes beyond the limit, the observer should call the night assistant.

Can the observers load their own catalogues from an external device?

No, the users have to create their catalogues entering the coordinates of the targets at the telescope control PC keyboard. The catalogues can be saved and edited as many times as desired.

Are there standard stars catalogues available for observers?

Yes, the users can find the following catalogues, among others, at the telescope control PC: **LANDOLT.USU** with the Landolt photometric standards stars; **BLANKS.USU** with the coordinates of several blank fields for sky flats; **BRIGHTS.USU** with the coordinates of bright stars. (y también pueden apuntar a FKs, BS e Hipparcos en "Apuntar objeto desde catálogo" poniendo el número de la estrella).

How to offset the telescope?

There is a hand paddle that can move the telescope. By default, the hand paddle buttons have the following functions when used for telescope control: **F1: performs offsets of 1''; F2: offsets of 10''; F3: offsets of 1';** F4 and F5 perform continuous motion (F5 faster than F4).

How to proceed if the pointing is lost?

In case the user cannot identify his/her field or if the pointing is not accurate enough, attempt to **go to a bright star of visual magnitude of 3 or brighter** (see for instance the FK catalogue in the telescope control room). Even though the star is not in the field, a reflection should be visible in any of the edges of the CCD. In this case, the user can move the telescope to that direction using the hand paddle to centre the star in the field (do not forget to select short exposure times). Once the star is centred, the correction can be saved with the option 'Ajustar *coordenadas*' (pero esto solo lo podría hacer el operador de telescopios, porque nos la han liado los astrónomos a veces) in the telescope control PC. In case no even a refection is visible, ask the night assistant.

Can the IAC80 perform non-sidereal tracking?

Yes, the IAC80 telescope is able to perform non-sidereal tracking of Solar System objects. The tracking velocity should be expressed in arc second per hour.

How to focus the telescope?

Observer can change the telescope focus (**in steps of 25 or 50 units)** by typing the absolute value on the telescope control PC. The typical focus is around **20000 units.**

3. THE GUIDER

Is it possible performing non-sidereal guiding?

Yes, the guider system has an option of non-sidereal guiding. **The proper motions should be expressed in arc seconds per hour**.

What is the field of view of the guider camera?

The camera of the guider has a rectangular field of view of 6'.4x4'.8.

4. THE CAMERA CAMELOT

What are the operational characteristics of the CCD?

The CCD has **2048x2048 pixels** and two low noise amplifiers in the readout register so two channels are available for individual (A) or simultaneous (A+B) use. There are two *prescan* regions, of 50 pixels each, at both sides of the detector in two channels mode and one *prescan* region, also of 50 pixels, on the right side in one channel mode The observer can select different readout speeds: 100, 200, 500 or 900 kHz to optimize for low noise or high speed operation. **Table 1** shows the characteristics of the detector for these different modes and one channel readout (in two channels mode the CCD lasts reading half this readout time). **The default configuration is one channel readout at 200 kHz speed**.

Readout (kHz)	Readout time (s)	Gain (e⁻/adu)	Readout noise (e⁻)/(adu)		Dinamical range (*adu*)	Relative noise (x10³)
100	44	1.66	2.69	1.62	65,536	0.02
200	**22**	**1.25**	**3.37**	**2.70**	**65,536**	**0.04**
500	9	4.31	5.52	1.28	41,300	0.03
900	4.8	14.67	12.97	0.88	12,100	0.07

Table 1: CCD operational characteristics. In two channels mode the CCD lasts (¿spends?) reading half this readout time.

Is the CCD linear in all its range?

Yes, the CCD is linear in all its dynamical range. In the standard configuration, deviations from linearity are less than 1% until the saturation level (~60000 adus) is reached.

What are the pixel size and the field of view?

The CCD has **2048x2048 pixels** of 13.5 x 13.5 µm/pixel each. One pixel is equivalent to **0".304** on the sky so the field of view is a square of **10'.4 side on the sky**.

How is the CCD orientated?

The CCD is placed so that the **north is upwards and the east is to the right**. In the CAMELOT display the image is shown in the standard orientation.

Is it possible windowing the CCD?

Yes, windowing the CCD is an option. When a window is activated the detector is read for one single channel so, **unless the window size is less than half the full CCD, there is no saving in read-out time with respect to the two-channel readout mode.**

Is it possible binning the CCD?

Yes, binning the CCD is an option. When a binning is activated the detector is read for one single channel. The size of an image after binning is always 2098x2048 pixels because CAMELOT keeps the binned image in one corner of the CCD putting the rest of the pixels to the *prescan* level (see **figure 1**). So, **there is neither saving in read-out time nor in disk space with respect to the two-channel readout mode.**
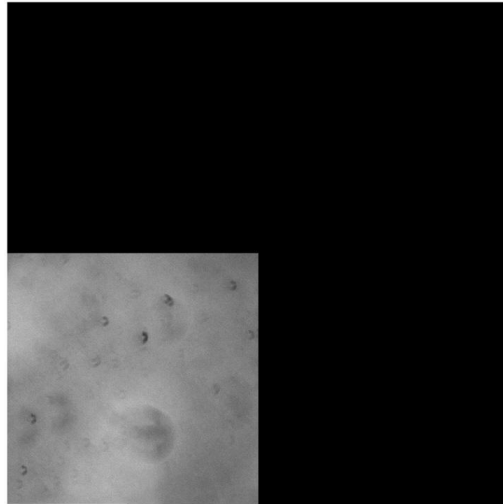
Figure 1: Example of a 2x2 binned flat field.

Which temporal resolution can be reached in a series of consecutives images?

By combining the two channels, or the window mode, with high speed readout the readout time can be considerably reduced. For instance, because there are 3 pixels in one arc second on the CCD, a window of 1 arcmin^2 has $(60 \times 3)^2 =$ 32.400 pix so, at 900kHz, it lasts only 36 ms reading out. However, **to calculate the time resolution in a series of consecutive images, the observer has to take into account that the system requires about 6 seconds to save each image in disc.** We recommend the observers to use the TCP (Tromsø CCD Photometer) instead of CAMELOT in case their projects require very high time resolution.

How long does the shutter take to open and close?

CAMELOT shutter lasts about 10 ms for opening and 10 ms for closing in the centre. For this reason, images taken with less than 5 s exposure time show a vertical bright band around the image centre because the exposition in the centre is 20 ms longer than in the edges. Although this feature represents only a 2-3% in expositions of 1 s, **we recommend using exposure times longer than 3 s such that the shutter does not interfere with even illumination**.

How precise is the clock of CAMELOT?

The CAMELOT control PC is equipped with a PCI card that receives the time signal from the GPS, so the time synchronization of the observations is excellent.

5. FILTERS

How many positions has the filter wheel?

The CAMELOT filter wheel has **12 positions**. Except in exceptional occasions, seven positions are always occupied, five of them by Johnson-Bessell's or Sloan broad-band filters, one is always free (white light) and another is blocked. **Therefore, five positions are available for narrow band filters**. A list of all available filters is in: http://www.iac.es/telescopes/tcs/filtros.htm#FiltrosIAC80

Can the visitor observer use his/her own filters?

Yes, these filters have to be round of 50 mm diameter or square of 50 or 60 mm side. In any case, **the observers must contact their support astronomer at least one week before their CAMELOT run with their filter requirements.**

6. OBSERVATIONS

Are bias and *prescan* correction equivalent?

Yes, in the default mode reducing images using the bias or the *prescan* region makes not difference. However, experience has shown that **in the two-channel readout mode, *prescan* areas are suspected to be affected by the illumination of the imaging area, so they are not recommended as bias level reference.**

How many bias frames are necessary?

The final noise in an image after subtracting the average of N bias frames can be expressed as:

$Noise= RNoise*(1+1/N)^{1/2}$

Where RNoise is the readout noise. So, when subtracting one single bias frame a factor $2^{1/2}$ is added to the readout noise, whereas combining 10 bias means that a 5% more of noise is added.

Are dome and sky flat fields equivalent?

Yes, dome and sky flats can be considered equivalent. Ratios between *BVRI* twilight sky and dome flats show different illumination patterns less than 5%.

How to take flat fields?

Precision in the final measurement demands great care in the acquisition of flat field images, so the observer has to take many, and well exposed, frames in order to reduce the noise level of the finished flat field. **Each flat field should have an average count of about 60-70% full well capacity (35000-45000 counts in the standard mode) avoiding saturation. Extremely short exposures (less than 5 s) should be avoided because the shutter action may not be completely uniform.**

How many flat field frames are necessary?

The signal to noise ratio (S/N) of an image obtained by combined N frames can be expresses as follows:

$S/N = (S\_ADU*G*N)^{1/2}$

Where S_ADU is the level of counts and G is the gain. So, in the CAMELOT standard mode, **the combination of 10 frames of 35000 adus has an error of only 0.15%**.

Should the observer take dark images?

No, dark current is negligible in CAMELOT so in general dark images are not necessary.

Must the visitor observer take their own calibration frames?

Yes, taking bias, flats and darks (if necessary) is the responsibility of the observer.

Is it compulsory to give part of the observing time for *routine* programs?

Yes, the IAC80 telescope offers time for *routine* programs each night. **The observer must give a maximum of one hour in summer, an hour and a half in autumn and spring and two hours in winter**. The support astronomer or the night assistant will try to reconcile the visitor observer's and the *routine* programs.

Is it compulsory to give part of the observing time for override programs?

Only if the program has been previously approved by the Time Allocation Committee (CAT). If there is any override observation during the run, the observer will be informed.

Is there an exposure time calculator for CAMELOT?

Yes, there is an empirical exposure time simulator for CAMELOT. We have performed a program of observations with the standard Johnson-Bessell filters in which we have taken different standard Landolt fields for several dark photometric nights under different seeing conditions. The analysis of these data allows us to offer interesting information to the observer, such as the magnitude limit vs. the exposure time or the signal to noise ratio, obtained for a given star under certain seeing conditions. This resource can be found at:

http://www.iac.es/telescopes/simu_ot/simu_ot_eng.html

How to check the weather conditions?

The IAC weather station is located near the IAC80 telescope. The current conditions can be checked on:

 http://www.iac.es/telescopes/tiempo/weather.html

What are the closure limits in case of bad weather?

The dome should be closed if the **humidity is above 80%**. It must be below 80% for 30 minutes before the telescope can be opened again.

Regarding the wind, the telescope facilities are designed for the operation below certain wind speeds, so that their operational and mechanical integrity are maintained. There are some restrictions under different wind speeds regimes: 1) Wind speed below an average of 35 km/h and with peaks below 35 km/h in the last 5 minutes: no restrictions in the operation; 2) Wind speed over 35 km/h in the last 5 minutes (including average over 35 km/h): operation restricted to azimuths larger to ±40 degrees out of the main wind direction. The main shutter must be in automatic mode to guarantee a more effective protection. 3) **Average over 45 km/h in the last 5 minutes or peaks over 55 km/h: stop the operation and close the dome**.

The dome should also be closed if there is a large amount of dust in the air. **In all cases, the night assistant has the last word** so the observer must follow her/his recommendations.

How to reports fails or express an opinion?

The observer must fill a report at the end of the run with the IAC80 telescope, even if no observation has been done. **We encourage the observers to send this report.** The confidentiality of the answers is guaranteed by the Telescope Manager. The report is in:

http://www.iac.es/telescopes/Encuesta/Formulario-eng.htm

7. THE CCD CONTROL SOFTWARE

How can the observer open the graphic interface?

The observer does not need to initialize the CCD control software, but in case the system needs to be restarted click on the **CCDNEW** icon in the PC called "iac80ccd".

Is it possible changing the filters automatically?

Yes, the observer can create and run a macro to take multiple frames with different filters and exposure times.

How many rows can contain a macro?

A macro can contain as many rows as desired. Furthermore, the same macro can be run several times.

8. COMPUTING

Is there a visitor account for working in the control room?

Yes, there are two PCs in the control room: one labelled as "**iac80ccd**", to control the instrument under a Windows XP environment, and the other one called "**asteroide**", working under LINUX environment. From this PC the observer can analyse or reduce their images with IRAF. The visitor account user is **obstcs1** where the password is in a label on the monitor. There are more computers at the telescope, both in Windows and Linux enviroments, that can be used by the visiting astronomers.

Are there computing facilities for observers to reduce their data?

Yes, CAMELOT data reduction is a standard procedure and the PC *asteroide* has the software (IRAF) from where the user could make her/his own data reduction.

In '*asteroide'* there is also a python script to automatically reduce the CCD images at the IAC80 telescope (subtract bias and correct flat field). To run the macro just type in the directory /**iac80ccd**:

>python redcam.py directory speed channel

Where 'directory' is the name of the directory with the images (with the date format yymmmdd), 'speed' is the selected readout speed of the CCD (possibilities are 100, 200, 500 and 900 kHz) and 'channel' is the number of readout channels (1 or 2). For example:

>python redcam.py 10may02 200 1

The reduced images will be stored in the scratch of 'asteroide' in the following directory:

/scratch/iac80ccd/directory/REDUCED_speed_channel

In our example:

/scratch/iac80ccd/10may02/REDUCED_200_1

Can the users connect their own laptops to the internet?

Yes, the telescope has a wireless connection called 'iacext'. It is also accessible from the guest house (*residencia*). The password should be provided by the support astronomer or the telescope assistant.

How to record the data?

IAC users can connect via ssh with the "**asteroide**" machine, access the folder with their observations named as /**iac80ccd**/**yymmmdd**/ (where yy is the year, mmm the three first letters of the month in Spanish and dd the day), and then copy the images to their own computers. Non-IAC users have to transfer the data to their own ftp. A DVD copy of the data can be provided at the telescope if needed, but the users should ask for it to the telescope operator at the beginning of each observation night.

How to get the data of a service or a *routine* program?

The PIs of the service and routine programs (from both inside and outside the IAC) can get their data **from the IAC ftp server**. The corresponding ftp address will be sent by email.

How long will be data in storage?

There is not a specific policy for data saved in the telescope PC but depends on the disk capacity at the time of the observations. However, *routine* and service data will only remain 15 days in the ftp. **We strongly recommend the observers to save their data immediately after their run.**