

# TRIPOL User's Guide

## for SAAO 30" Telescope

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### Contents

1. Introduction
2. Start Up
3. Shut Down
4. Observation
5. Data Files
6. Misc. Info

### 1. Introduction

Welcome to TRIPOL.

TRIPOL is g'r'i' triple color imaging camera. It is also capable of polarimetry, but that function is not installed at this point.

TRIPOL consists of 5 parts: an optical box, 3 CCD cameras and a control PC. Optical box contains 2 dichroic mirrors and 3 broad band filters (g', r', i'). CCD camera model is SBIG ST-9XEI with 512 x 512 pixels (20um x 20um pixel size). 3 CCD cameras are connected to the control PC through USB. All software needed for observation are installed in the control PC, which OS is Linux (Xubuntu 10.04).

### 2. Start Up

#### 2.1. Power on all devices

Each CCD camera and control PC has it's own power supply unit. Connect these power supply units and power on all devices. Order is not important. Make sure USB cables are connected between control PC and each CCD camera, and network cable is connected to control PC.

#### 2.2. Login to the control PC

Login to the control PC ("tripol1") from observation PC (ex. your laptop) through network using ssh.

IP Address of the control PC: 10.2.203.30

User name: observer

Password: tripol001

Example command (on the observation PC):

```
ssh -X -l observer 10.2.203.30
```

After login, it is convenient that start some terminals, like  
xterm &

X server must be running on the observation PC.

#### 2.3. Start CCD control software

Start CCD control software ("ccdserver") with the command:

```
start_ccd
```

this command takes 10 seconds.

Start "ds9" FITS viewer. You can use

```
start_ds9
```

Take test images to check the CCD cameras work:

```
TL 6 1
```

## 2.4. Cool down CCD chips

Set CCD temperatures to 0 to -20 degC depending on outside temperature.

For example, to set -10 degree, type

```
set_temp -10
```

and then check the temperature

```
print_temp
```

or

```
print_temp -s
```

After CCD temperatures settle to their set point, you can start observation.

Optional: If you want to write weather information into FITS header, type

```
weather.sh &
```

## 3. Shut Down

### 3.1. Stop CCD cooling

```
set_temp 99
```

### 3.2. Copy data from the control PC to your PC

For example, from YOUR PC, type

```
scp -pr observer@10.2.203.30:/data/111014 your/data/folder/
```

or

```
rsync -av -e "ssh -l observer" observer@10.2.203.30:/data/111014 mydata/
```

or try windows share:

```
\\10.2.203.30\data
```

or use any other way you like.

### 3.3. Power off the control PC and all CCD cameras

Press power button of the control PC to shutdown it. Or you can shut it down by command:

```
sudo poweroff
```

of course you will be forced to logout.

## 4. Observation

There is no GUI observation software for TRIPOL. You must use command line. Observation commands of TRIPOL are very similar to those of IRSF/SIRIUS.

### 4.1. Focus Adjustment

Set telescope "Analog Focus" value to as low as possible (around 410).

That will do. Of course you can adjust focus value, but perhaps you cannot find best focus position.

### 4.2. Observation Strategy

Except object frames of your target, dark and twilight frames should be taken each night. Twilight frames are used to make flat frames.

### 4.3. Observation Commands

\* TL

Take test images.

\* Lo

Take data.

TL and Lo are most important commands. Usage of them is common:

```
TL mode exposure_time(sec) [object_name [iteration]]
```

```
Lo mode exposure_time(sec) [object_name [iteration]]
```

mode: usually 6

exposure\_time: exposure time, shortest time is 0.12sec.

object\_name: value of FITS header "OBJECT" key (default: TEST)

iteration: how many frames do you take (default: 1)

You must specify "object\_name" if you want to set "iteration".

For example,

```
Lo 6 60 NGC2100 30
```

This command takes 30 frames ( x3 colors) with 60 seconds exposure time, OBJECT='NGC2100'.

Images taken with "TL" command are not saved as data.

#### \* twflat

This is for taking twilight frames. Exposure time is fixed to 5 sec.

Usage: twflat iteration

ex.

```
twflat 100
```

takes 100 frames. This is equivalent to

```
Lo 6 5 twflat 100
```

#### \* dark

This is for taking dark frames. Takes 10 frames of dark image with specified exposure time.

Usage: dark exp1 [exp2 exp3 ...]

ex.

```
dark 5 10 60
```

takes 5, 10 and 60sec dark images, 10 frames each. This is equivalent to commands:

```
Lo 7 5 dark 10
```

```
Lo 7 10 dark 10
```

```
Lo 7 60 dark 10
```

because mode '7' is for dark images.

#### \* xstop

This command stops iteration of Lo, TL, twflat and dark commands after current exposure ends. You cannot cancel ongoing exposure.

#### \* point2

Point telescope to selected object.

Before you use this command, you have to prepare object list file.

List file contains object's info in each line as:

```
object_name epoch RA_h RA_m RA_s Dec_d Dec_m Dec_s
```

Parameters are separated by space or tab, so you cannot include space character to object\_name.

For example, if "objlist" file contains a line such as

```
NGC253 2000 00 47 31.0 -25 17 48.0
```

you can point telescope to NGC253 by

```
point2 path/to/objlist NGC253
```

#### \* offsetx

This command slightly offsets telescope from current position.

Usage: offsetx ra\_off dec\_off

Both ra\_off and dec\_off are in arcseconds.

ex.

```
offsetx -20 30
```

If you add "-p" option, you can specify offset values in pixels (but not so accurate).

```
offsetx -p 100 0
```

## 5. Data Files

All the image files are stored in /data/ of the control PC.

Under /data/, a directory of the observation day is automatically created like "111012" that means 12th October 2011. This "day" will change

at 8 am SAST, so if you start observation at 3 am of 15 Oct 2011, the directory name will be "111014".

Image files taken are stored in /data/111014/rawdata/ directory, for example.

The name of each data file consists of:

"band name" + "day" + "\_" + "number" + ".fits", like:

g111014\_0092.fits

r111014\_0092.fits

i111014\_0092.fits

The number starts from 0001 and is automatically incremented as you take data. During observation, you can check the NEXT number by the command  
counter\_check

You can also set the number by yourself.

counter\_set 201

will set the number of next data files to 0201. Be careful that if the files "\*\_0201.fits" already exist, they will be overwritten.

You cannot change the directory name.

## 6. Misc. Info

### 6.1. Self Guiding

Self guiding function is under development. If you are brave enough to try it:

1. first take test image with TL command
2. decide band (g r i) and guide star to use
3. set 3 parameters: band, star position (x, y) with the command  
guidepar band x y

ex.

guidepar g 231 190

4. use Lo command with mode 9 instead of mode 6:

Lo 9 60 NGC1234 30

You may want to edit "/usr/local/tripol/telguide.sh" file to get guiding works well.

### 6.2. About CCD Temperature

It may be better to cool down CCD chips gradually to avoid dew condensation. I don't know whether it also applies to warming up.

CCD temperatures should not be changed during whole night.

CCD cooling power (most right value of "print\_temp -s") should not reach to 100% during observation, otherwise the CCD temperature will fluctuate.

It seems that r' band CCD camera lacks of cooling power compare to g', i' camera. You might set the r' CCD temperature higher than g', i' CCD, 3-4 degrees. For example,

set\_temp -10

ccd1 r settemp -6 (not "set\_temp")

these 2 commands set temperatures of g', i' camera to -10 degree and that of r' to -6 degree.

### 6.3. Re-connection of CCD camera

If the control PC has not been shut down from last night, you don't need "start\_ccd"; but if you have shut down CCD cameras, you need to tell CCD control software to re-connect CCD cameras by

ccd3 relinkccd

and ignore "OS error" message.

### 6.4. Afterimage

If you take images of bright star which cause saturation (image count of 65535), you will see afterimages after those frames. Levels are very little, but are obvious especially long time dark frames such as 60 seconds. I don't know why this occurs. Are there any way to avoid it?