# Guider interface using Raspberry Pico

Warning: Please be careful when interfacing to your telescope. I cannot be responsible for any damage caused due to errors either due to your wiring etc or this software. I have tested this on my LX10.

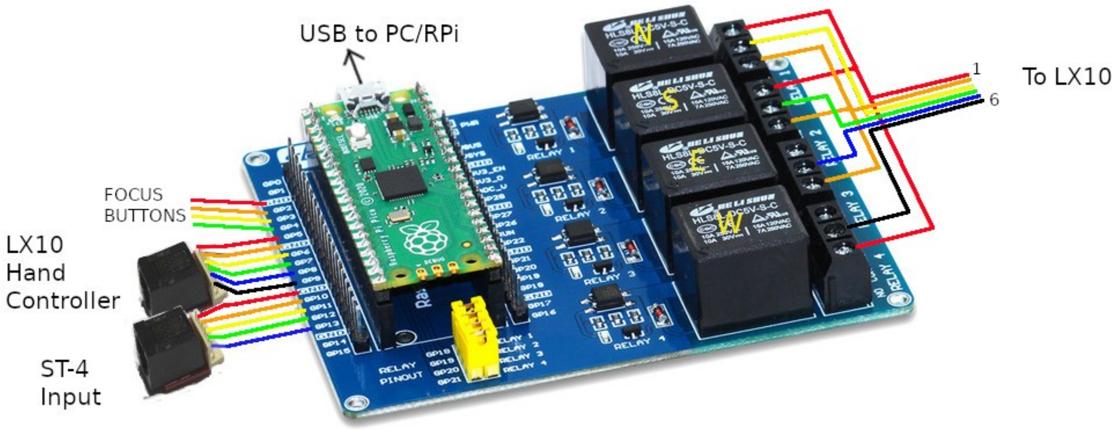
This interface enables guiding using guiding software such as PHD2 on a Pc, or my software for a Raspberry Pi. Communications between the PC / RPi and Pico is via USB. The interface also gets its 5v from the USB. Install main.py into the RP PICO

It can be interfaced to a ST-4 or other types of mount. Details are provided for connection to a ST-4 or Meade LX10. The ST-4 interface uses a 4-channel Phototransistor Output Optocoupler, the ILQ74. The Meade LX10 uses either mechanical or solid state relays.

There is also an option to use a PWM control for the LX10 but this is entirely experimental. This replaces the existing drive circuitry (not physically , it is simply switched off and the interface connected through the front panel port).

You will need to provide the interface from the Pico to the telescope/mount port. The Pico provides 4 outputs for N,S,E & W (Dec +,Dec -,RA- & RA+). These are +3.3v when active (although this can be inverted in the Micropython code for active low relay boards), note many boards available are for Arduinos requiring 5v so may not work with the Pico.

Here is one example of an available board that should work as it uses the same GP outputs, connect as shown in the generic relay interface.



Parts:
https://thepihut.com/products/raspberry-pi-pico
https://thepihut.com/products/male-headers-for-raspberry-pi-pico
https://thepihut.com/products/raspberry-pi-pico-with-pre-soldered-headers
https://thepihut.com/collections/pico/products/raspberry-pi-pico-relay-board
https://proto-pic.co.uk/product/sparkfun-bob-14021-rj11-breakout/
https://proto-pic.co.uk/product/sparkfun-prt-00132-rj11-6-pin-connector/
https://proto-pic.co.uk/product/sparkfun-prt-10366-jumper-wire-0-1-6-pin-4/
https://proto-pic.co.uk/product/sparkfun-prt-10371-jumper-wire-0-1-6-pin-6/
https://proto-pic.co.uk/product/sparkfun-prt-10365-jumper-wire-0-1-5-pin-4/

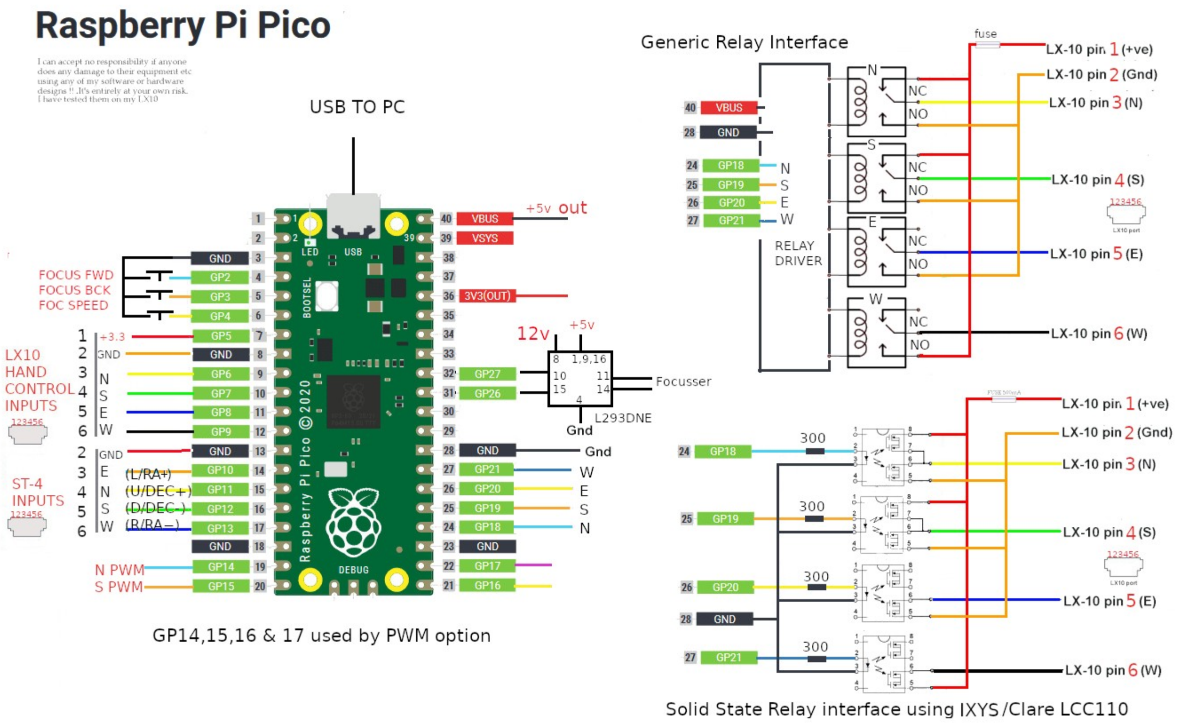
## Programming the Pico

**https://magpi.raspberrypi.org/articles/programming-raspberry-pi-pico-with-python-and-micropython**

**https://www.raspberrypi.org/documentation/rp2040/getting-started/#getting-started-with-micropython**

**https://datasheets.raspberrypi.org/pico/raspberry-pi-pico-python-sdk.pdf**

## Wiring schematic using relays.



You can connect a LX10 hand controller into the Pico to also provide manual control. There are also ST-4 control inputs, or you could make your own hand controller using 4 push buttons from the ST-4 inputs to gnd. You can also add 3 buttons for Focus control, driving a Meade #1209, and the L293DNE and feed it from 12v.

I have tested it with PHD2  v2.6.9, ASCOM Platform 6.5.SP1 and drivers for Meade LX200 Classic and Autostar #494, #495, and #497.

https://openphdguiding.org/
https://ascom-standards.org/Downloads/Index.htm
https://ascom-standards.org/Downloads/ScopeDrivers.htm

## My Raspberry Pi Autoguide Software:

https://github.com/Gordon999/Pi-AG_Lite
https://github.com/Gordon999/Pi-AutoGuider

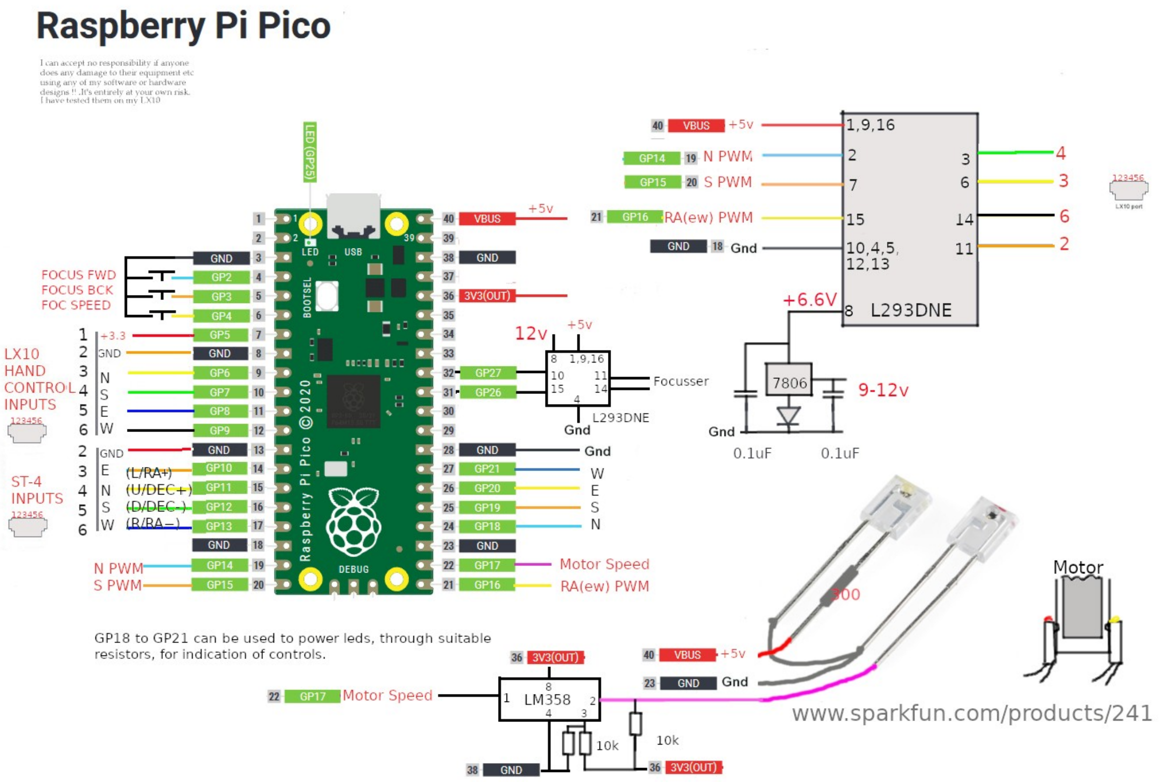
**There is also the option to try using PWM to drive the LX10.  This is for experimenting and is not proven to be sufficiently stable for astrophotography yet. At your own risk !!.**

To provide motor speed detection you need to fit a led transmitter and detector to the motor in the LX10, which involves drilling a hole in the motor. This was a modification proposed by Mark on the LX10 forum.

It provides a PWM signal to power the RA motor at the required rate, and by monitoring the motor speed can maintain a constant rate (set for 20.89Hz). It also provides PWM for the DEC motor.

PWM is disabled in the software as supplied, simply change it to pwm_on  = 1 to enable.

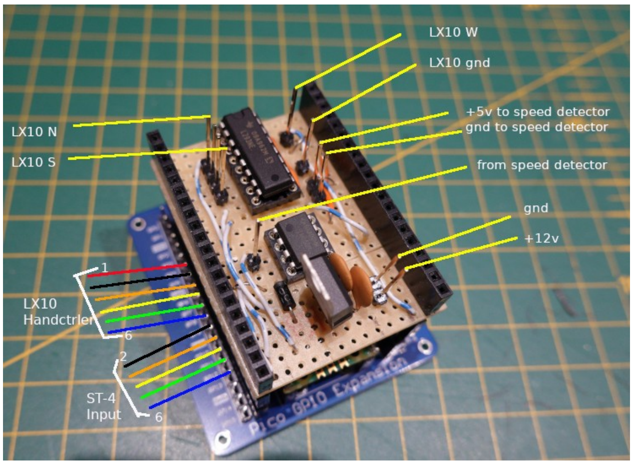
The outputs from the L293DNE are connected to the LX10 port. <u>ENSURE the LX10 is switched OFF.</u>
This can also be controlled by PHD2 etc.



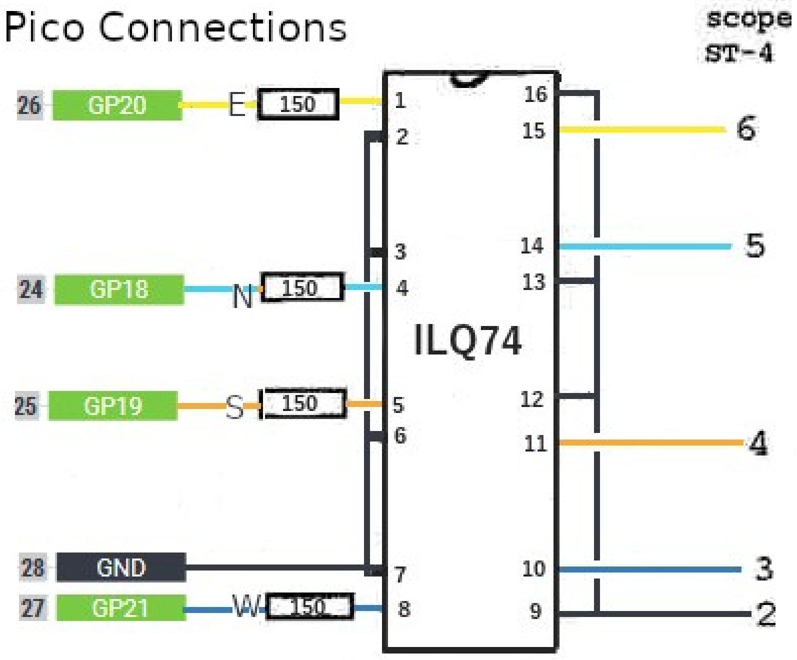
I can accept no responsibility if anyone does any damage to their equipment etc using any of my software or hardware designs !! .It's entirely at your own risk. I have tested them on my LX10

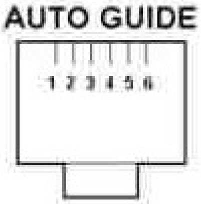
GP18 to GP21 can be used to power leds, through suitable resistors, for indication of controls.

<u>PWM Prototype</u>



**ST-4 output interface (NOT FOR LX10).**





| Auto Guide Port Pins | Function |
|---|---|
| 1 | Not connected |
| 2 | Ground |
| 3 | Move RA Positive |
| 4 | Move Dec Positive |
| 5 | Move Dec Negative |
| 6 | Move RA Negative |

<u>LX200 ASCII Commands between PC/RPi and Pico.</u>

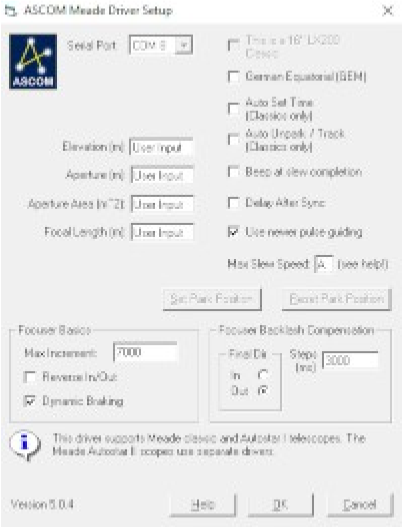
**:Mx** move in required direction, where x = n,s,e or w. eg. **:Mn**
**:MgxYYYY** move in required direction for a required period where x = n,s,e or w and Y = 0000 to 9999. eg **:Mgn1000** move North for 1 second.
**:Qx** quit move, where x = n,s,e,w or # (all). eg. **:Qn**

<u>If Meade #1209 focusser fitted (and L293DNE interface):</u>
**:F+,:F-** Focus forward / backward
**:FQ** Stop Focussing
**:FP+XXXXX, :FP-XXXXX** Focus Forwards / Backwards for XXXXX mSeconds eg. :FP+01000
**:FS,:FF,:F1 to :F4** Set Focus speed SLOW,FAST or 1 to 4

The following commands are also acknowledged to enable connection with PHD2:
**:GR,:GS,:GW,:AT0,:GD,:GA,:Gt,:GVT,:GVP,:GVF,:GVN,:GVD,:?+**

**<u>Connecting to PHD2 on a Windows 10 PC.</u>**

Run PHD Guiding 2
Click on **Guide** and **Connect Equipment** and choose the required **Serial Port**. (Use Device Manager to find it if unknown). Click on **OK**



ASCOM Meade Driver Setup

Serial Port: COM 8

☐ This is a 16" LX200 Classic
☐ German Equatorial (GEM)
☐ Auto Set Time (Classics only)
☐ Auto Unpark / Track (Classics only)
☐ Beep at slew completion
☐ Delay After Sync
☑ Use newer pulse guiding

Elevation (m): User input
Aperture (m): User Input
Aperture Area (m^2): User Input
Focal Length (m): User Input

Max Slew Speed: 4 (see help!)

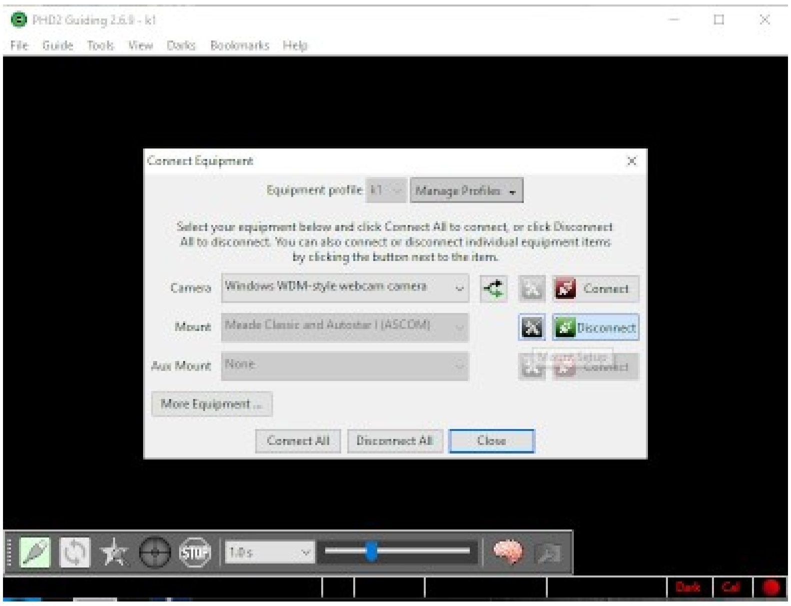
Focuser Basics: Max Increment: 7000; ☐ Reverse In/Out; ☑ Dynamic Braking

Focuser Backlash Compensation: Final Dir: In ○ Out ●; Steps (ms): 3000

This driver supports Meade classic and Autostar I telescopes. The Meade Autostar II scopes use separate drivers.

Version 5.0.4

Choose the **Meade Classic and Autostar 1 (ASCOM)** Mount (assuming you have installed the driver) and click **Connect.** Click **Close** if successfully connected.



PHD2 Guiding 2.6.8 - k1

Connect Equipment

Equipment profile: k1

Select your equipment below and click Connect All to connect, or click Disconnect All to disconnect. You can also connect or disconnect individual equipment items by clicking the button next to the item.

Camera: Windows WDM-style webcam camera
Mount: Meade Classic and Autostar I (ASCOM)
Aux Mount: None

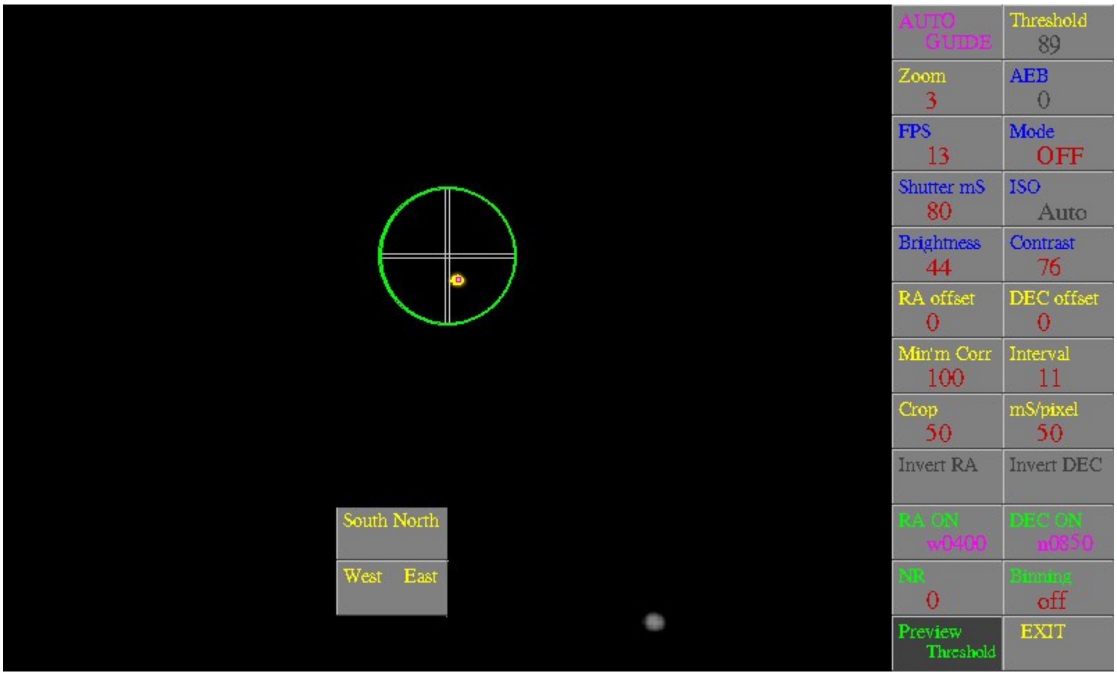
To test click on **Tools** and then **Manual Guide**, then click on **North, South, East or West** and listen for the scope moving.

## Using Pi_AG_Lite (PiAGL.py) on a Raspberry Pi for guiding

Copy PiAGL.py into '/home/pi' on the Raspberry Pi.
Install opencv with 'sudo apt install python3-opencv'

Python3 PiAGL.py to run.

You can use a Pi Camera or a Philips 740/900 USB webcam * attached to your guidescope.
Connect the pico to a USB port on the Pi. It should appear as '/dev/ttlAMC0'.
*(* Note there is an issue with RaspiOS and Philips webcams, you need to carry out a sudo rpi-update for them to work, hopefully this will be fixed in future RaspiOS updates)*
To test the connection click on North/South/West/East and look for the telescope moving.



| | |
|---|---|
| AUTO GUIDE | Threshold 89 |
| Zoom 3 | AEB 0 |
| FPS 13 | Mode OFF |
| Shutter mS 80 | ISO Auto |
| Brightness 44 | Contrast 76 |
| RA offset 0 | DEC offset 0 |
| Min'm Corr 100 | Interval 11 |
| Crop 50 | mS/pixel 50 |
| Invert RA | Invert DEC |
| RA ON w0400 | DEC ON n0850 |
| NR 0 | Binning off |
| Preview Threshold | EXIT |

Screenshot using a Pi Camera.

There are various parameters that can be adjusted.

For the Pi camera: **AEB, FPS, Mode, Shutter mS, ISO, Brightness & Contrast.**

For the Philips webcams: **Gain,Gamma, Exposure, Auto Gain, Brightness & Contrast.**

**South, North, West & East,** send short (250mS) corrections.

**AUTO GUIDE**, switches guiding ON/OFF
**Threshold**, sets detection threshold for pixels. 0 for Auto
**Zoom,** Zoom image in / out
**RA & DEC offsets**, moves image to allow centering on screen
**Minimum Correction**, no correction will be made below this level
**Interval**, determines when corrections sent , timed in video frames

**Crop**, sets size of window for detection
**mS/Pixel,** how much the scope is moved for each pixel correction required
**Invert RA & DEC**, invert corrections if required
**RA & DEC ON**, switch these on/off if required
**NR**, noise reduction
**Binning**, 2x2, 3x3 etc for low levels of brightness
**Preview Threshold**, displays detected pixels
**EXIT**, exit script

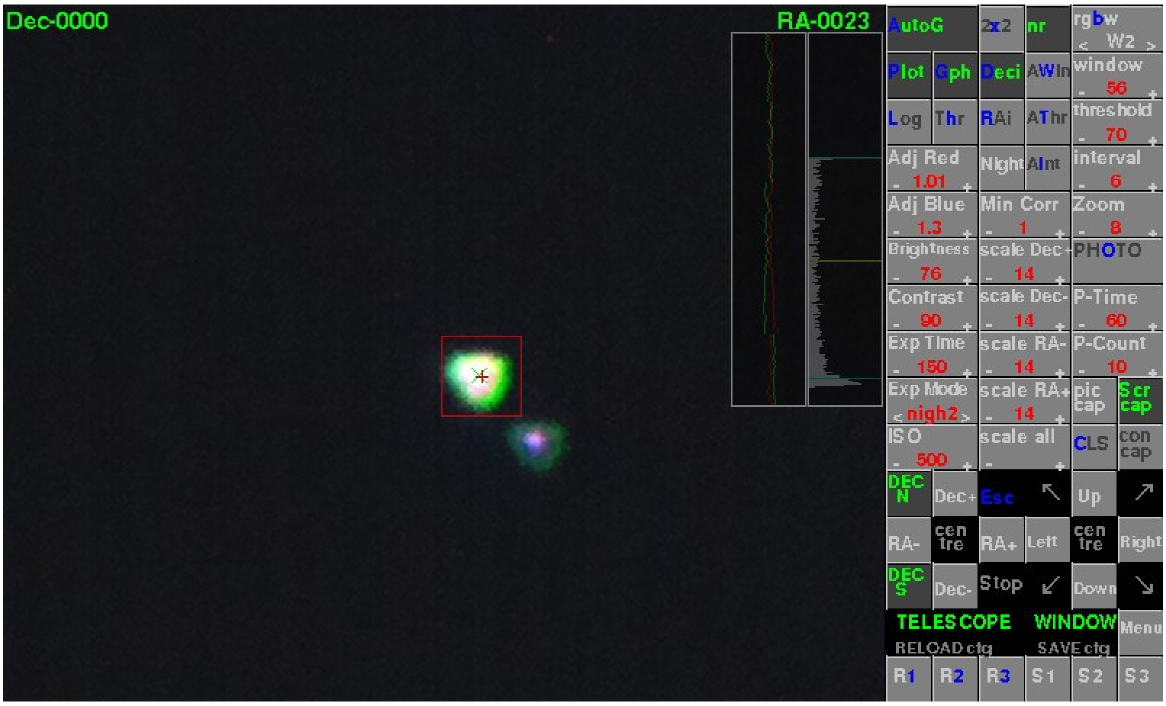
## Using Pi_Autoguider (PiAG.py) on a Raspberry Pi for guiding

Copy PiAGL.py into '/home/pi' on the Raspberry Pi.

Change 'serial_connected = 1'

Python3 PiAG.py to run.

You can use a Pi Camera or a Philips 740/900 USB webcam * attached to your guidescope. Connect the pico to a USB port on the Pi. It should appear as '/dev/ttlAMC0'.
*(* Note there is an issue with RaspiOS and Philips webcams, you need to carry out a sudo rpi-update for them to work, hopefully this will be fixed in future RaspiOS updates)*



Dec-0000
RA-0023
rgbw W2
window 56
threshold 70
Adj Red 1.01
interval 6
Adj Blue 1.3
Min Corr 1
Zoom 8
Brightness 76
scale Dec+ 14
Contrast 90
scale Dec- 14
P-Time 60
Exp Time 150
scale RA- 14
P-Count 10
Exp Mode nigh2
scale RA+ 14
ISO 500
scale all