

Flip Bahtinov mask & lamp assembly instructions

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11/19/17

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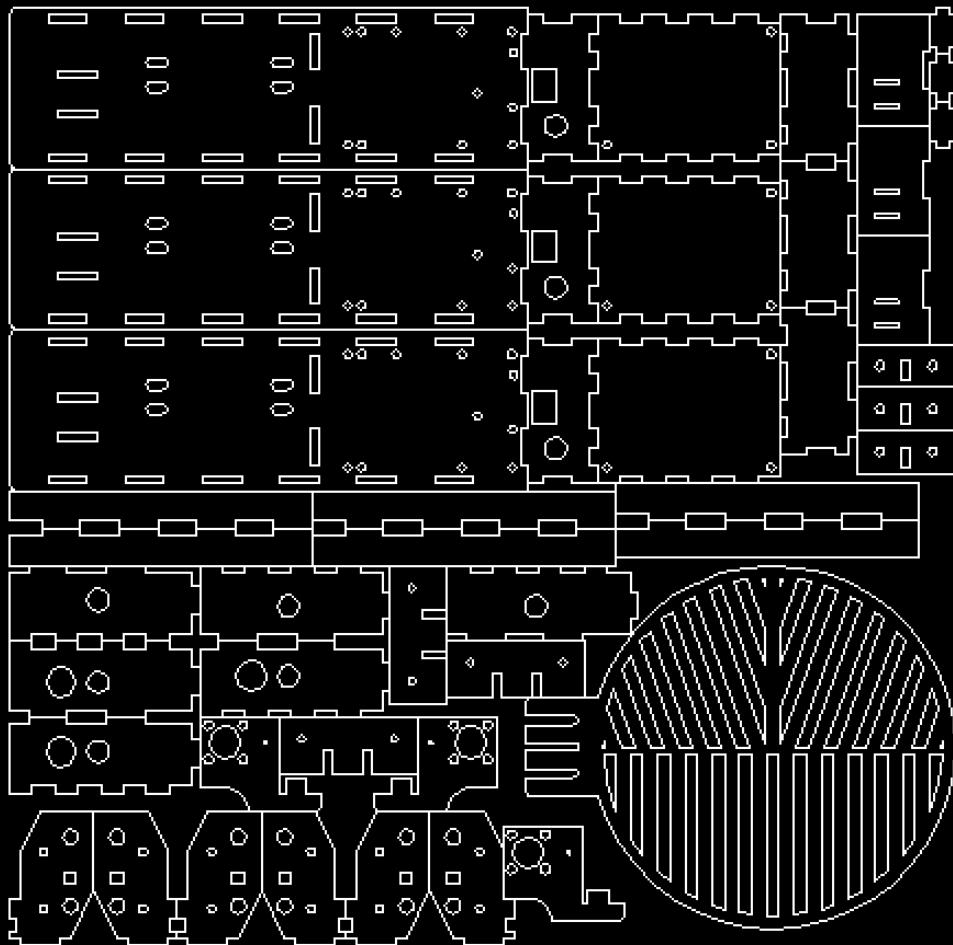
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Assembly instructions

- These instructions will only highlight the important parts of the assembly.
 - The assembly is quite straightforward, but as usual, there are some parts of the assembly that need a little bit of care and feeding.
 - All the required parts are listed in the bill of materials.
 - All the plastic parts required to build the flip mask and lamp have been laser cut from 3 mm thick black acrylic.
 - Some reinforcement is required with aluminium plates.
 - All the parts are either cemented together or bolted together.

Laser cut the flip mask and lamp parts

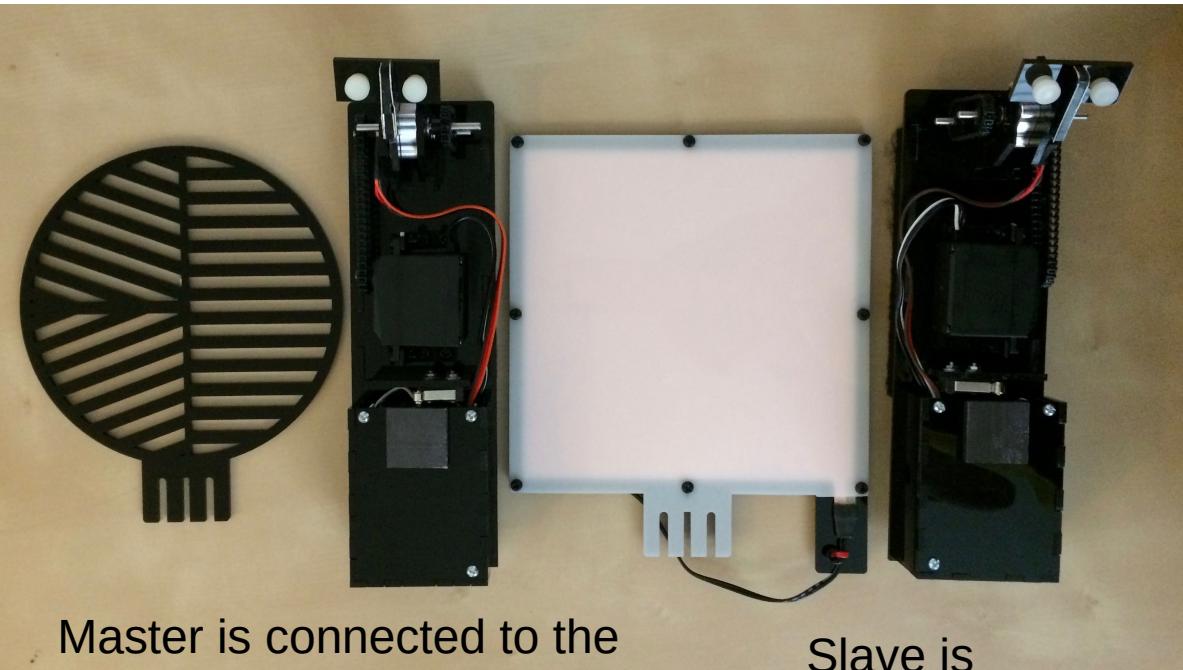


The flip mask and lamp parts are made using the design that is in the ponoko directory of this distribution.

The lamp is made from a sandwich of delrin, electro-luminescent panel and acrylic.

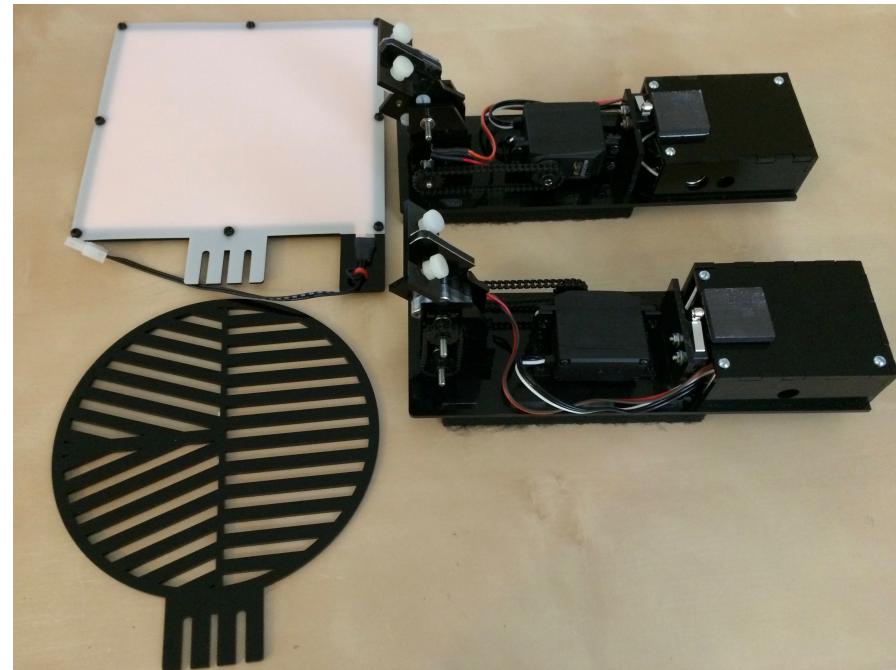
There are sufficient parts to make one complete set of flip mask and lamp controller. The remaining parts can make up either one flip mask or lamp controller.

Completed flip mask and lamp pair



Master is connected to the Bahtinov mask

Slave is connected to the lamp



The completed mask and lamp pair consists of a pair of master and slave controllers. The master controller is connected to the Bahtinov mask while the slave controller is connected to the lamp.

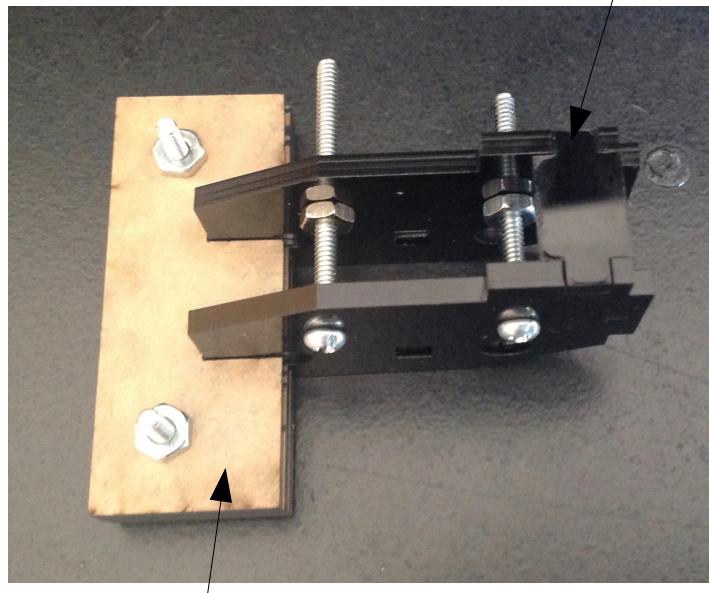
Notice that the master and slave units are mirror images of each other.

Making the tower

The tower



Cement cross piece to the tower pieces



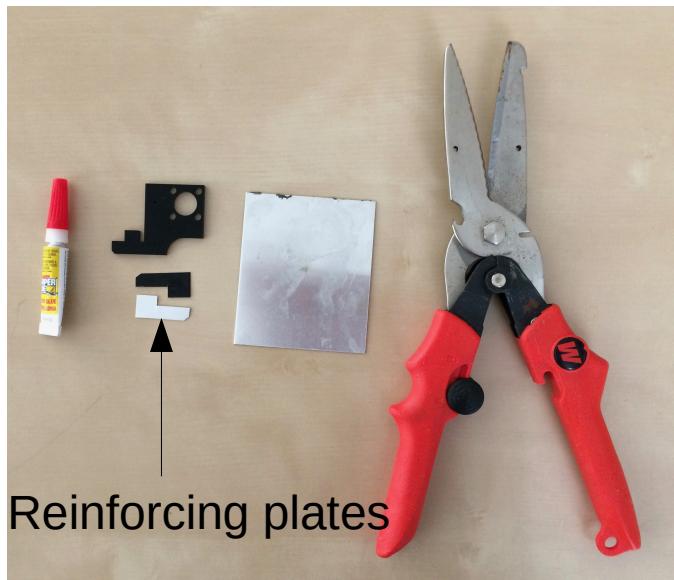
The supplied fixture is used to make sure the separation of the two tower pieces are correct



To make the tower, the distance between the two tower pieces have to be correct. This is done by bolting together the tower pieces with the separation determined by the supplied fixture. The fixture is bolted together using 3 laser cut pieces with 2 notches. These fixtures are part of the laser cut design shown on slide 3.

Cement is applied to the cross piece to join the tower pieces together.

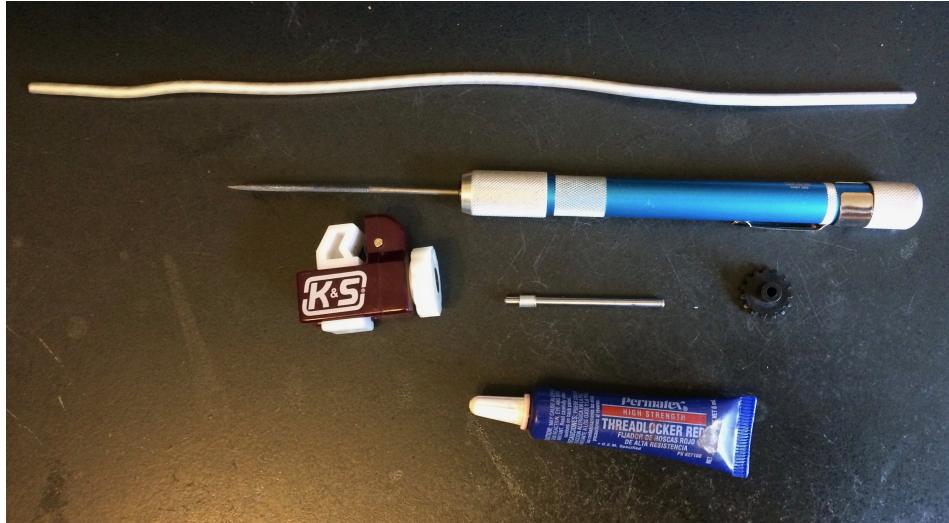
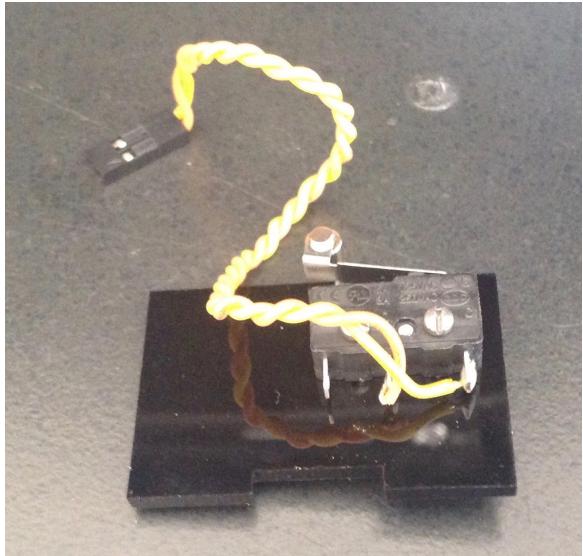
Reinforcing the paddle



The paddle has to be reinforced with aluminium plates. These plates are made from 0.5 mm thick aluminium sheet. These plates are superglued to the paddle.

Using clothes pegs
to hold the plates
while the glue dries.

The interlock switch and the axles

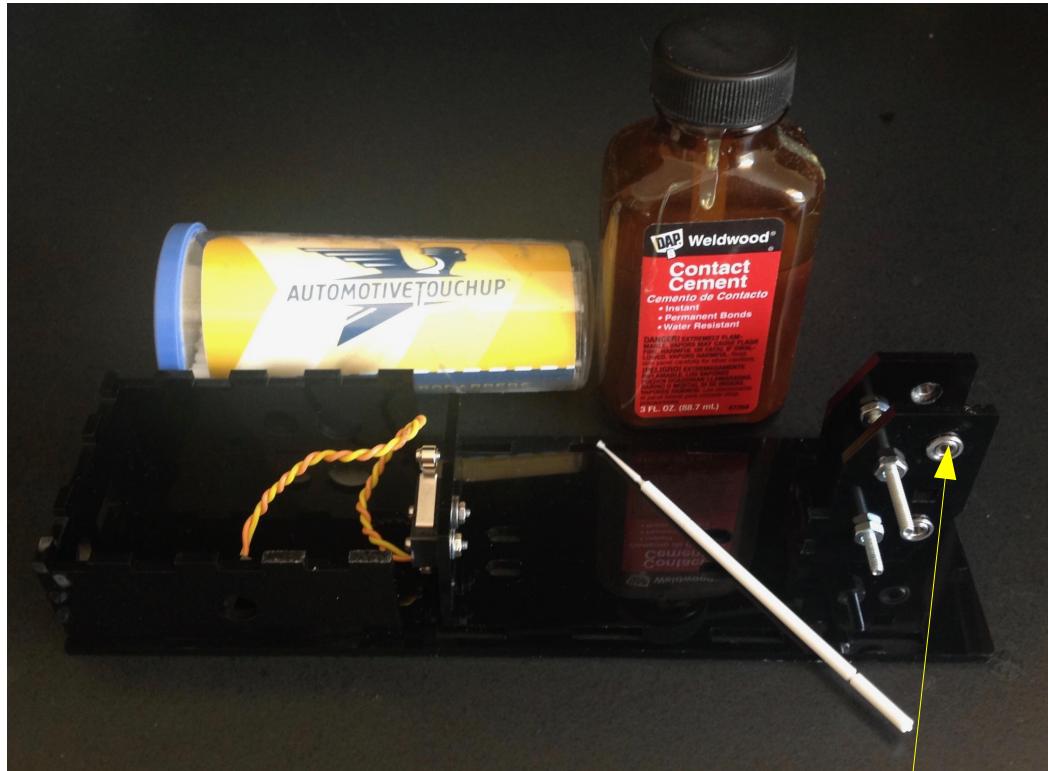


It's easier to install the interlock switch that indicates that either the mask or lamp is "off", i.e. in its stored position.

Make sure that the lever is in the middle of the mount.

The 1/8" stainless steel axles for the sprockets have to roughed up of with a file. The inside of the plastic sprocket has to roughed up as well. Once roughened, the thread locker can glue the sprocket to the axle securely. Spacers are made with 5/32" aluminium tubing.

Cementing the towers to the base and gluing the ball-bearings



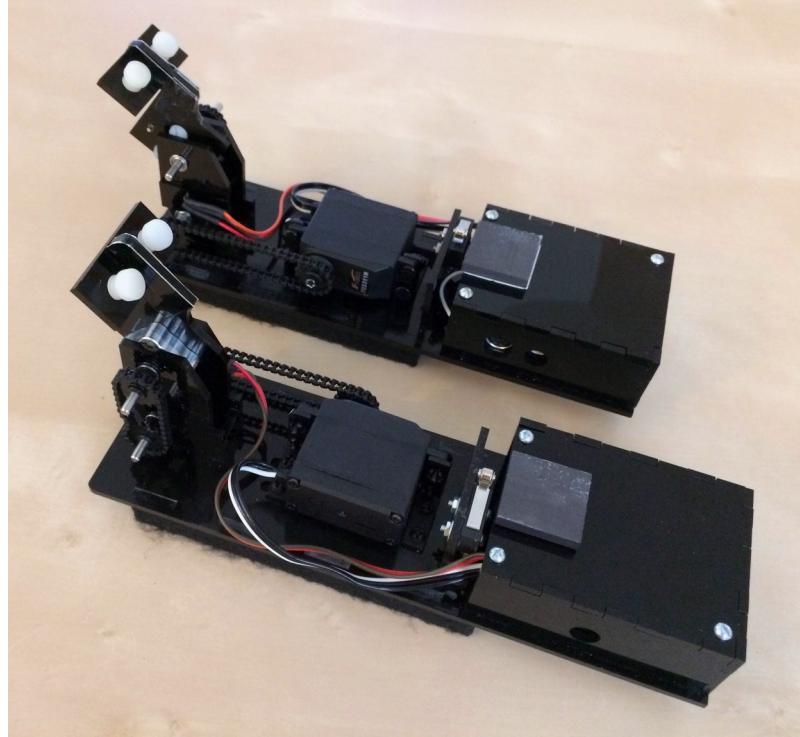
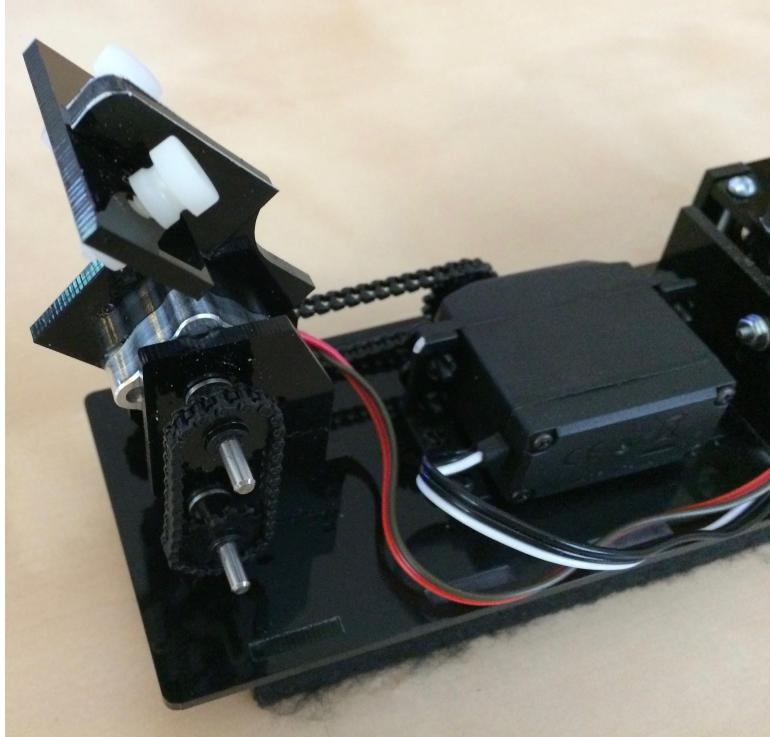
Ball bearings

The towers are cemented and the mount with the interlock switch are glued onto the base.

The bolts are left in the towers to keep them separated correctly. They are removed after the cement is dry.

The ball bearings are cemented with contact cement to the towers. Small micro brushes are used to apply the contact cement.

Glue sprockets and install chains

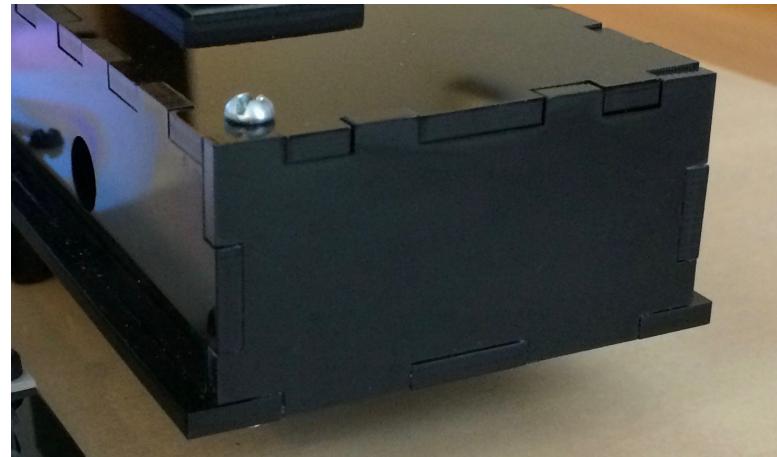


Glue the sprockets to the steel axles after making sure that the sprockets are aligned. Also make sure that the sprockets and chains on the slave is a mirror image of the master. The side of the telescope where the power for the lamp will be mounted determines the side where the slave will be installed. This in turn determines the direction the servo gear sticks out because it is recommended that the control cable between the master and slave be on the lower side when mounted on the telescope. See slide 17,

Back side of master and slave units



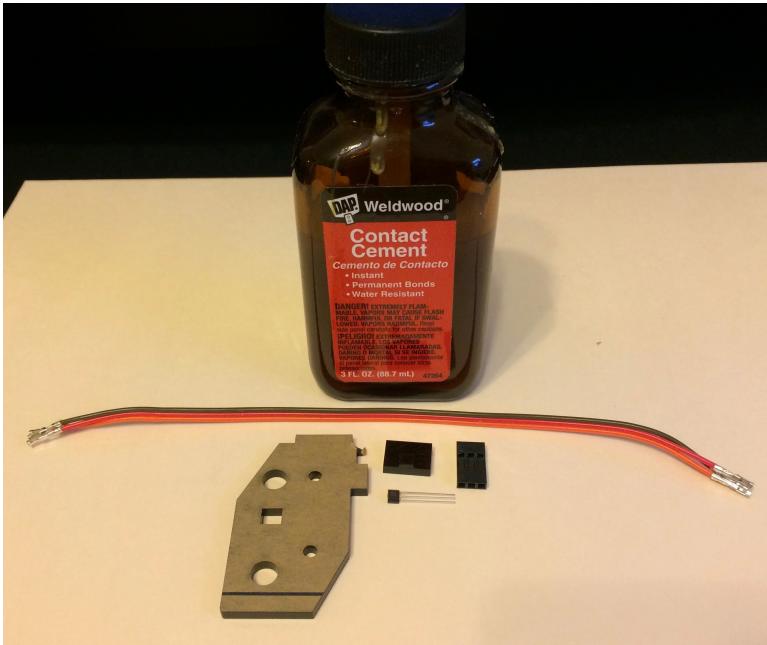
The master unit has the USB port and the input power port



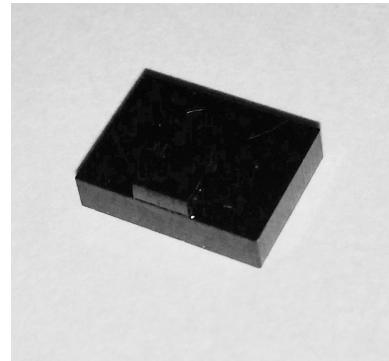
The back of the slave unit is blank

Both control units are mirror images except for the back side.

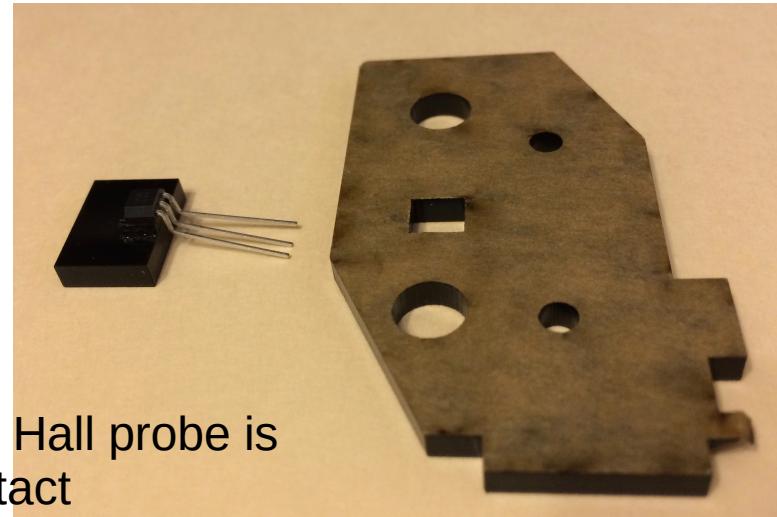
Mounting the Hall switch



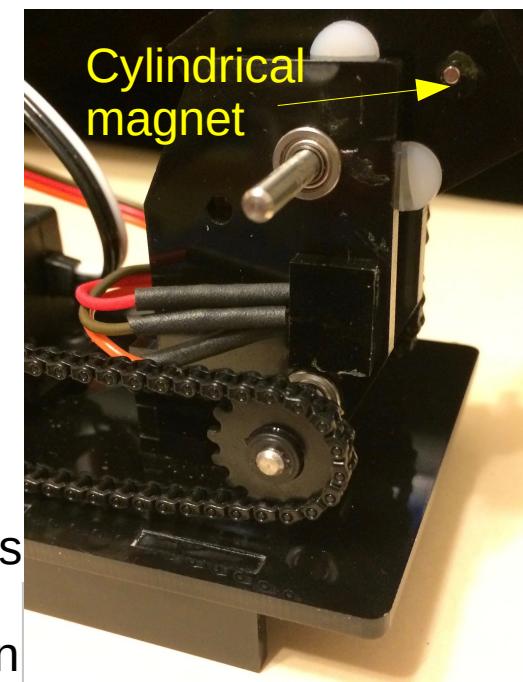
A mount has to be made for the Hall switch by cementing 2 blocks together from the laser cut pieces. The Hall switch is contact cemented to the Hall switch mount. The Tower piece square hole is used to make sure that the Hall switch is properly glued to the correct place on the Hall switch mount.



The Hall switch mount made from cementing 2 blocks together

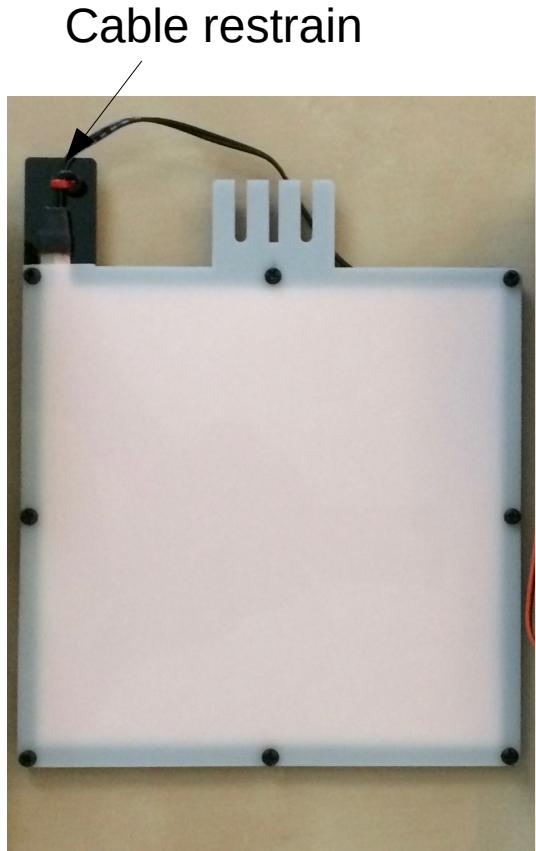


The Hall probe is contact cemented into the square hole with the Hall switch mount.



The cylindrical magnet is superglued into the paddle. The South pole has to be as close as possible to the Hall switch when closed.

Assembling the lamp



Cable restrain

The lamp is assembled as a sandwich with a Delrin front, electroluminescent (EL) panel, and acrylic back.

The EL panel has a cable that has to be restrained. This is done by knotting it to the cable tie that is attached to the acrylic back.

The sandwich is bolted together with nylon bolts.

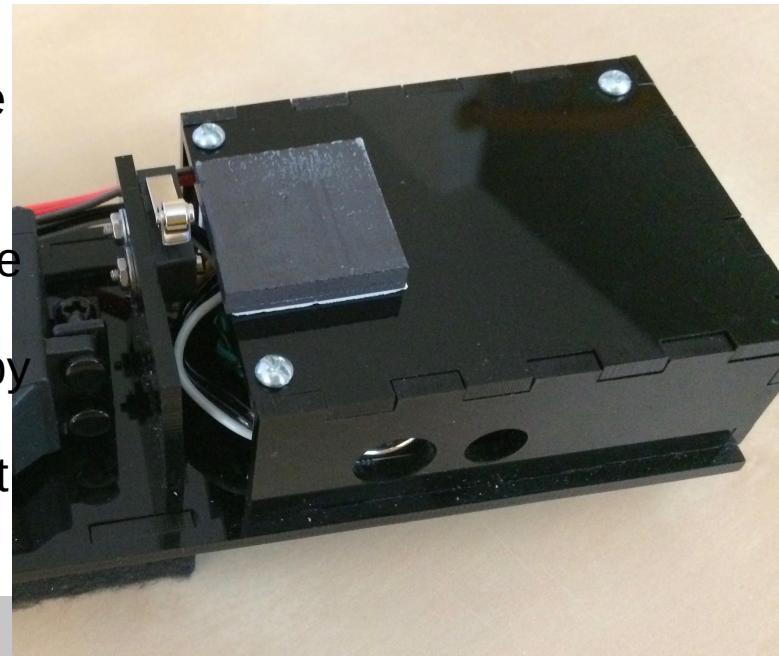
Magnetic holder



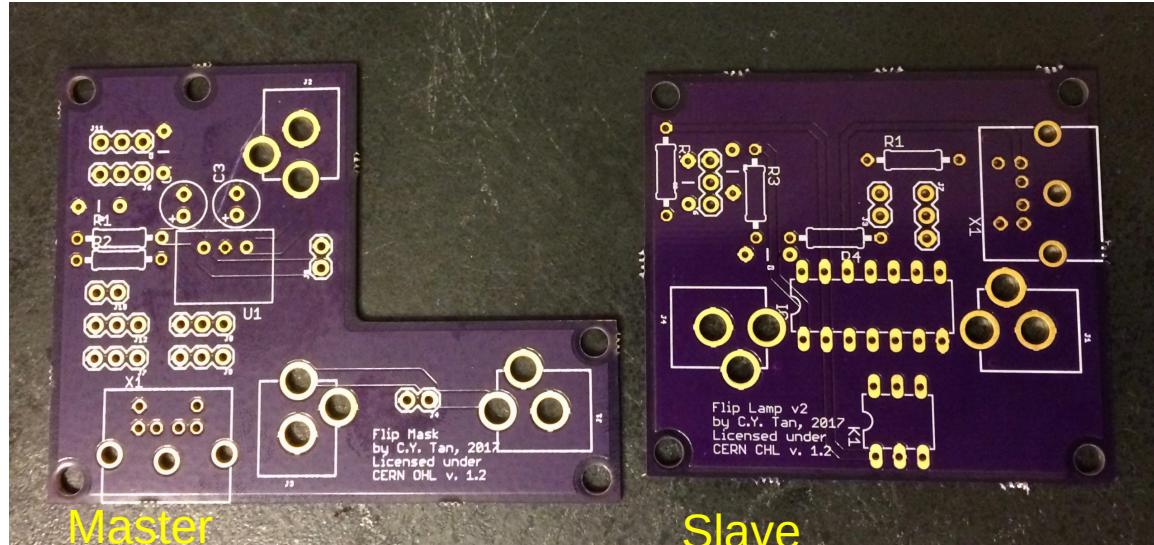
The metal is glued to the back of the mask and lamp.

A magnet is used to pull the mask or lamp down onto the interlock and to keep them properly retracted on the telescope.

Note: the magnet cannot be a rare earth magnet because the servo is not strong enough to pull the mask or lamp away from the magnet after the mask or lamp attracted by it. The craft magnet that is used is weak enough for the servo to pull the mask or lamp away from the magnet but strong enough to keep them from flopping about when retracted.



Electronics



The master and slave PCBs. Assemble according to the circuit diagram in the eagle directory of this distribution.

The master controller also contains the 6 channel Maestro servo controller. See
<https://www.pololu.com/product/1351>.

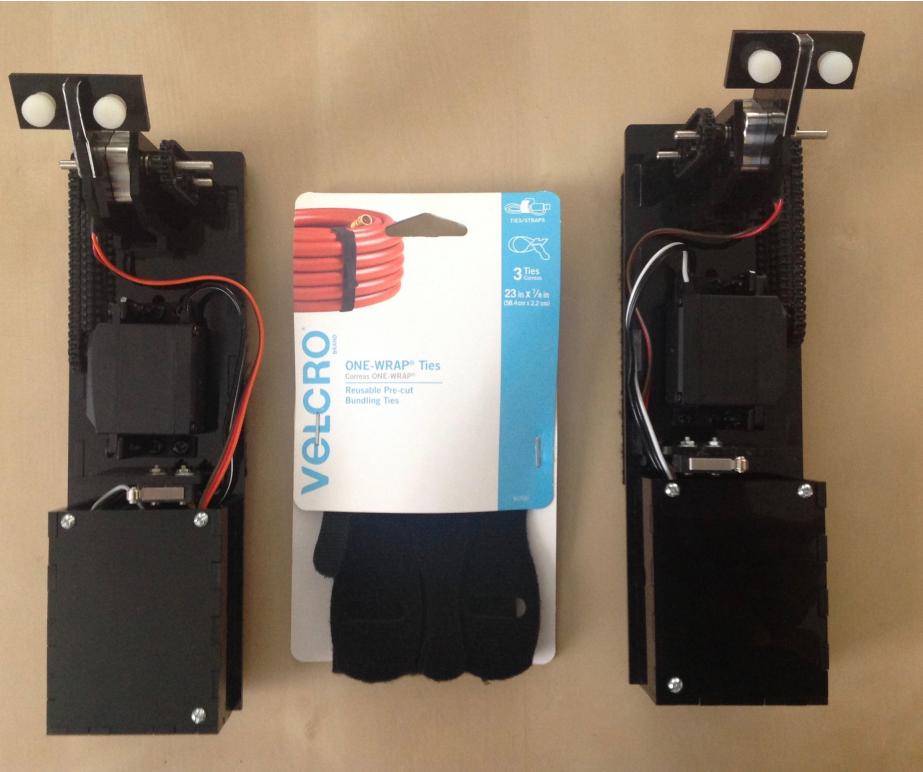
See slide 19 For setting up the maestro.

Felting the base

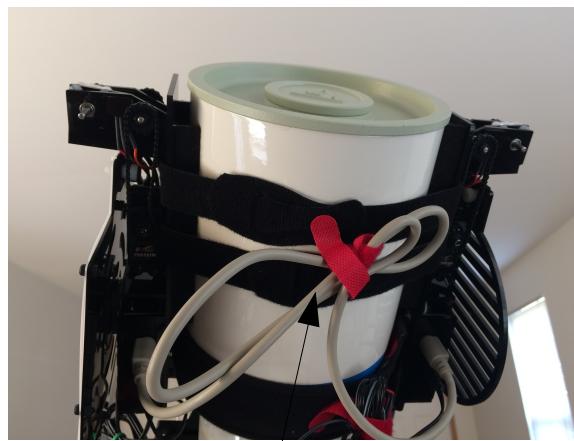


Both control units need to have felts glued to the base so that they do not scratch the telescope.

Mounting the flip mask and lamp



The master and slave control units are strapped to the telescope with velcro straps



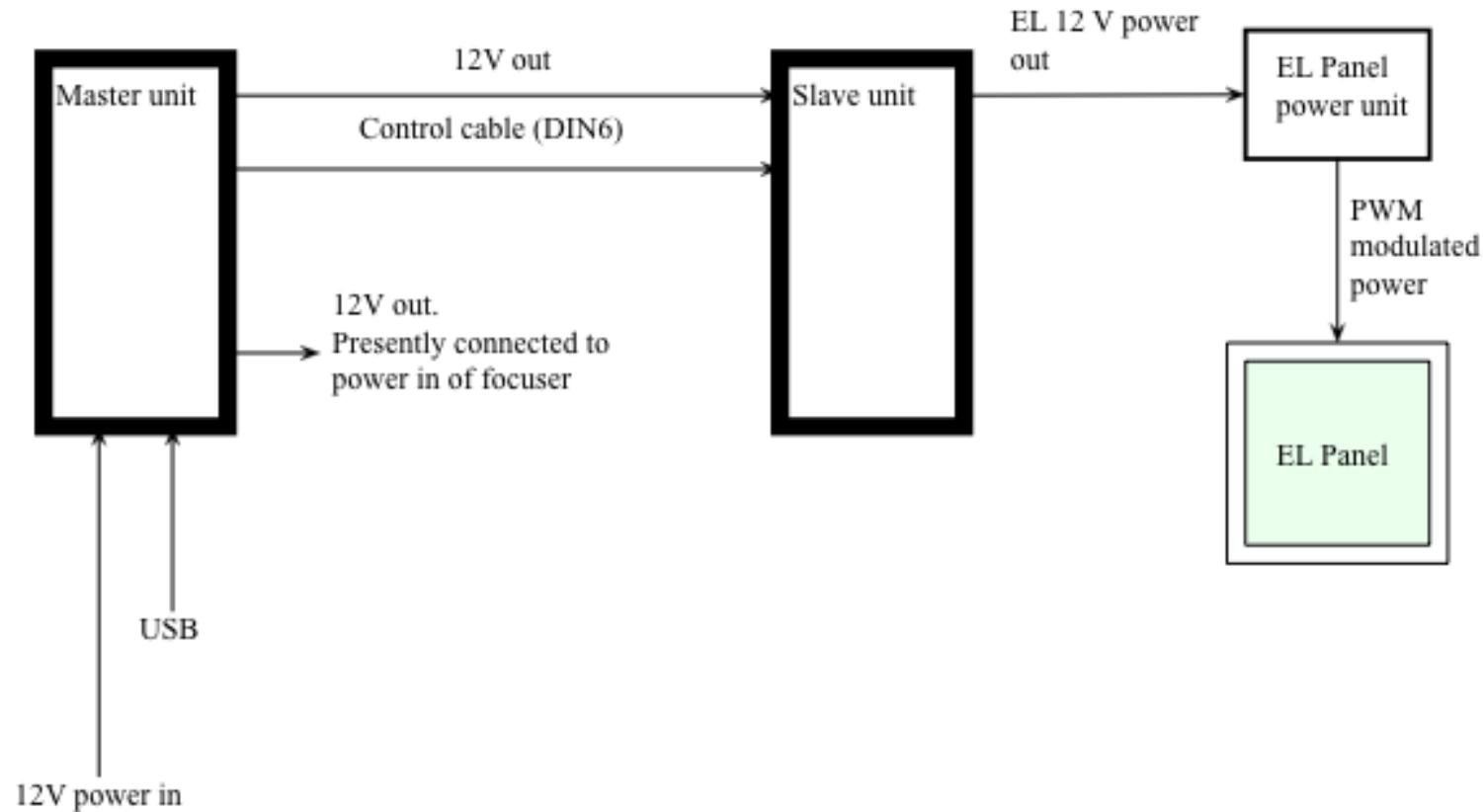
The control cable between the master and slave is on the lower side of the telescope



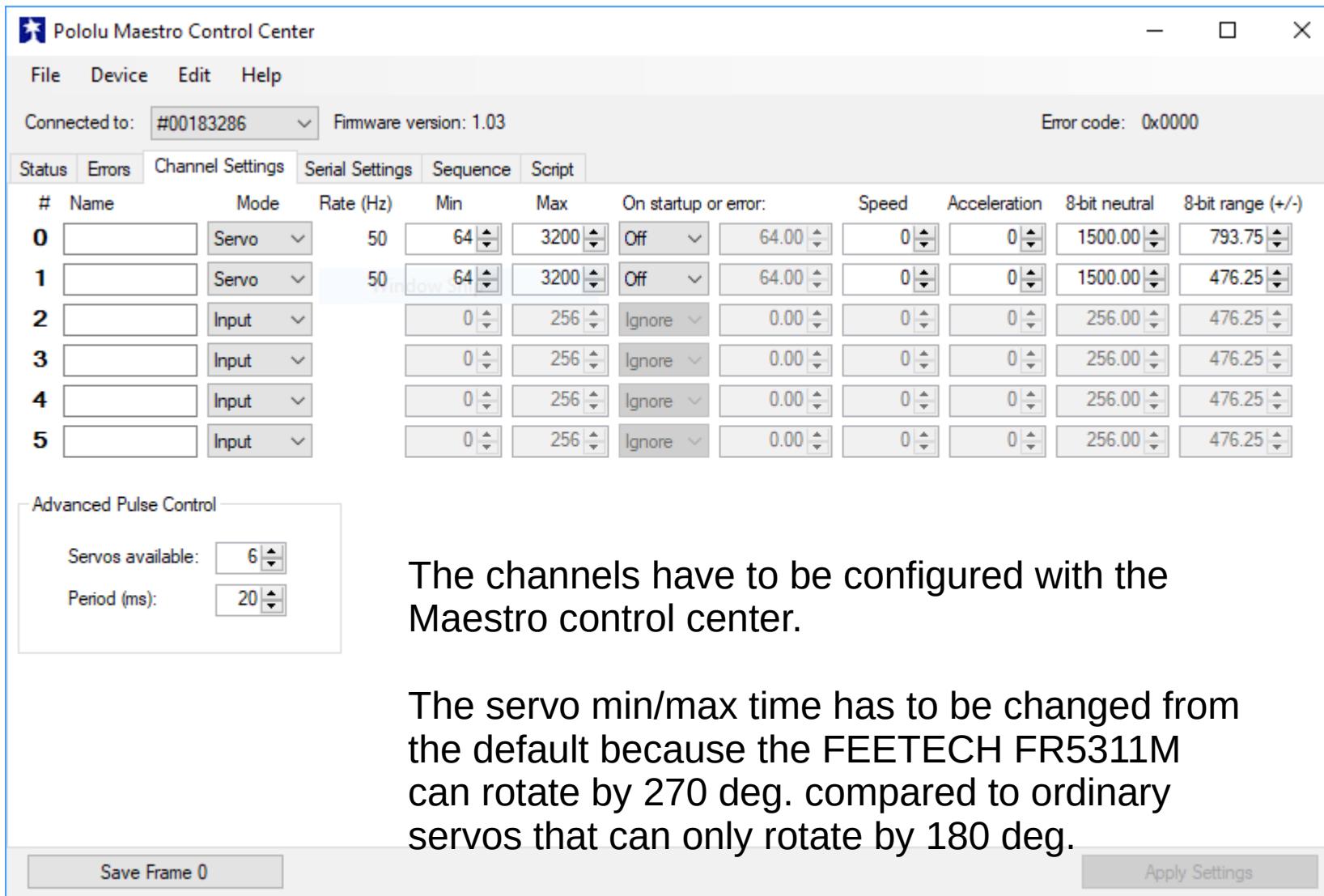
EL power supply with dimmer

The side where the slave unit is mounted is determined by the location of the EL power supply unit.

Cable and power connections



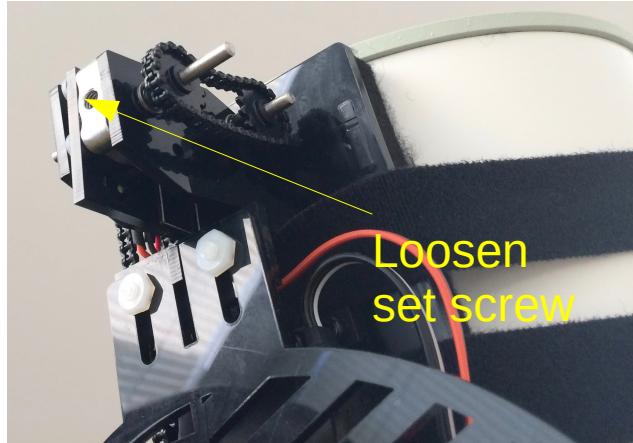
Setting up the Maestro



The channels have to be configured with the Maestro control center.

The servo min/max time has to be changed from the default because the FEETECH FR5311M can rotate by 270 deg. compared to ordinary servos that can only rotate by 180 deg.

Adjusting the position of the mask and lamp



To adjust the position of the mask on the telescope:

- 1) Setting the “off” position:
 - 1) Loosen the set screw to rotate the mask to rest on the magnet.
 - 2) Run the flipit.py program to set the motor to the “off” position.
 - 3) Then tighten the set screw.
- 2) Use the flipit.py program to set the mask to the “on” position
 - 1) Adjust the mounting screws, the velcro straps and position of the control unit so that the mask is flat at the front of the telescope.

Lamp assembly



This procedure is repeated with the lamp.

November 19, 2017

Flipit.py

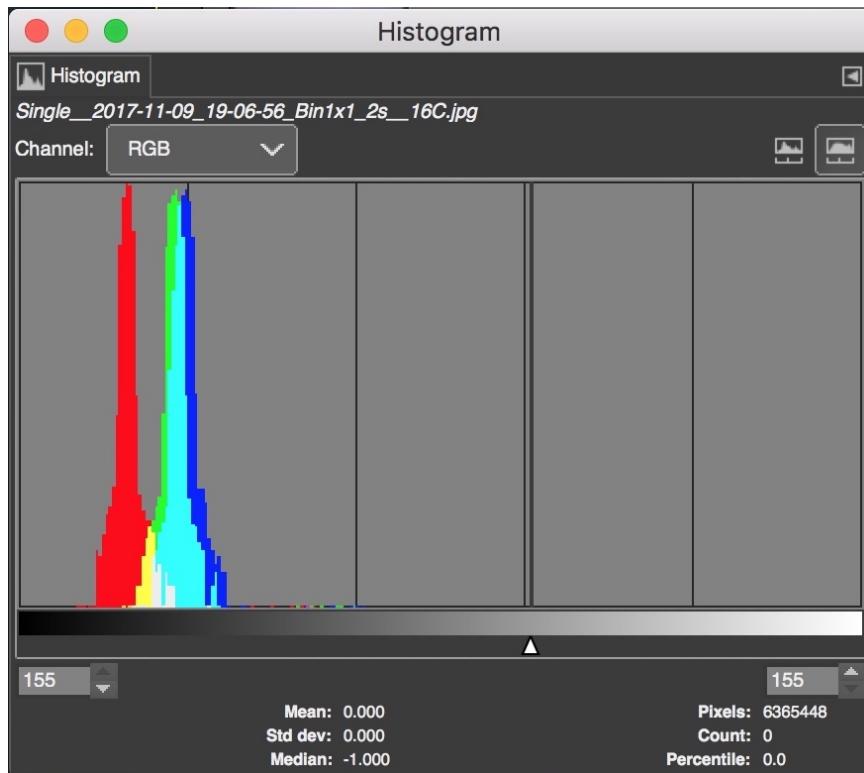
flipit.py is the python code that is used to control the flip mask and lamp.

For flipit.py to work on the Mac OSX Sierra, the firmware on the Maestro must be at least version 1.03:

- See <https://www.pololu.com/docs/0J40/4.f>
- flipit.py can only be run with python v3.
 - The maestro python library comes from <https://github.com/FRC4564/Maestro/>
 - The code has been tested on both Win10 and Mac OSX Sierra.

Addendum: Adding filters

I wasn't too happy with the spectrum of the EL panel seen by my SBIG STF8300C. See below:



The RED component of the flat is a lot weaker than the BLUE and GREEN components.

My solution is to add filter sheets to the EL panel so that all the colour components have the same strength.

Addendum: The filters

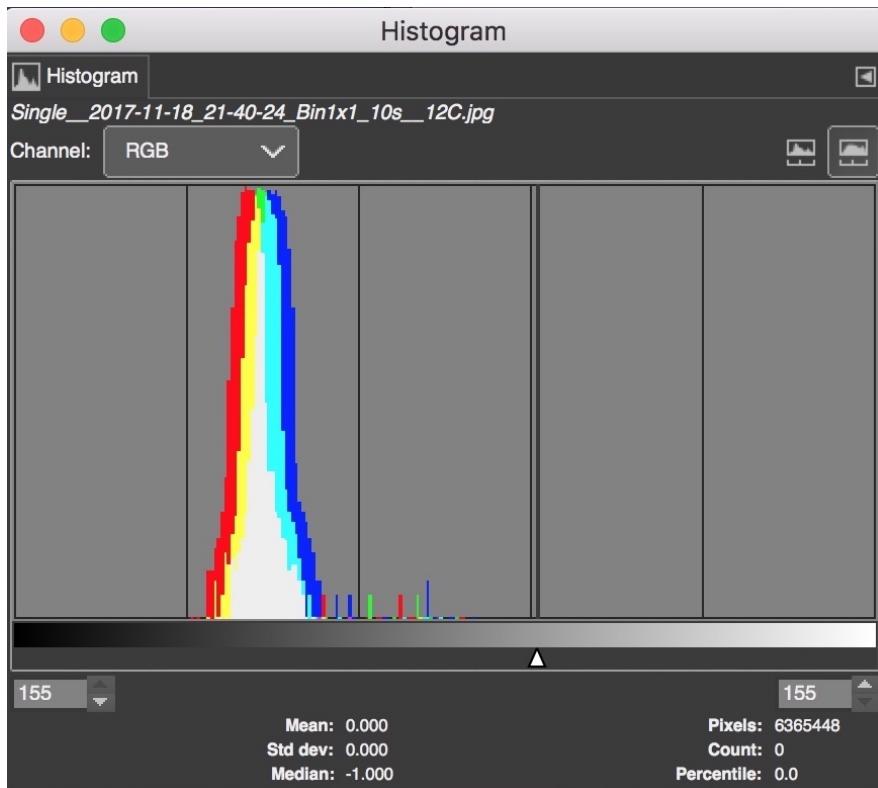
The filter sheets that I used are all from Roscolux:

- 1) Tharon Delft Blue R365
- 2) Pale Rose Pink R37
- 3) Light Salmon R40
- 4) Pale Yellow R07



Addendum: After adding filters

After adding the 4 filter sheets, the intensities of all the colour components become nearly the same:



The filtered spectrum clearly shows that all three components have near identical strengths.

However, the addition of the 4 filter sheets make the intensity 10 times lower. I had to increase the integration time from about 1 second to about 10 seconds per subframe to get the same integrated value before the filters were added.