Open source fiber coupled LED for in vivo optogenetics

Anders Asp

Tools

- Not pictured, but needed: heat gun (for shrink wrap), hot glue gun, multimeter (recommended), stereotax or micromanipulator, burette clamp.

LED Materials

ebay	1	5/pkg	XLamp XP-E Blue 470-475NM	http://www.ebay.com/itm/like/221250661683?lpid=82	$1.58
luxeon Star LEDs	1	each	LXT-S-12	Pre-Cut, Thermal Adhesive Tape for 20 mm Star LED Assemblies - (12 Piece Sheet)	$0.62
luxeon Star LEDs	1	each	LPD25-15B	25 mm Square x 15 mm High Alpha Heat Sink - 15.6 °C/W	$4.97
amazon	1	50/pk	B00CTQELTE	Phantom YoYo 50pcs Jumper Wire 200mm Male to Female + 40p Dupont Cable 200mm Male to Female	$7.98
thorlabs	1	meters	FP200URT	0.50 NA, Ø200 µm Core Multimode Fiber, High OH	$1.62/m
Plexon	1	each	40644-100	Patch cableOPT/PC-LC-LCF-200/230-1.0L KIT	$130.00
Thorlabs	1	piece	CFLC230-10	Ø1.25 mm Multimode LC Ceramic Ferrule, Ø230 µm Hole Size (10 Pack)	$4.90
Thorlabs	1	piece	LF1D	6" x 6" Diamond Lapping (Polishing) Sheet, 1 µm Grit (5 Sheets)	$8.00
Thorlabs	1	piece	LFG3P	13" x 9" Aluminum Oxide Lapping (Polishing) Sheet, 3 µm Grit (10 Sheets)	$1.35

Note: The Plexon patch cable works very well but is quite expensive. I just ordered some of the newly released .50NA thorlabs fiber and will see how well it works.

SwivelMaterials

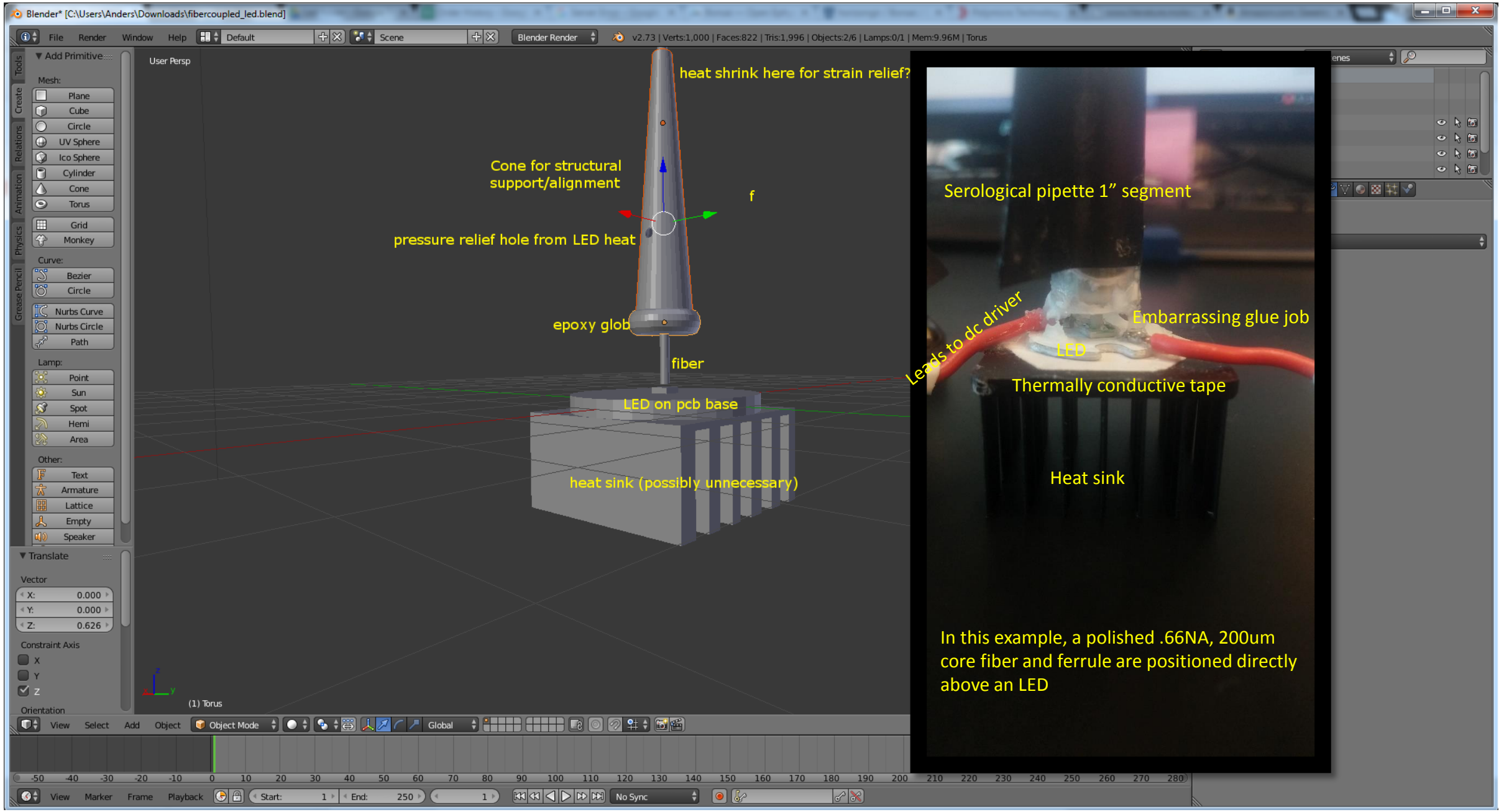
- Not pictured: hot glue, shrink wrap, solder

Cost - $17.50/unit
Usage – 1 per bilateral unit
Vendor - www.adafruit.com/products/775

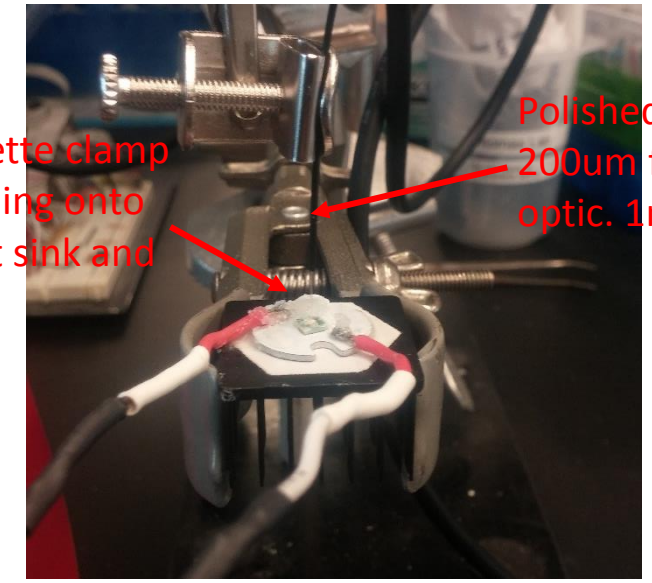
Cost - $5.47/unit
Usage – ~1/20th per bilateral unit
Vendor – Home Depot

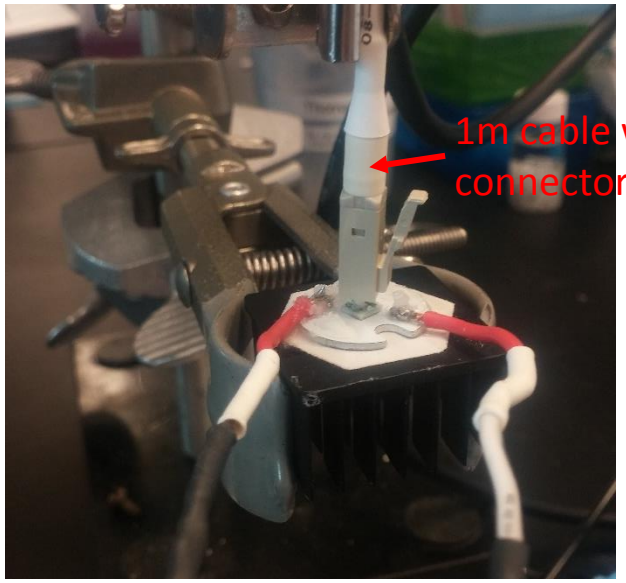
1/2 in. CPVC CTS Slip x MPT Male Adapter
Cost - $0.34/unit
Usage – 1 per bilateral
Vendor – Home Depot

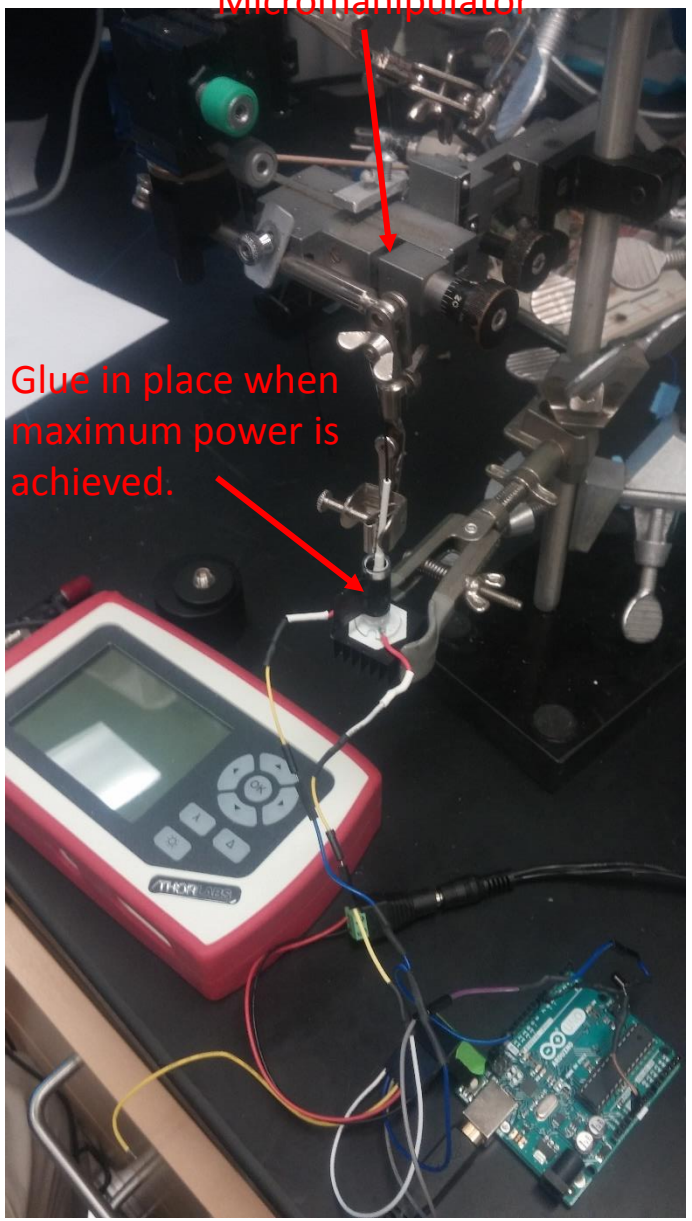
Exploded view of fiber coupled LED model



Align fiber with micromanipulator



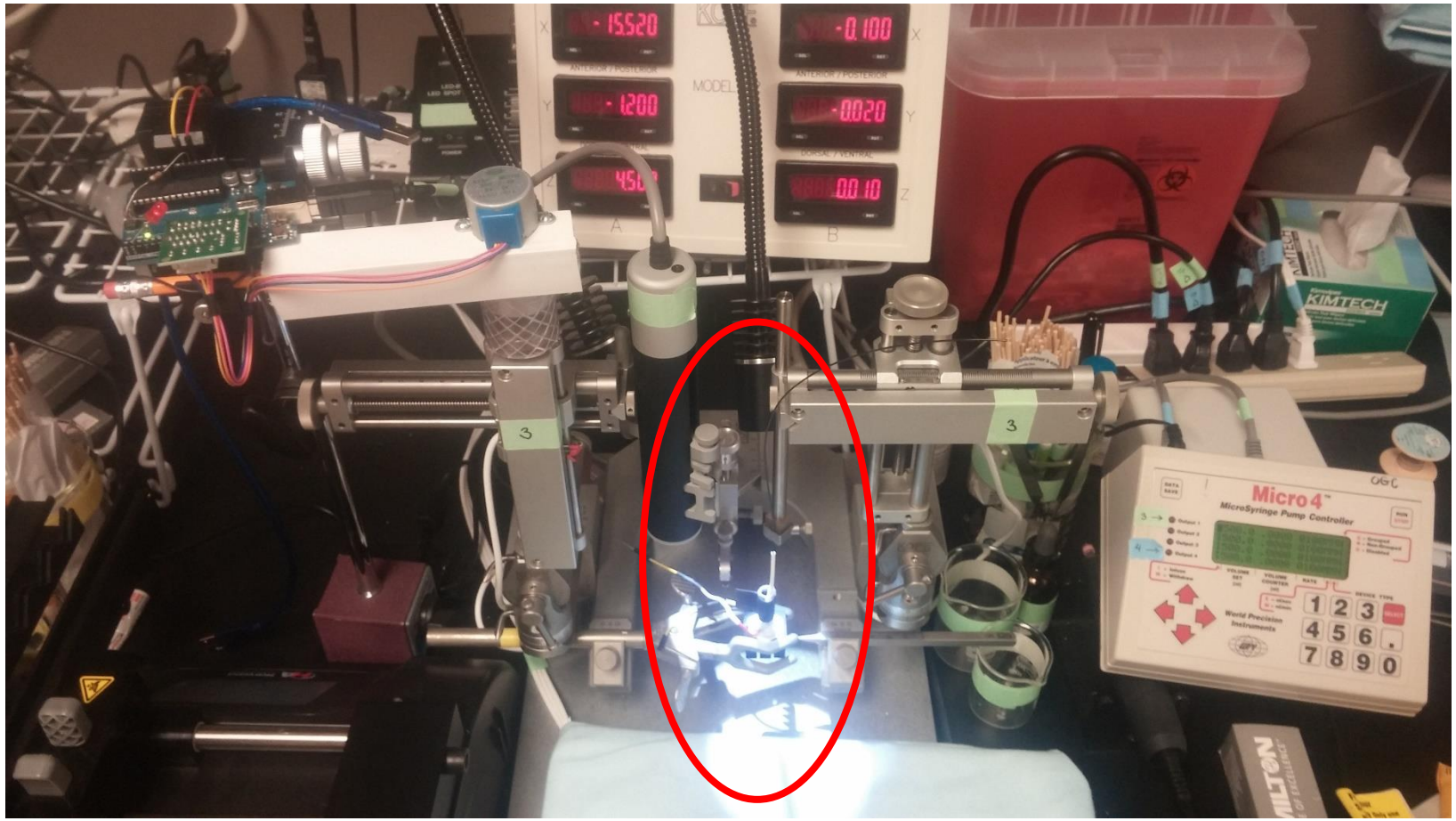


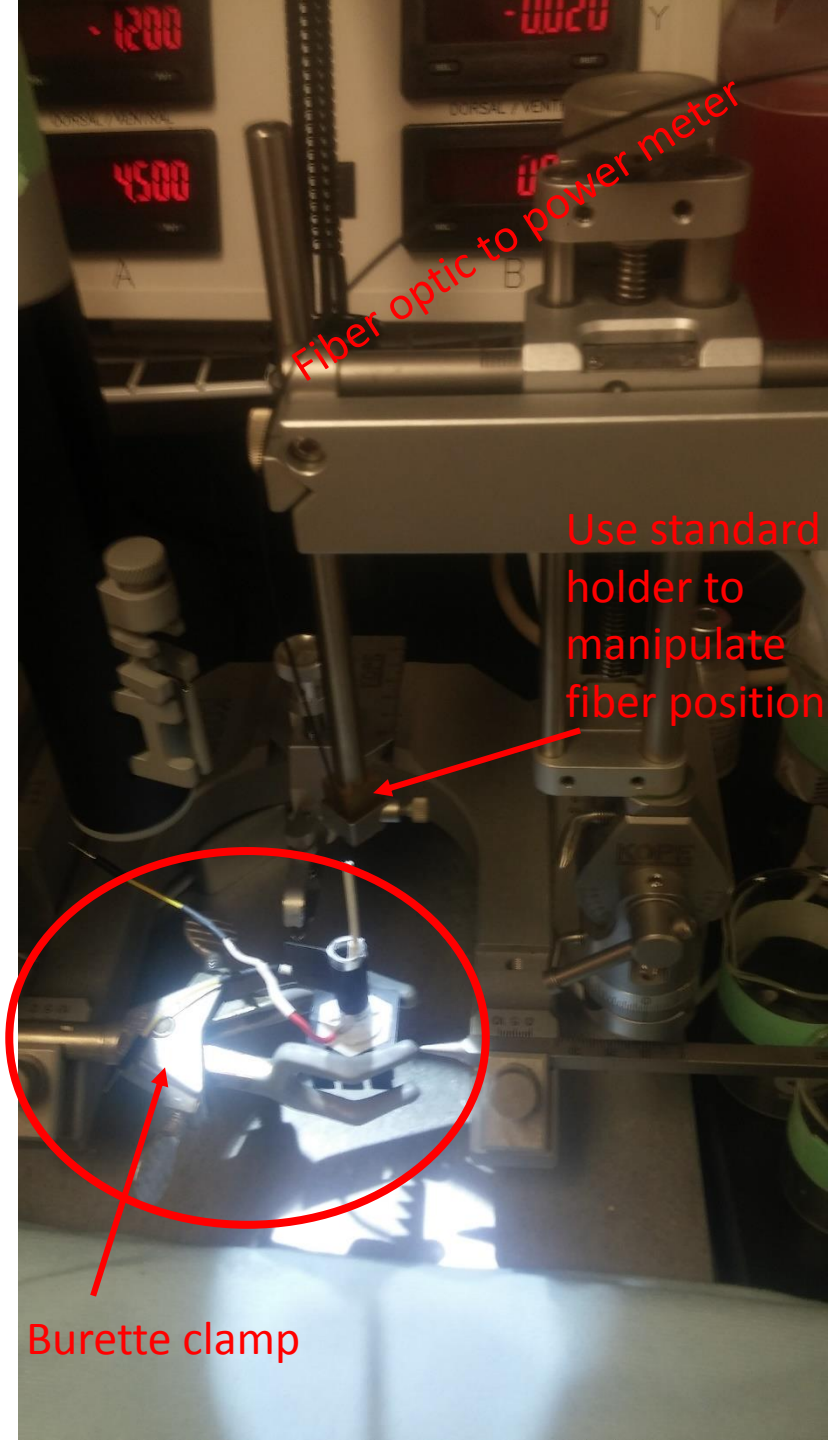


1. -Attach LED to heat sink with thermally conductive adhesive/tape.
2. -Polish/cleave fiber optic cable flat
3. -Affix LED with clamp and manipulate fiber over LED until maximum power is achieved, as measured by thorlabs pm100d power meter.
4. -Glue components into place.

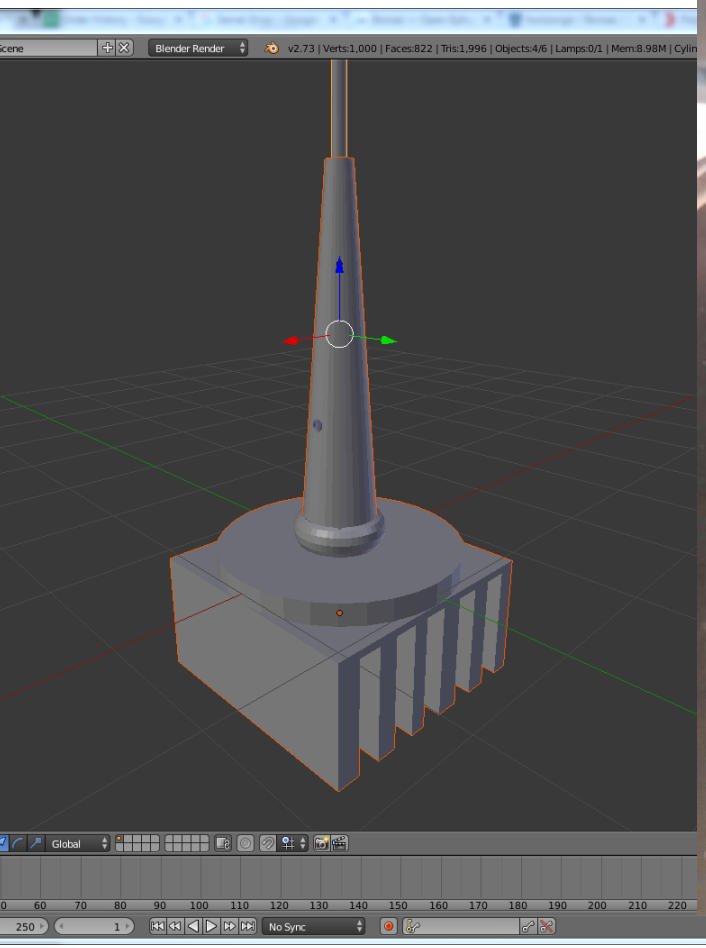
Or… align fiber with stereotax if you have a micromanipulator.

Same procedure as previous slide. Use stereotax in place of micromanipulator to optimize LED-fiber coupling.

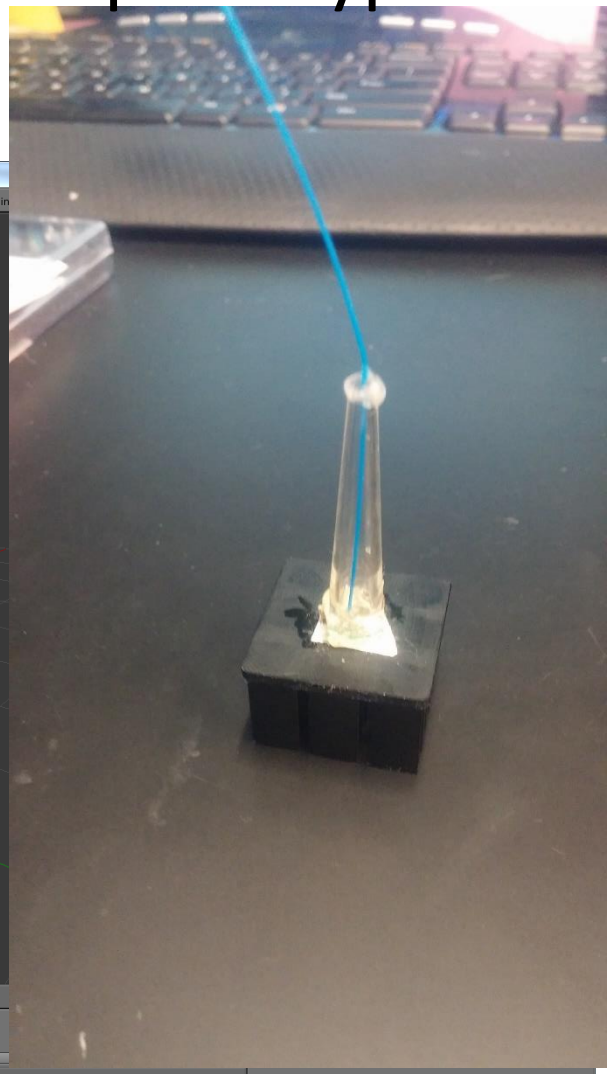




3D model and various prototypes

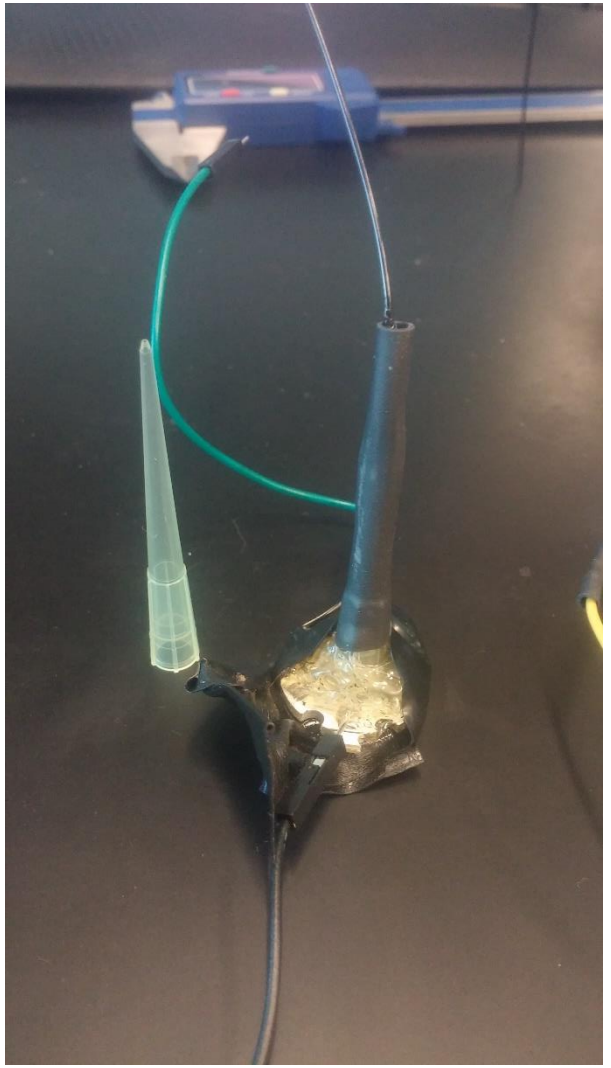


Fiber coupled Led, modeled in blender



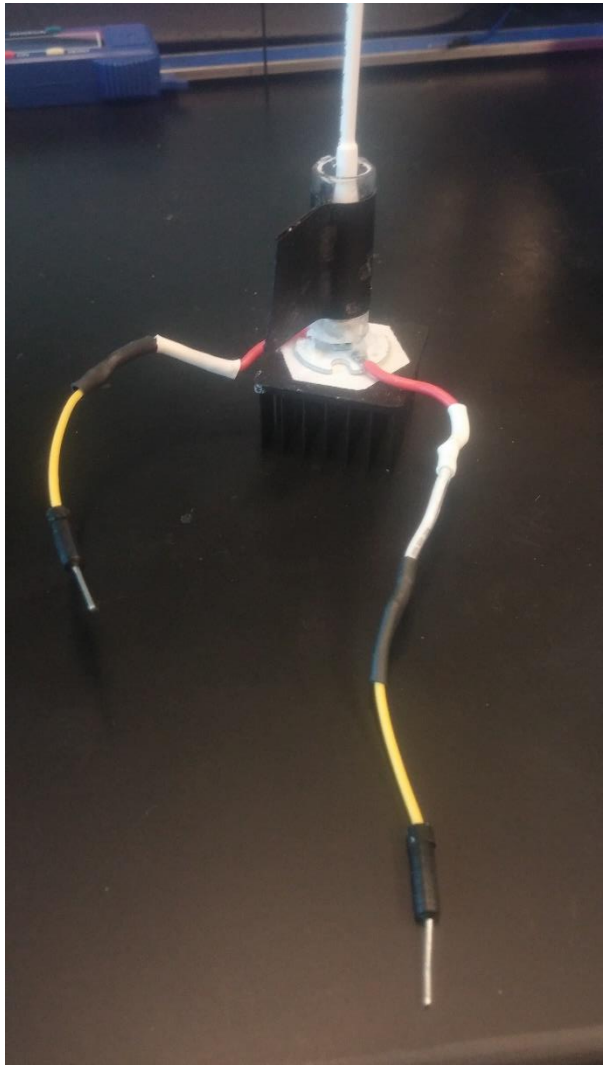
Fiber coupled Led 1

- Serological pipette tip for structural support
- .39 NA, 200um thorlabs fiber. Very low coupling efficiency (~2mW max power)



Fiber coupled Led 2

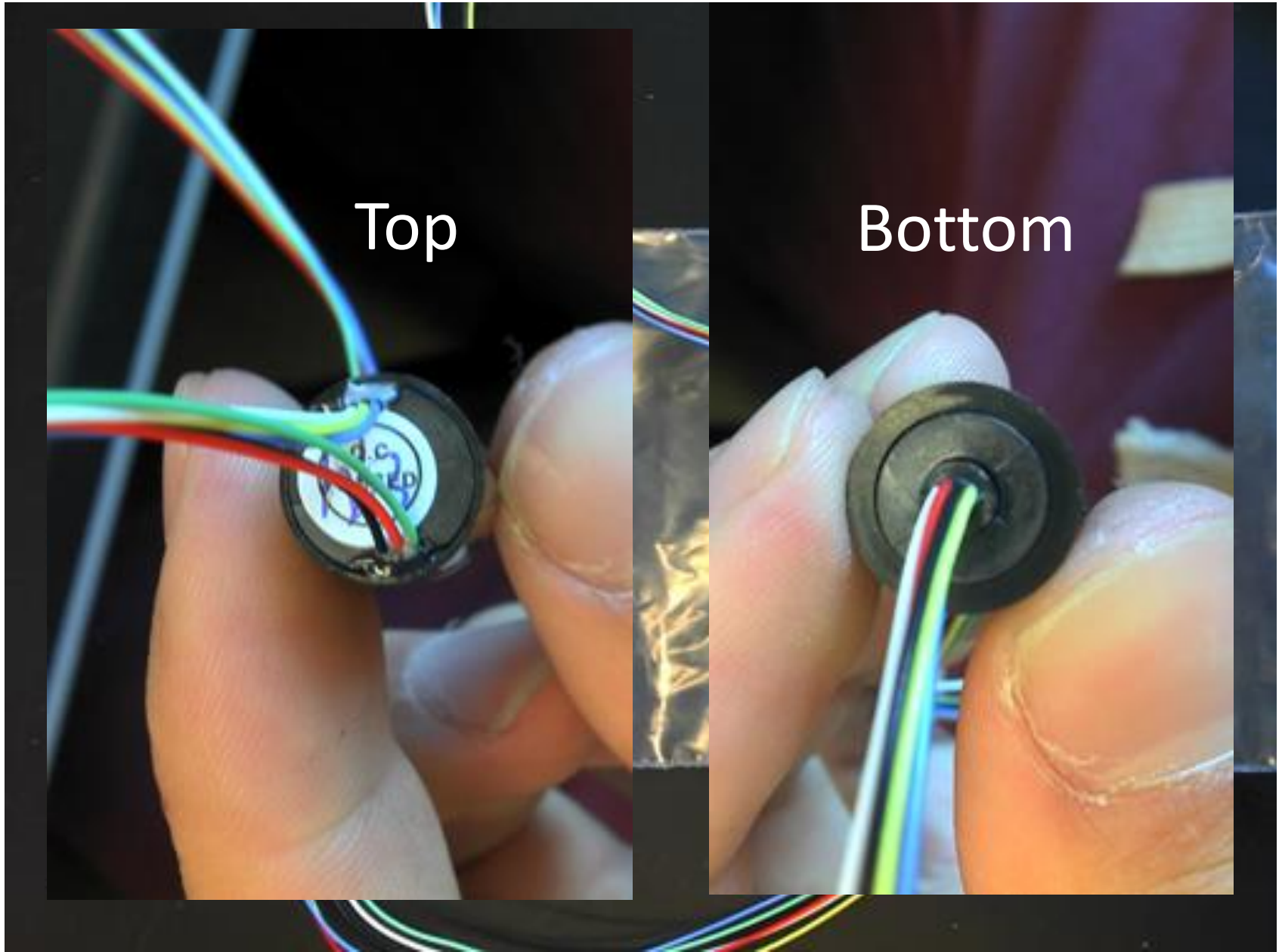
- Plastic pipette tip for structural support
- .66 NA fiber from plexon, no heat sink.
- Rapid heating and power loss when powered at 1A
- 13-18mW power from 1m fiber tip.



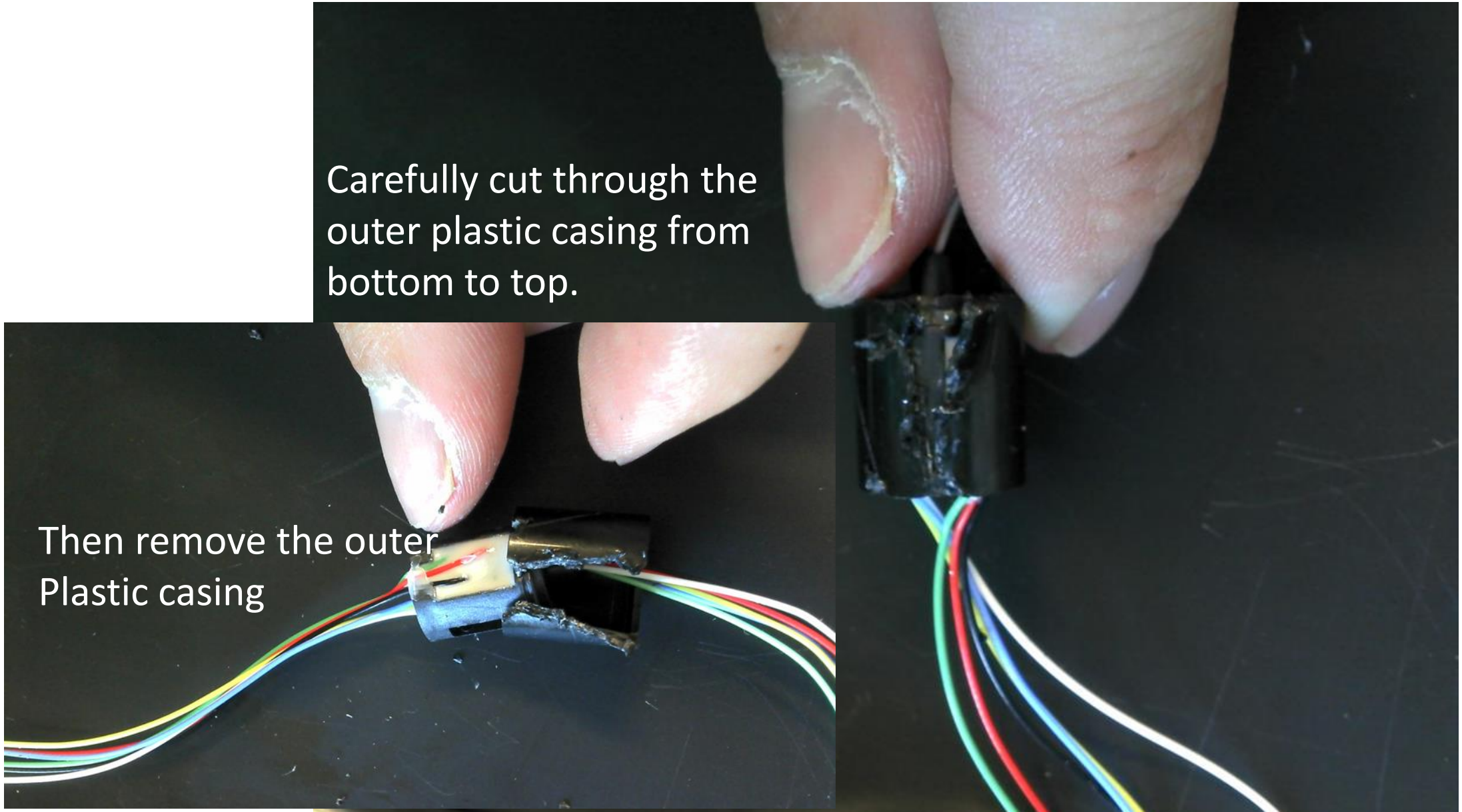
Fiber coupled Led 3

- Serological pipette tip for structural support
- .66 NA fiber from plexon + heat sink.
- 13-18mW power from 1m fiber tip.
- 11-15mW from 1m cable + implant.

Electrical swivel



Adapting the electrical swivel



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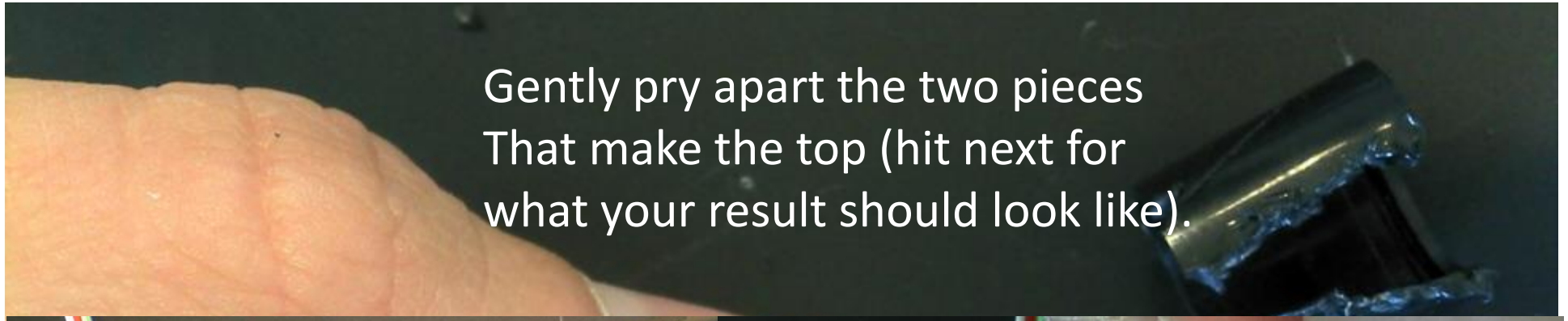

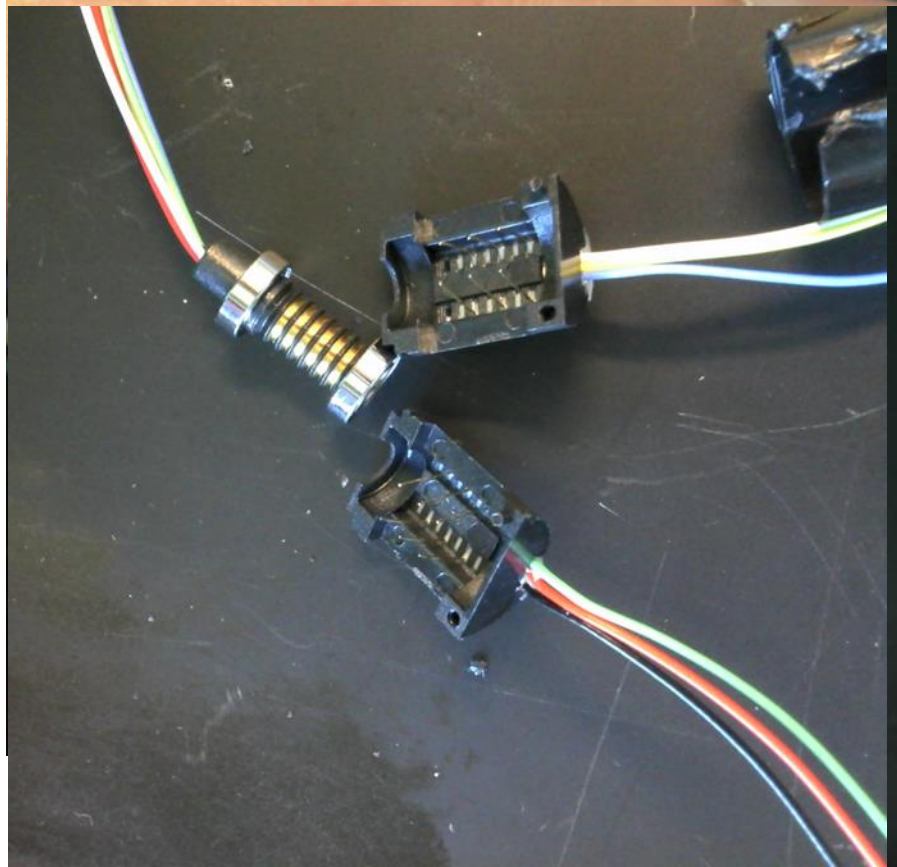

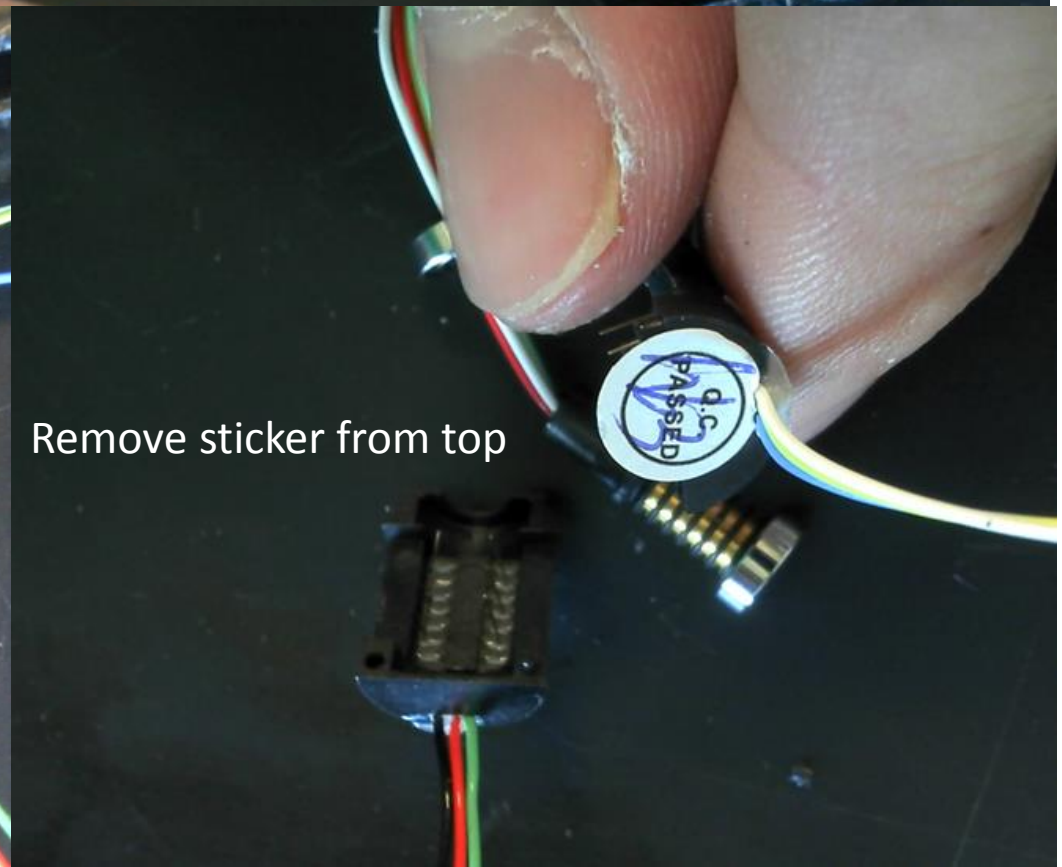

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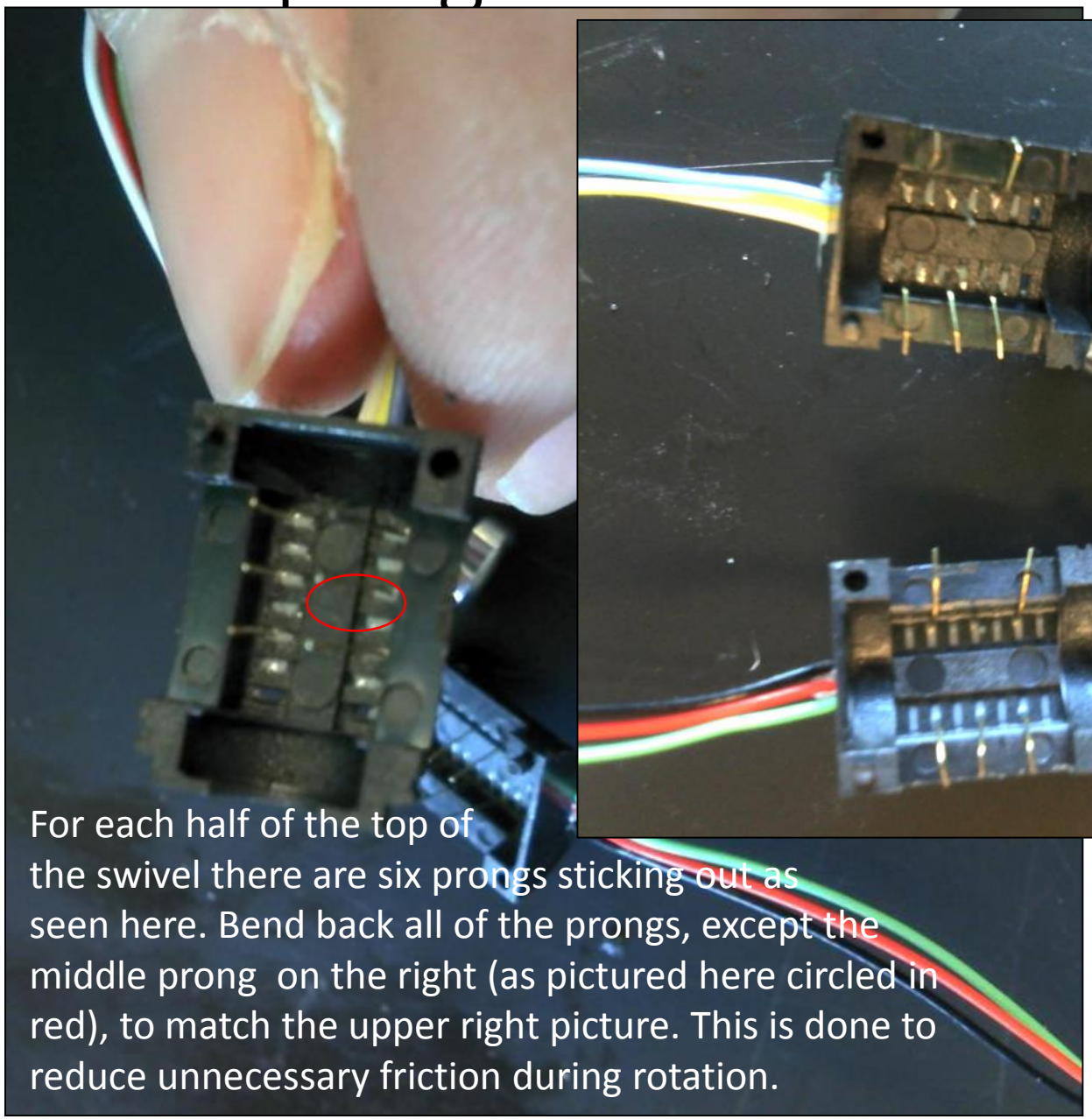
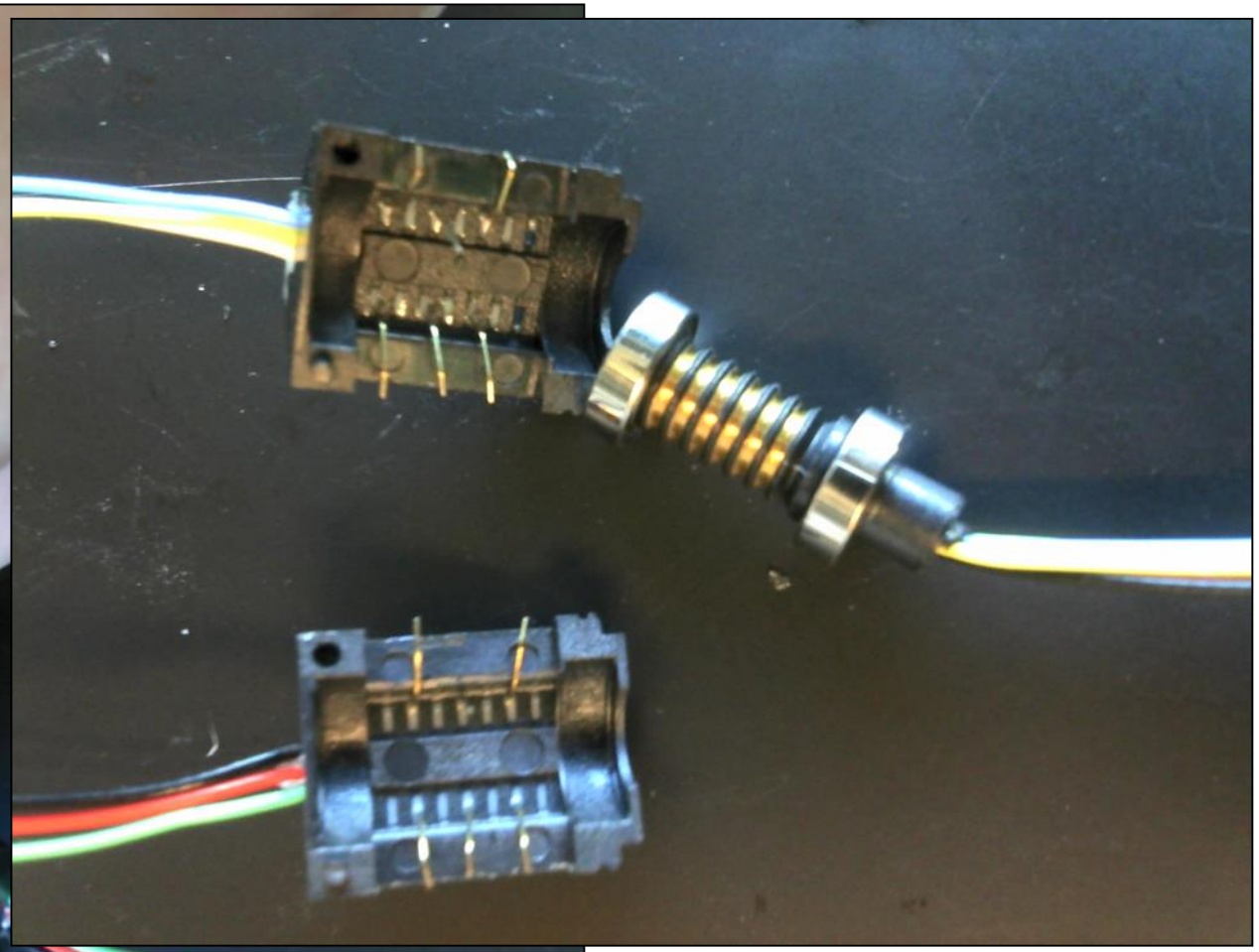
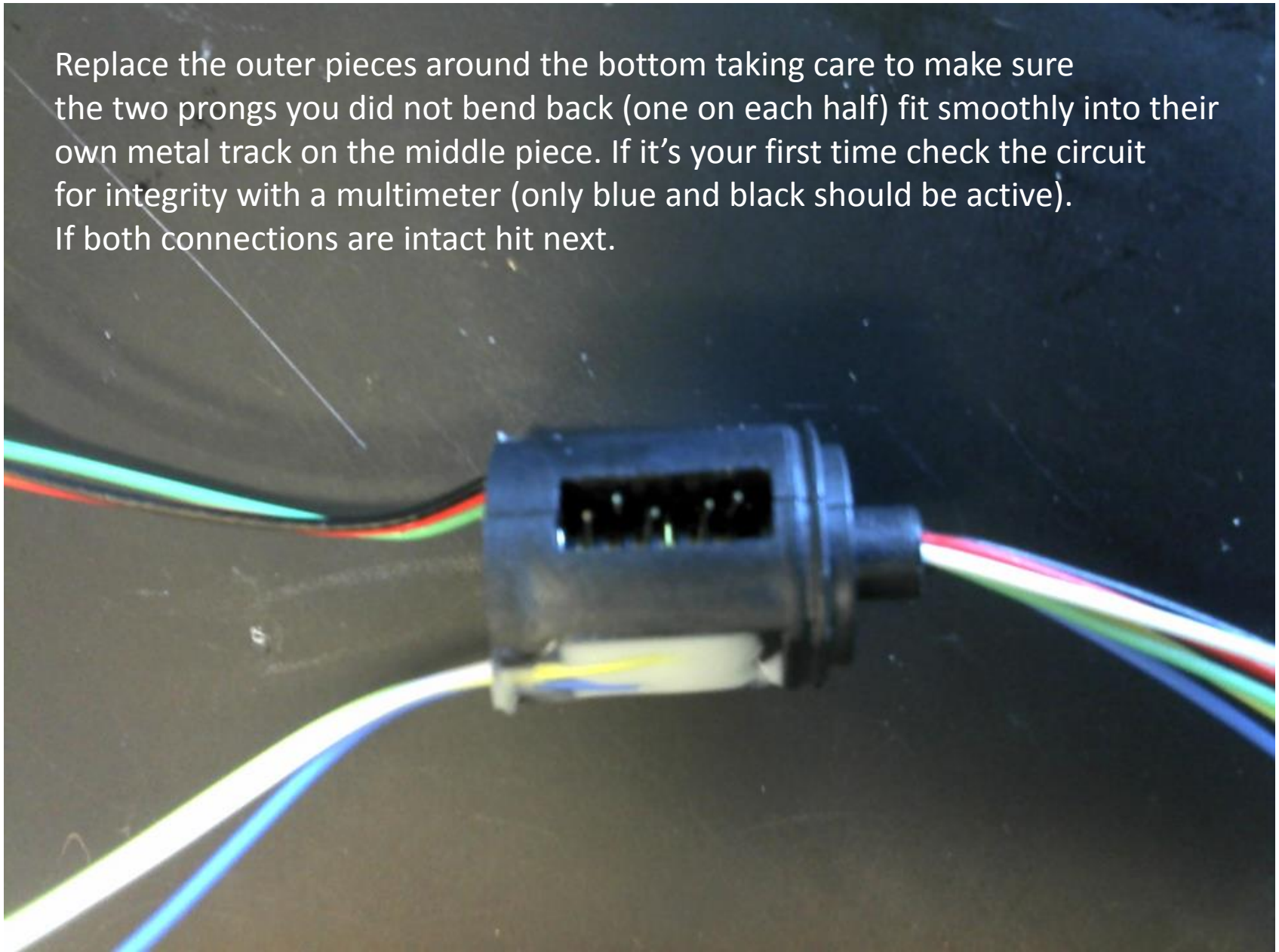


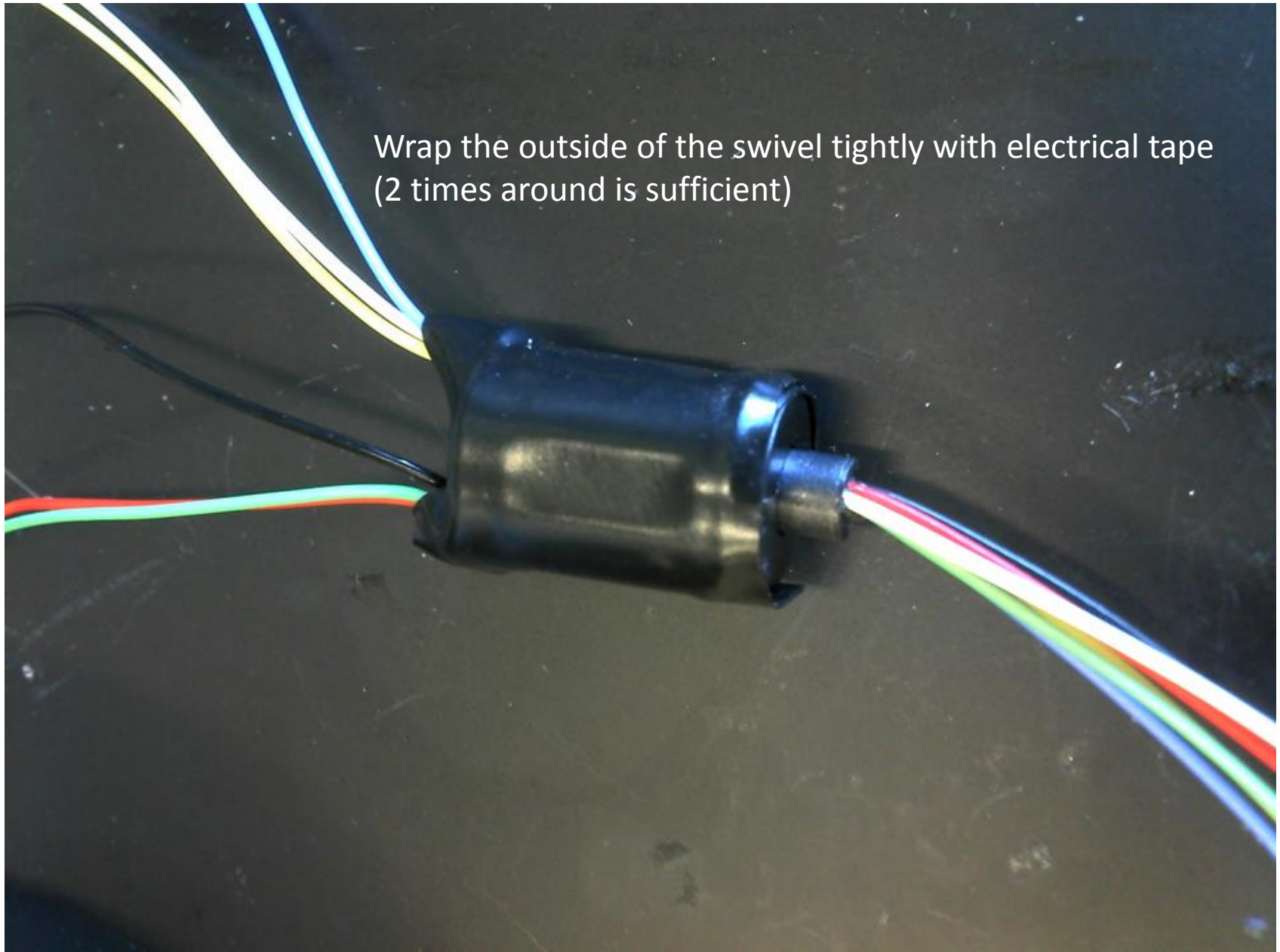


For each half of the top of the swivel there are six prongs sticking out as seen here. Bend back all of the prongs, except the middle prong on the right (as pictured here circled in red), to match the upper right picture. This is done to reduce unnecessary friction during rotation.

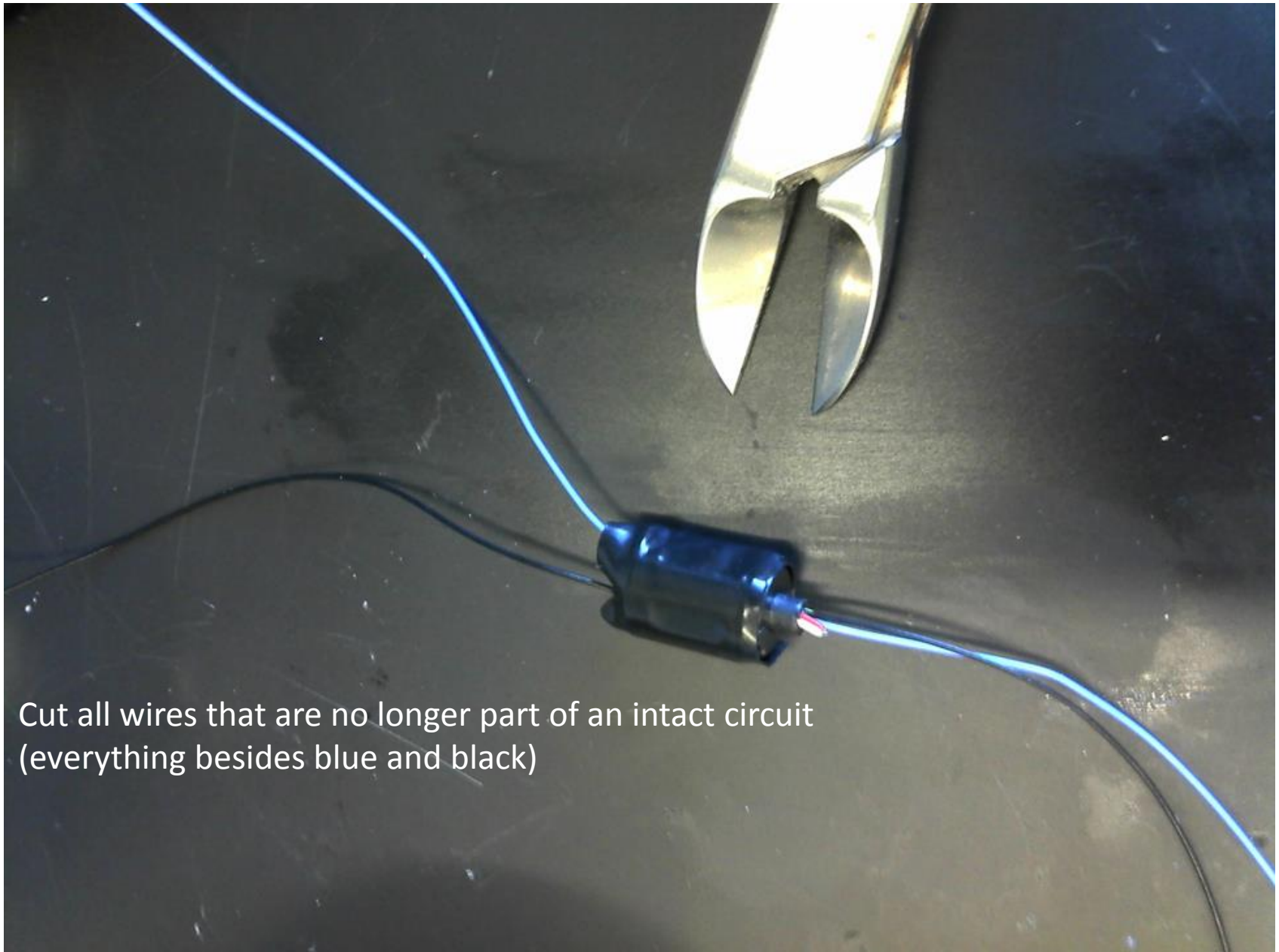
Adapting the electrical swivel



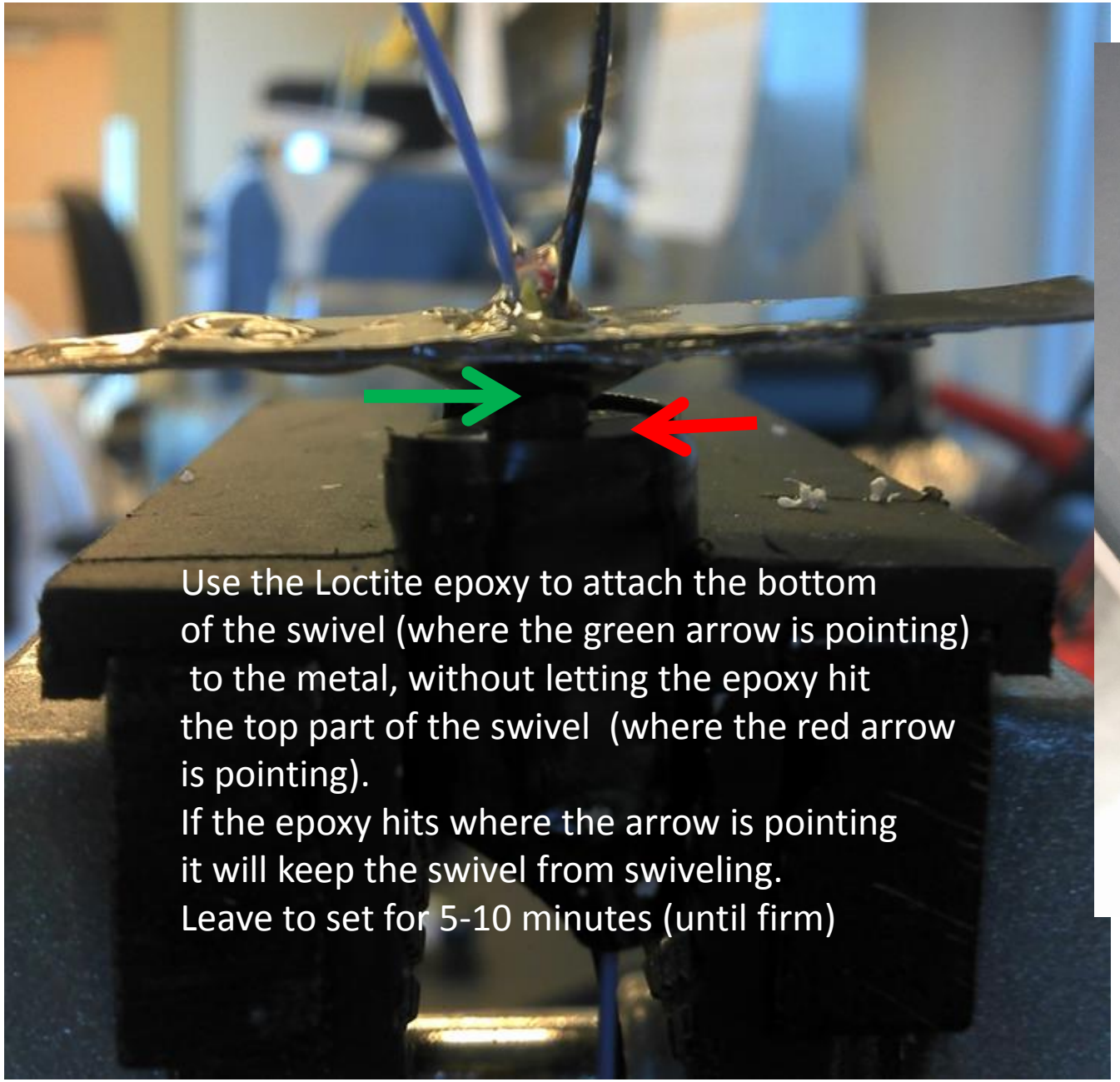
Adapting the electrical swivel



Adapting the electrical swivel



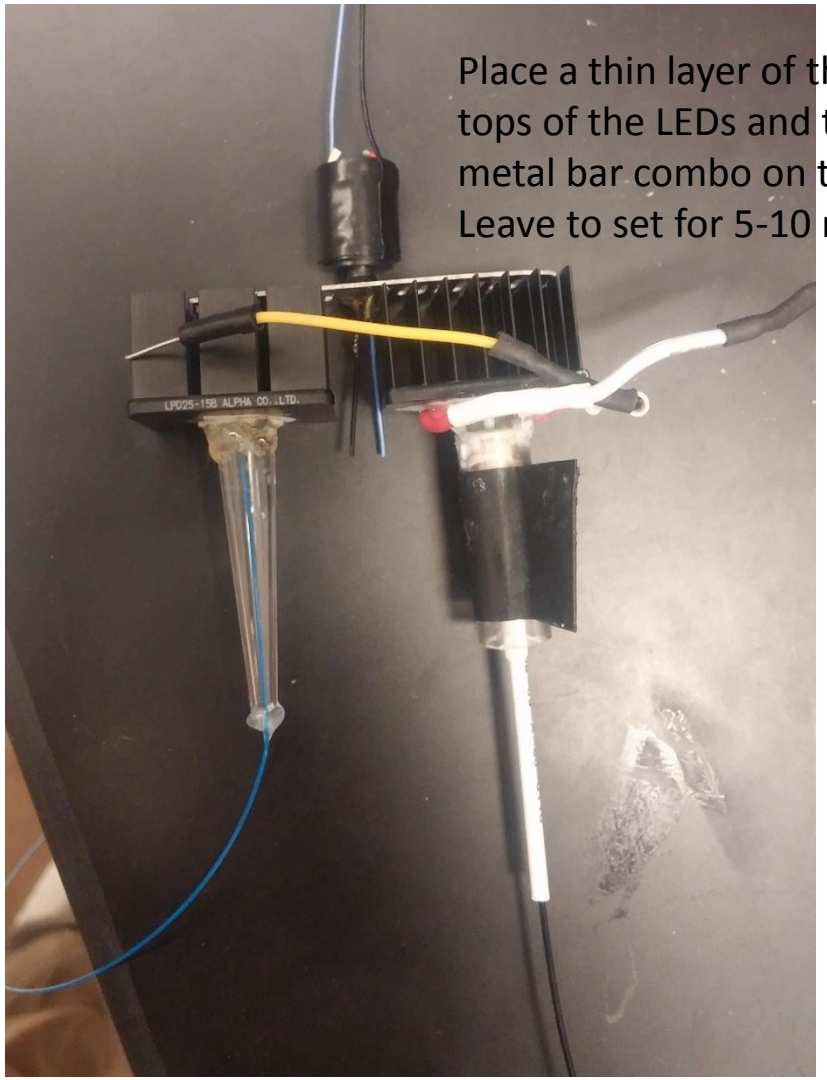
Connect the LEDs to the swivel



Use the Loctite epoxy to attach the bottom of the swivel (where the green arrow is pointing) to the metal, without letting the epoxy hit the top part of the swivel (where the red arrow is pointing).
If the epoxy hits where the arrow is pointing it will keep the swivel from swiveling.
Leave to set for 5-10 minutes (until firm)

I have plans to make a 3d printable version of this metal piece.

Connect the LEDs to the swivel



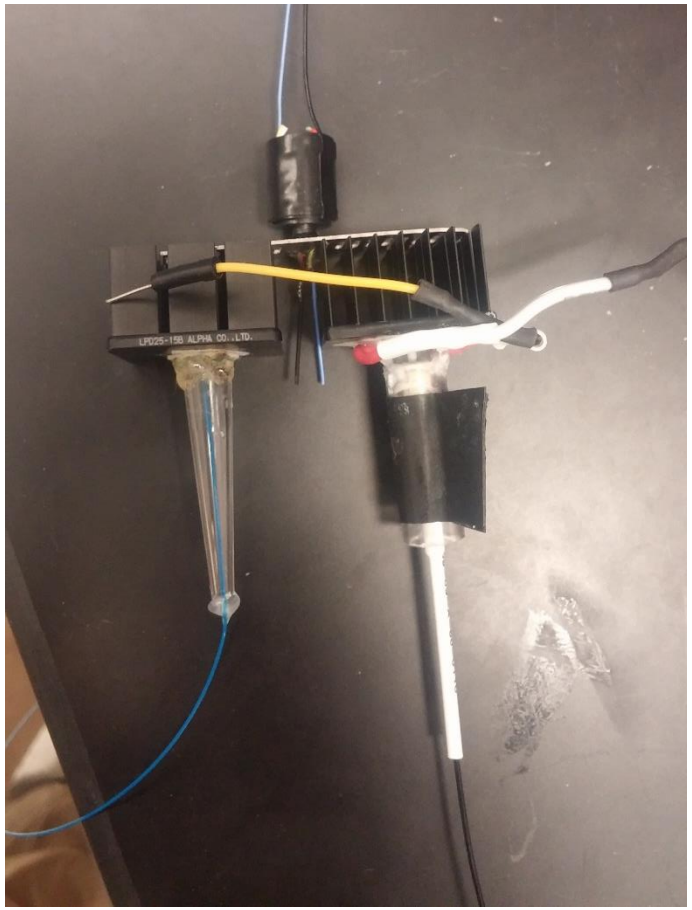
Place a thin layer of the Loctite epoxy on the tops of the LEDs and then set your swivel metal bar combo on top.
Leave to set for 5-10 minutes (until firm).

Note:
I'm still thinking of better ways to connect the LEDs to the swivel. Plexon uses a magnetic connection system, but this makes the LEDs fairly heavy for a mouse to rotate.

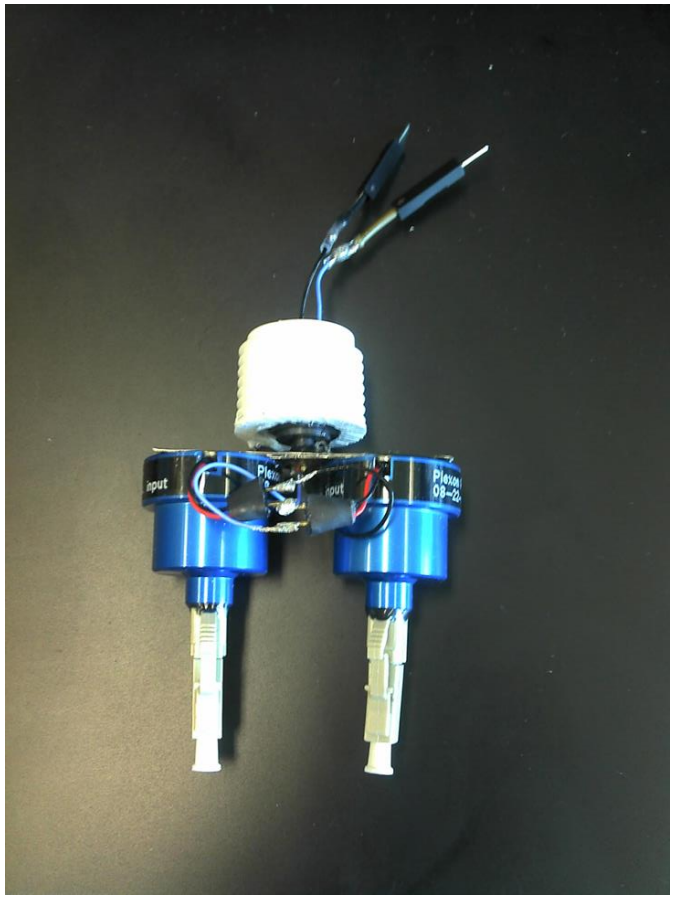
Here, the swivel is affixed to two plexon LEDs here.

Connecting bilateral unit to structures

Connecting bilateral unit to structures



Hot glue the PVC connector to the outside of the swivel.
Make sure it's level.
Solder/connect LEDS in series.



Here, the swivel is affixed to two plexon LEDs here.