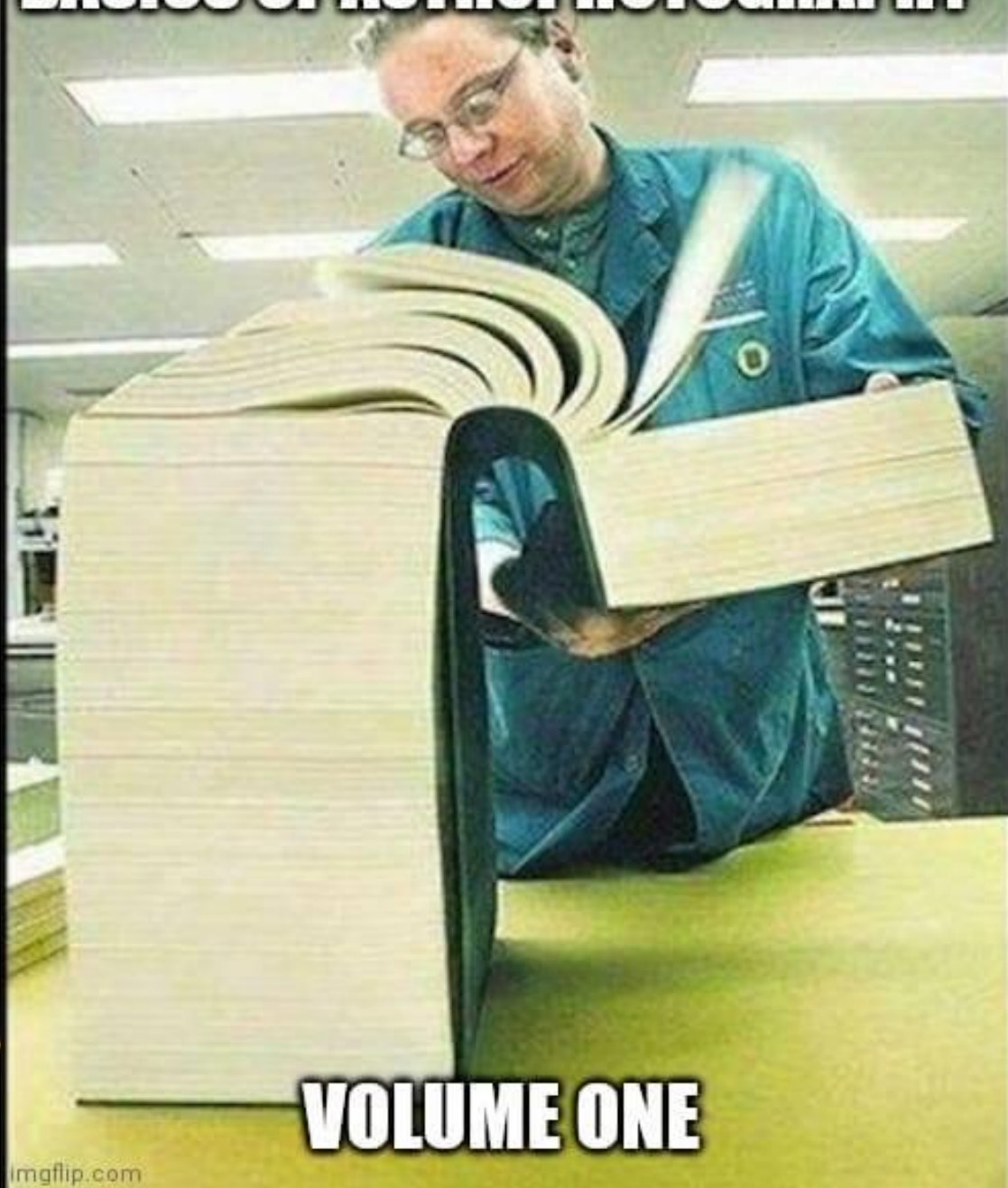# DIY Astronomy

Telescope Mount Improvements

Doug Holland

In the world of astrophotography, there are a lot of things that can go wrong.

Luckily, everything we need to know is documented in the handbook: 'Basics of Astrophotography' =>

BASICS OF ASTROPHOTOGRAPHY

VOLUME ONE

Telescope Mount - One of the most important components in astrophotography.

For average focal length telescope and average pixel pitch camera:

1 pixel correlates to about 1 arc second in sky

1 degree = 60 arc minutes

1 arc minute = 60 arc seconds

$\Rightarrow$ 1 degree = 60 x 60 = 3600 arc seconds

• Challenging to get mechanical system to track the sky within 1 arc second

  • Otherwise, smeared pixels / image

Mount to be improved: Losmandy G11
=> Principals apply to other mounts too

Declination (DEC) Axis –

North / South

Right Ascension (RA) Axis –

East / West

Issues –
DEC: Stiction (static friction)
=> Jerkiness during movement
RA: Periodic Error
=> Elongated stars, smeared images

DEC

RA

Mount built in 2005, purchased used in 2010.

DEC: Stiction (static friction)
 => Jerkiness during movement

Remove DEC axis

Disassemble

Thrust bearings gummed up with old lubricant – causing stiction

Thrust Bearings

Thrust bearings gummed up with old lubricant – causing stiction

Thrust Bearings

Clean & Degrease
All metal components

Ventilation

Lubricate:
Super Lube (Teflon base) +
Tungsten Disulfide WS2 Powder

Reassemble

Much Improved Stiction

RA: Periodic Error
  => Elongated stars, smeared images
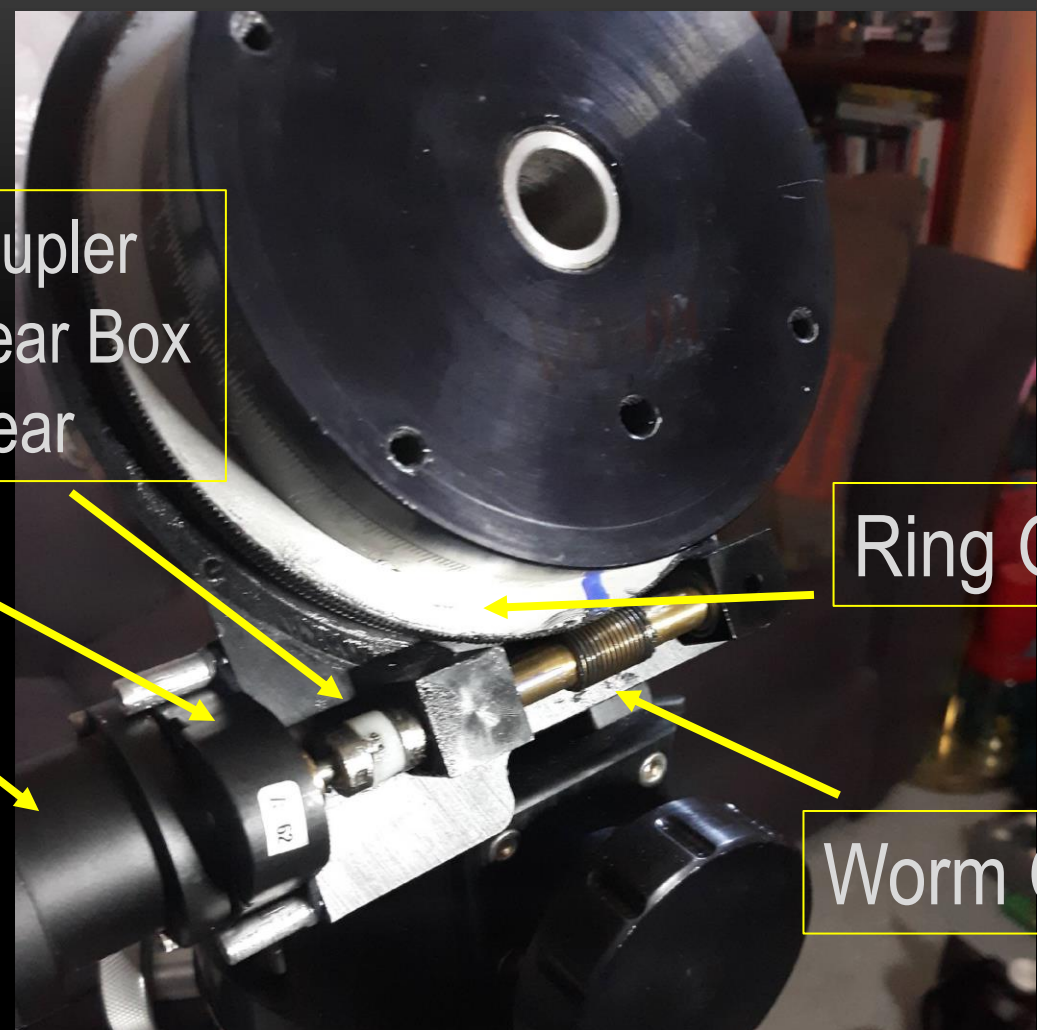
1. First have to understand how RA axis works

Oldham Coupler Couples Gear Box to Worm Gear

Gear Box

Motor

Ring Gear

Worm Gear

Periodic Error – Changes in rate of RA axis rotation due to imperfections in Worm Gear & associated mechanism. Repeats once per rotation of Worm Gear (e.g. 4 minutes).

RA axis with DEC axis removed

1. Disassembled, degreased & lubricated RA axis

Clean & Degrease
All metal components

Lubricate:
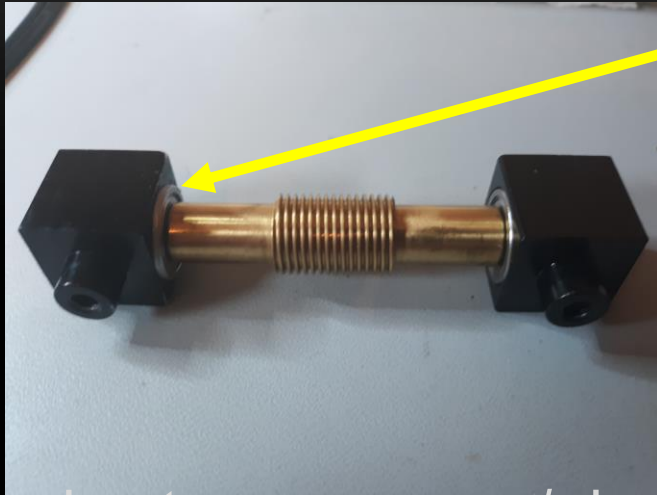Super Lube (Teflon base) +
Tungsten Disulfide WS2 Powder

2. Replaced bearings

- Tried Boca Bearings and Losmandy replacement bearings
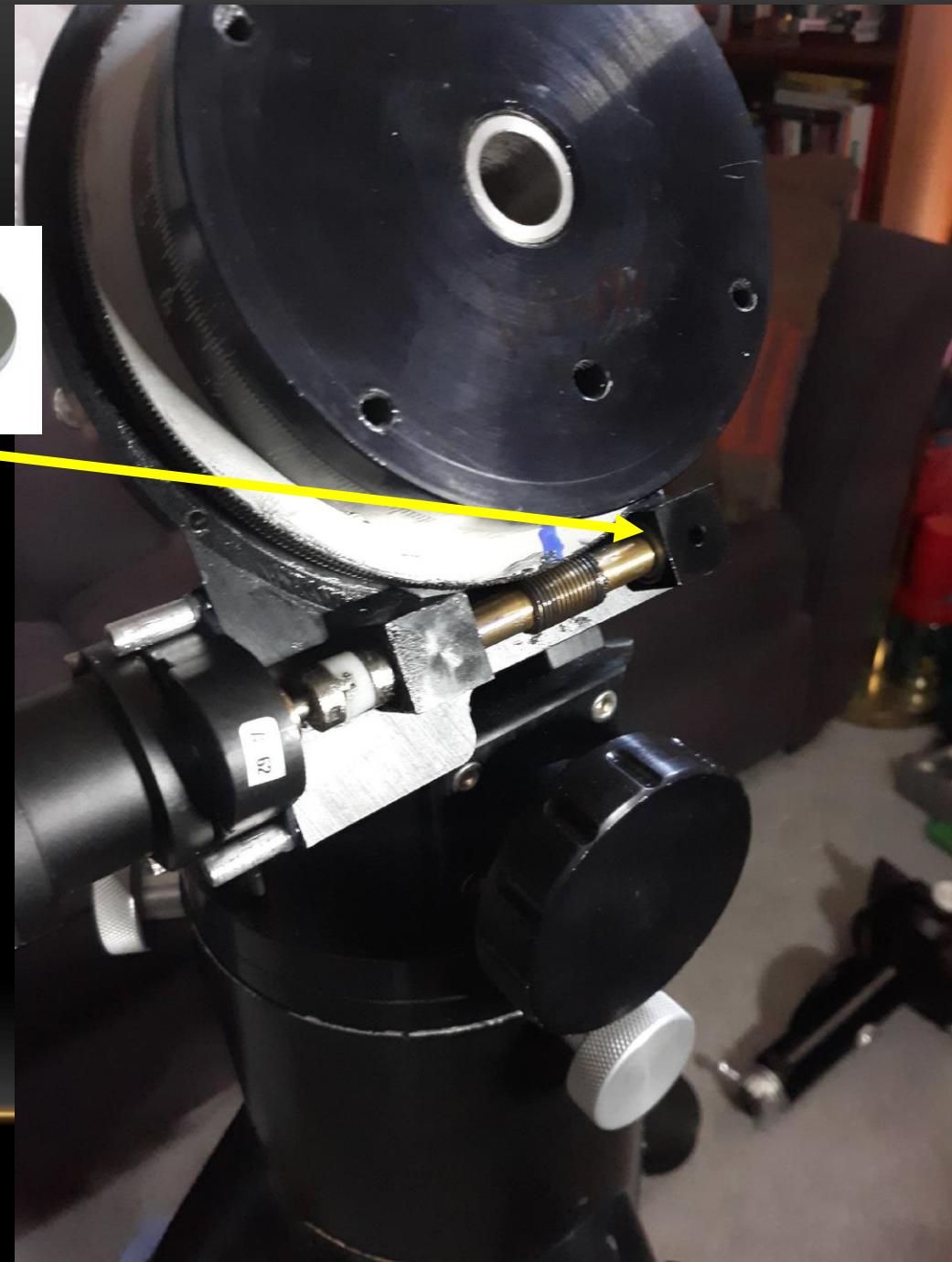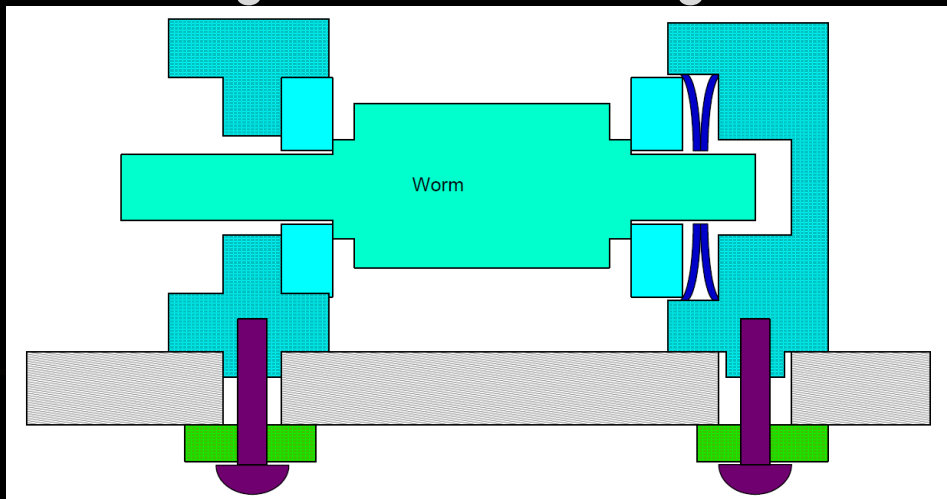- Others prefer Boca, I had better luck with Losmandy
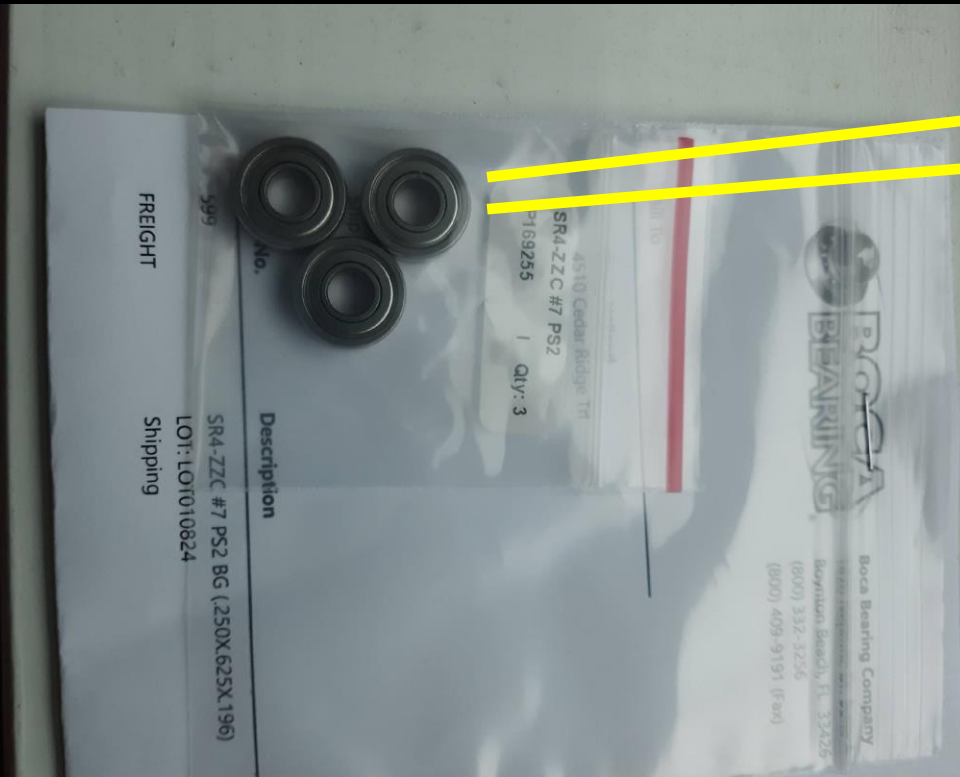
Changes Made
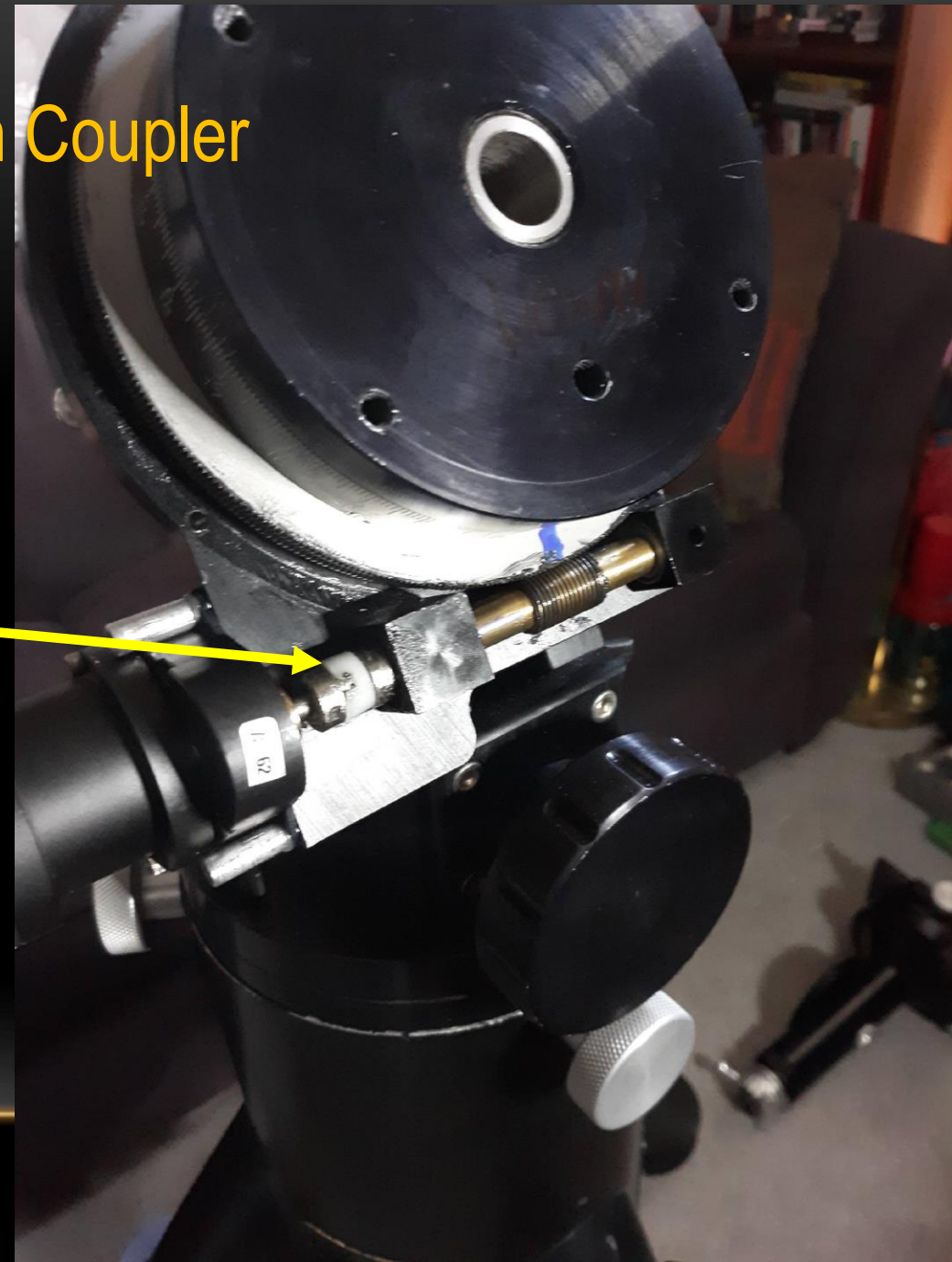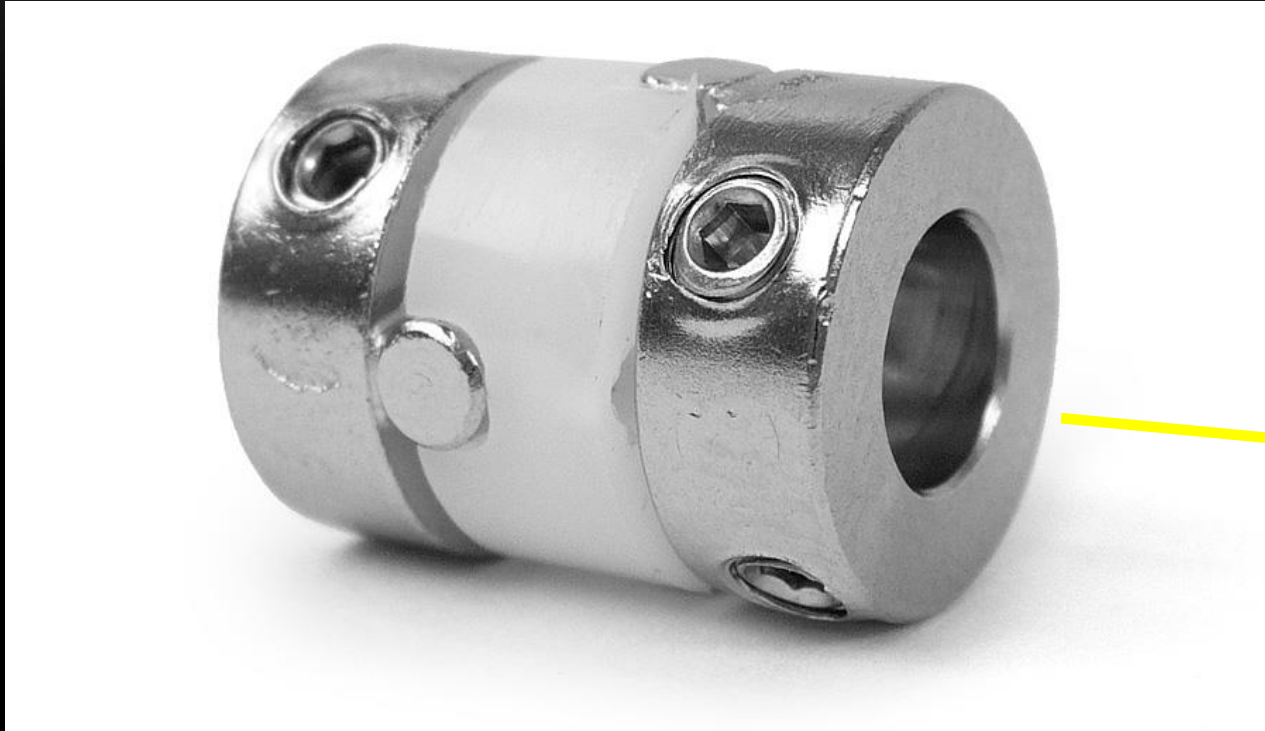## 3. Added Belleville Washer to Bearing Block

Applies tension to worm gear / ring gear interface.
Keeps worm gear from moving back & forth.

Instructions on improving the Losmandy OPW PE behavior by Michael H. Herman

4. Replaced & applied Super Lube to Oldham Coupler

Changes Made (cont'd)

5. Set gap between Worm Gear & Ring Gear

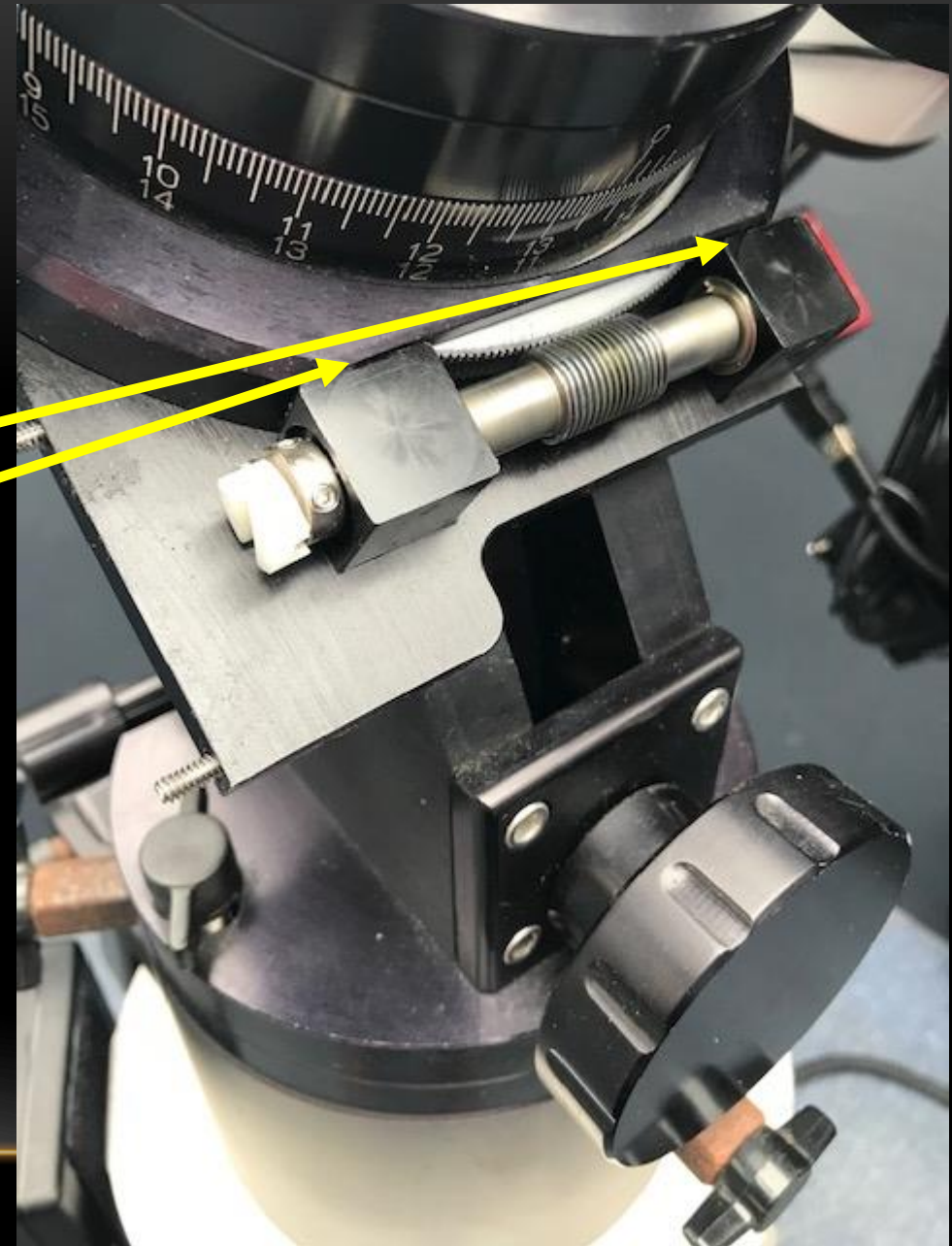=> Use gap gauge to set Bearing Blocks

* Reduce backlash

- vs. –

* Being too tight thus stalling motor
(RA Motor Lags message)

Right Bearing Block moves more than left

In end – Worm Gear should move smoothly, but no play / backlash.

Gap Gauge / Feeler Gauge

https://stargazerslounge.com/topic/374219-adjusting-the-ra-worm-blocks-on-an-older-losmandy-g11/

6. Aligned motor with Oldham Coupler & Worm Gear to decrease movement of Oldham Coupler during rotation

Motor + Gear Box mount here

File out motor mount holes and fill in. Align with Oldham Coupler.

Threaded Posts

Changes Made (cont'd)

7. Truth is Truth

    7.1 Re-did adjustments 4 times before satisfied.

    7.2 Damaged multiple bearings during process.

    7.3 Got 'RA Motor Lags' message after initial adjustment.

    7.4 Started with 2 Belleville Washers, changed to 1.

    7.5 Had difficulty getting bearings out of bearing block. Had to buy new bearing blocks.

    7.6 Found that Ring Gear had some 'high spots' where Worm Gear encountered more friction.

    7.7 Got grease on Clutch Plates. Had to disassemble to clean.

Results (Unguided)

Obtained using PHD2 Guiding Assistant (under Tools)
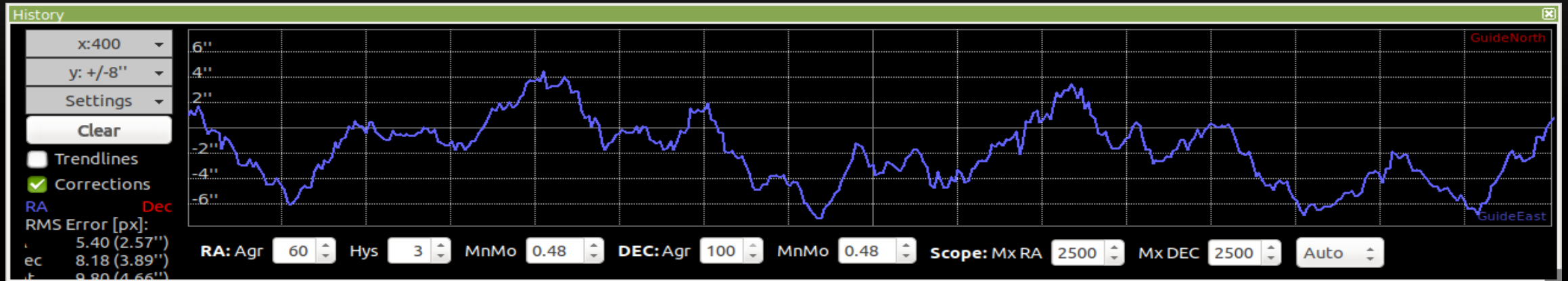
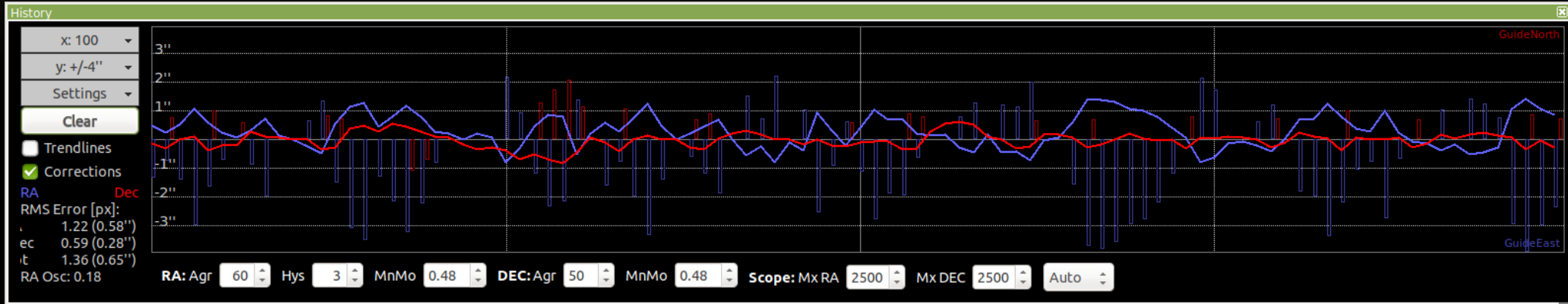
Before – Approx. 11" peak to peak periodic error.
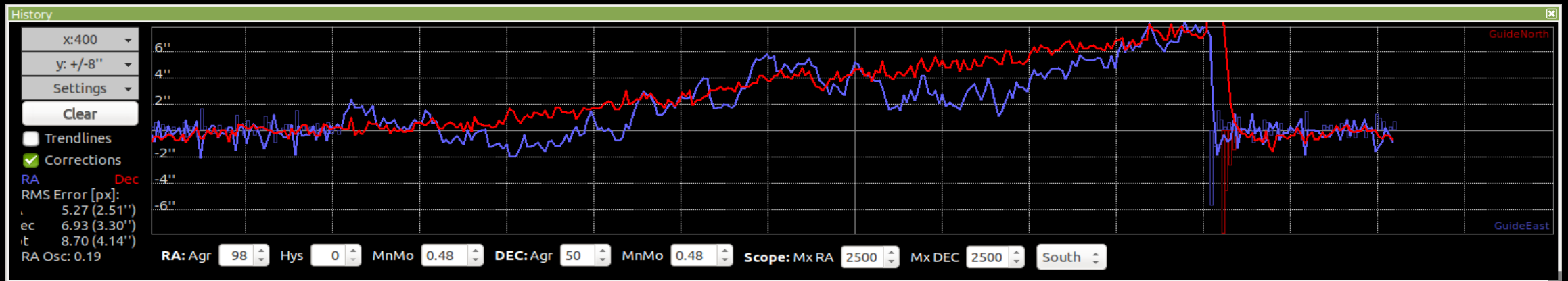
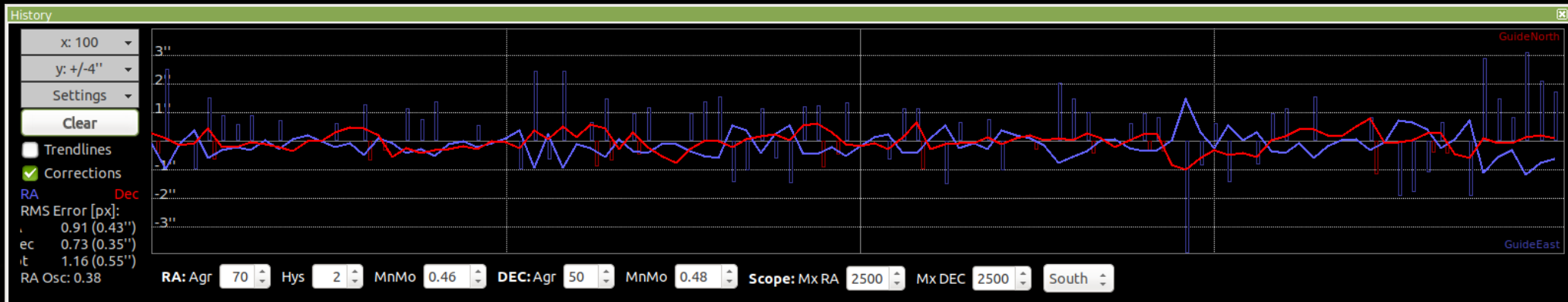After – Approx. 4" peak to peak periodic error. (Ignoring drift)

Results (Guided)

Prior to adjustments, typical approx. 1.5" RMS error

{{{ Comparison of ST4 vs. Pulse Guiding }}}

ST4 / Autoguiding Port: 0.58" RMS error

Pulse Guiding / RS232 Port: 0.43" RMS error

Image taken after mods:

1. Smaller stars
2. Stars less elongated

M13 –

Globular Cluster

in Hercules

www.holland-observatory.net

The End