Autoguiding – a Deep Look

András Dán, MSc, Hungary

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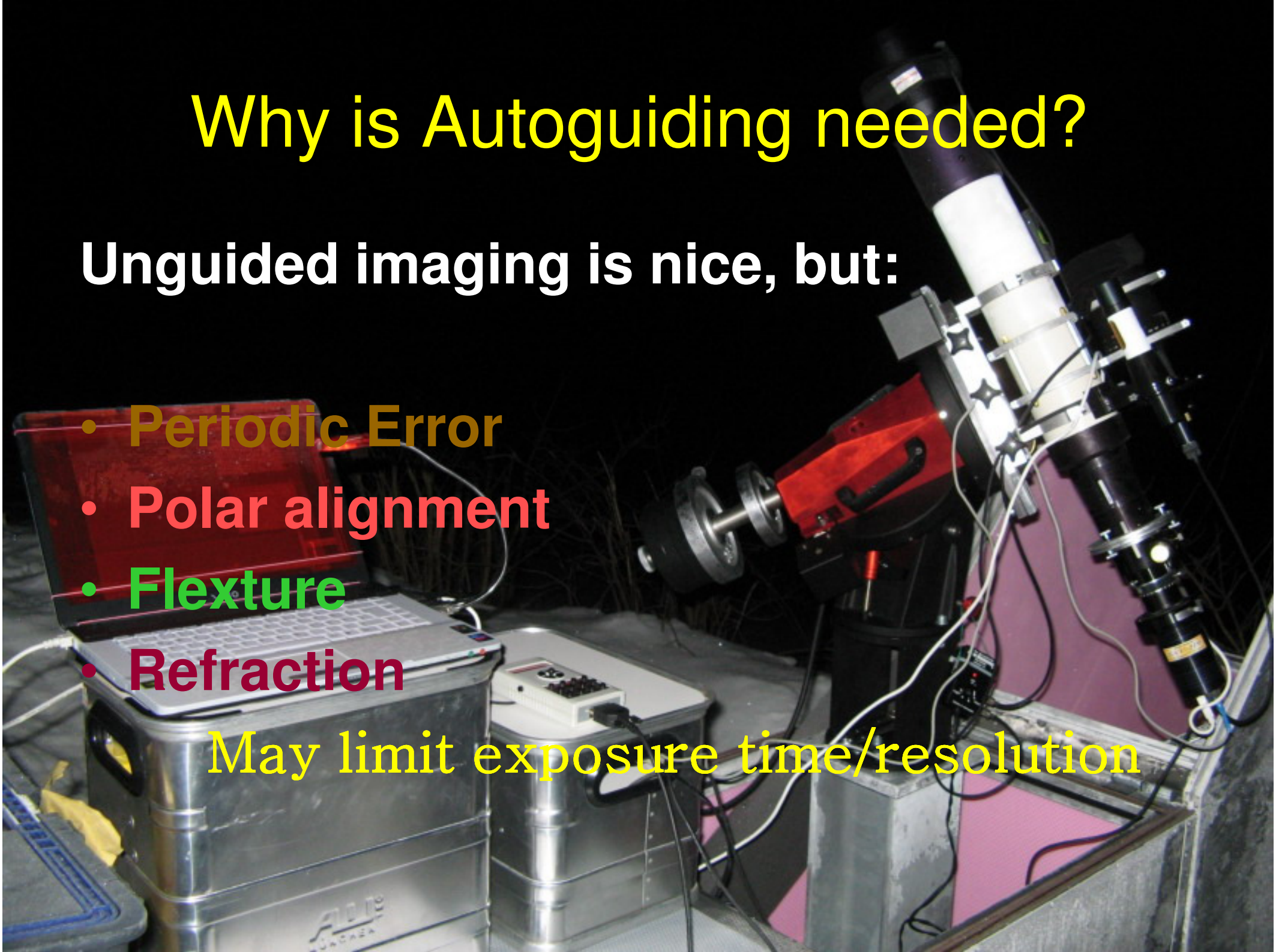

Why is Autoguiding needed?
Unguided imaging is nice, but:
• Periodic Error
• Polar alignment
• Flexture
• Refraction
May limit exposure time/resolution

Do we need long exposures at all?

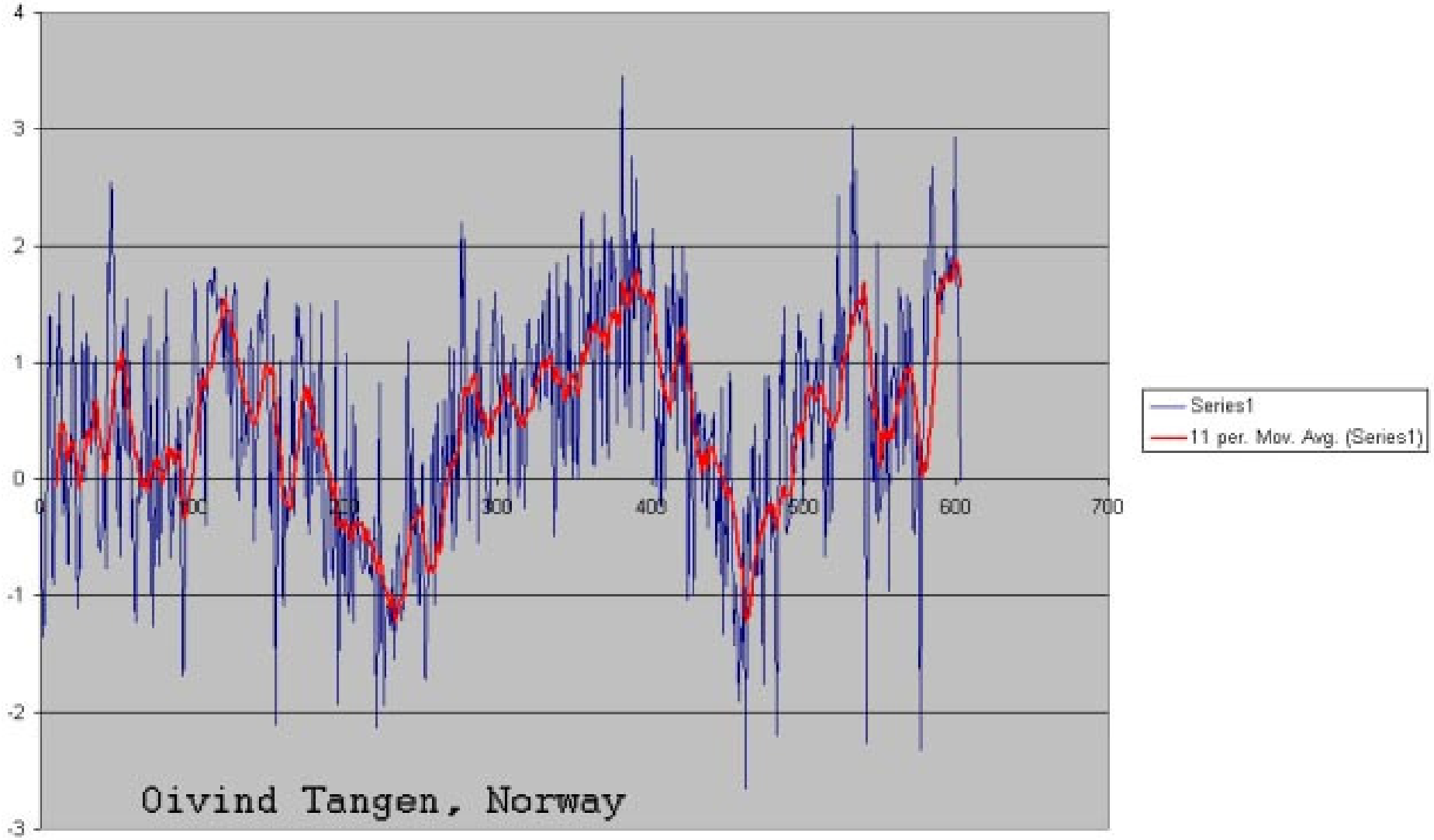
YES, because we have:

- *Narrow band filters*
- *Low surface brightness objects*
- *Multifilter image acquisition that lasts several nights*

Tracking in RA

(for 2-3 sec intervals)

Error Source	Typical value (arcsec)	Characteristics	Relative value
PE+Drift	**0,1- 0,4**	***systematic***	10 - 40%
Flexture	**0 - 0,02**	***semi-systematic***	
Seeing	**0,5 - 2**	***random***	90 - 60%

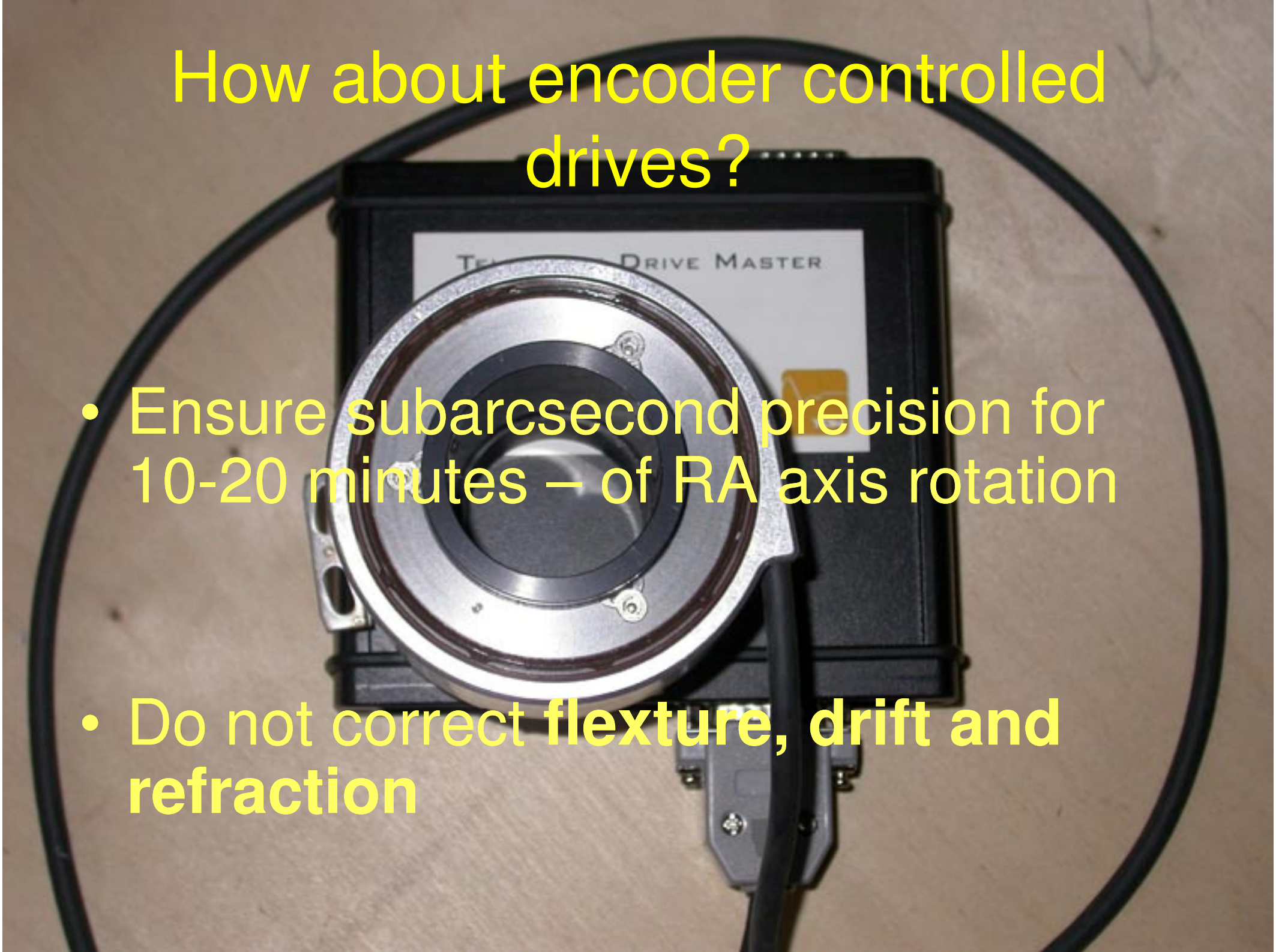


Gemini G42, no PEC, poor seeing

Tracking in DEC

Error Source	Typical value (arcsec)	Characteristics	Relative value
Drift	0 – 0,2	Systematic	10 – 40%
Flexture	0 – 0,05	Semi systematic	
Seeing	0,5 - 2	Random	90 – 60%
RA bearing	0,1 - 2	Random	

How about encoder controlled drives?



- Ensure subarcsecond precision for 10-20 minutes – of RA axis rotation
- Do not correct **flexture, drift and refraction**

Autoguiding parameters

»1 Calibration

Done under *constant speed* – used in *acceleration*

This ensures a slight undercorrection.

Autoguiding parameters

- **2 Guidestar quality**

An aberrated or dim stellar image gives unreliable centroid values.

E.g.: off axis situations

Autoguiding parameters

»3 Exposure time

- Longer – reduces seeing effects
- Shorter – corrects PE better

Autoguiding parameters

- **4 Agressiveness**

Compensates seeing and calibration problems.

- **5 Pause after correction**

Helps to avoid oscillations.

Current Practices
of Autoguiding

- **Guidescope**

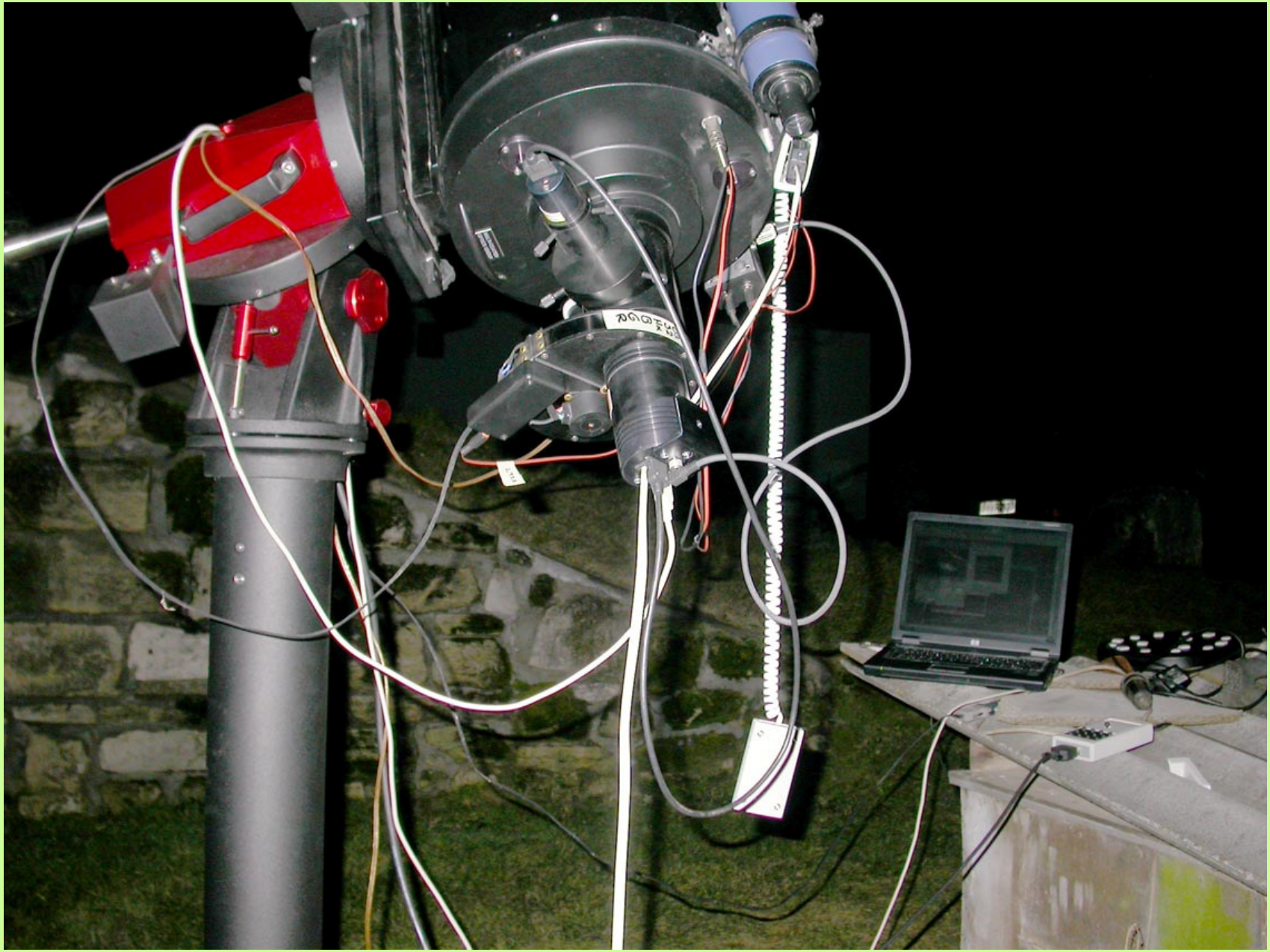
Flexible star selection – flexture

- **Off-Axis**

Good rigidity – small field

Example - guidescope

Example – Off axis



Current Practices

- **Dual Chip**

Highest rigidity – filter problem

- **Interline Transfer Chip**

Simplest solution – image noise

Current Practices

- **Active optics**

Best results – backfocus problems, camera choice limited

Practical Tips

- Minimize flexture

Small weight, reinforcements, quality focusser

- Use threaded or conic interfaces


Oivind Tangen

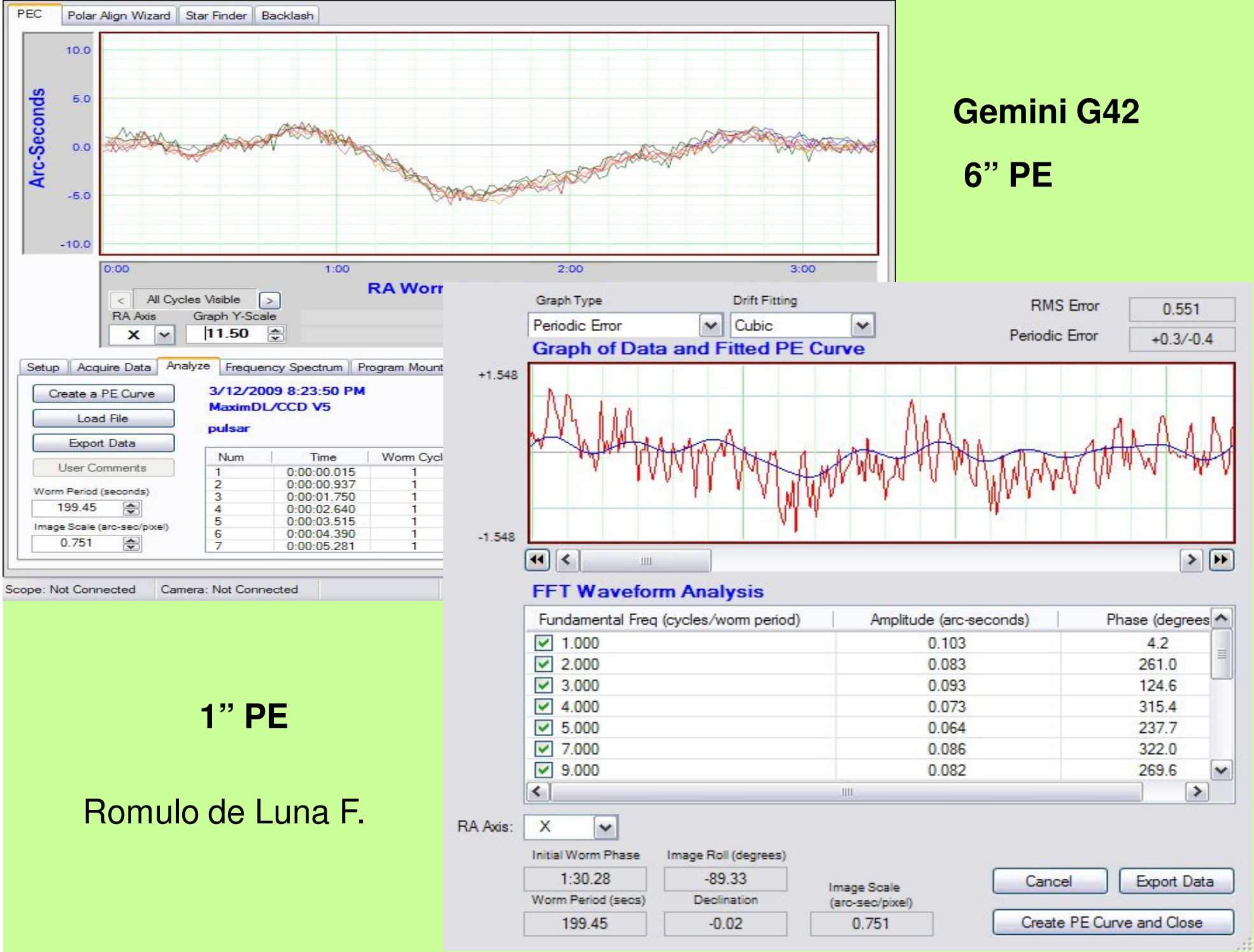
Practical Tips

- PEC active

Longer exposure, less seeing effects

- Small aperture guidescope

Up to 10cm the seeing is always fair



Gemini G42

6” PE

1” PE

Romulo de Luna F.

Trailed Stars – What shall I do?

- Direction of the trail

  E-W, N-S, Other

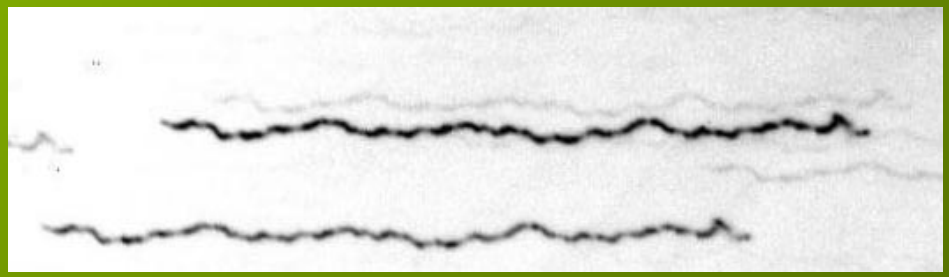
- Set of short expos with intervals

  3s expo, 60sec pause, 15 times (guiding ON)

Trailed Stars

- Compare 1 worm cycle **guided** and **unguided** exposures

- Make startrail images (30”/min drift)



Images courtesy of

- Althoff, Gerd
- Kerschuber, Günther
- Mori, Eiji
- Tangen, Oivind
- Freire, Romulo de Luna

In order of appearance.

Thank you for your attention!