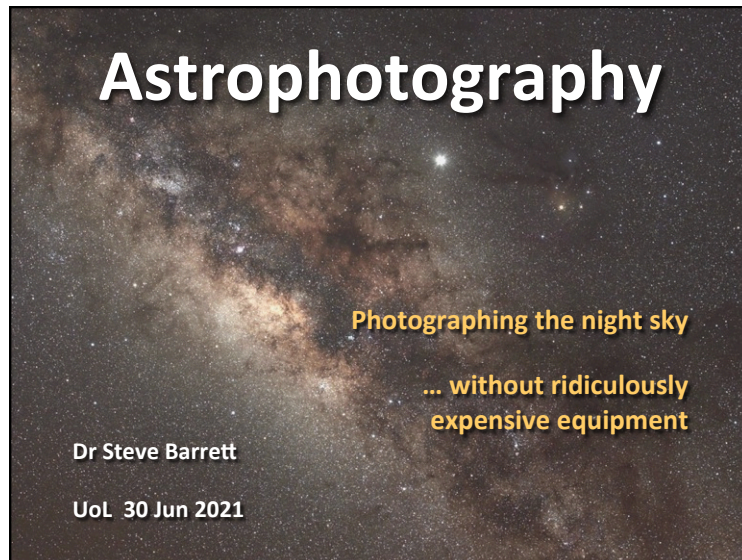


# Astrophotography

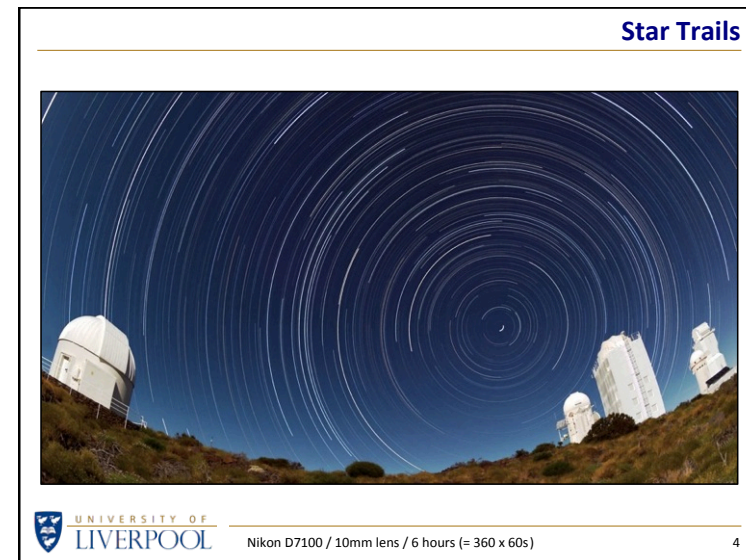


## What Do You Need?

<b>Start Simple</b>	Just a camera and tripod
<b>Equipment</b>	Telescopes and mounts
<b>Equipment</b>	Cameras and star trackers
<b>Photo Gallery</b>	Some of my images
<b>Astro Africa</b>	Under the darkest skies

UNIVERSITY OF LIVERPOOL

2



# Astrophotography

Comet Holmes



Right Place ... Right Time



Right Place ... Right Time



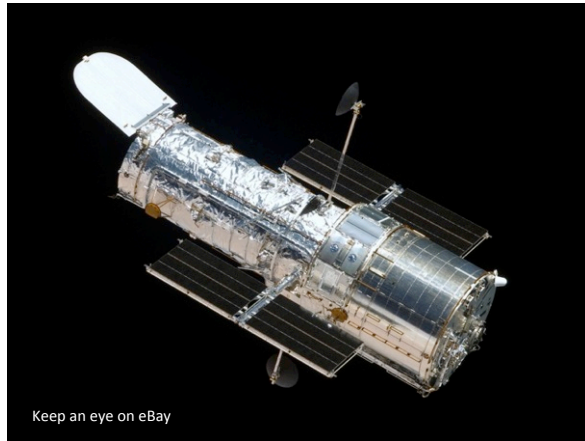
Total Eclipse – Sahara Desert – 29 Mar 2006

What Do You Need?

Start Simple	Just a camera and tripod
Equipment	Telescopes and mounts
Equipment	Cameras and star trackers
Photo Gallery	Some of my images
Astro Africa	Under the darkest skies

# Astrophotography

## What Do You Need?



Keep an eye on eBay

## What Do You Need?

If you have a \$billion to spare ...



M51



M16

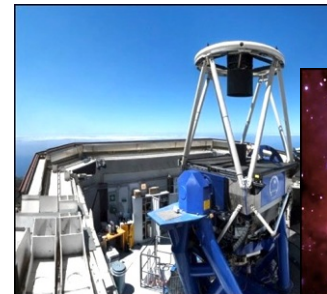
## What Do You Need?

If you have a \$100 million to spare ...



## What Do You Need?

If you have ~£million to spare ...



Liverpool Telescope, La Palma



M51



M16



# Astrophotography

## What Do You Need?

If you have  
~£250 – £25,000  
to spare...



## What Do You Need?

If you have  
~£250 – £25,000  
to spare...



Turning a telescope into tech spaghetti

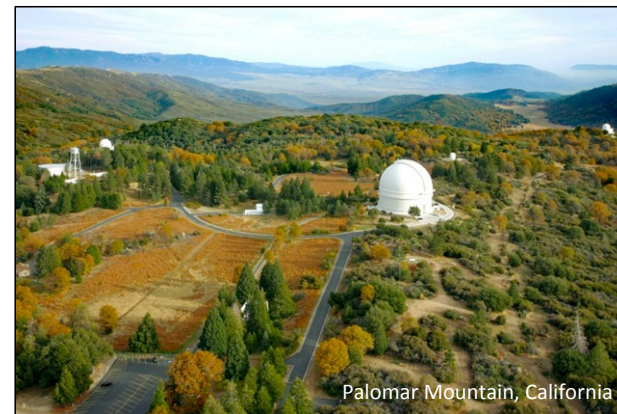
## What Do You Need?

If you have  
~£250 – £25,000  
to spare...



Many astronomers would  
advocate the use of a telescope  
mount that is the most sturdy and  
most precise that you can afford.  
Is this mount worth \$10,000?

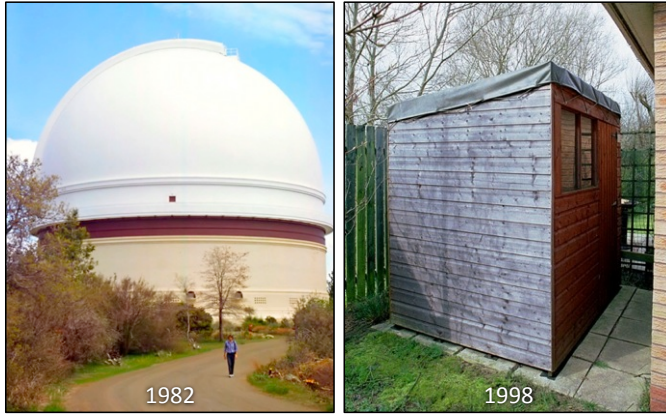
## Where To Put the Telescope?



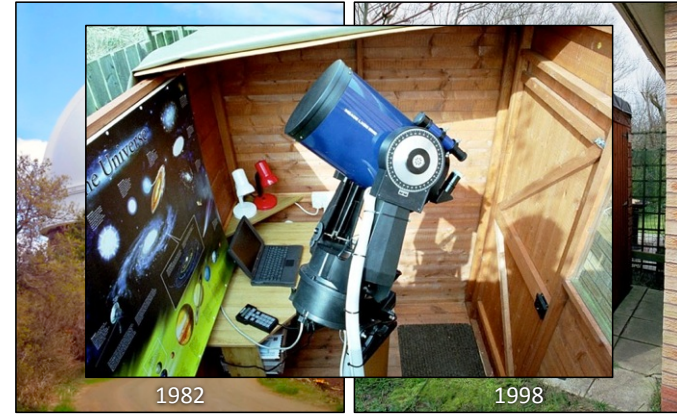
Palomar Mountain, California

# Astrophotography

Back Garden Observatory



Back Garden Observatory



Our closest  
neighbour can  
be fascinating ...

... watching the  
shadows of the  
craters and  
mountains  
change from  
night to night



Saturn

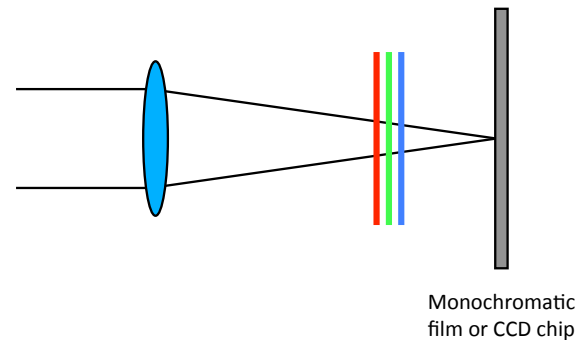


# Astrophotography

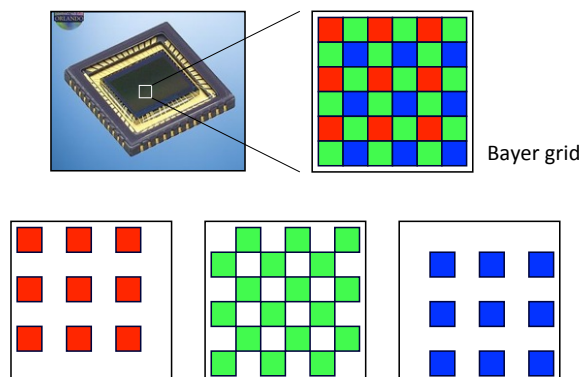
## What Do You Need?

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<b>Photo Gallery</b>	Some of my images
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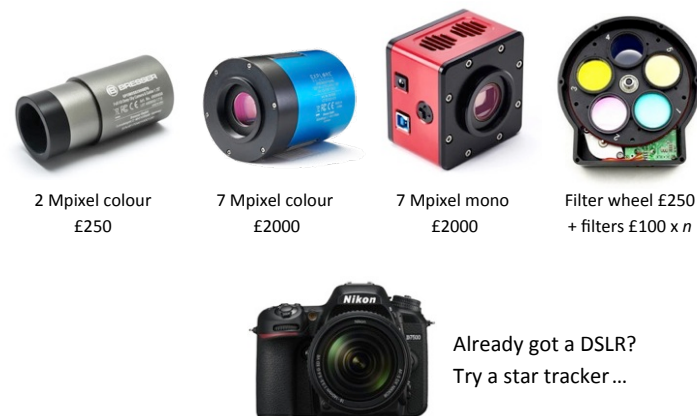
## Colour Imaging



## Colour Imaging

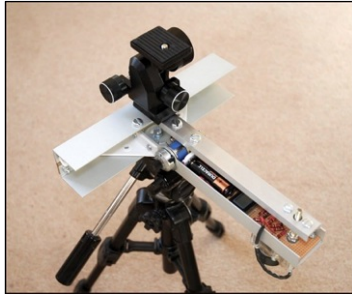


## Astronomical Cameras



# Astrophotography

## Star Trackers



DIY star tracker 'K2' that I designed and built  
Used 2007–2013



iOptron SkyTracker™  
Used since 2015

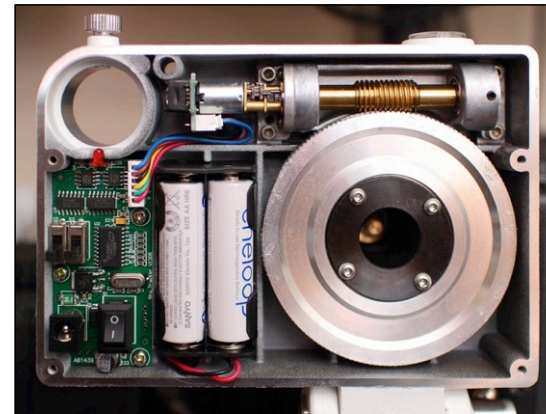
## Star Trackers



## Star Trackers



## Inside a Star Tracker





# Astrophotography

## What Do You Need?

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Astro Africa	Under the darkest skies

## Image Processing

NGC7000 North America Nebula



Single raw image

20 images stacked in *Image SXM*

Tweak the contrast/saturation

BASoc Star Party  
28 September 2019



M45  
Pleiades Cluster

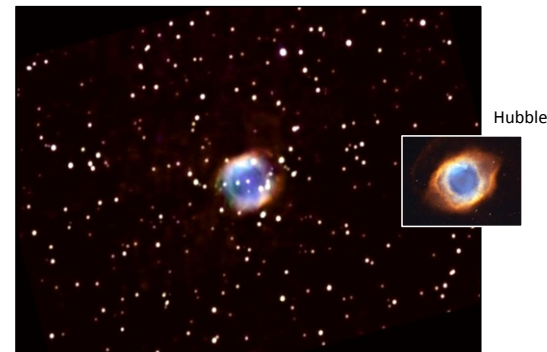


C33 + C34  
Veil Nebula



M31  
Andromeda  
Galaxy

## Helix Nebula



Hubble



# Astrophotography

Rho Ophiuchi Molecular Cloud Complex



Nikon D7500 / 135mm lens / 60 x 120s

33

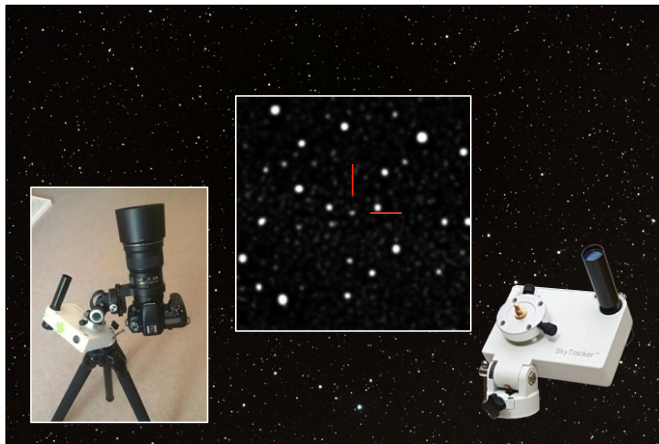
Markarian's Chain



Nikon D200 / 300mm lens / 10 x 120s

34

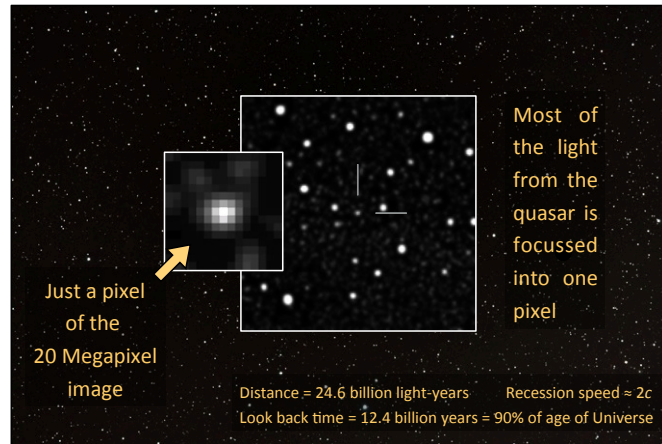
Lockdown Challenge



Nikon D7500 / 300mm lens / 256 x 30s

35

Lockdown Challenge



Nikon D7500 / 300mm lens / 256 x 30s

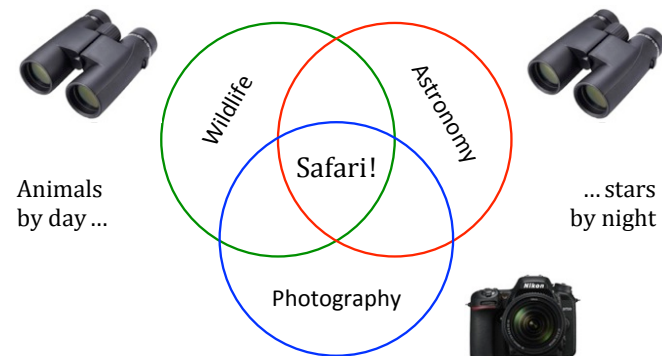
36

# Astrophotography

## What Do You Need?

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## Wild Astronomy

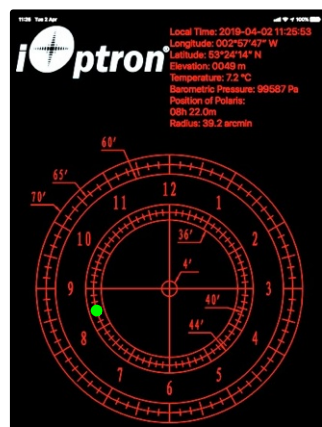


## Aligning Using Polaris

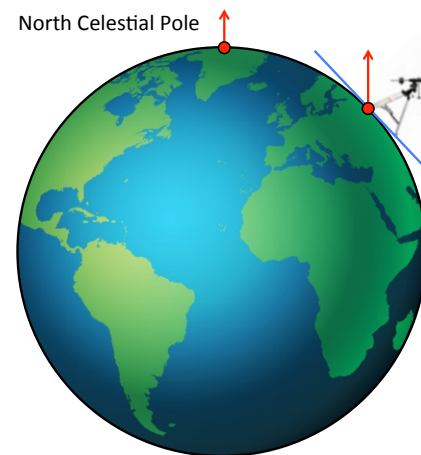
With Polaris visible, aligning a star tracker is easy in the UK.



But ...



## Aligning a Star Tracker



In East Africa the NCP and Polaris are very close to the horizon, and hence are hidden behind elephants or distant hills.

# Astrophotography

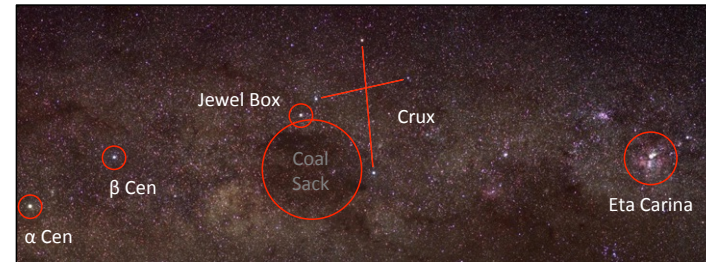
Large Magellanic Cloud



Nikon D7100 / 85mm lens / 30 x 60s

41

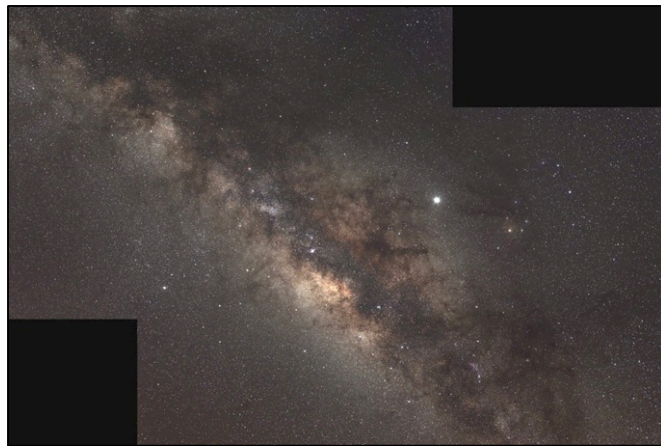
Centaurus–Crux–Carina



Nikon D7100 / 35mm lens / 30 x 60s

42

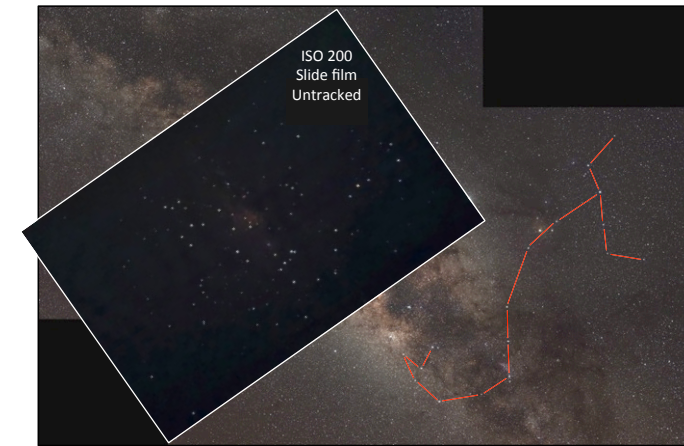
Milky Way



Nikon D7500 / 35mm lens / 10 x 120s

43

Milky Way



Nikon D7500 / 35mm lens / 10 x 120s

44



# Astrophotography

