

# AstroCruise

Imaging the Cosmos

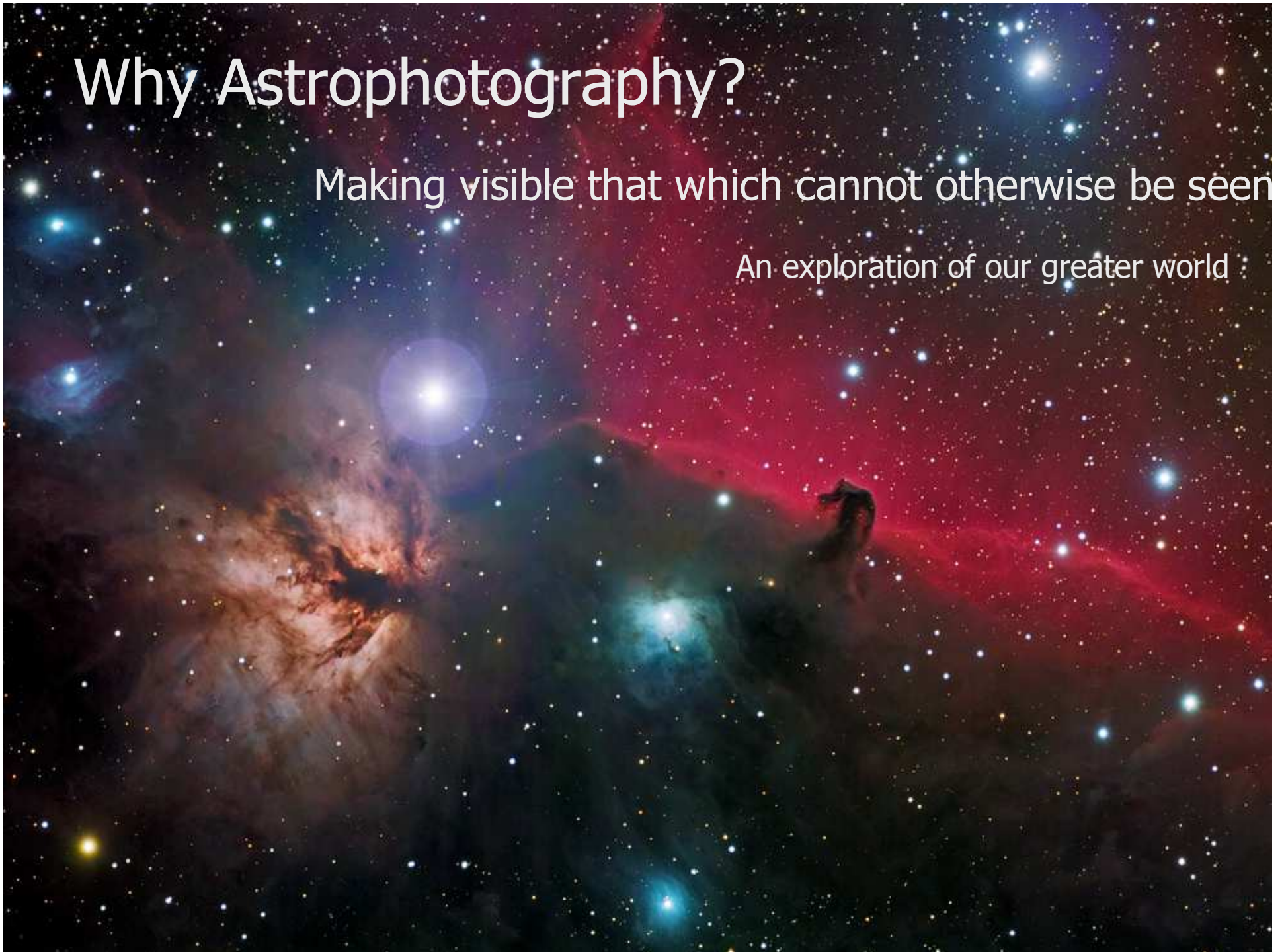
Crewkerne and District  
Astronomical Society

21 September 2016

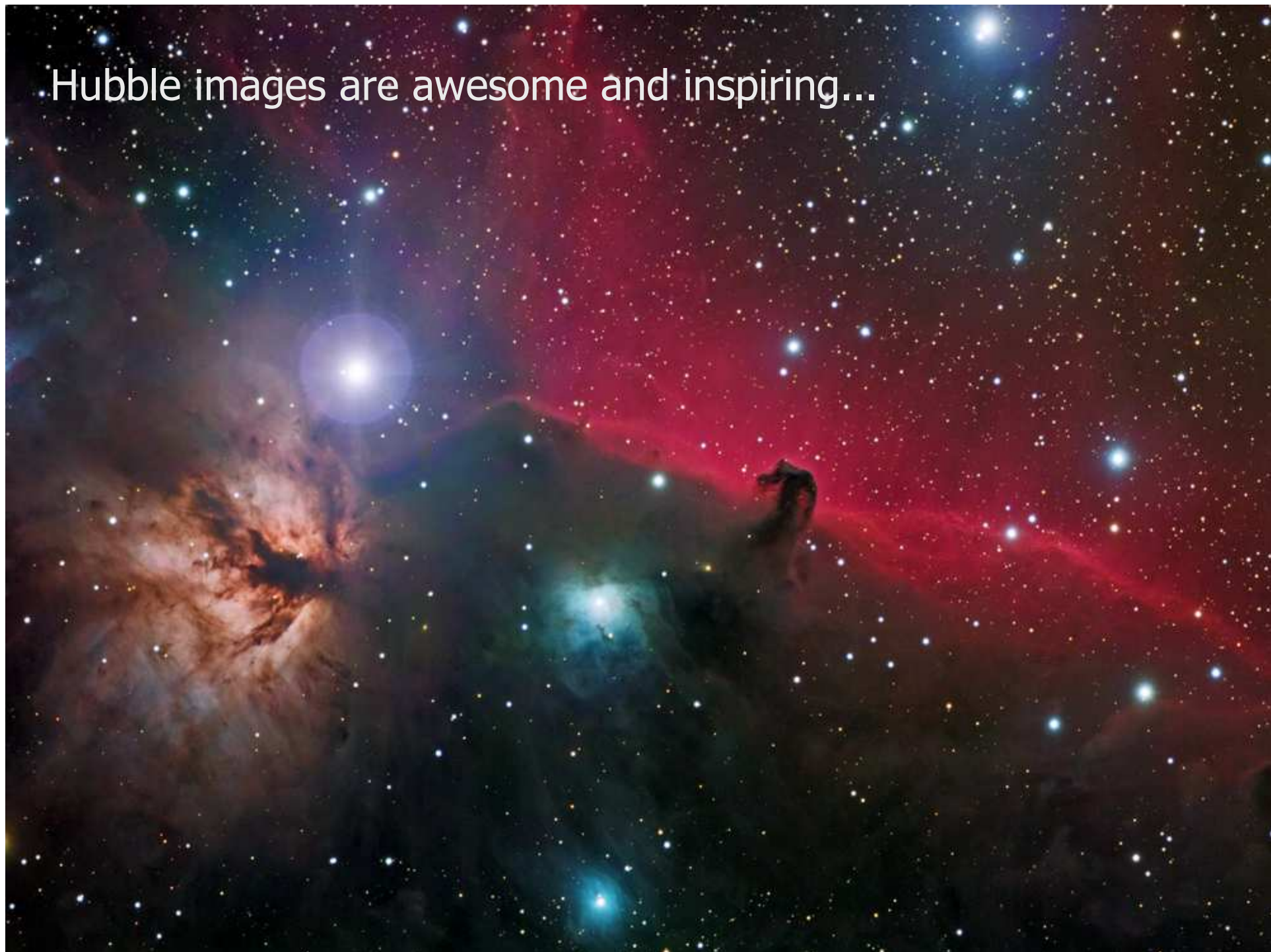
# Why Astrophotography?

Making visible that which cannot otherwise be seen

An exploration of our greater world



Hubble images are awesome and inspiring...



...but nothing is so exciting and motivating...



...as doing the exploring yourself

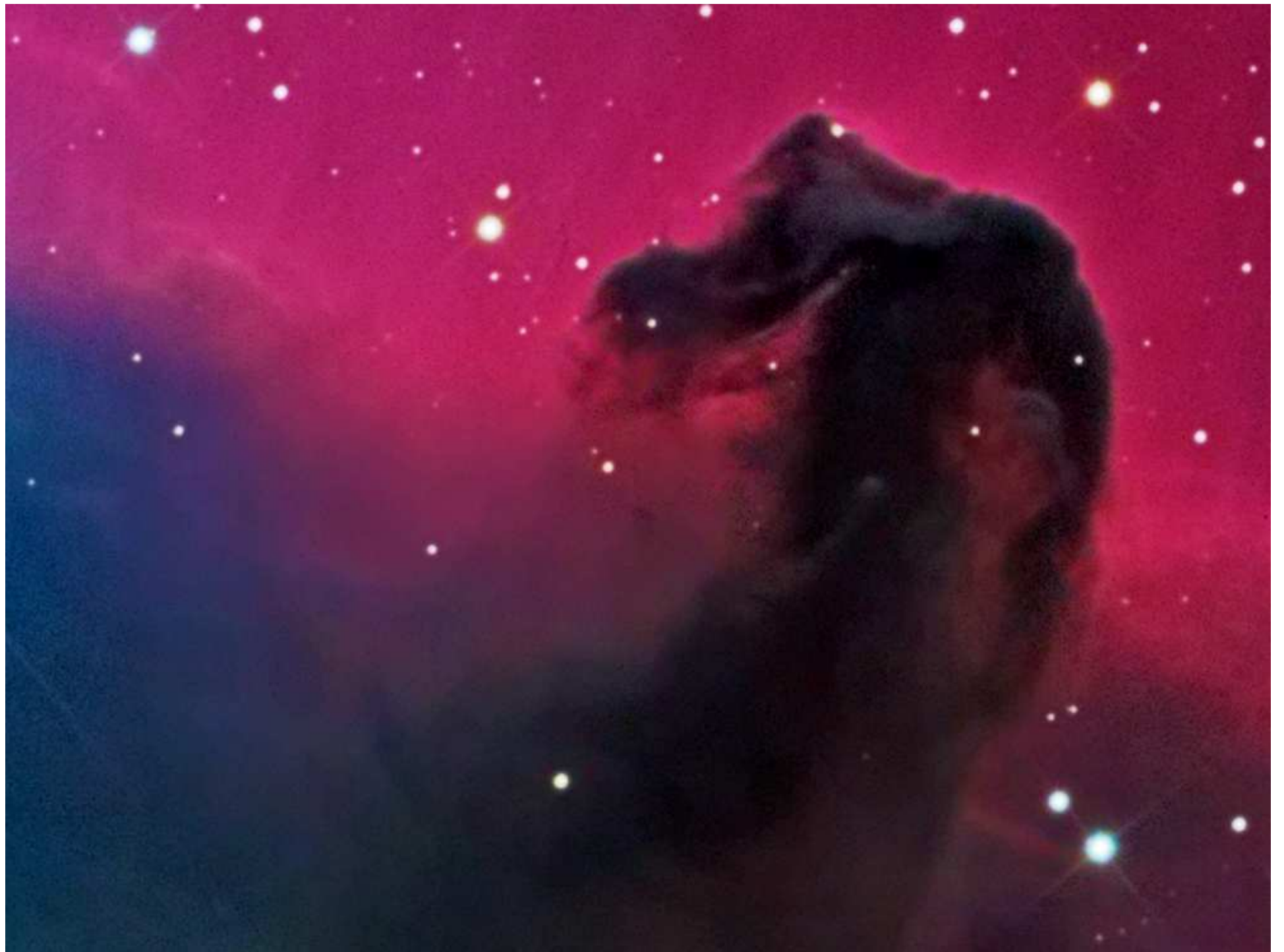


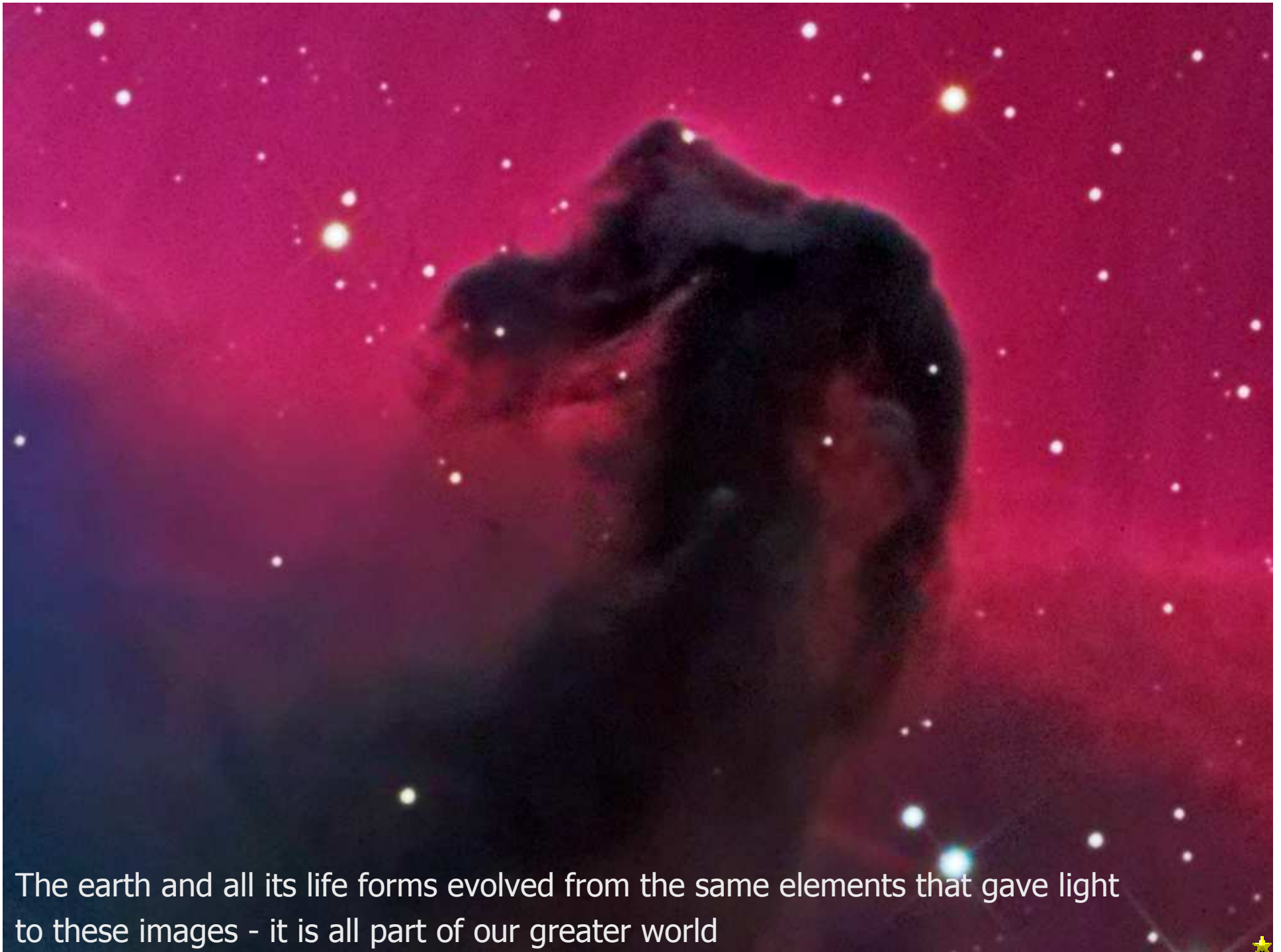












The earth and all its life forms evolved from the same elements that gave light to these images - it is all part of our greater world



# A Web Site Article About Light Pollution

A Tribute To The Work of Bob Mizon

Some Ideas... (will focus on local issues initially)

## Light Pollution - some local street lights



Old style, very prevalent, exposed luminaire, blinds onlooker, causes light pollution, wastes energy



Newer style, less prevalent, partially shielded luminaire, less light pollution, less energy waste, much better illumination



## Residential - Rottweiler light in back garden



## Typical "Security Light" - Can You See The Burglar?



## 'ALP' Light Properly Adjusted - Now Can You See The Burglar?



## Considerably better than a Rottweiler light...

Homebase Model #536270 "300W Anti Light Pollution Floodlight" But this is directed light and 300W is excessive.

Solution: the luminaire can be changed to 150W - you can get them in the 118mm width from [www.mygreenlighting.co.uk/](http://www.mygreenlighting.co.uk/)





# It's About Photography...

A typical DSLR can take good astrophotos





Pentax 67 / 45mm lens f/4 / fixed tripod / 10 secs on Fuji NPZ 800 120



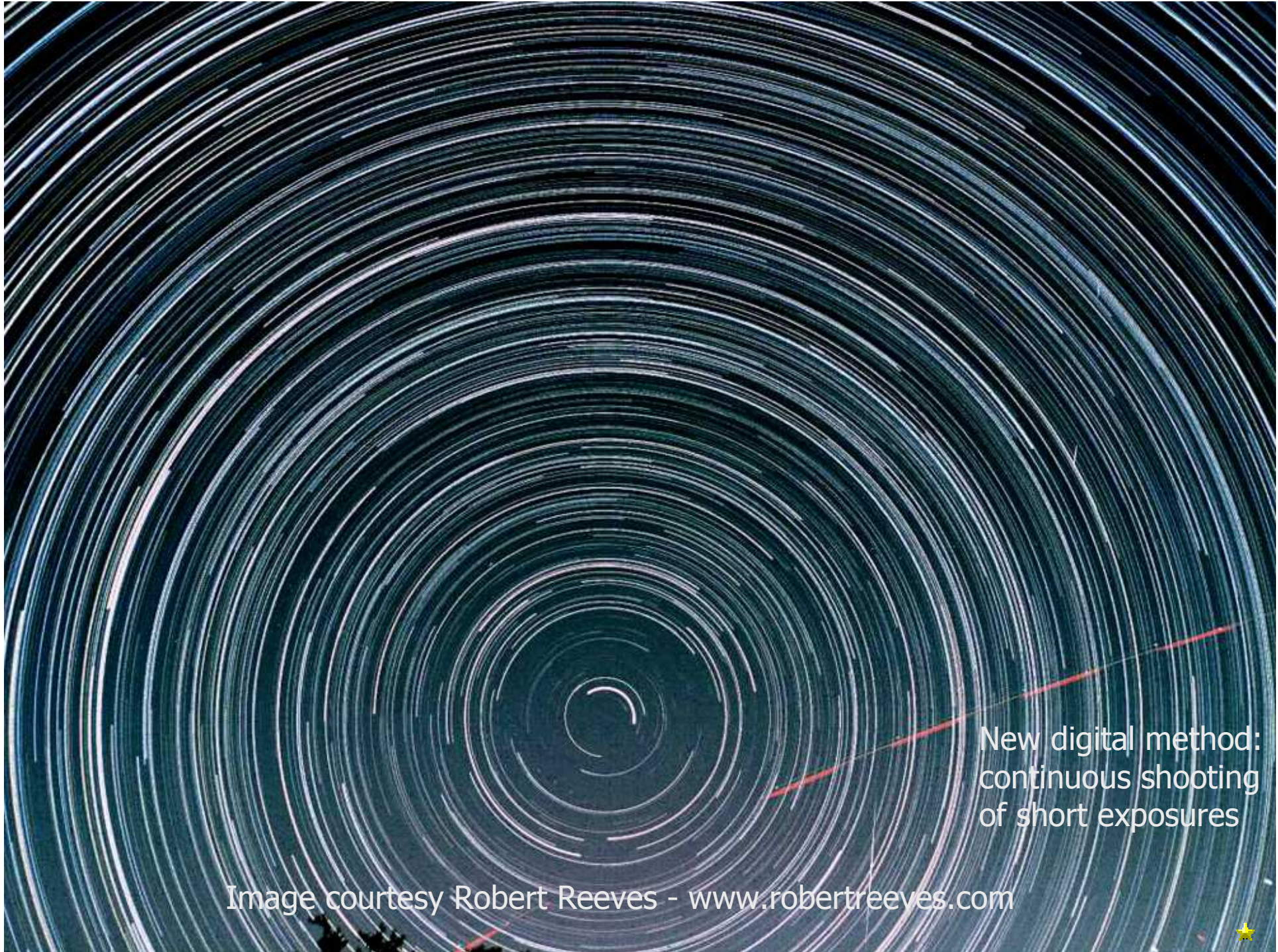


Image courtesy Joshua Strang



Pentax 67 / 45mm lens f/4 / fixed tripod / 20 secs on Fuji NHG 400 120





New digital method:  
continuous shooting  
of short exposures

Image courtesy Robert Reeves - [www.robertreeves.com](http://www.robertreeves.com)

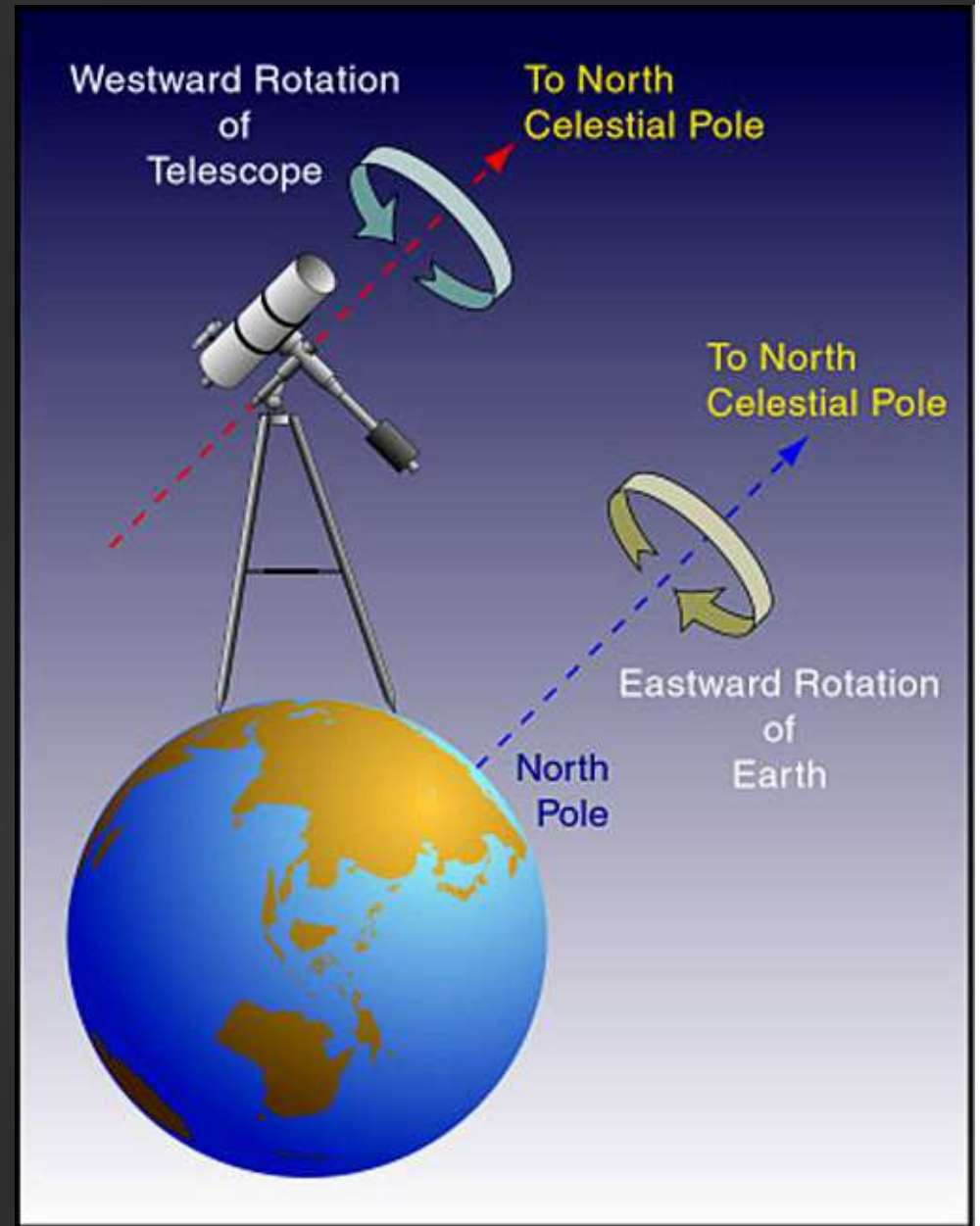
# Imaging Above the Horizon

## The Next Stage

Avoiding star trails...

We must compensate for the earth's rotation

We do this with an astronomical mount





# Imaging Above the Horizon - avoiding star trails...

Barn Door Mount: - simple and cheap

- surprisingly good results
- easily home made

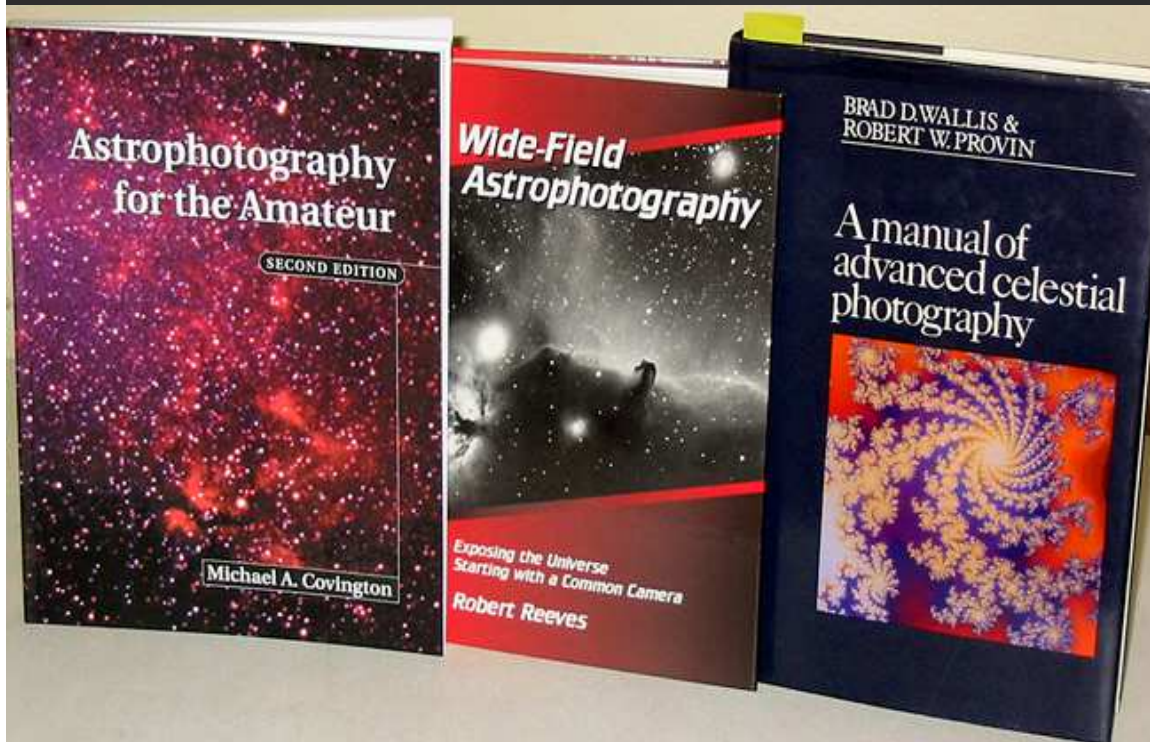


Image courtesy Pedro Ré [www.astrosurf.com/re/](http://www.astrosurf.com/re/)

## Avoiding star trails...

AstroTrac: [www.astrotrac.com](http://www.astrotrac.com)

- portable, relatively inexpensive
- can produce very good results



Courtesy Robert Reeves - [www.robertreeves.com](http://www.robertreeves.com)



Courtesy Robert Reeves - [www.robertreeves.com](http://www.robertreeves.com)

## Imaging - getting more serious...

Previous examples are good for wide field imaging.

Mount quality becomes very important for high resolution imaging. Higher resolution needs more quality.

Losmandy G11 and Meade LX-series are popular medium cost choices.



Losmandy G11  
German Equatorial Mount  
(GEM)



Meade LX-series  
Fork Mount

## Imaging - getting more serious...

Many astrophotographers use German Equatorial Mounts such as this - the AP 900 GTO

Mount quality is very important for high resolution imaging.

One high quality mount is a good investment because it can carry all your future telescopes.



One good quality mount can carry all your telescopes!



## Crazy Mount!

It helps if the mount can track past the meridian

In this case the mount starts off on the 'wrong side' in the east

It will pass to the 'right side' as crosses the meridian

It means that the mount can track the whole night long - you never have to stop imaging to flip the mount.



Easiest form of imaging  
- refractor + DSLR



1/400 sec means that mount quality or alignment not that important

# Webcam Imaging

Good seeing essential

Good optics essential

Better to use short-focus high quality optics with focal extender... ⇒

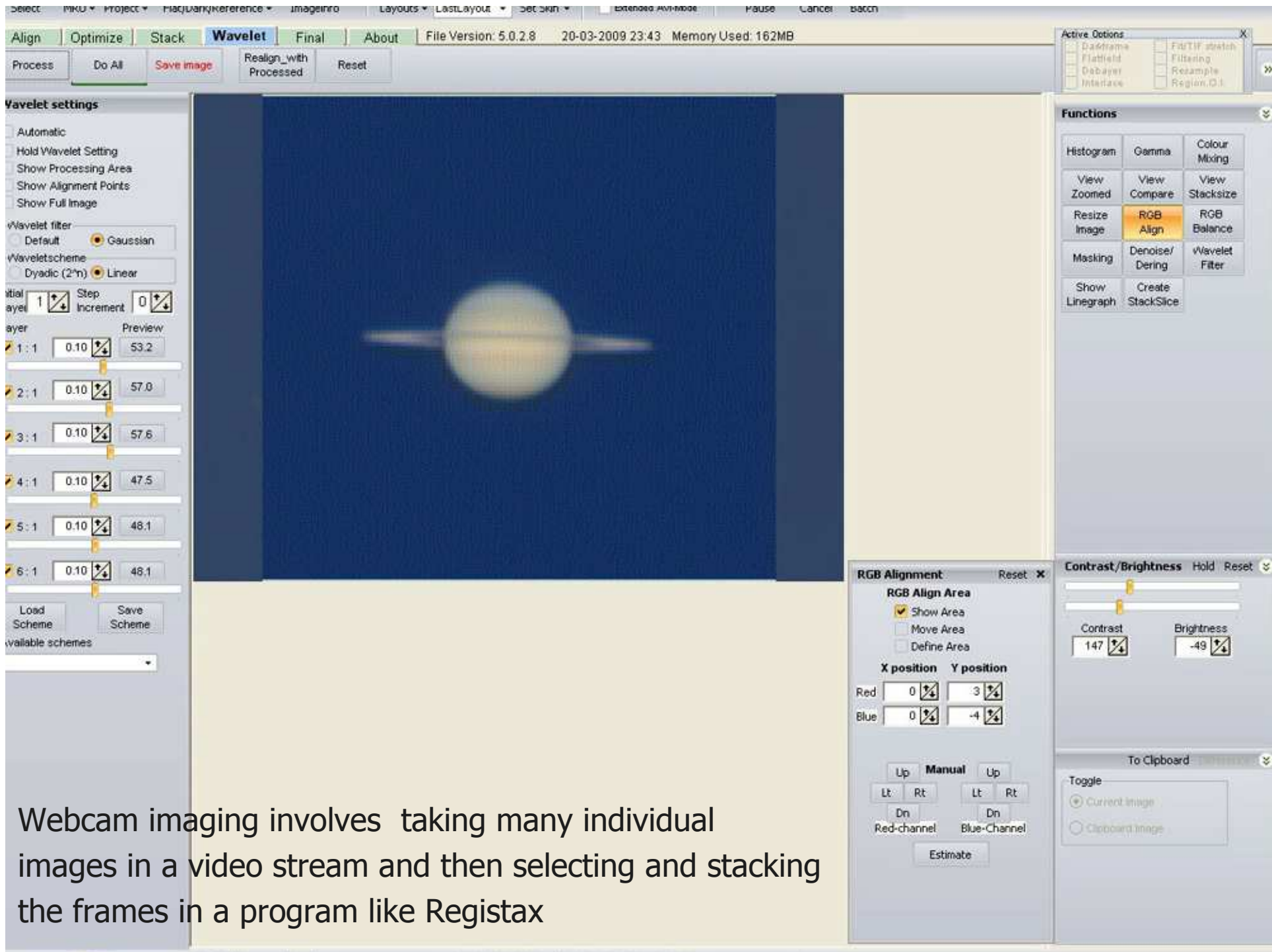
...than long-focus lower quality optics with no extender ⇒

Best optical systems for webcam imaging are: Newtonians, some Schmidt-Cassegrains, high quality ED refractors with focal extender. Ritchey-Chretien may not be so good unless optics are of top quality

TeleVue 5x Powermate →



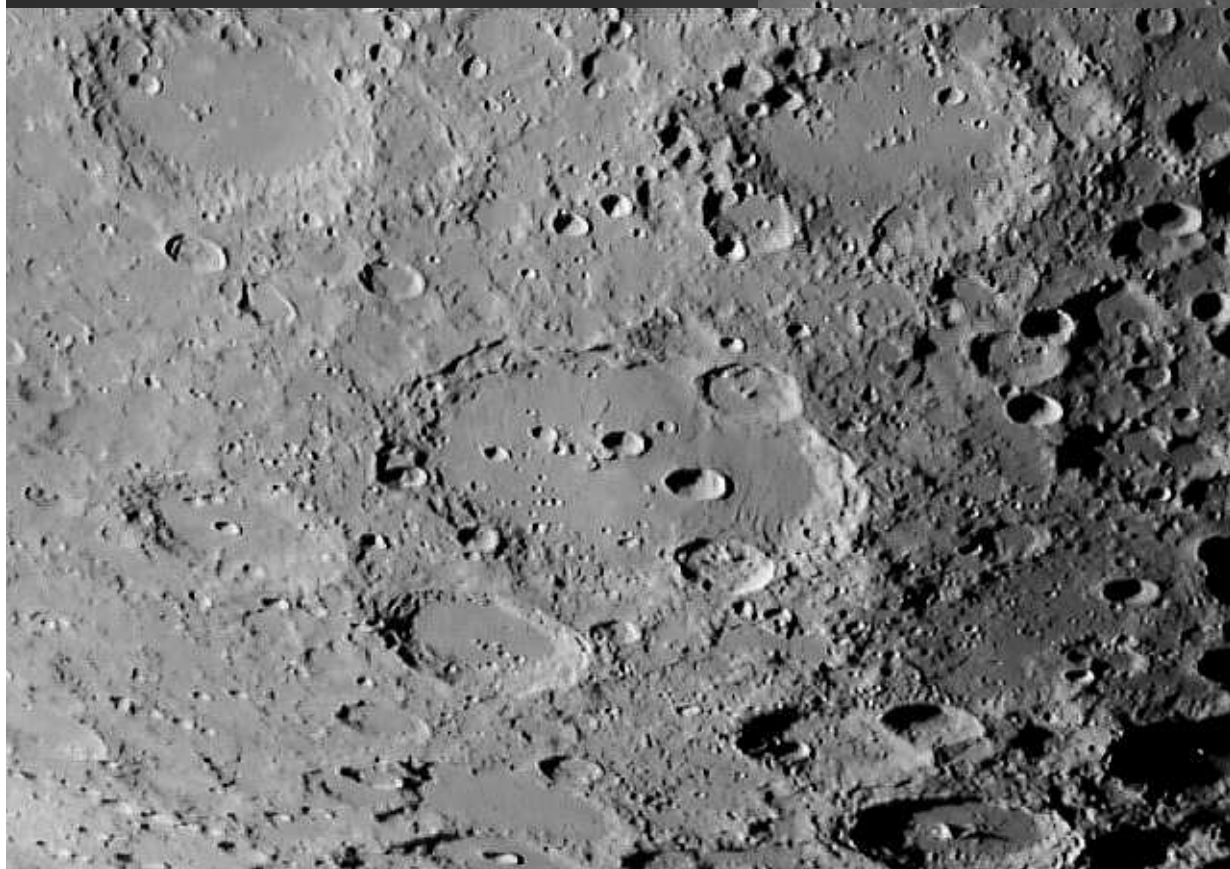
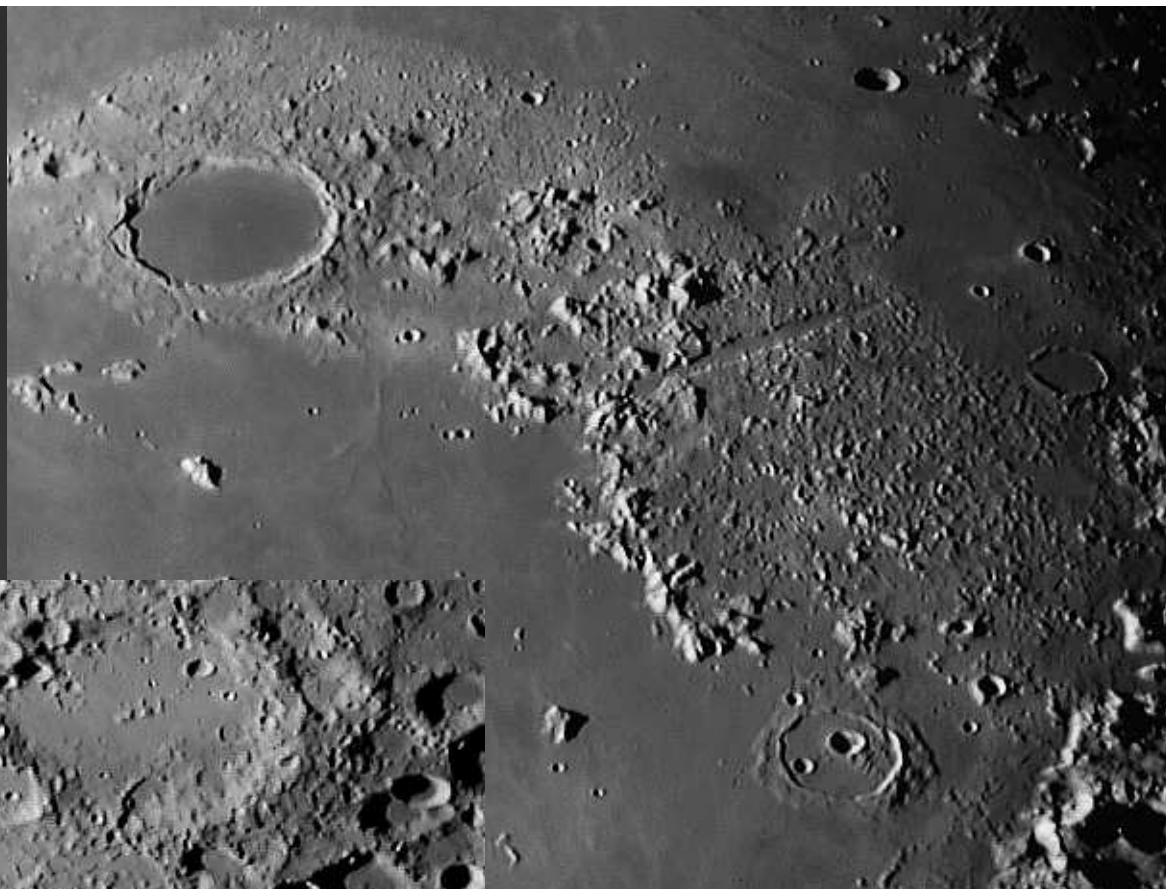




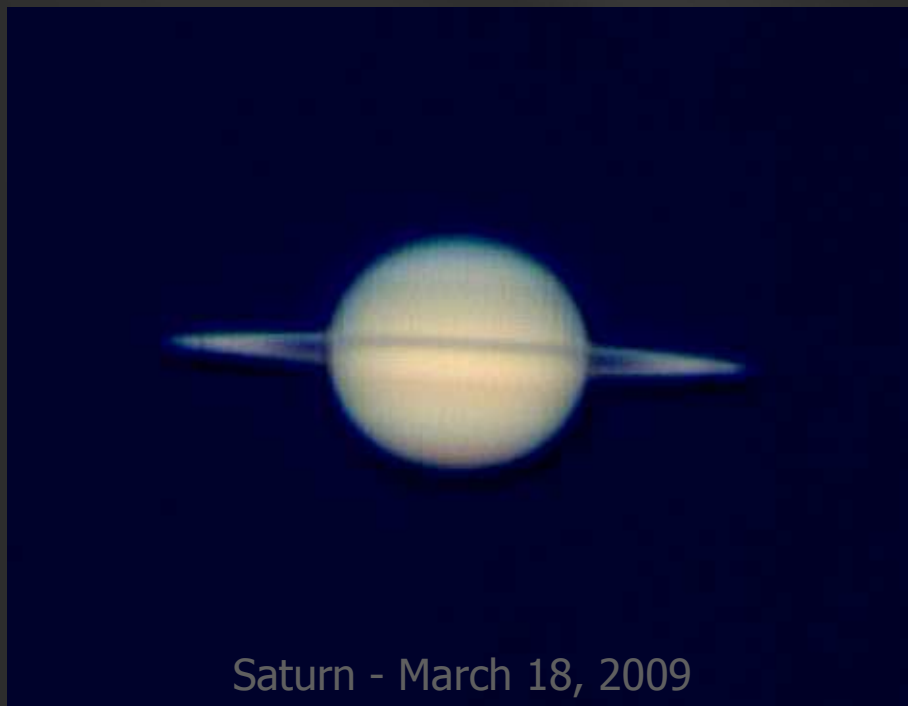
Webcam imaging involves taking many individual images in a video stream and then selecting and stacking the frames in a program like Registax

# Webcam Imaging

Results with the RCOS  
can sometimes be OK



# Webcam Imaging



Piggyback photography  
can be quite easy.  
The bearer instrument  
becomes an accurate  
guidescope.

But use firm, high quality  
couplings, such as Losmandy  
plates, rings, and mounting  
blocks.





Comet Hale-Bopp April, 1997



Antares - Rho Ophiucus June, 2008



Imaging comets can be quite easy  
No guiding - just let the mount track  
and align images on comet core using  
astronomical software

Comet Neat (C/2001 Q4) May 15, 2004



A more advanced technique using separate  
compositing of sky and comet with  
Sigma Clip blending

Comet Lulin (C/2007 N3) February 25, 2009





## Let's get back to cameras...

A standard DSLR can be used for astrophotography, but there are limitations (mostly with nebulae):

The integral Infra-Red filter blocks some wavelengths essential for imaging nebulae

Imaging sensor is not cooled

Bayer mask not optimum for high resolution RGB

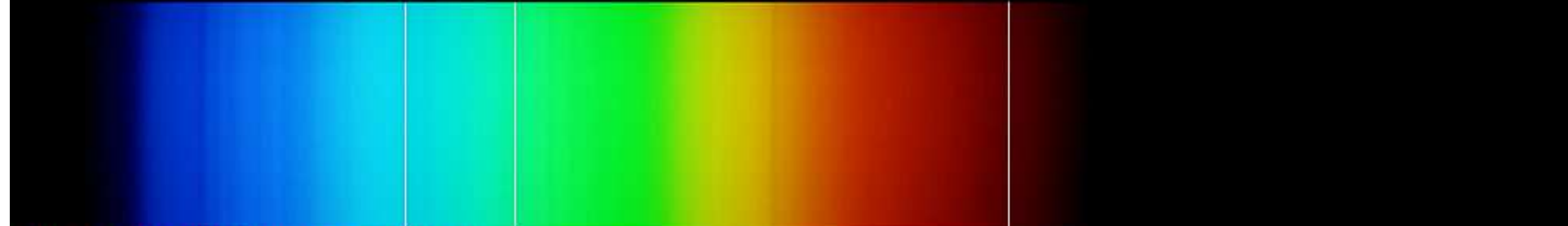
Not fully computer controlled

Not ruggedised for all-night use

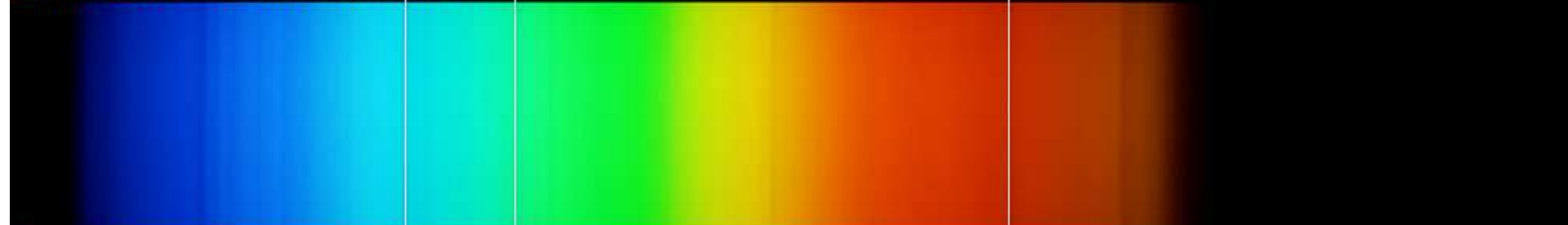


# Spectral Emission Lines important for CCD Imaging & the H-alpha block in DSLRs

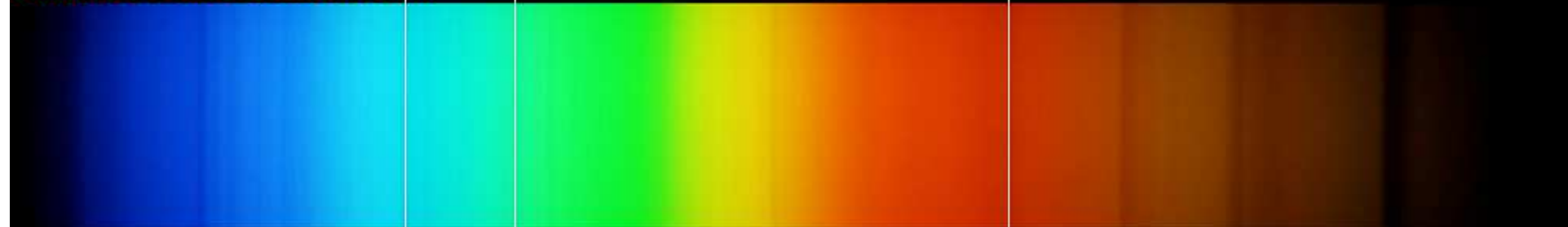
Canon EOS 350D with original IR cut



Canon EOS 350D with Baader IR cut



Canon EOS 350D without IR cut



400nm

500nm

600nm

700nm

H-beta  
486nm

OIII  
500.3nm

H-alpha  
656nm

# The effect of blocking H-alpha in DSLRs

## Standard DSLR

- hardly any H-alpha recorded



## Modified DSLR with extended red response filter

- H-alpha records normally



# How to unblock the H-alpha response

Modify the IR filter yourself:

<http://ghonis2.ho8.com/rebelmod450d1.html>

(possible but “hairy”)

Get someone else to modify it, or:

Buy a pre-modified DSLR

Google “dslr ir filter mod”

Buy a CCD camera designed for  
astrophotography

Google “ccd camera for astrophotography”

(A modified DSLR can produce nice results but  
even so is not optimum for astrophotography and  
some other science applications)



# CCD camera designed for astrophotography



# CCD camera designed for astrophotography

Specialised digital camera:

- Cooled CCD chip
- Plus water cooling (if necessary)
- Integral filter wheel
- Integral autoguider
- Fully controlled by computer
- Ruggedised for all-night use



# CCD Imaging

CCD camera internals. Monochrome CCD is better if possible

- avoids Bayer mask,  
thus: integral filter wheel →

Integral autoguider ↓



## CCD Imaging - Calibration

Need Flat, Dark, and Bias Calibration Frames

Temperature of calibration frames needs to match the image frames

Temperatures achievable with 2-stage cooler:

-30 C in winter, -20 C in summer

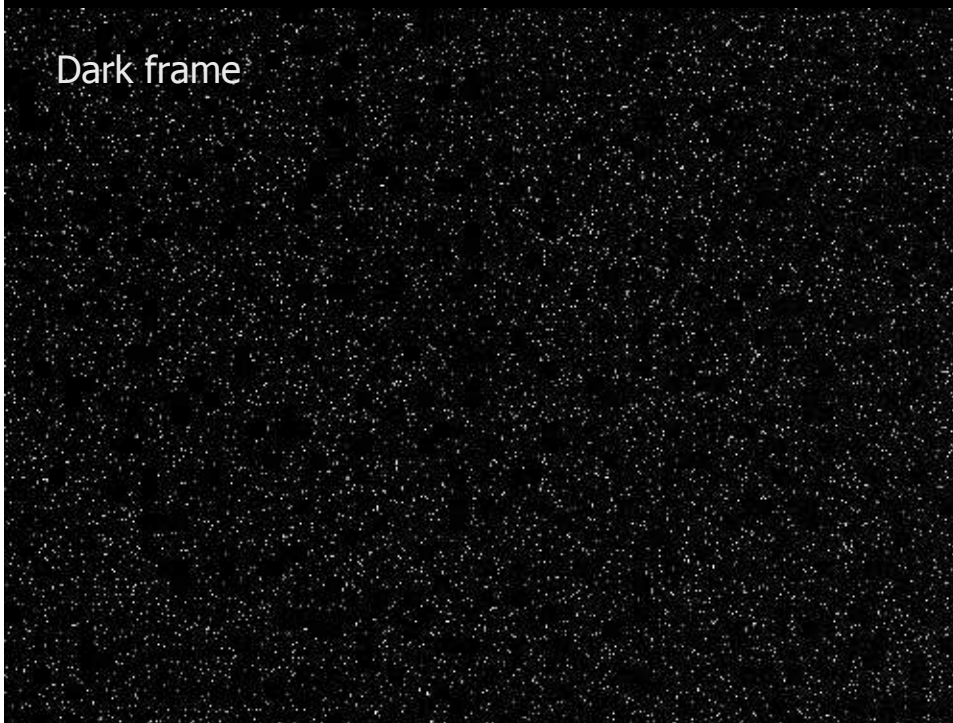
Dark frames can take a long time - we don't want to take out valuable imaging time with dark frames...

Answer: to take dark frames in the daytime, put the CCD camera in the fridge!

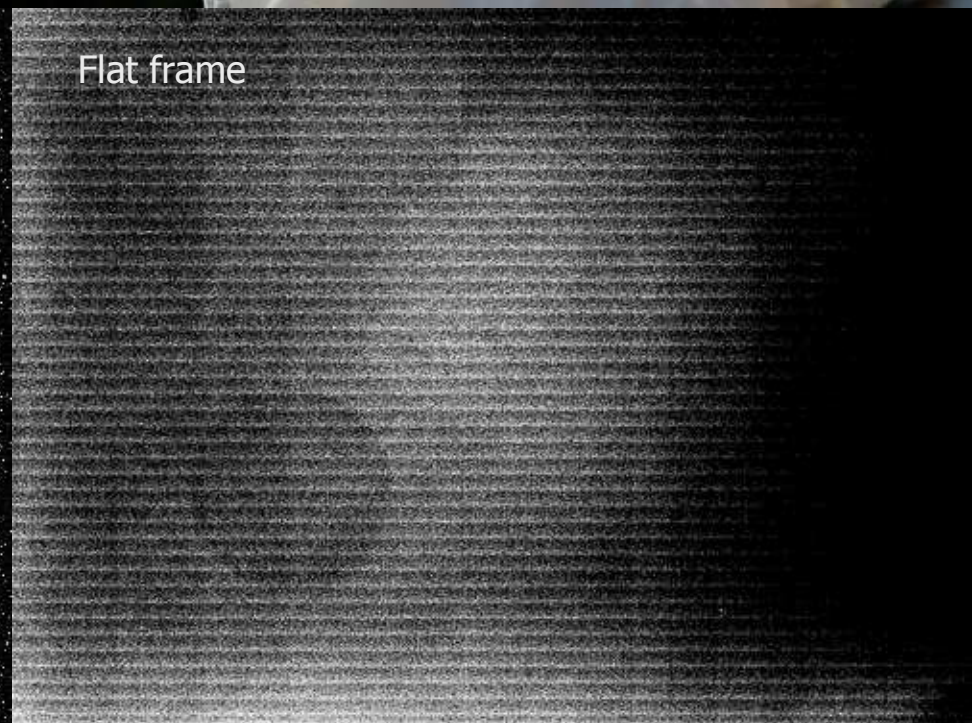
T-shirt Flat



Dark frame



Flat frame





# CCD Imaging: Calibration, Combining, and Processing

(Brief notes - needs to be covered by a separate talk)

Maxim: Flat, Dark, and Bias frames used to calibrate luminance and RGB images separately  
(Luminance images normally Bin 1, RGB images normally Bin 2)

Maxim: Luminance and RGB images aligned and combined separately also, using SD Mask  
(see: [www.astrocruise.com/articles/stacking/stacking.htm](http://www.astrocruise.com/articles/stacking/stacking.htm))

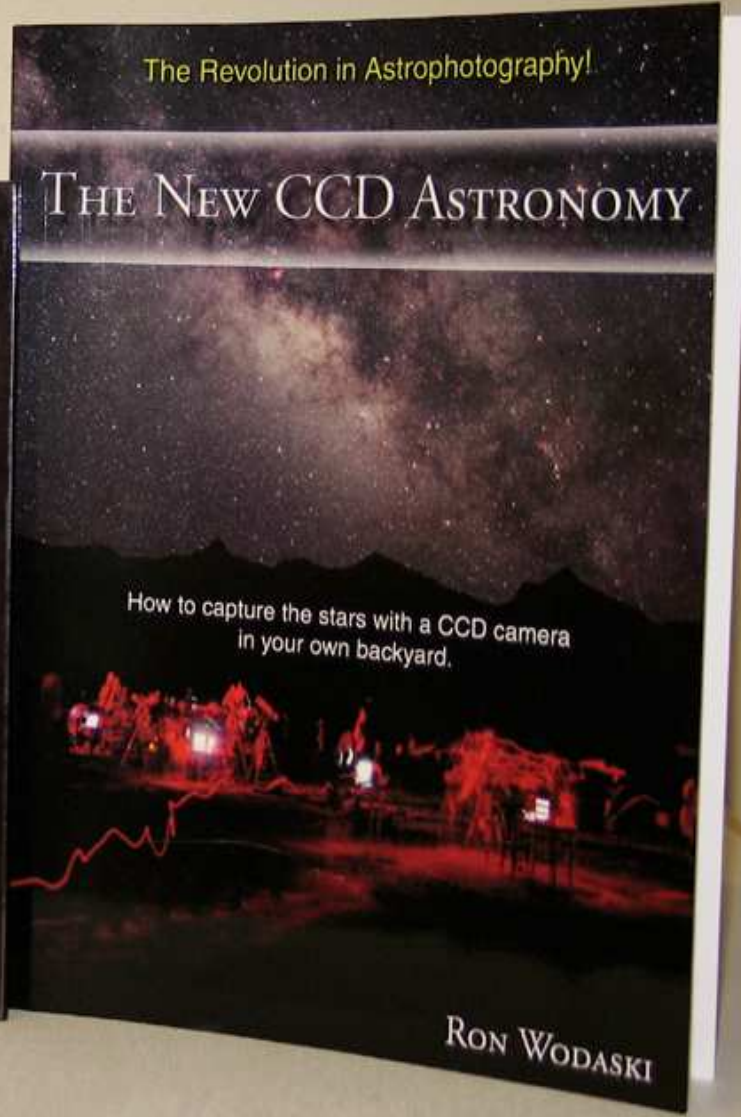
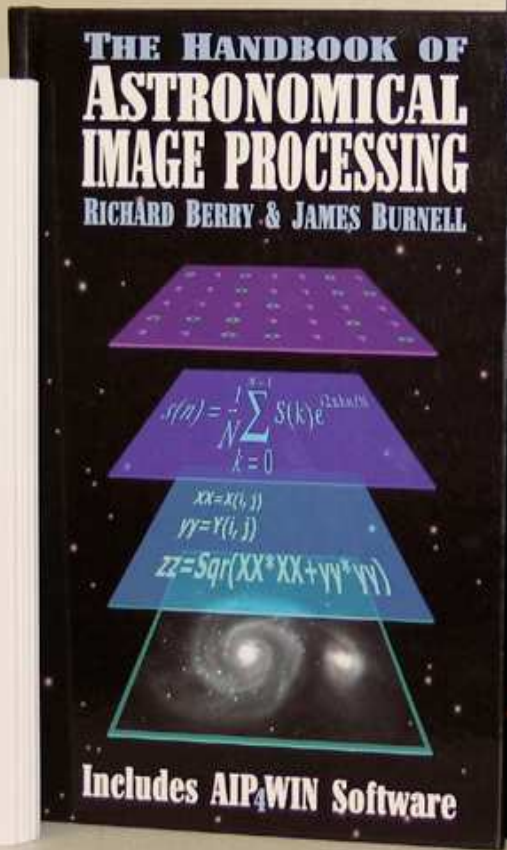
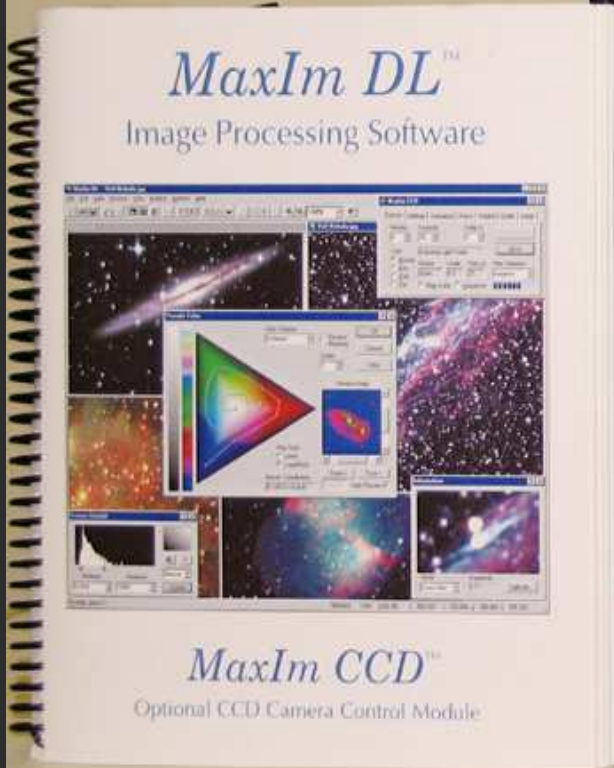
DDP and noise reduction applied to both stacks (large topic)

RGB Images: RGB weights adjusted for correct colour balance

RGB stack sometimes aligned and scaled to Luminance stack using Maxim, sometimes using RegiStar, followed by combining in Photoshop using Luminance layering. ProDigital Astronomy Tools installed but not used so far

FIT images converted to TIFF / PSD depending on the workflow used

RGB stack sometimes enhanced separately in Photoshop, using layering techniques, sometimes strengthening channels in Lab mode. LRGB enhancement usually by Photoshop layering techniques



# Star Maps - using Megastar

MegaStar 16/4/09 23:23 LT 14h 26m LST Philip G. Perkins

Stars NSOs SolarSys Field Overlays Database Options Scope Help

07h 06m 3.7s -11° 05' 02" Dist: --- 7.6° x 4.0° Mon Urano 273 Alt: -22.0° Az: 275.8°

C D E F G H I J K L M N O P Q R S T V W X Y Z ? z @ + - \* / < > ↓ ↑

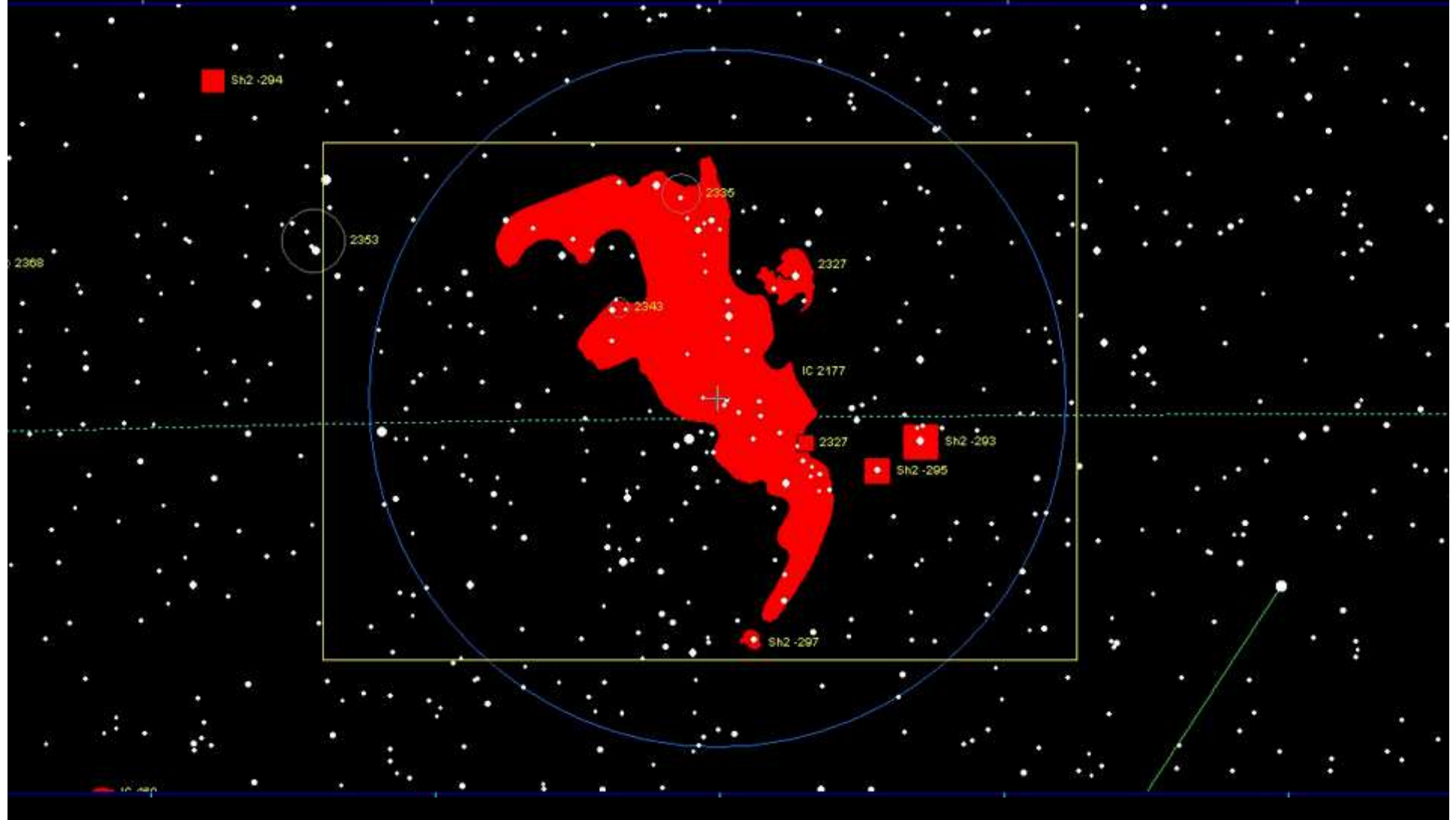
7h 18m

7h 12m

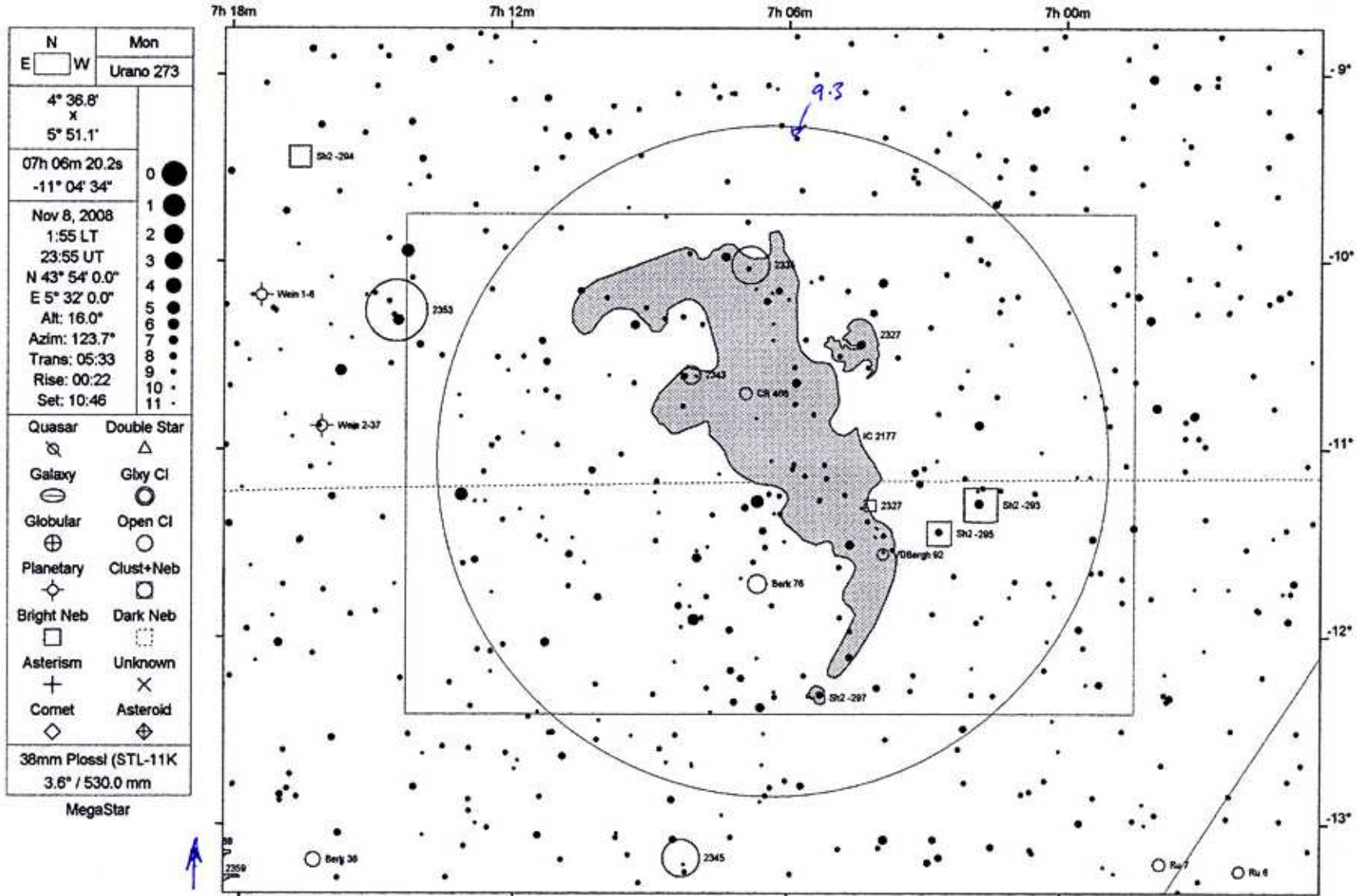
7h 06m

7h 00m

6h 54m



# Star Map Printout - as used next to telescope



N		Mon	
E	W	Urano 273	
4° 36.8'			
x			
5° 51.1'			
07h 06m 20.2s		0 ●	
-11° 04' 34"		1 ●	
Nov 8, 2008		2 ●	
1:55 LT		3 ●	
23:55 UT		4 ●	
N 43° 54' 0.0"		5 ●	
E 5° 32' 0.0"		6 ●	
Alt: 16.0°		7 ●	
Azim: 123.7°		8 ●	
Trans: 05:33		9 ●	
Rise: 00:22		10 ●	
Set: 10:46		11 ●	
Quasar	Double Star		
Galaxy	Glob Cl		
Globular	Open Cl		
Planetary	Clust+Neb		
Bright Neb	Dark Neb		
Asterism	Unknown		
Comet	Asteroid		
38mm Plossl (STL-11K)			
3.6" / 530.0 mm			
MegaStar			

*Seagull Nebula*

Seagull Nebula -- FSQ-106ED @f/5.0 -- STL-11K

Nov 8, 2008 1:55 *RGR 3x 10, 6.5, 10*  
*600, 390, 600*

# High Resolution Imaging

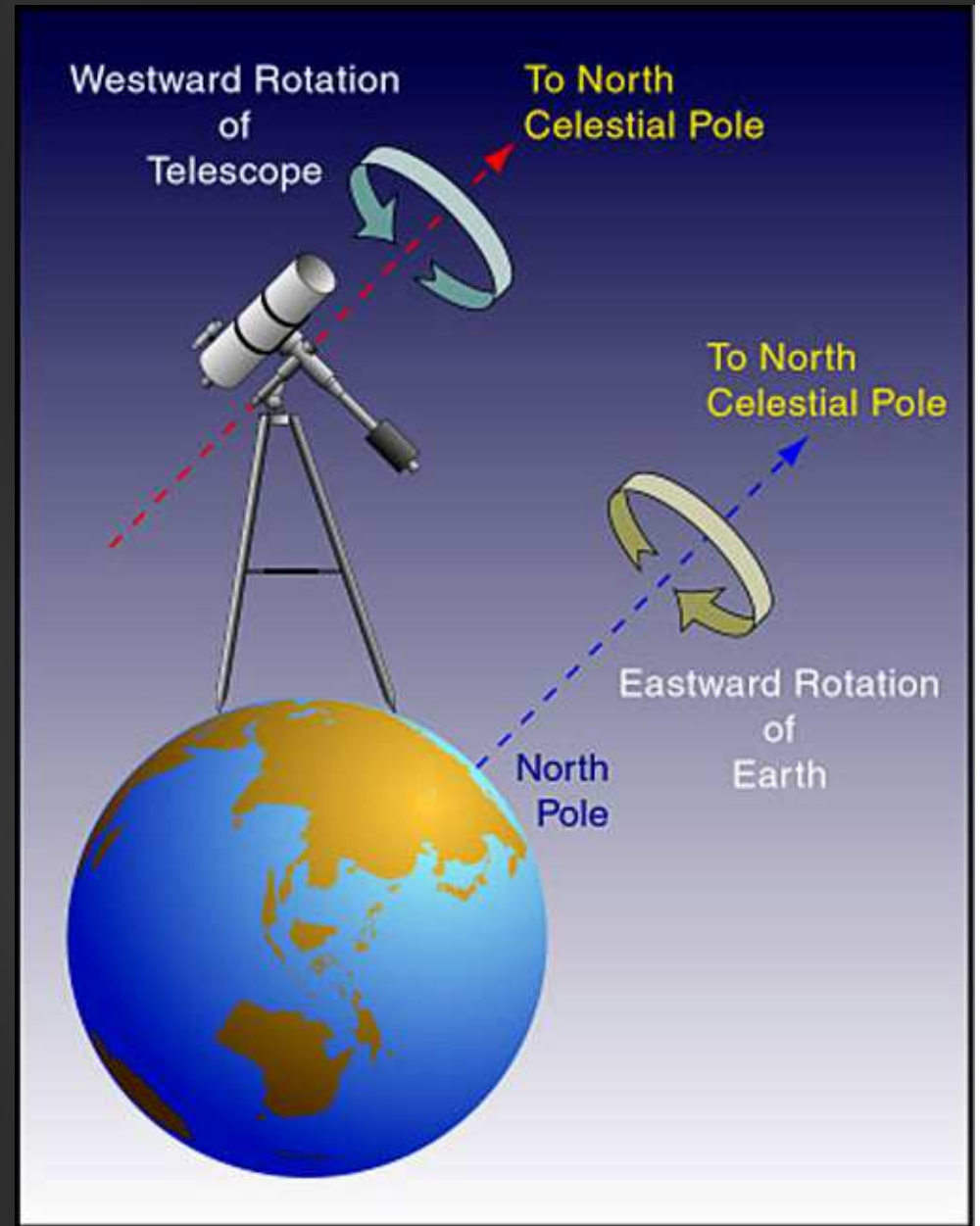
Polar Alignment is important...  
the mount has to emulate the motion  
of the earth

It is the process of aligning the  
mount's Right Ascension axis  
(only) with the North Celestial Pole

It involves making two mechanical  
adjustments to the RA axis:  
Azimuth and Altitude

That is all

The Drift Method is very reliable



# High Resolution Imaging

For high resolution imaging...

Seeing (atmospheric turbulence) is very important. It must be as low as possible

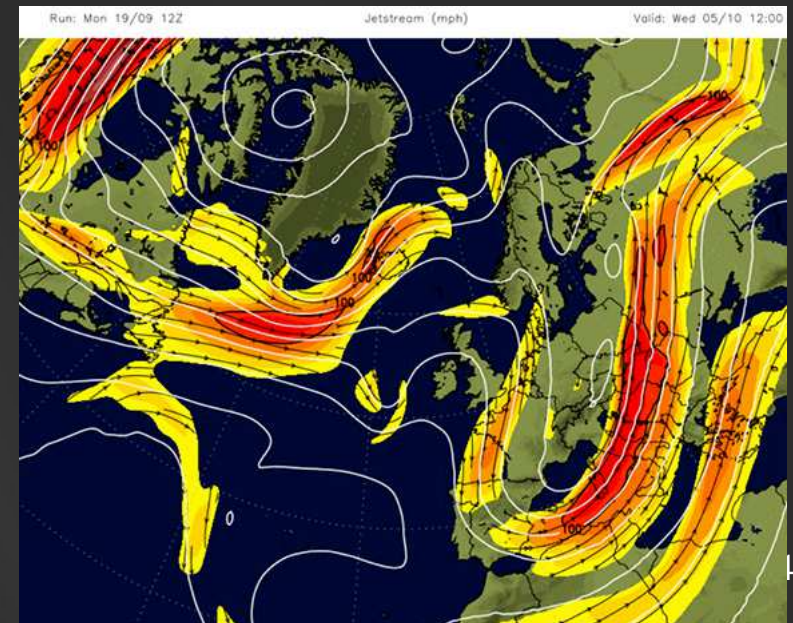
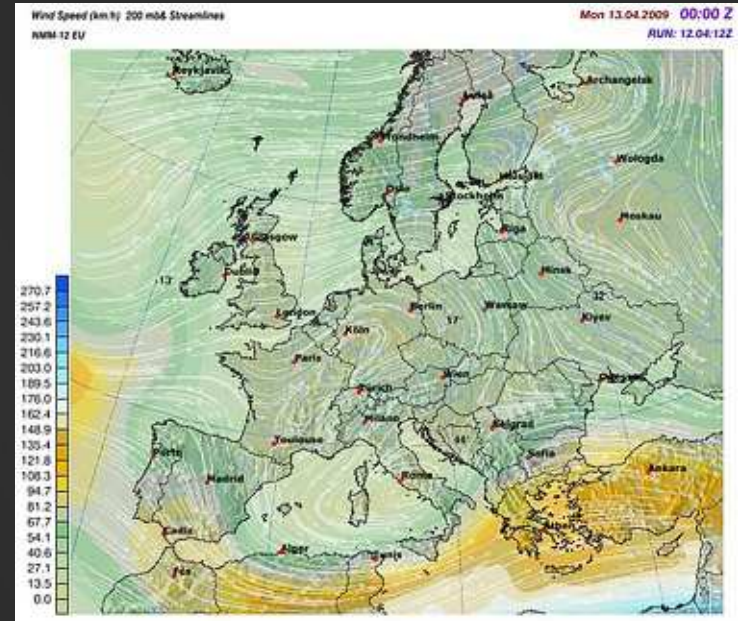
Over many years I have seen a strong correlation between seeing and Jetstream

16 day forecast is at: <http://www.netweather.tv/index.cgi?action=jetstream;sess=>

Provided that MSL pressure is high then low Jetstream = good seeing

Jetstream forecasts can help a great deal

3 day forecast is at: <http://www.meteoblue.com/>



# CCD Imaging - using the RCOS 12.5"

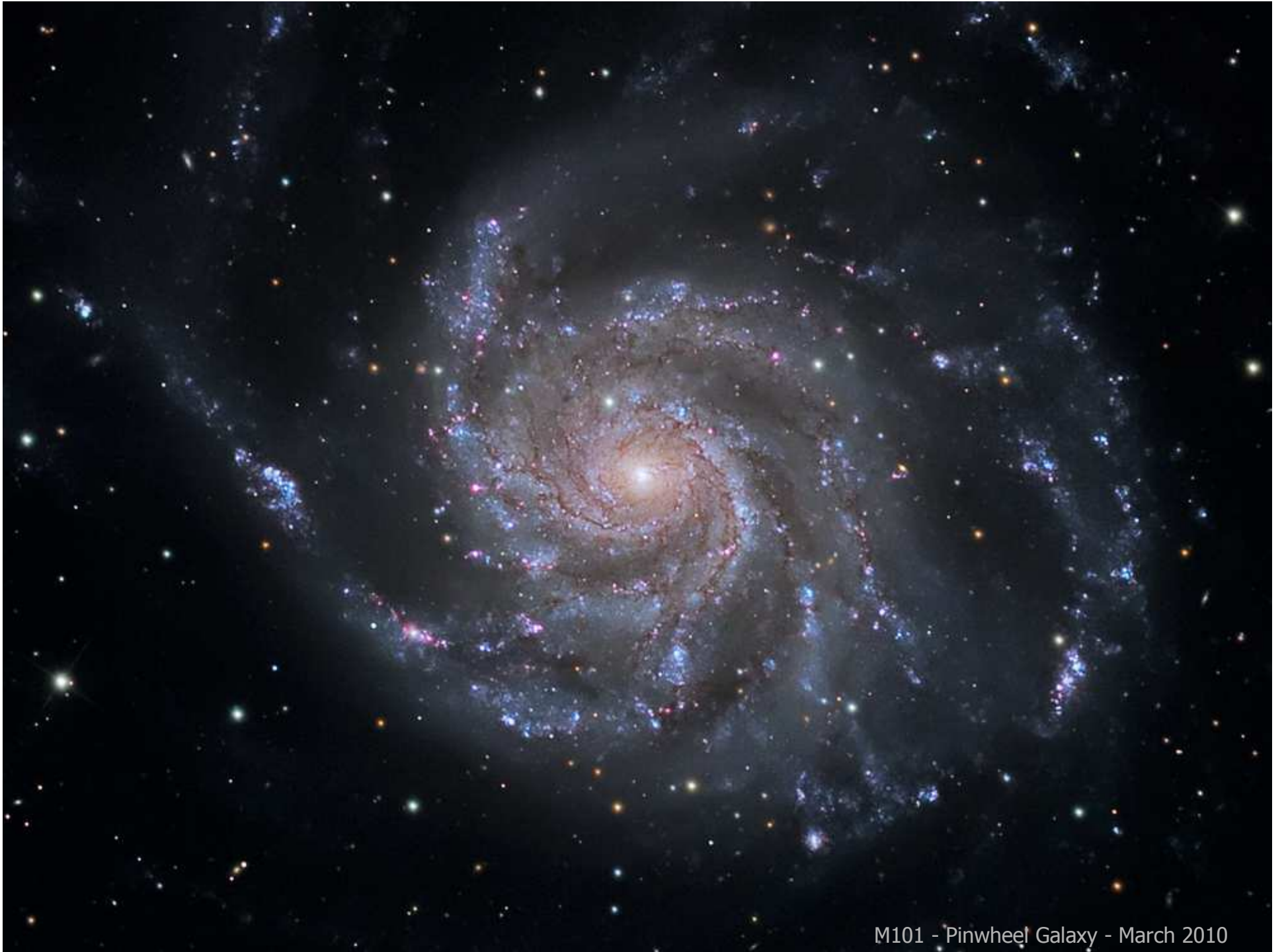


M51 - Whirlpool Galaxy - March 2010



M64 - Blackeye Galaxy - March 2007





M101 - Pinwheel Galaxy - March 2010



NGC 3718 - March 2010



M1 - Crab Nebula - November 2009



Horsehead Nebula - November 2009



ASTRO  
CRUISE

M78 - November 2011

# CCD Imaging - using the AP 155



Rosette Nebula - February 2009



M42 - Great Orion Nebula - December 2007



Horsehead, Flame & Alnitak - December 2007





M45 - Pleiades - October 2007



Pleiades detail

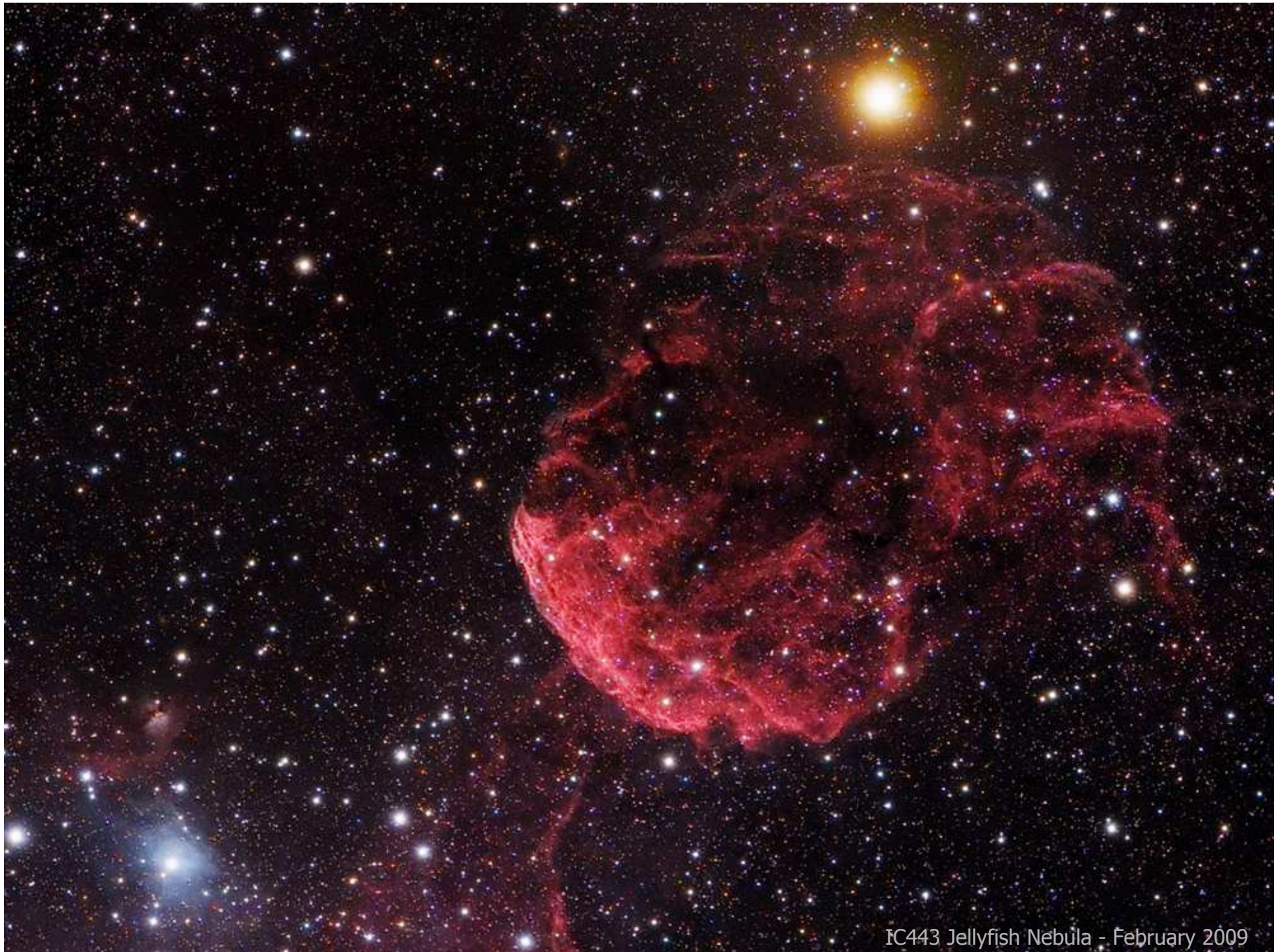


Pleiades detail

# CCD Imaging - using the Tak FSQ-106ED



IC2177 Seagull Nebula - February 2009



IC443 Jellyfish Nebula - February 2009



IC2118 Witch Head Nebula - November 2008



ASTRO  
CRUISE

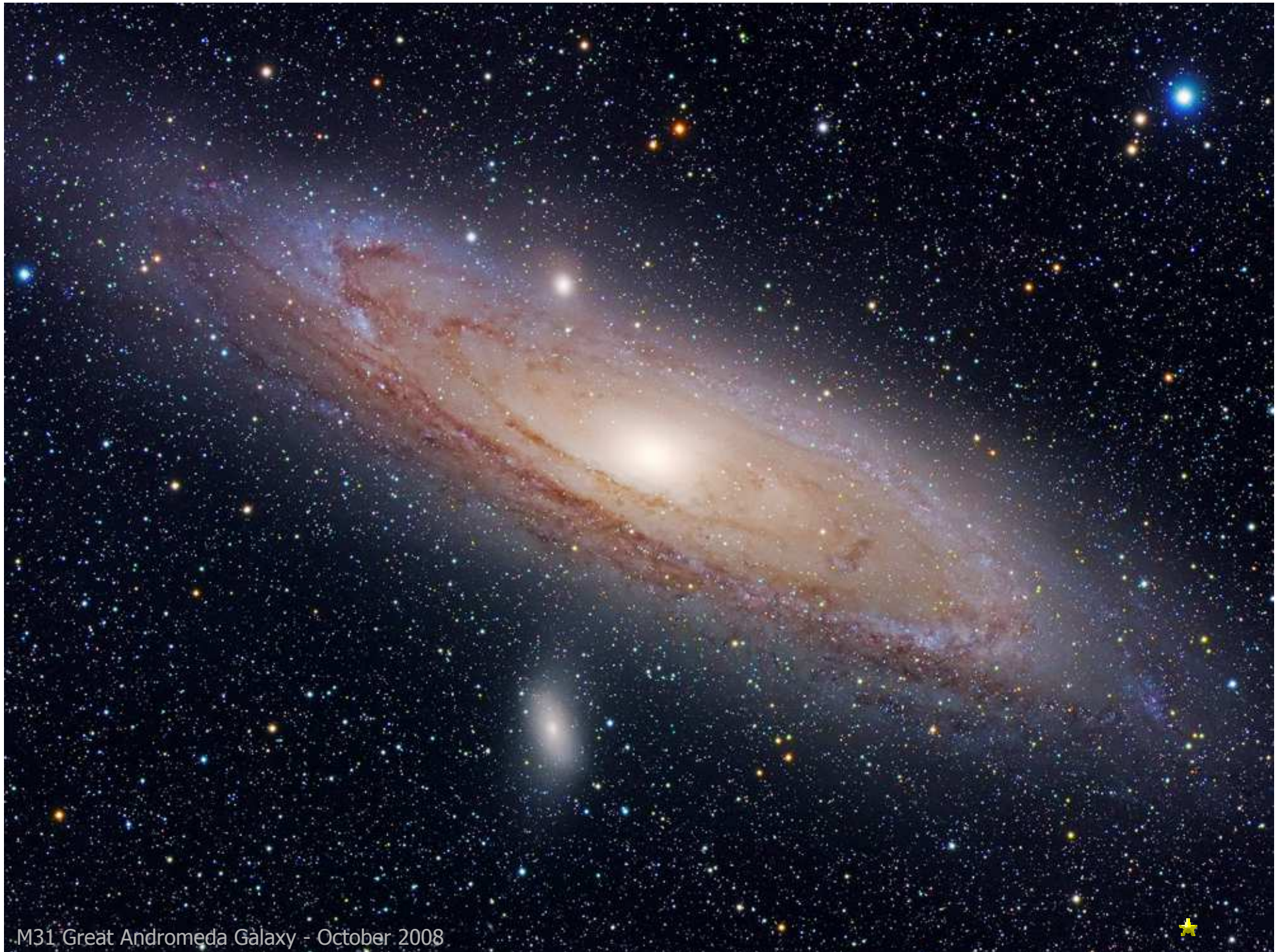
NGC 7000 N.America Nebula - November 2011



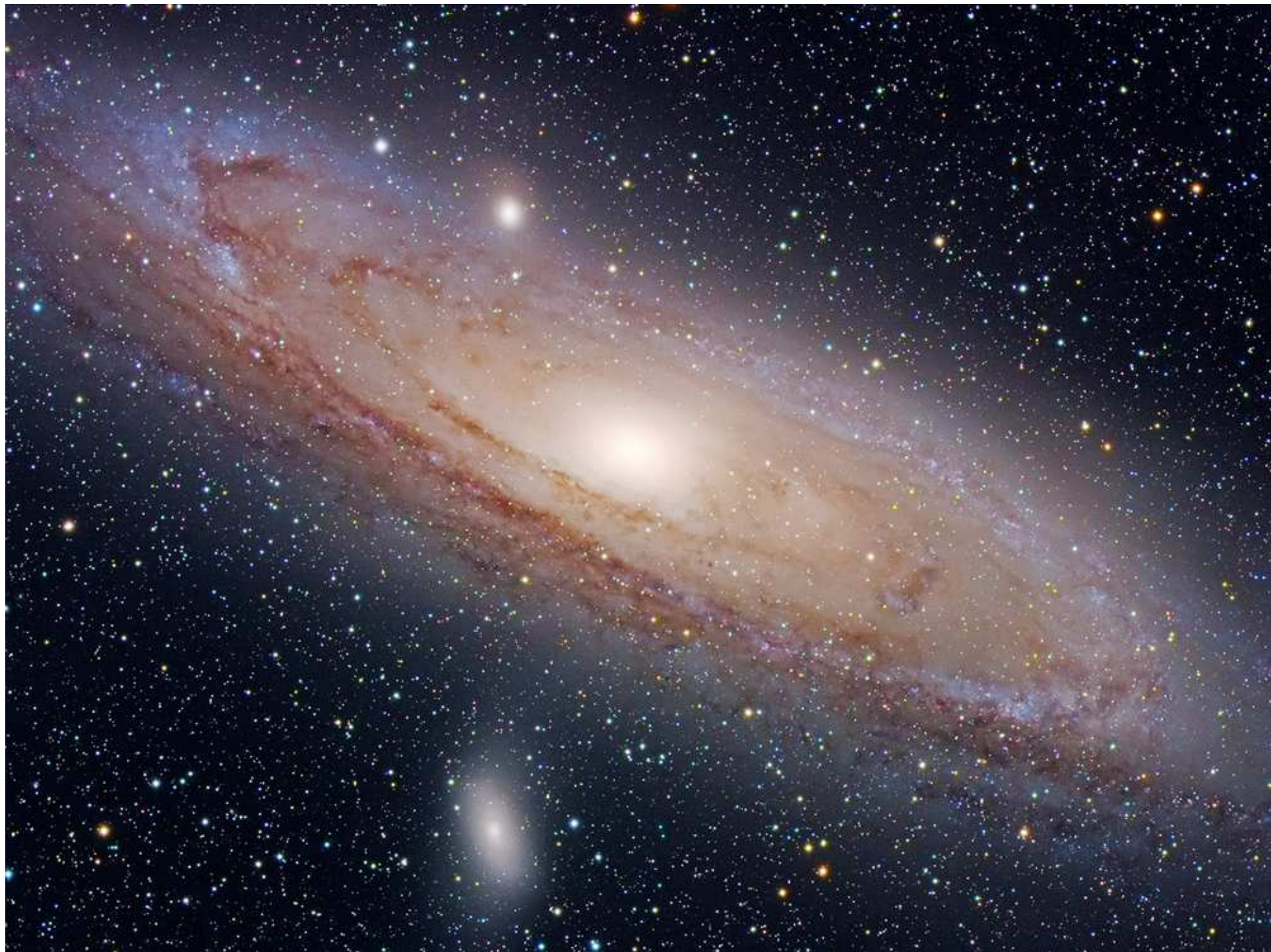
ASTRO  
CRUISE

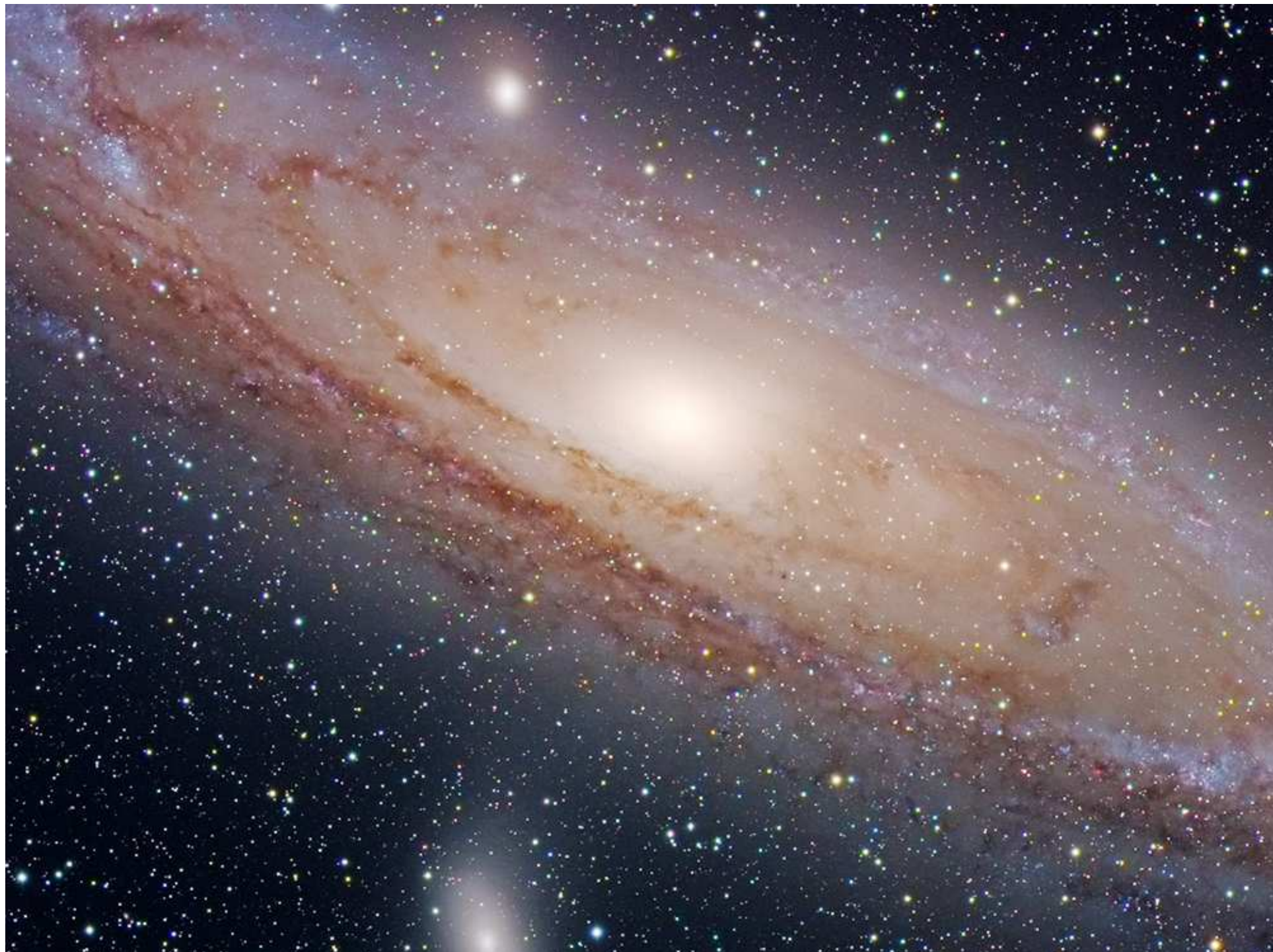
NGC 7000 N.America Nebula - September 1998





M31 Great Andromeda Galaxy - October 2008









[www.astrocruise.com](http://www.astrocruise.com)