Astrophotography Basics

Elizabeth Warner
UM Observatory
University of Maryland
warnerem@astro.umd.edu

www.astro.umd.edu/openhouse
www.astro.umd.edu/~warnerem

Basic Techniques

- Non-Tracking
  - Handheld
  - Tripod
    - Widefield
    - Time lapse
    - Afocal
- Tracking (Polar-aligned!)
  - Barn-door
  - Piggyback
  - Through the scope
    - Afocal
    - Prime focus
    - Projection

Handheld

- Any camera!
- Usually sun/moon rise/set pictures

Safely observing the sun through a solar filter. The little white disk is the sun!

Moonrise and colorful clouds.

Tripod

- Any camera with a “bulb” setting or capability of taking exposures >1sec (and up to 30 or more sec)
- Tripod or ***other method*** of steadying the camera
- Shutter-release cable
- Star trails, meteor showers, aurorae, satellites, conjunctions, some eclipses, star parties, …

Scorpio Star Trails

Orion Rising

Left: foreground trees are lit by house lights

Right: Friends setting up their telescope

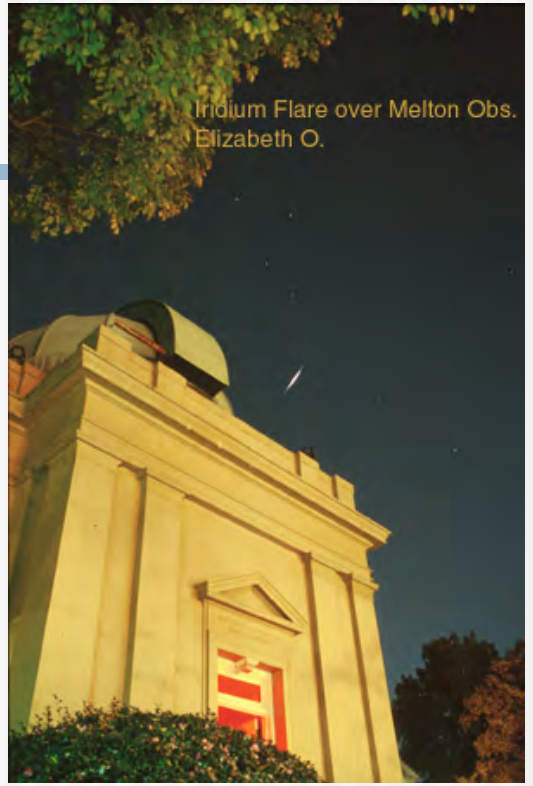
Tripod

Top right: IR Flare

Bottom right: shuttle launch

Bottom left: conjunction

Top left: meteor



Tripod

Aurora!
date: 24 November 2001, approx. 5:20am MST
location: Warner/Pines Cabin, Westcliffe, CO
setup: Canon EOS D30
film: none, digital
exposure: 10 @ 15sec each about 30sec apart

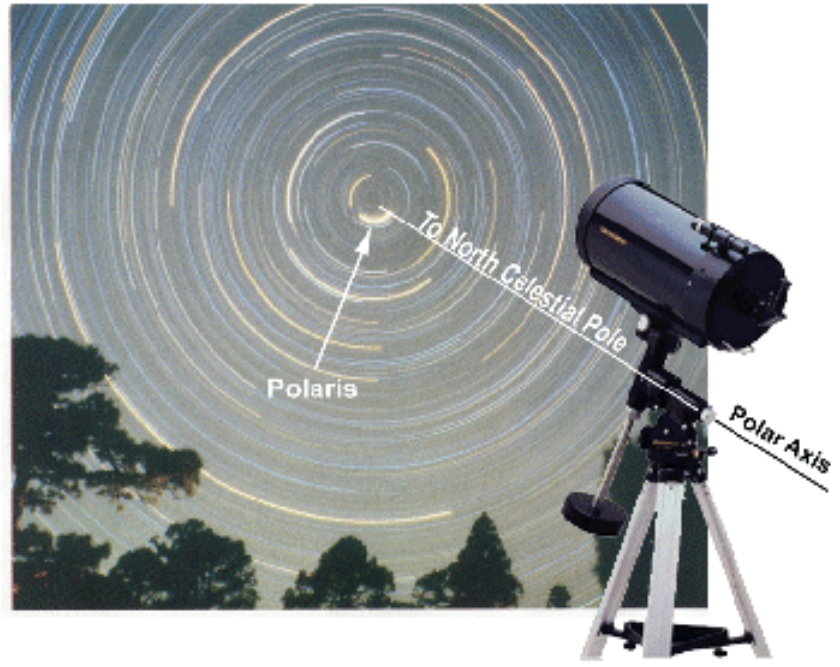
comments: used Adobe Photoshop 6 and ImageReady 3.0; note the head of Draco rising!

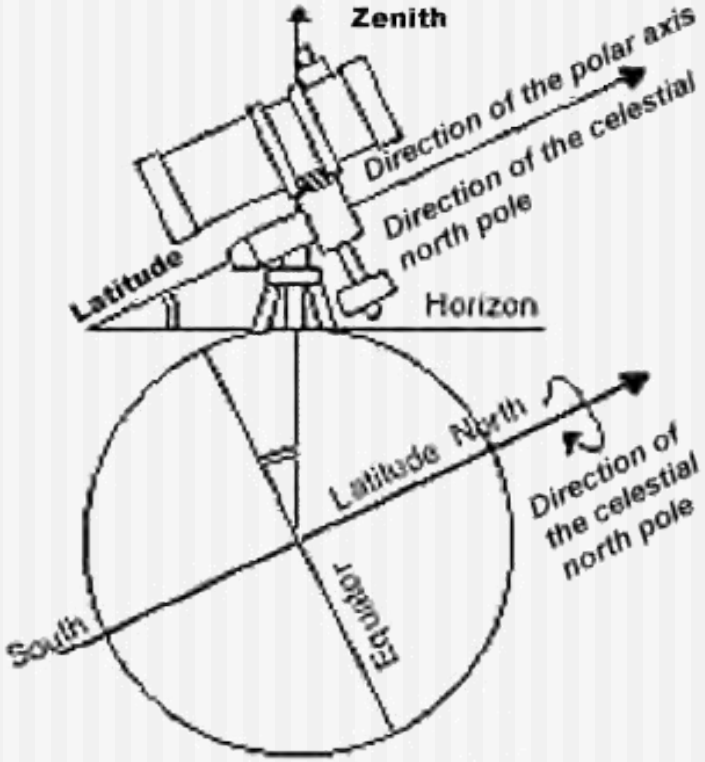
www.astro.umd.edu/~warnerem/Gallery/aurora/Aurorae.shtml

Time-lapse over the Subaru Telescope on Mauna Kea
(not sure where I got it, I've been searching, but could only find some similar ones
http://www.youtube.com/watch?v=nMi1nVDSRXQ,
http://www.flickr.com/photos/sebastian_egner/4146134355/)

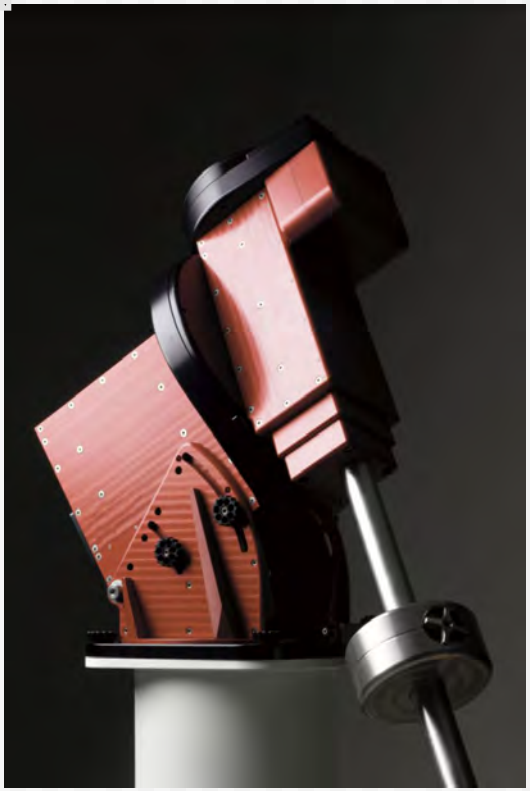
Tripod - Afocal

Tracking – Polar alignment





German Equatorial



Fork

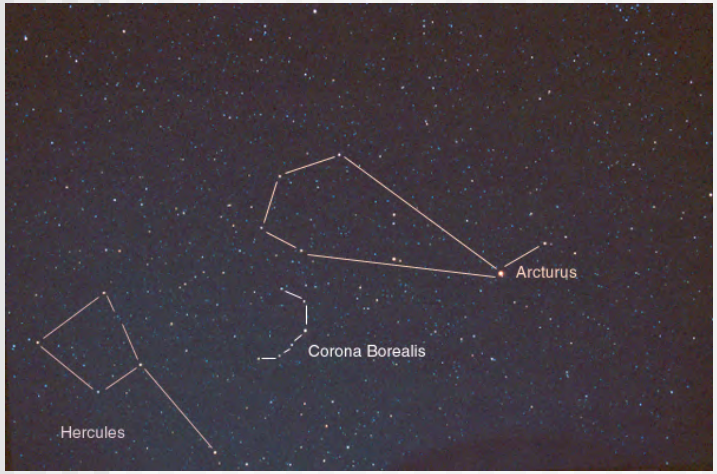
Barn Door Tracker

- Any camera with a “bulb” setting
- Shutter-release cable
- Home-made contraption
- tripod
- Like piggybacking
- Wide-angle constellation shots, comets

Piggyback

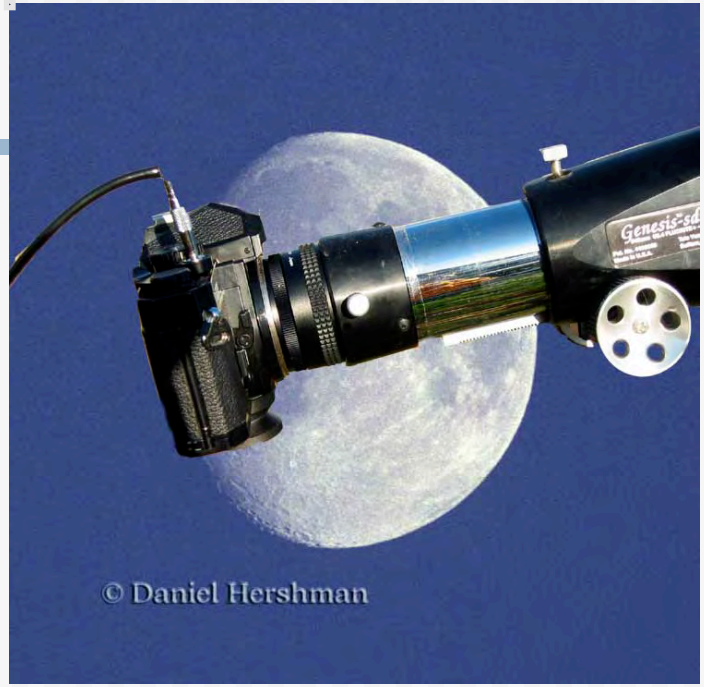
- Any camera with a “bulb” setting
- Shutter-release cable
- Tracking telescope, piggyback mount
- Wide-angle constellation shots, comets

Piggyback



Prime-focus

- Any camera with a “bulb” setting and removable lens
- Shutter-release cable
- T-ring, t-adapter, other adapters
- Tracking telescope
- Telescope becomes the lens
- Close-up on moon, planets, other solar system stuff, deepsky



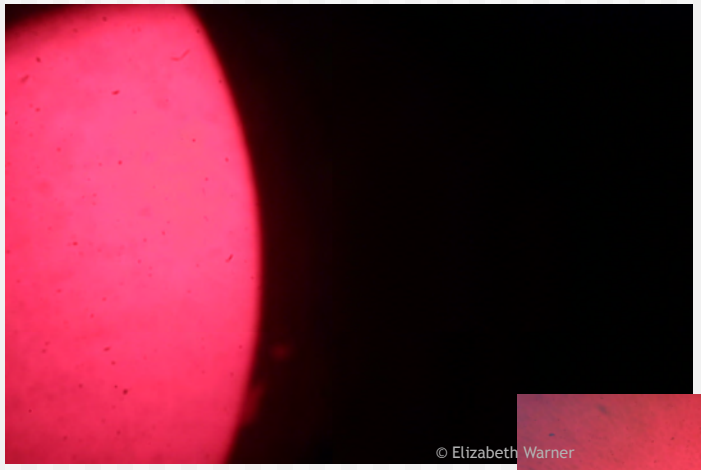
Prime-focus

Auto-guiding

Afocal

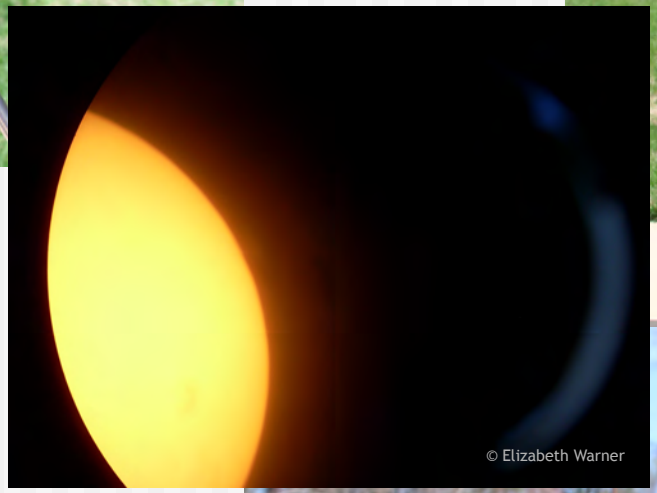
- Usually point and shoot or small camcorders
- Either lots of stills to stack or movies
- Some kind of adapter to hold camera/camcorder over eyepiece
- Subject matter can be almost anything although moon and planets are the typical targets

Afocal




ORION
SteadyPix SLR Camera Mount


CELESTRON
ULTIMA 2000
© Elizabeth Warner


© Elizabeth Warner

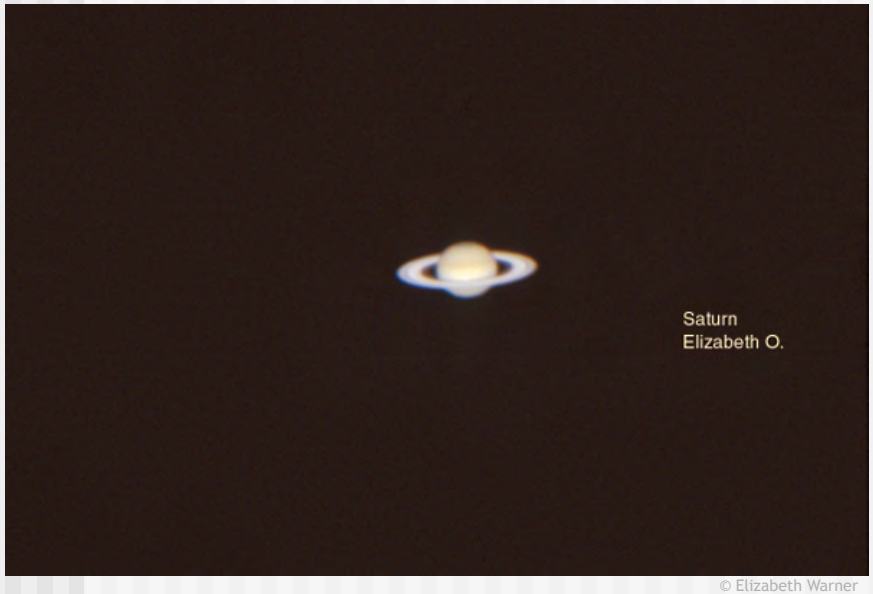

ORION

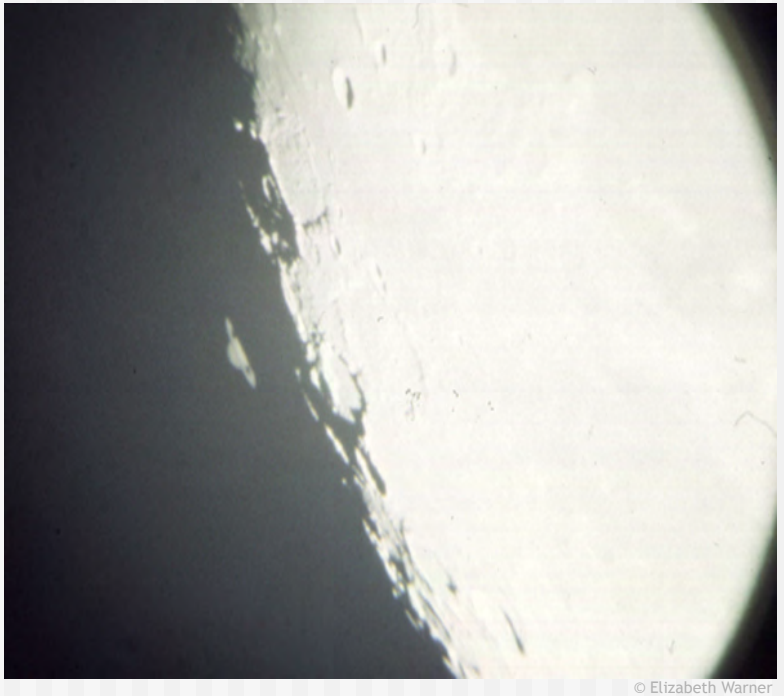

© Elizabeth Warner

Projection

- Any camera with a “bulb” setting and removable lens
- Shutter-release cable
- T-ring, t-adapter, other adapters
- Tracking telescope, eyepieces, guiding mechanism
- Close-up on moon, planets, other solar system stuff, deepsky

Projection





Film vs. digital (SLR, ccd, webcam)

- Higher-res
- B&W or color
- Have to wait and see results
- (cameras) More durable, many are totally manual (power requirements!)
- Have to scan if you want to digitally manipulate (have processor scan to CD when you have film developed)
- Are a pain to focus!
- Don't lose the negatives or slides!

- Some CMOS and CCD cameras have surpassed film!
- Dedicated astro CCD cameras are usually monochrome (would need to use filters to make color images; interesting opportunities with narrowband filters!). CMOS (DSLRS) are color and some new 1-shot color CCD cameras available.
- Immediate satisfaction
- Need dependable power source especially in cold weather
- Already digital
- Are a pain to focus!
- Don't lose the original digital files!

Multiple short exposures

- Total exposure time (1 long = many short) *
- Short exposures = less noise
- Short exposures = less star blooming *
- Short exposures require less precise tracking
- Many exposures = less likely to have shoot destroyed by satellite, airplane, car headlights, etc.
- Many exposures increase S/N ratio
- Requires careful alignment – translation, stretching (refraction)

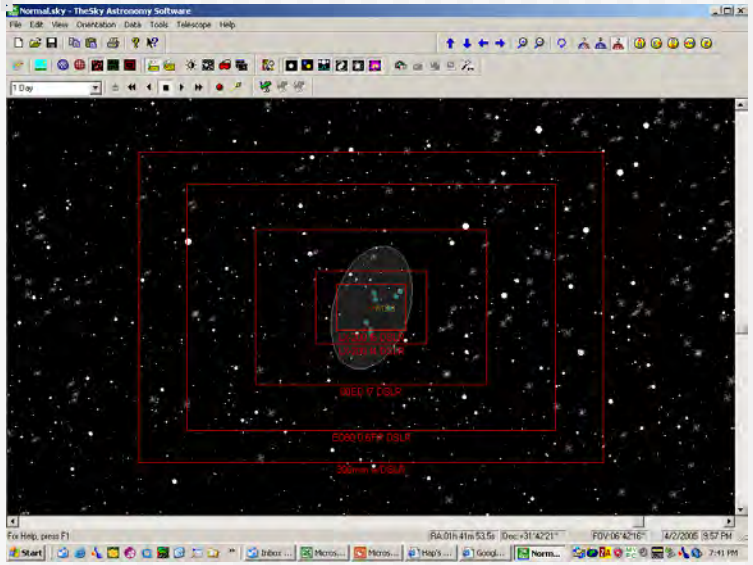
* Assumes proper processing

Processing Workflow

- Convert RAW frames to TIFFs or FITS files (either color or mono Bayer color data)
- Calibrate files with bias, dark, and flat frames
- Grade and cull calibrated frames
- Align usable calibrated frames
- Stack frames (various algorithms)
- Digital Development (histogram stretching)
- Color balance
- Image enhancement
- Noise reduction
- Cropping and conversion to final presentation format

Composition!

- Be aware of current sky events!
- Plan your images with planetarium software.
  - iPad: The Photographers' Ephemeris (also on computers)
  - iPad: Lighttrac
- Use the right lens and doublecheck the settings!
- Bracket the exposures.
- Take multiple exposures (for stacking) and your calibration frames!



Misc tricks…

- With film, take ‘normal’ shots every couple of frames (so developer knows where to cut/scan film) or request that they do not cut the film
- Keep a log!!!
- Have spare batteries
- Don’t fidget! At least not right next to your setup!

Possible problems

- Equipment issues
  - Focusing
  - Vignetting
  - Tracking
  - Stability
  - power
- Other issues
  - Light pollution (reciprocity failure)
  - Humidity
  - Bugs
  - Operator errors

Practice, Practice, Practice!

Even on easy targets like the moon, focusing can be difficult!

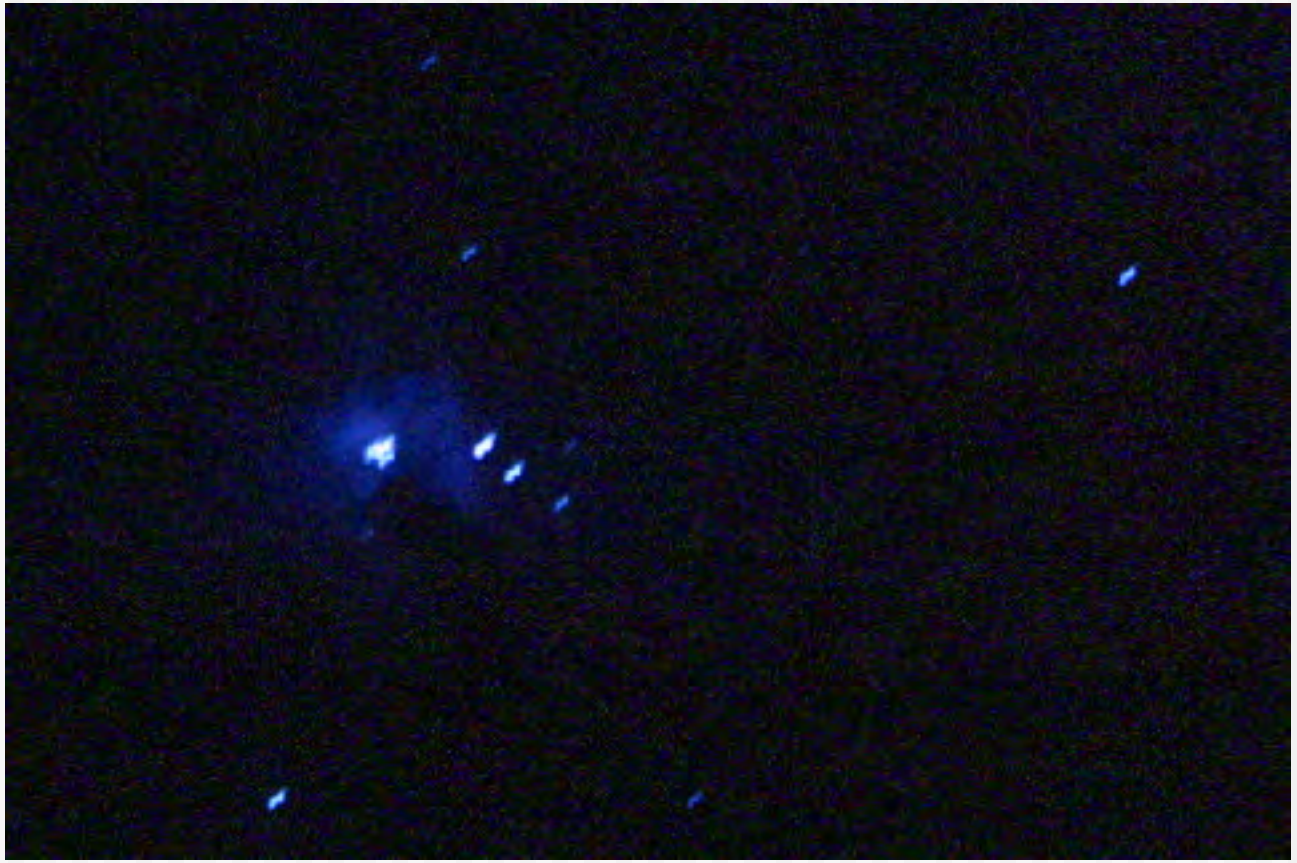
This one's a bit soft in the focus and it looks like it also got kicked during the exposure.

Practice, Practice, Practice!

Focusing is always the hardest, particularly with planets. Seeing (steadiness of atmosphere) is a big factor – observing is a better idea on windy nights!

Star Trails are nice if you have a constellation shot, but not if you are trying for a deepsky object! Shot of Orion's sword (the fuzzy stars are M42).

Practice, Practice, Practice!



Alignment, tracking, kicking the tripod – who knows? But it's not pretty!
M42

Practice, Practice, Practice!

Close. Always bracket and take lots of shots. It helped that I 'hid' the monument behind the trees, but the exposure was still too short to capture the planets off to the right.

Practice, Practice, Practice!

3 images

-- longer exposure but trails (5 min)

-- shorter exposure, kicked (2 min)

-- shorter exposure, close (2 min)

Antares & M4

23 June 2006

Rocky Mtn Star Stare, CO

Canon EOS 20Da pf through Orion Shorttube 80 piggybacked on Meade 10" LX200

3 tries and still not quite good enough. This one's still cool though – it's from a digital camera!

Success!

Success!

Success!

Lightning over Tucson, APOD 18 Aug 2004

Recent Images

Comet McNaught

My balcony in Alexandria, VA

File Name: IMG_6570.CR2
Camera Model: Canon EOS 20D
Shooting Date/Time: 1/8/2007 5:46:19 PM
Shooting Mode: Manual Exposure
Tv (Shutter Speed): 1/20
ISO Speed: 400
Image Size: 3504x2336
Image Quality: RAW
White Balance Mode: Auto
AF Mode: Manual focusing
Color Space: sRGB
Noise Reduction: Off

Left: converted to jpg, then processed in Photoshop – unsharp mask, brightness/ contrast enhanced

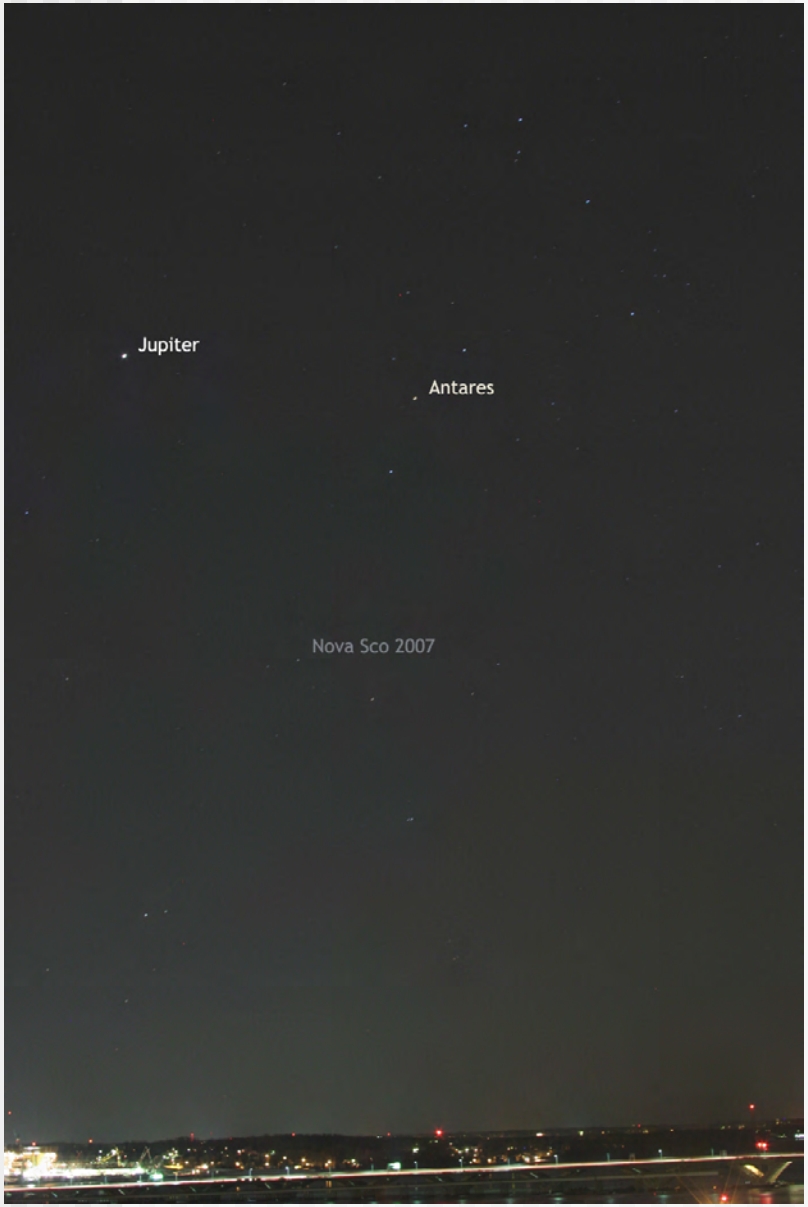
Right: raw converted to jpg

Recent Images

Moon & Venus

File Name: IMG_6774.CR2
Camera Model: Canon EOS 20D
Shooting Date/Time: 1/20/2007 6:16:01 PM
Shooting Mode: Manual Exposure
Tv (Shutter Speed): 1.3
Av (Aperture Value): 5.6
Metering Mode: Evaluative Metering
ISO Speed: 400
Lens: 28.0 - 135.0mm
Focal Length: 135.0mm
Image Quality: RAW
Flash: Off
White Balance Mode: Auto
AF Mode: Manual focusing
Color Space: sRGB
Noise Reduction: Off

Recent Images



Nova Sco

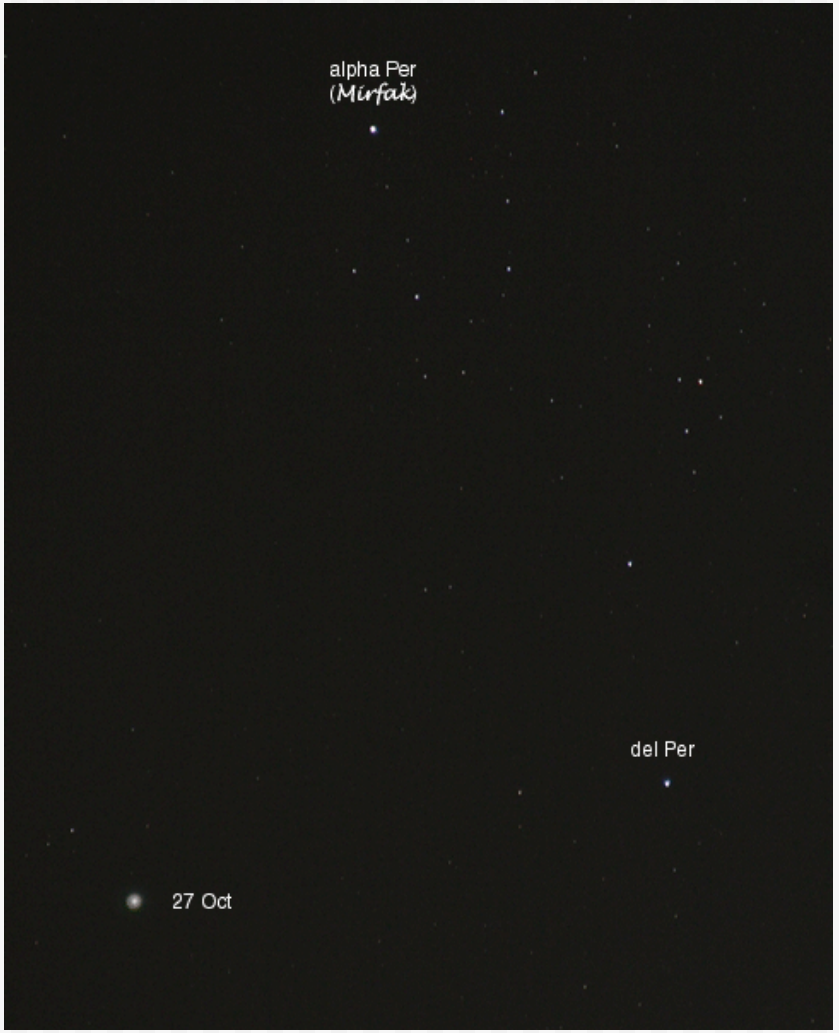
Shooting Date/Time: 2/19/2007 5:18:44 AM
Tv (Shutter Speed): 15
Av (Aperture Value): 5.6
ISO Speed: 400

Lunar Eclipse

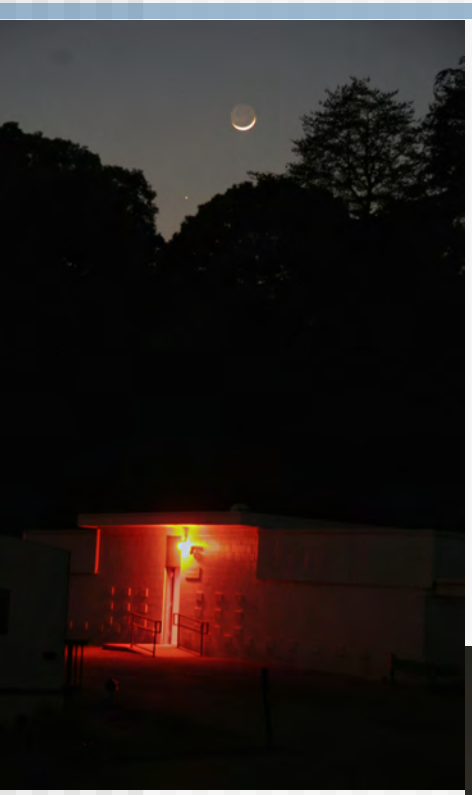
Shooting Date/Time: 3/3/2007 7:03:36 PM
Tv (Shutter Speed): 5
Av (Aperture Value): 0.0
ISO Speed: 400

Recent Images

“Although not spectacular like McNaught, Holmes has its own unique charms! I stayed most of the night at the campus observatory to get these pics and have to be back at work shortly. But it was well worth it!” Details: Canon 20Da ISO 800, 152mm f/9 refractor, 2x30s shots about 75 minutes apart (12:27, 01:43 EDT)

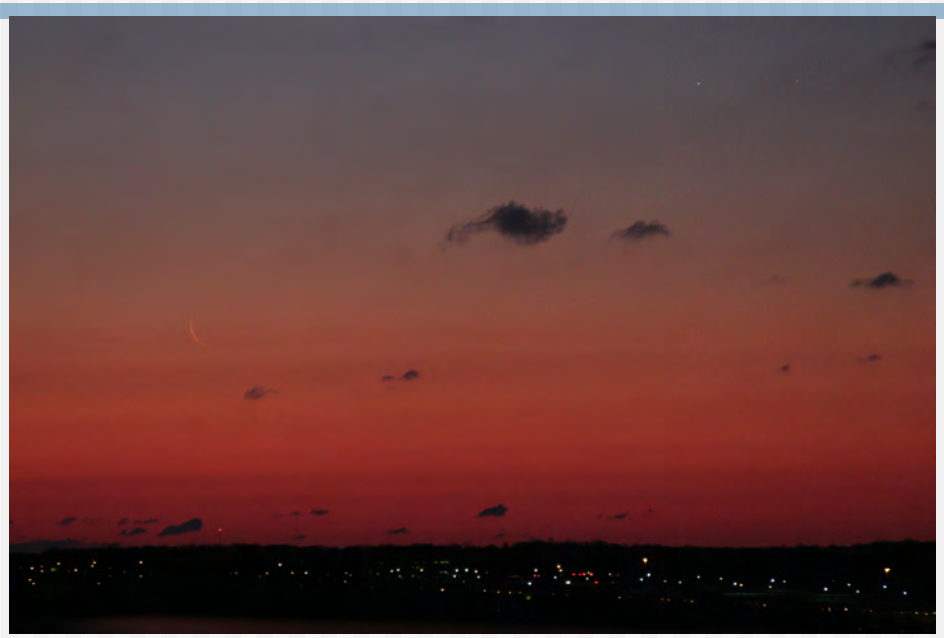


Recent Images

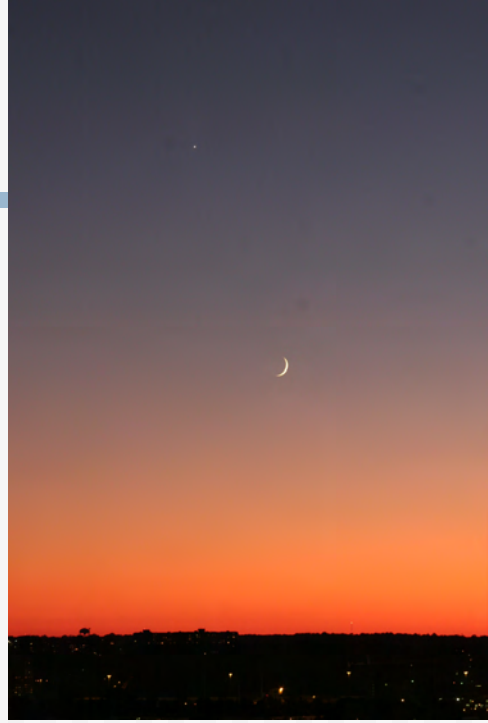


Moon & Mercury
2008 May 6
ISO 800
Right: 1.6sec f/5 400mm
Top: 2.5sec f/5.6 72mm

[Similar alignment tonight??!!]



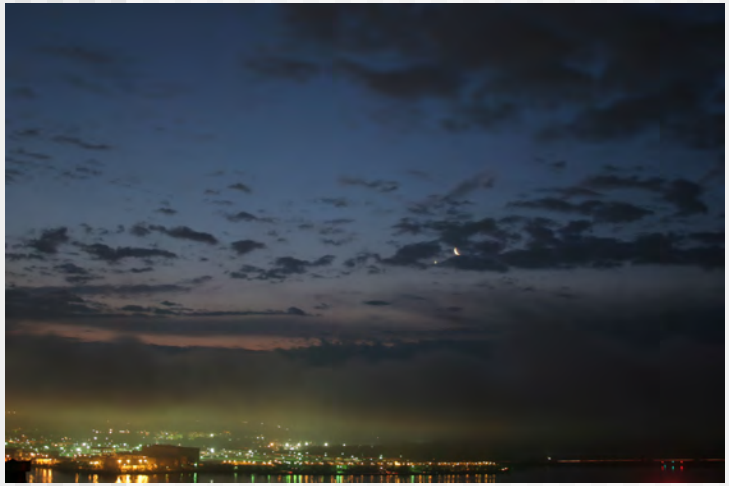
Moon,(Mars), Jupiter, Mercury
2009 Feb 23
ISO 1600
1/30sec f/5.6 135mm



Moon & Venus
2008 Oct 31
ISO 800
1/10sec, f/6.3, 75mm

Can you tell I like conjunctions??

Recent Images



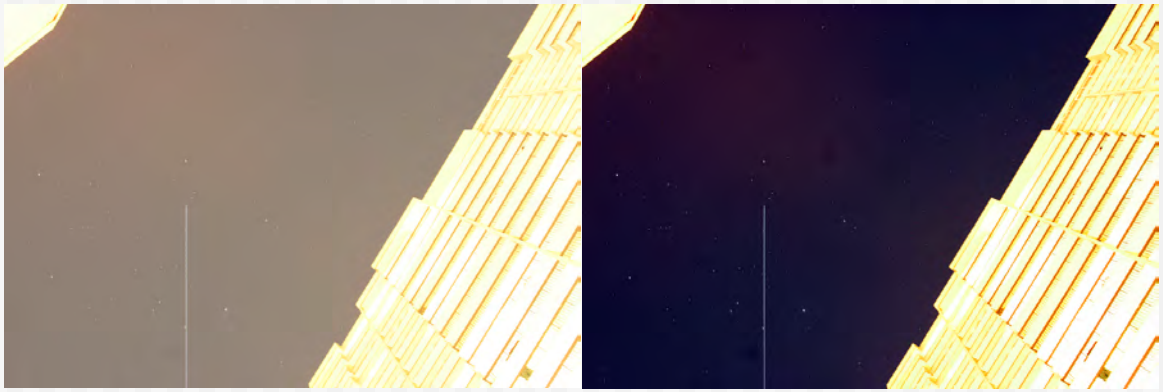
Moon & Venus
2009 Apr 22

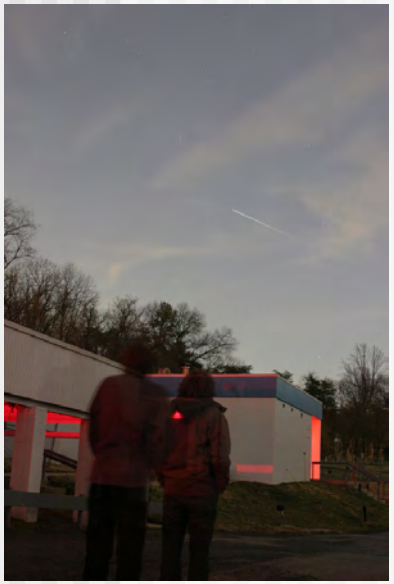
2009 Sep 19

2009 Apr 25

2010 Jan 23

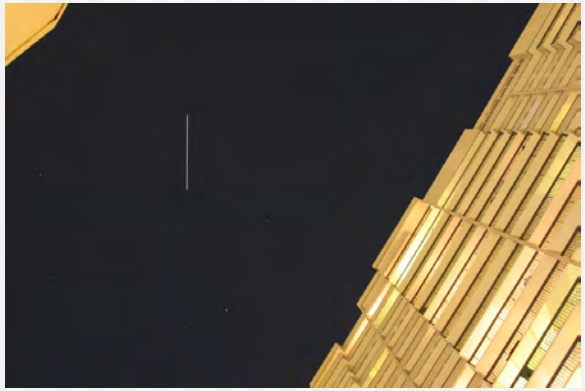
Recent Images





Top: 39 sec

Left: 19 sec



All: Canon 20Da
f/5.6 ISO 1600
28-135mm @ 28mm

Top: 31 sec

Middle: 4 sec

Right: 28 sec

ISS & Discovery (STS-133)
7 Mar 2011

ISS
8 Mar 2011

Local AstroImagers

- John Settle
  mywebpages.comcast.net/jjs-cts/
- Greg Piepol
  www.sungazer.net/
- Jeff Forsyth
  www.TeamForsyth.com/
- Steve Robinson
  www.highenergyastro.homestead.com/
- Guy Brandenburg
  home.earthlink.net/~gfbranden/GFB_Home_Page.html
- Doug Healy
  www.dougsimages.com/
- Elizabeth Warner
  www.astro.umd.edu/~warnerem/
- Fred Espenak
  www.mreclipse.com/MrEclipse.html
- Geoff Chester
  jeffhotep.home.comcast.net/astro/index.html
- Harold Geller
  myslooh.com/hgeller
- Tom Kennedy
  www.tomkennedy.org/Astronomy.htm

Other AstroImagers

- Jerry Lodriguss
  www.astropix.com/
- Robert Gendler
  www.robgendlerastropics.com/
- Chris Cook
  www.abmedia.com/astro/
- Russell Croman
  www.rc-astro.com/
- Jason Ware
  www.galaxyphoto.com/
- Chuck Vaughn
  astrophotography.aa6g.org/
- Matt BenDaniel
  starmatt.com/
- António Cidadão
  www.astrosurf.com/cidadao/
- Bill & Sally Fletcher
  www.scienceandart.com/
- Tony & Daphne Hallas
  www.astrophoto.com/
- Wallis & Provin
  geogdata.csun.edu/~voltaire/wallis_provin.html
- MAC
  midlandsastronomyclub.org/gallery/gallery.shtml
- Digital Astro
  digitalastro.skyinsight.net/gallery/
- Sky & Telescope
  www.skyandtelescope.com/howto/astrophotography

Recent Images

2010 Feb 08 Shuttle Launch from Alexandria, VA!

ISO 100, 26sec, f/8, 44mm (28-135mm)