Digital Single Lens Reflex (DSLR) Astrophotography Basics

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Agenda

- Introduction
- History
- How DSLRs Work
- Balancing Act of Capturing Astrophotos
- Easy Methods of Using DLSRs for Astrophotography
    - Tripod Subjects
        - Wide Angle
    - Piggy Back Subjects
        - Wide Angle
        - Moon
    - Video with DSLR
        - Moon
        - Sun
        - Satellites
        - Planets
- Questions

Introduction

- About Me
  - Retired Army Signal Officer
  - 2 Years in Astronomy
  - 1.5 Years in Astrophotography

- What we will not cover
  - Deepspace Guided photos
  - Stacking Pics
  - Processing Pics

- What we will cover
  - Tripod & Unguided Piggyback Photos
  - Wide Angle Photos
  - Lunar
  - Planets
  - Solar

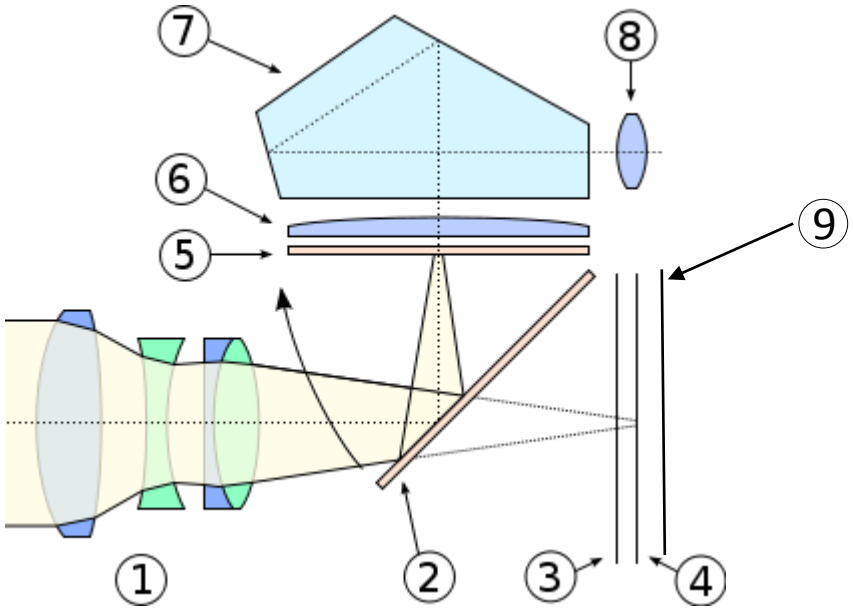
A Little DSLR History

"Film is dead. Ok, we said it"

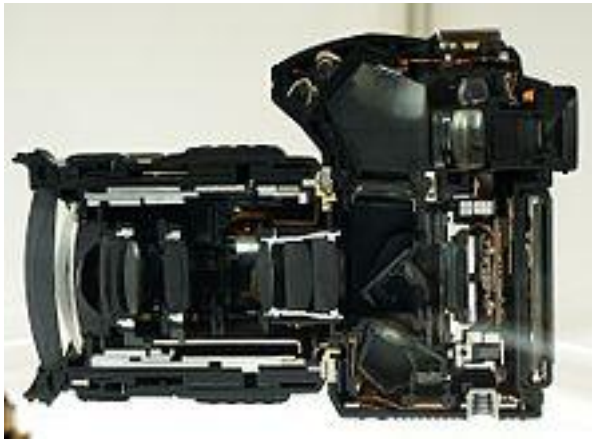
Terence Dickinson & Alan Dyer The Backyard Astronomer's Guide Third Edition, 2010

- 1826 Photography invented – Joseph Nicepore Niepce
- 1861 British patent granted for Single Lens Reflex Camera
- 1884 First Production SLR appears in America
- 1949 Contax S - first pentaprism SLR
- 1960s Advances in optical and mechanical technology lead to SLR becoming camera of choice for Professional and Serious Amateur Photographers.
- 1969 Willard Boyle & George Smith at AT&T invent the first successful imaging technology using a digital sensor, a CCD (Charge-Coupled Device). Boyle and Smith were awarded the Nobel Prize in Physics in 2009 for this achievement.
- 1975 Kodak engineer Steven Sasson invents the first digital still camera
- 1991 Kodak released the first commercially available fully digital SLR, the Kodak DCS-100
- 1999 Nikon Introduces the Nikon D1. The D1 shared similar body construction as Nikon's professional 35mm film DSLRs, and the same Nikkor lens mount, allowing the D1 to use Nikon's existing line of AI/AIS manual-focus and AF lenses. Although Nikon and other manufacturers had produced digital SLR cameras for several years prior, the D1 was the first professional digital SLR that displaced Kodak's then-undisputed reign over the professional market.
- 2004 Konica Minolta Introduce Image Stabilization
- 2009 Nikon released D90, first DSLR to feature video recording.

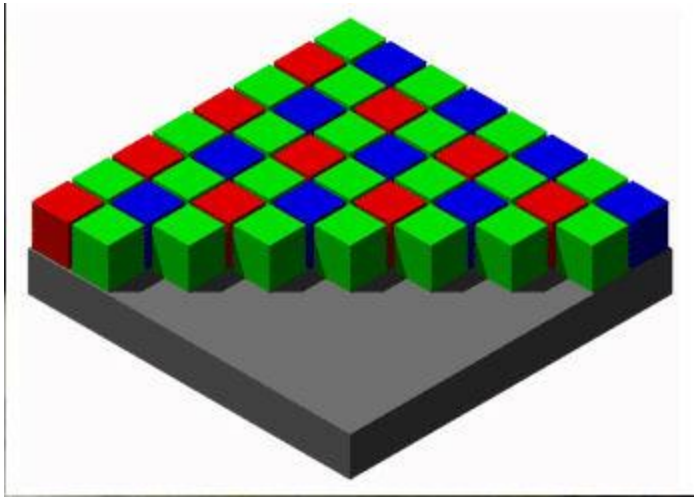
DSLR Cross-Sectional View



1. Camera Lens
2. Reflex Mirror
3. Focal-Plane Shutter
4. Image Sensor
5. Matte Focusing Screen
6. Condenser Lens
7. Pentaprism
8. Vewfinder eyepiece
9. LCD Monitor



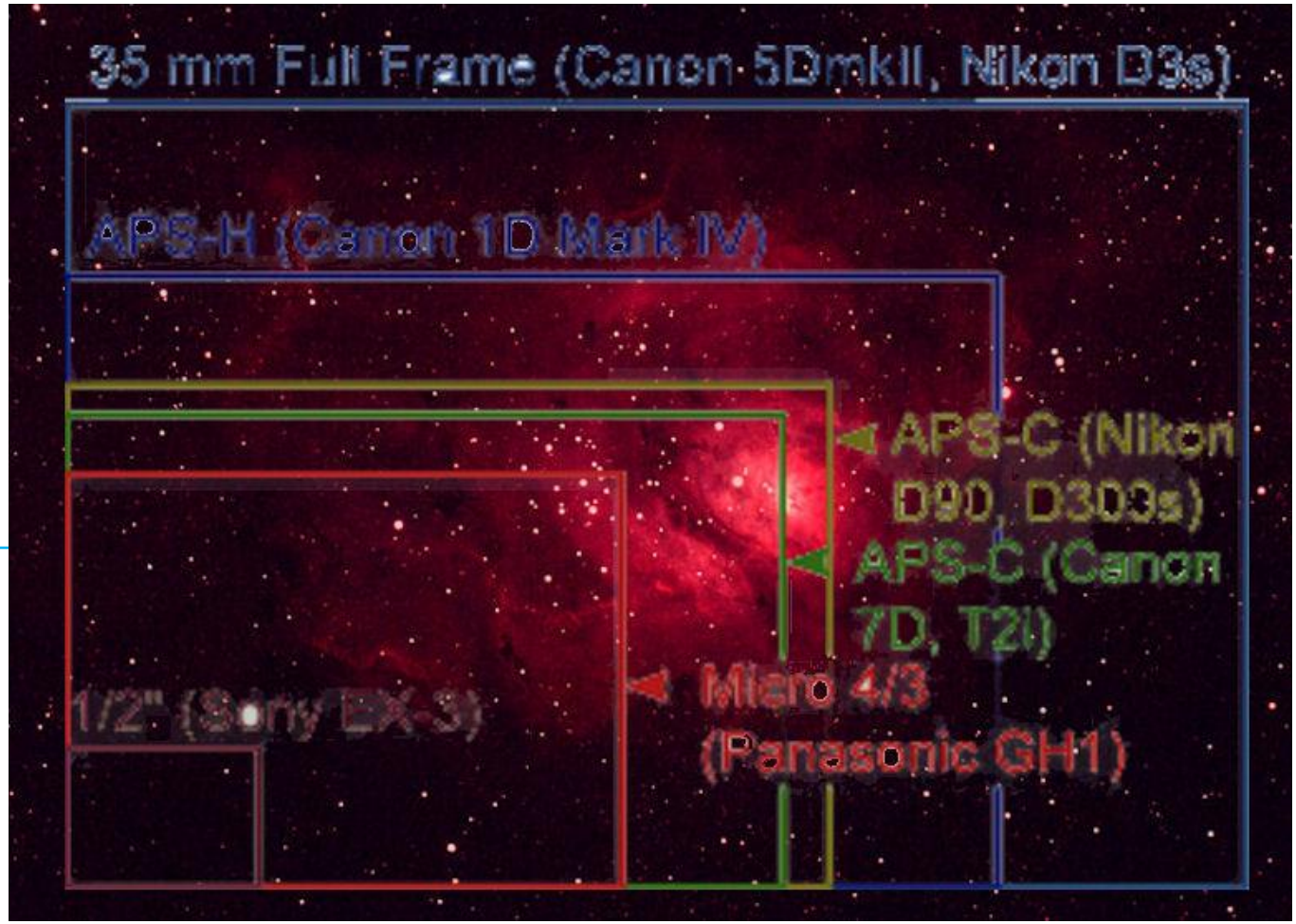
Digital Sensor



- Charged Coupled Device (CCD) and Complementary-Symmetry Metal–Oxide–Semiconductor (CMOS) chips provide photon sensitive area to record light that is far more sensitive than film
- Bayer Array - named for Kodak's Bryce Bayer
- Each four pixel block contains one blue, one red and two green pixels
- The three panels below show a typical Bayer Array, a scene to be captured and how the scene is processed using the Bayer Array

CCD Chip Sizes

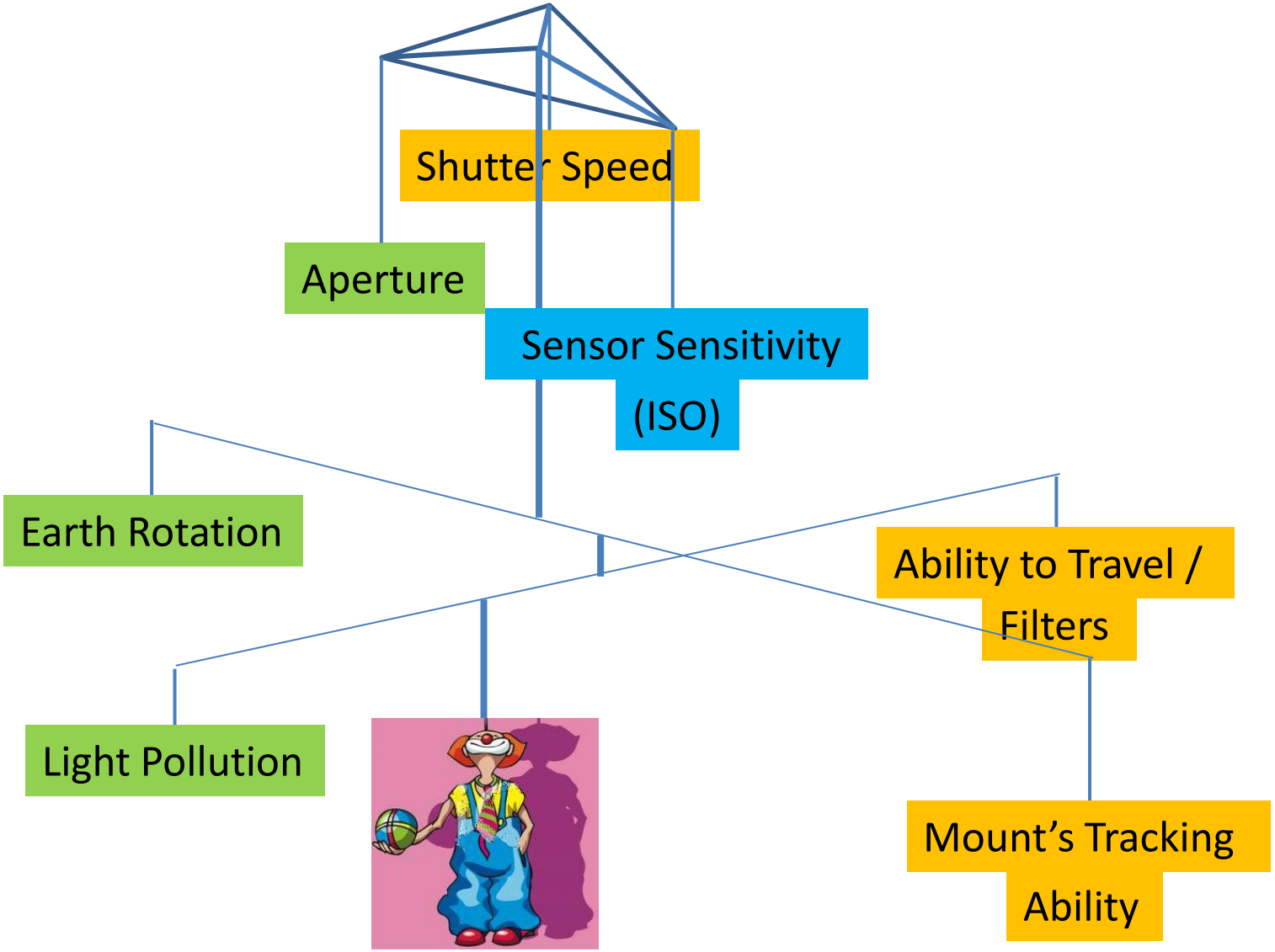
- Optimal size depends on function and budget



DSLR Modification For Astrophotography

- Makes DSLR more sensitive to Ha illuminated nebulosity
- Removes IR filter & replaces with astrophotography UV/IR filter that passes Ha (656.28 nm)
- Can be performed on most Canon DSLRs
- Canon 60da only commercially available stock DSLR set up for astrophotography
- Hap Griffith http://www.hapg.org/ & Astro Hutech http://www.hutech.com/ provide modification service in US

Light Capture Balancing Act



Live View Focusing

Basics of Live View Focusing

- Use manual exposure and manual focus
- Use ISO 1600, bulb shutter-speed, and a wide aperture.
- Use a bright star or planet to focus on
- Get close to focus before you use Live View!
- Zoom in to 10x to focus

Live View Focusing (con't)

Live View Focusing Demo

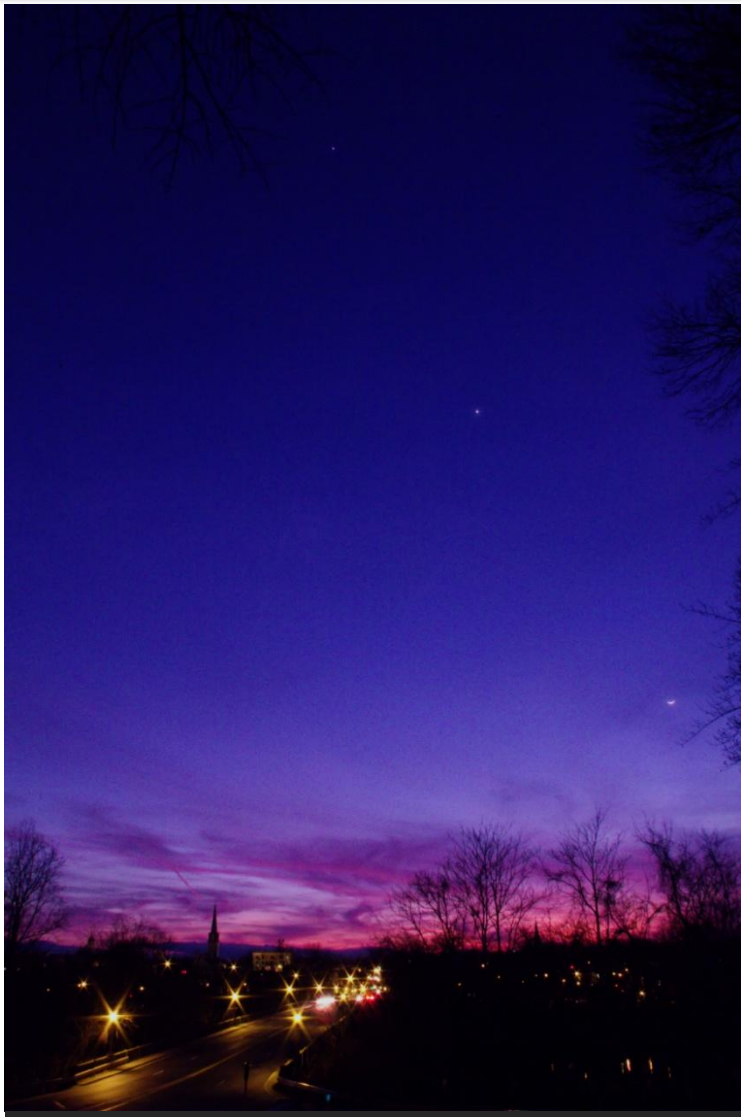
Tripod Subjects

Basic Reminders for Tripod Subjects

- Use Manual exposure and manual focus
- Use Live View to Gauge Adjustments
- Use a wide aperture.
- Keep shutter speed under 40 seconds

Twilight Scenes

- 1 to 8 seconds
- f2 to f5.6
- ISO 100 to 800



Venus, Jupiter & Moon over F'burg

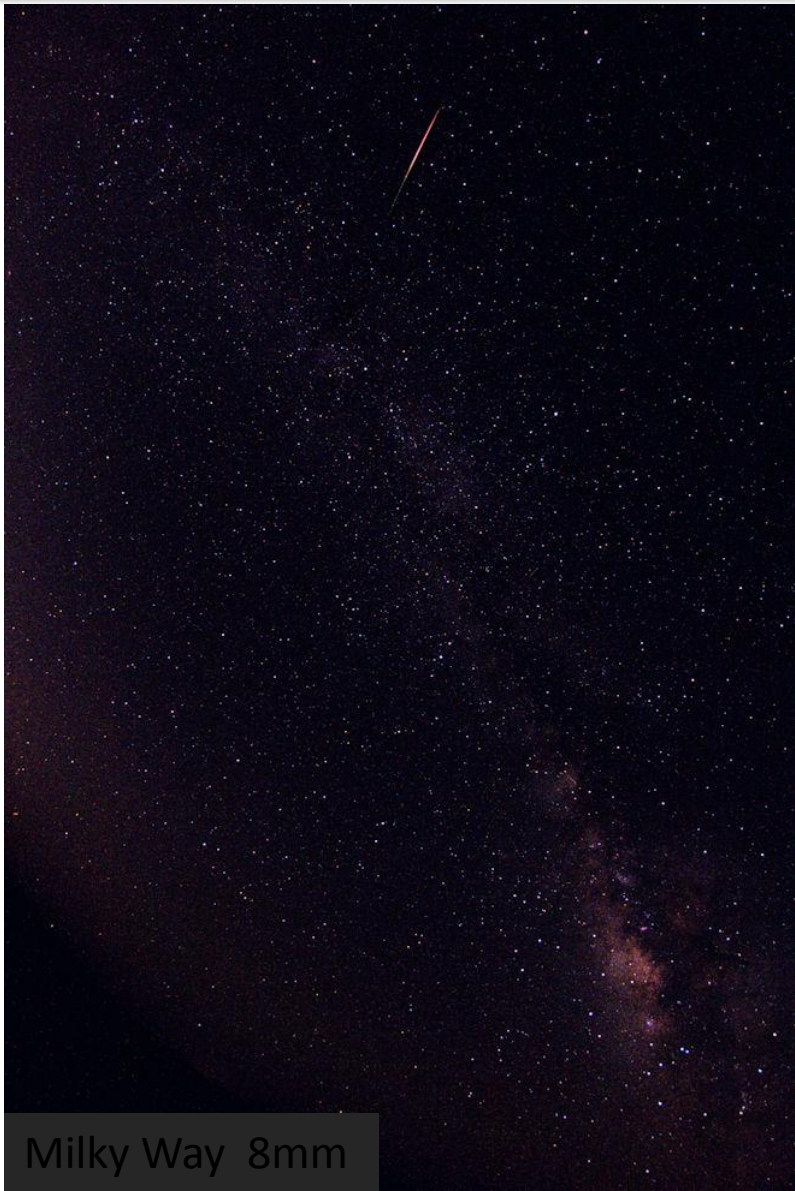
Tripod Subjects

Basic Reminders for Tripod Subjects

- The longer the focal length, the more star trailing becomes evident
- Wide angle nightscapes are best shot after midnight (plane traffic)

Constellations & Nightscapes

- 15 to 40 seconds
- f2 to f5.6
- ISO 800 to 1600



Milky Way 8mm

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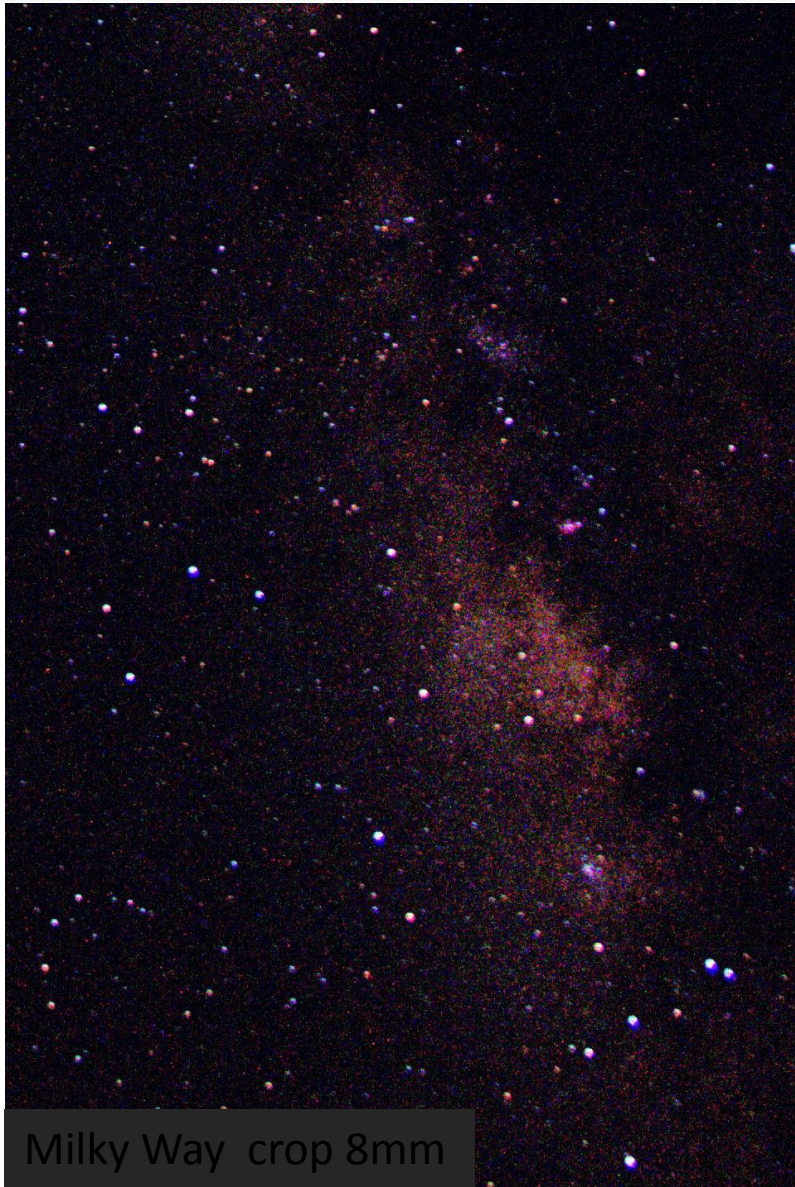


Milky Way crop 8mm

Piggy Back Subjects

Basic Reminders for Piggy Back Subjects

- German Equatorial Mount (GEM) capabilities help determine exposure length.
- Stacking raw pics allows you to increase “time on target” – http://deepskystacker.free.fr
- Post processing brings out brightness and color – GIMP - http://www.gimp.org/

Constellations & Nightscapes

- 15 seconds to limit of tracking capability
- f2 to f 5.6
- ISO 400 to 1600

Orion 50mm

Piggy Back Subjects

Basic Reminders for Piggy Back Subjects

- Longer focal lengths require lower tracking tolerances – Adjust to the circumstance.

Constellations & Nightscapes

- 15 seconds to limit of tracking capability
- f2 to f 5.6
- ISO 400 to 1600

M31 135mm

Piggy Back Subjects

Basic Reminders for Piggy Back Subjects (con't)

- Brighter Lunar shots allow for longer focal lengths

Lunar

- 2 to 1/250th seconds
- f2 to f 30
- ISO 100 to 800

Lunar Eclipse 1200mm

Video with DSLR

Basic Reminders for Video Capture

- Convert .MOV files to .AVI files
- Stack and Filter in Registax

http://www.astronomie.be/registax/

- Manual Exposure Control

Lunar

- 1/60 to 1/250th seconds
- f2 to f 30
- ISO 100 to 800

Northern Hemisphere 2000mm

Video with DSLR (con't)

Basic Reminders for Solar Video Capture

- Always use proper filtering when looking at or taking pictures of the Sun
- Does not require GEM (only at highest focal lengths)

Solar

- 1/125 to 1/1000th seconds
- f2 to f 30
- ISO 100 to 800

Sun Spots 1240mm

Video with DSLR (con't)

Basic Reminders for Satellite Video Capture

- Practice by tracking aircraft
- Use red dot finder
- Get updates from The Celestial Observer http://www.calsky.com/
- Raise shutter speed & ISO to freeze satellite

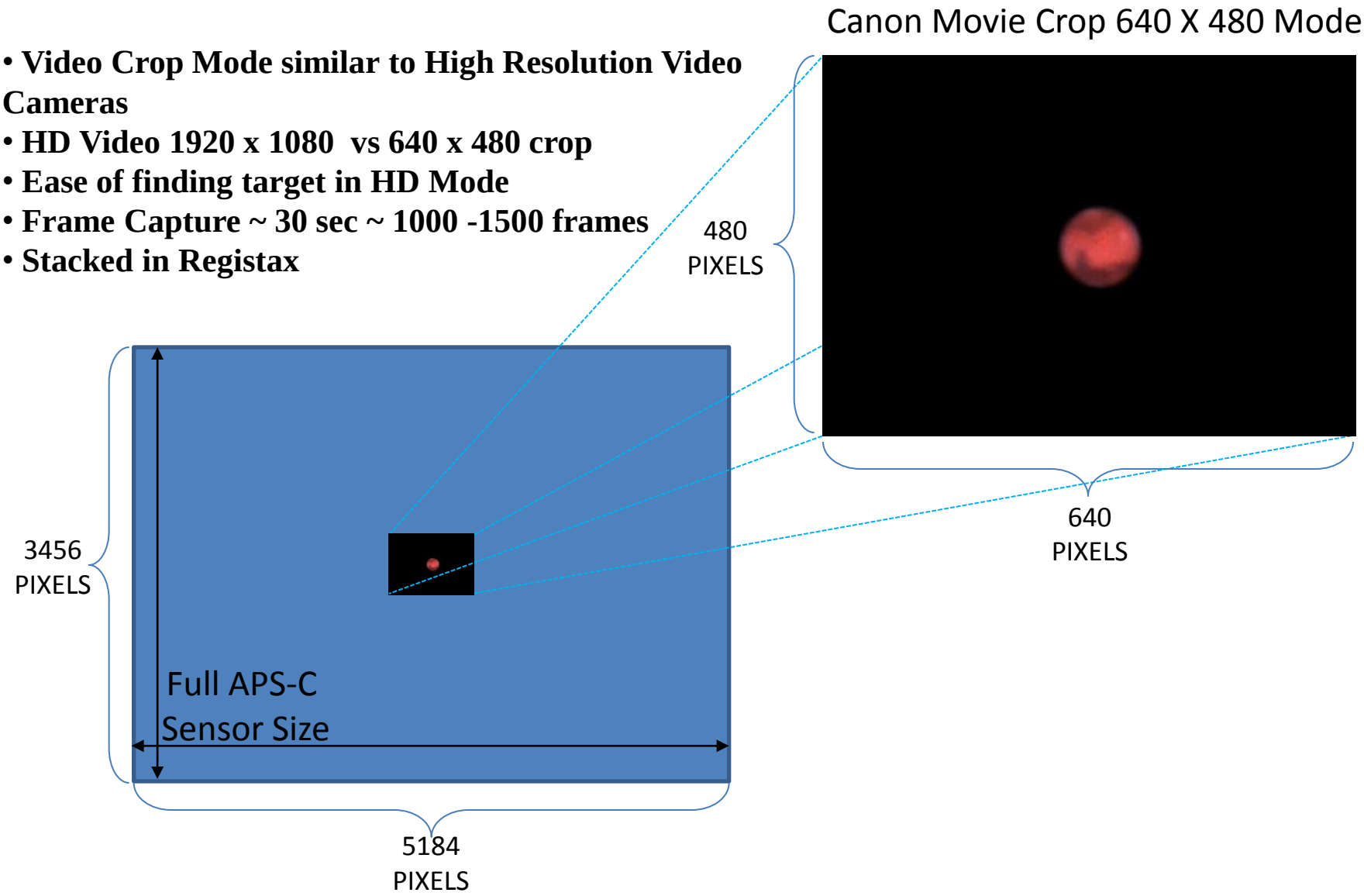
Lunar

- 1/250 to 1/2000th second
- f2 to f 30
- ISO 800 to 3200

ISS 980mm

Shooting Planetary Objects In Canon's DSLR Video Crop Mode

- **Video Crop Mode similar to High Resolution Video Cameras**
- **HD Video 1920 x 1080 vs 640 x 480 crop**
- **Ease of finding target in HD Mode**
- **Frame Capture ~ 30 sec ~ 1000 -1500 frames**
- **Stacked in Registax**



Video with DSLR

Basic Reminders for Video Capture

- Shot on tripod w stock lens

Lunar

- 1/60 to 1/250th seconds
- f2 to f 30
- ISO 100 to 800

First Quarter Moon 135mm

Questions?

Orion Close Up 200mm

Backup Slides

Orion Close Up 200mm

Current and Future Imaging Configurations

Configuration	Focal Length	Magnification	Focal Ratio	FOV X Axis	FOV Y Axis	Sampling (Arcseconds/Pixel)
Edge 8" X 2x Powermate X diagonal (640 x 480 crop)	6000	1526	30	0° 1‘ 41"	0° 1‘ 7"	0.148
Edge 8" X 2x Powermate X diagonal (full frame)	6000	192	30	0° 12‘ 47"	0° 8‘ 31"	0.148
Edge 8" X 2x Powermate	4000	128	20	0° 19‘ 8"	0° 12‘ 47"	0.222
Edge 8"	2000	64	10	0° 38‘ 20"	0° 25‘ 37"	0.443
Edge 8" X .7 Celestron Focal Reducer	1400	44.8	7	0° 54‘ 47"	0° 36‘ 36"	0.634
Orion ED80T CF X 2x Powermate X diagonal	1440	46.08	18	0° 53‘ 13"	0° 35‘ 35"	0.616
Orion ED80T CF X 2x Powermate	960	30.72	12	1° 19‘ 52"	0° 53‘ 20"	0.924
Orion ED80T CF	480	15.36	6	2° 39‘ 43"	1° 46‘ 44"	1.848
Orion ED 80T CF X .8 Orion Focal Reducer	384	12.288	4.8	3° 19‘ 37"	2° 13‘ 23"	2.31
Olympus Zuiko 200mm	200	6.4	4	6° 22‘ 55"	4° 16‘ 1"	4.435
Olympus Zuiko 50mm	50	1.6	1.8	25° 8‘ 38"	16° 57‘ 4"	17.739
Rokinon 8mm (Estimate)	8	0.256	3.5	~130°	~75°	110.9