Credits

Music from Geodesium “The MarsQuest Collection” 4.0 min

Credits

- **Images**
  - Michael Barber
  - Adam Block
  - Jim Brooke
  - Tom Carrico
  - Antonio Cidadao
  - Mike Ford
  - Jim Gleason
  - Robert Glender
  - Ed Grafton
  - Geroge Greenfield
  - Ed Hagerman
  - Bob Holzer
  - Gilbert Jones
  - Robert Kuberek
  - Chip Levinson
  - Larry Owens
  - Dabe Rajla
  - Mark de Regt
  - Roth Ritter
  - Matthew Russell
  - John Smith
  - Benoit Schillings
  - Stephen Shields
  - Don Shotz
  - Gary Stevens
  - Loke Tan
  - Diane Zeiders
  - Martin van der Voort

For my part I know nothing with any certainty, but the sight of the stars make me dream.

-- Vincent VanGogh

M31, Canon 10D


M33, Canon 10D

M104 Don Shotz, Mike Ford

M45, Canon 10D

M81, Canon 10D

Network Nebula Tom Carrico

M81/82, Canon 10D

M33 Matthew Russell

M51 Adam Block

M57 Anne, Karen and Dave Rajala

M64 Jim Gleason

NGC891 Adam Block

M81, M82 Bob Holzer

NGC253 Chip Levinson

M81 Adam Block

NGC6946 Adam Block

M42 Canon 300D

Rosette Nebula, Robert Glender

NGC 4631 Diane Zeiders, Jim Brooke

Deep Sky Imaging

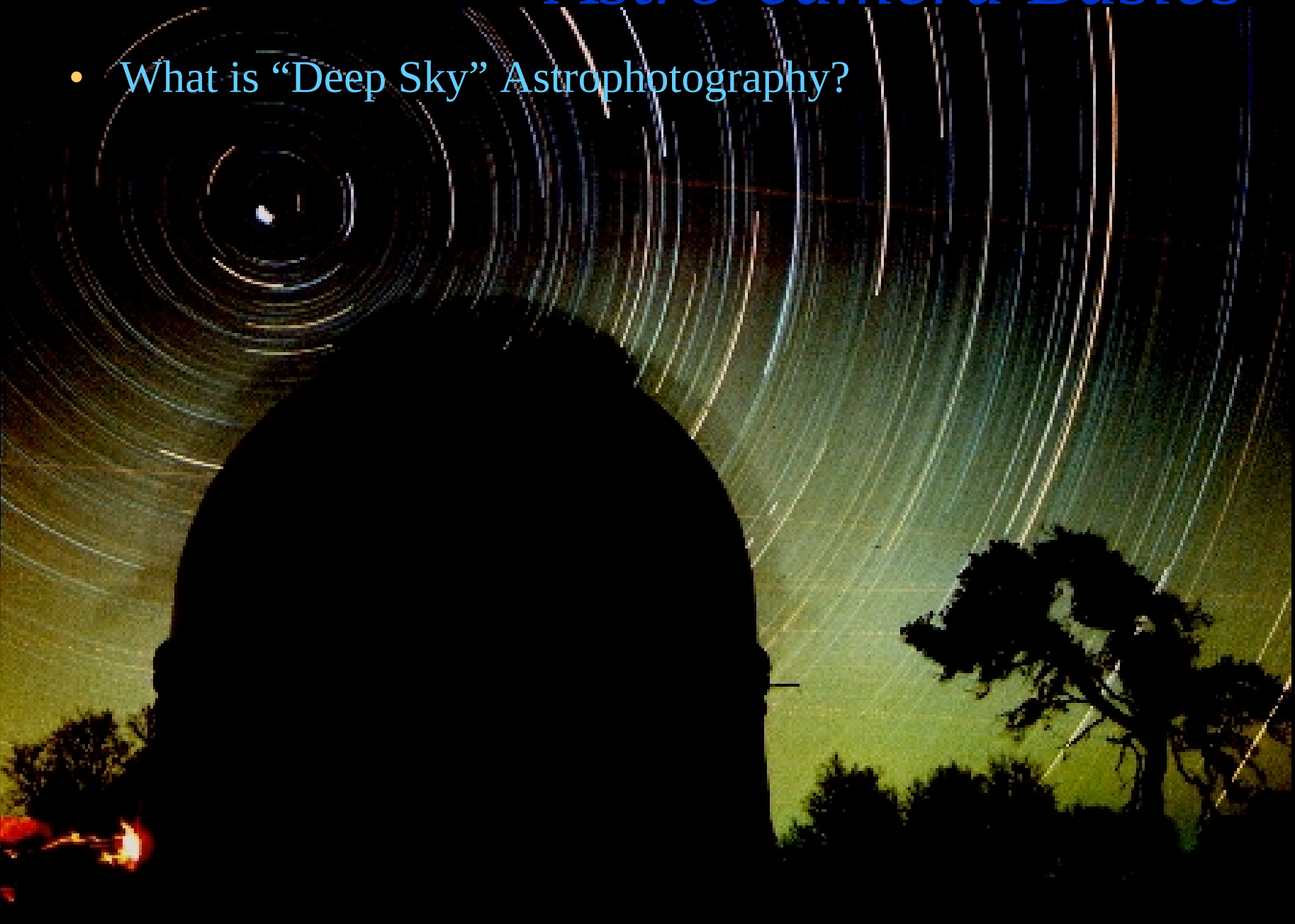
with Digital Cameras

Astro-camera Basics

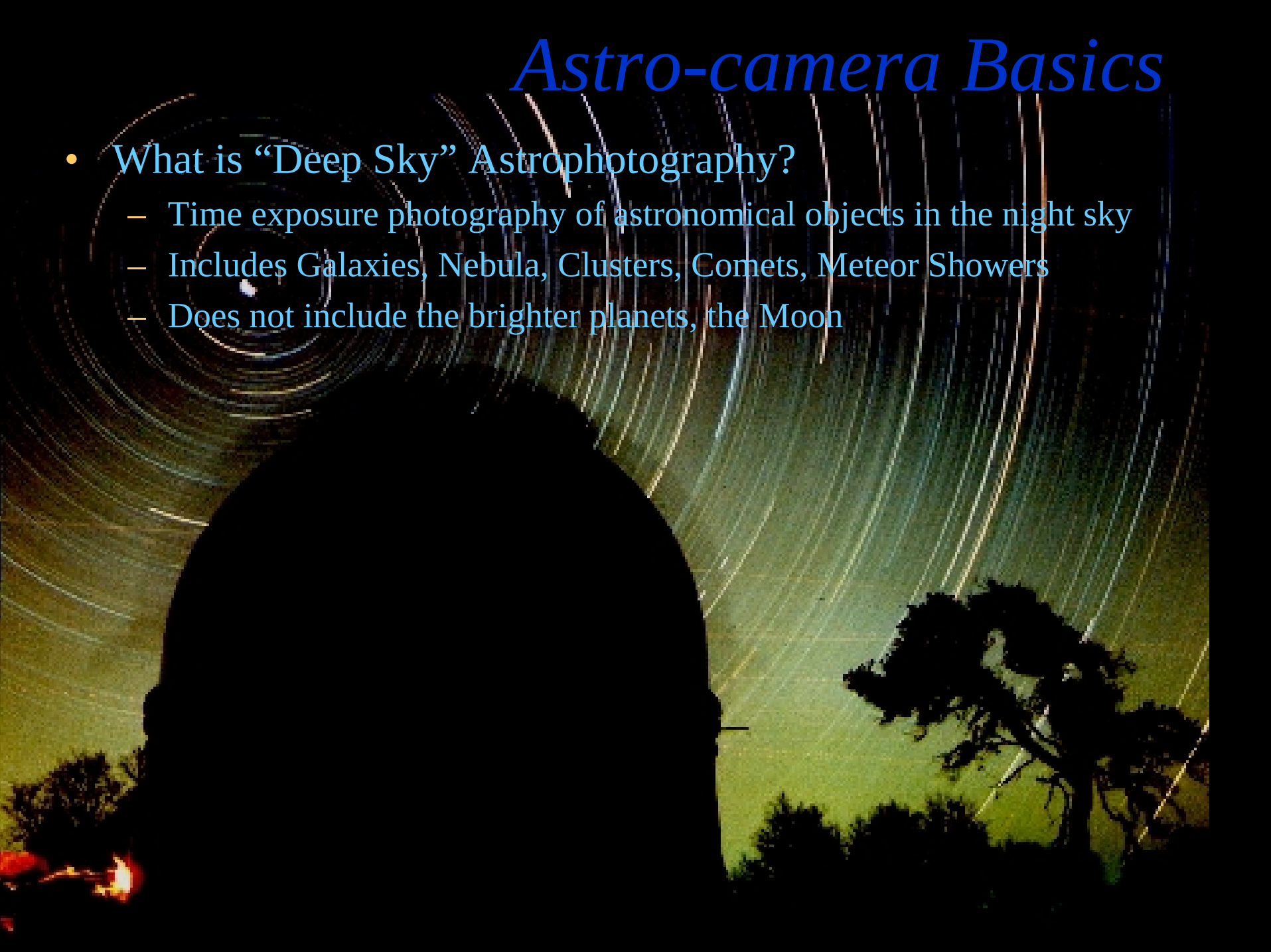
Hubble

Astro-camera Basics

- What is “Deep Sky” Astrophotography?



Astro-camera Basics



- What is “Deep Sky” Astrophotography?
  - Time exposure photography of astronomical objects in the night sky
  - Includes Galaxies, Nebula, Clusters, Comets, Meteor Showers
  - Does not include the brighter planets, the Moon

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- What kinds of Cameras can be used?

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- What kinds of Cameras can be used?
  - Digital Single Lens Reflex (SLR)
    - Removable Lens – Plentiful Adapters
    - Through the Lens Focusing
    - Excellent for Deep Sky

  - Astronomical CCD Cameras
    - Built for Astronomy
    - Sensitive, Low Noise
    - The Best for Deep Sky

Astro-camera Basics

- Digital SLR Cameras
  - Large CCD/CMOS chips – approaching 35mm film size
  - No Laptop Needed in the Field
  - Excellent Long Exposure Quality
  - Some Cameras have Astro Features
  - Can use for Astro and Vacations!
  - Price: $900 - $3000

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- Astronomical CCD Cameras
  - Large CCD/CMOS chips – approaching 35mm film size
  - Laptop is a must in the field
  - Refrigerated CCD Sensors
  - Extremely Low Noise – Very LONG exposures possible
  - Broad Bandwidth (with Mono)
  - Price: $8,000 - $20,000


What can you do with a
Digital Camera?

What can you do with a Digital Camera?

Larry Owens planetographer@comcast.net

Total Lunar Eclipse
October 27, 2004

What can you do with a Digital Camera?

What can you do with a Digital Camera?

What can you do with a Digital Camera?

What can you do with a Digital Camera?

Canon 10D Digital SLR, M31

What can you do with a Digital Camera?

Canon 10D Takahashi Epsilon 160 22-4min @ ISO 800 Rick Krejci Total exposure: 88min

What can you do with a Digital Camera?

SBIG STL11000M, RED-9x1200sec, GREEN-5x900, BLUE-10x1200sec,. AP155

William McLaughlin Total exposure: RED-180min, GREEN-75min, BLUE-200min

What can you do with a Digital Camera?

Canon 20Da M8/M20 Region Takahashi FSQ106/G11

Single 300 second exposure at ISO800 Erkc Blackhurst & Chriss Hoffman

What can you do with a Digital Camera?

Canon 10D Digital SLR, M81

What can you do with a Digital Camera?

Canon 10D Digital SLR, M33

What can you do with a Digital Camera?

Canon 20Da

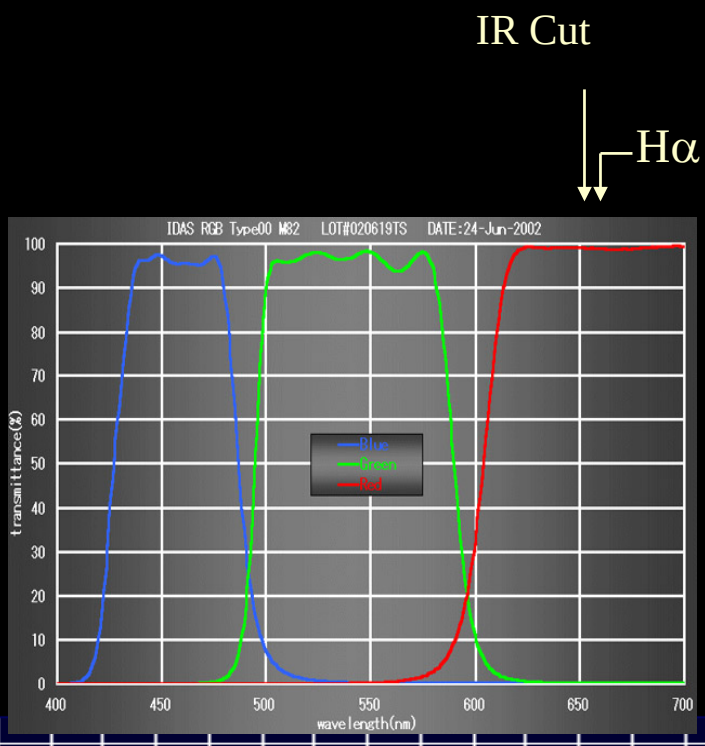
SBIG STL11000

What can you do with a Digital Camera?

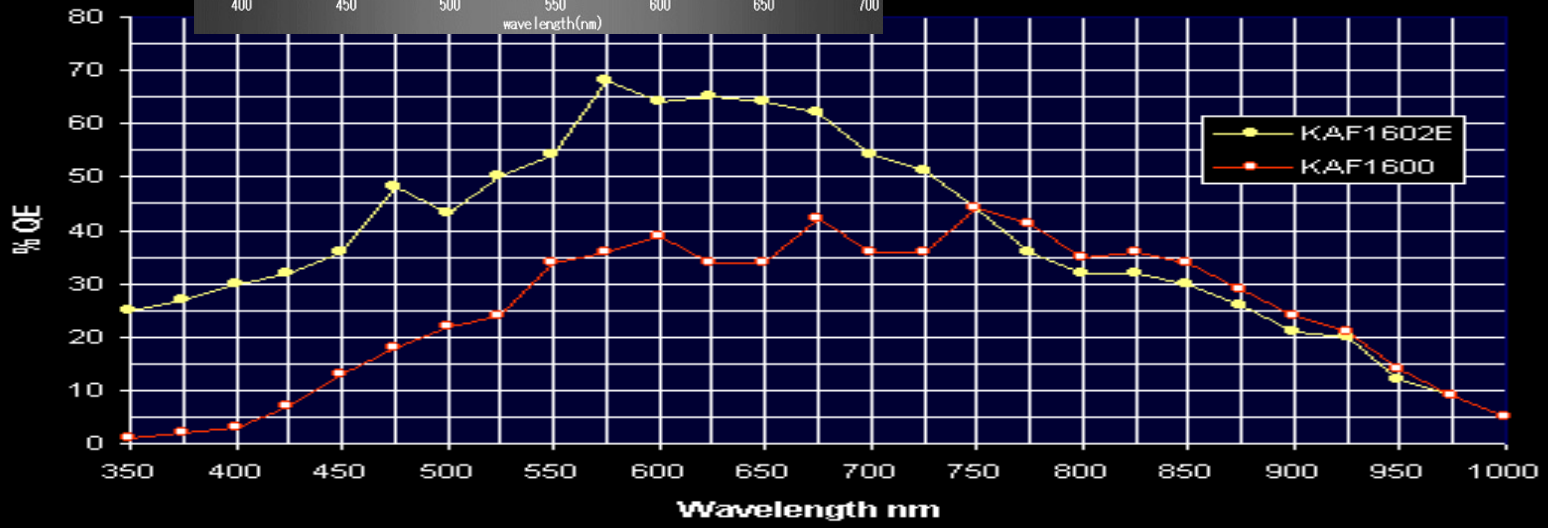
Digital Cameras for Astrophotography

Houston: *we have a problem*

Digital Cameras for Astrophotography



- Standard Digital SLR's
  - Sensors have broad spectrum response – from IR to UV
  - This interferes with color correction
  - IR blocking added to correct
  - Cuts starting at around 650nm
    - Cuts most of Hα (656.3nm)



Houston: *we have a problem*

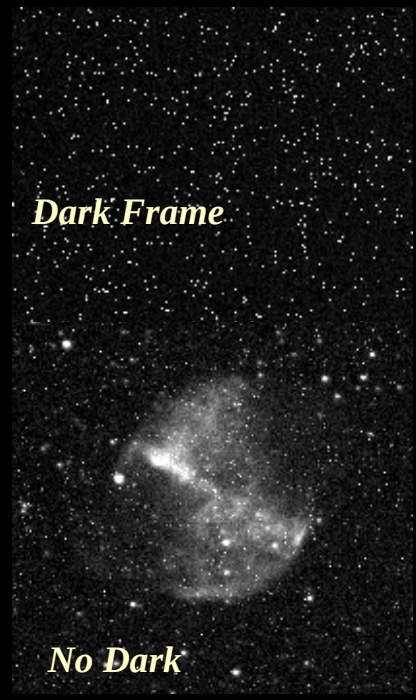
Digital Cameras for Astrophotography

- Modified Digital SLR's
  - Remove the factory IR cut filter from CCD
    - Makes camera *unusable* for general photography – everything has a red hue (can use an expensive IR block filter on each lens)
    - Restores Hα response, great for astronomy
  - Modify the factory IR cut filter
    - Extends the RED/IR response of the chip (Hα is better, not as good as *no* IR block)
    - Minimizes color balance problems for general use, can correct using camera's white balance
    - Excellent compromise

Houston: *we have a problem*

Digital Cameras for Astrophotography

- Other Issues with using Digital SLR's
  - Focus is difficult in the dark
    - Can use magnifier
    - Canon 20Da has an LCD focus aid
  - Long Exposures Amplify Defects
    - Defects show up as star like points and internal heat can cause glow on right side of image
    - Dark Frames to the rescue
      - Same temp and exposure
      - 20Da has auto dark
    - Some cameras have much less noise



Digital Cameras for Astrophotography

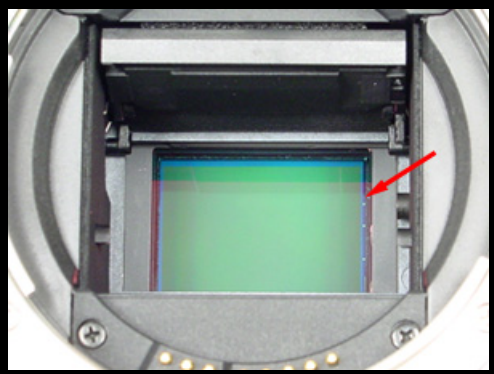
- Canon 20Da
  - "a" indicates "astronomy"
  - First digital SLR manufactured for astrophotography
  - 8.2 Mega Pixel
  - IR block filter modified to extend into IR for improved Hα
  - Can be used for general photography
  - "Live View" mode – video to LCD at 5x or 10x for fine focusing (a first for digital SLR)
  - Much better noise reduction
  - Option to take and apply "Dark Frames" with each exposure

Price: $2199

Extras you'll need:
"T" ring adapter
Electronic shutter release
Extra Battery
Compact Flash Memory Card
Lens (for general use)

Digital Cameras for Astrophotography

- Canon 20D Spectrum Enhanced
  - Two versions available:
    - IR block replaced with clear filter (must use exclusively for astronomy)
    - IR blocker replaced with a “Type I” astronomical filter (use a 2nd filter for general use, or just use white balance adjustment)
    - Modified and warranted by Hutech
  - 8.2 Mega Pixel

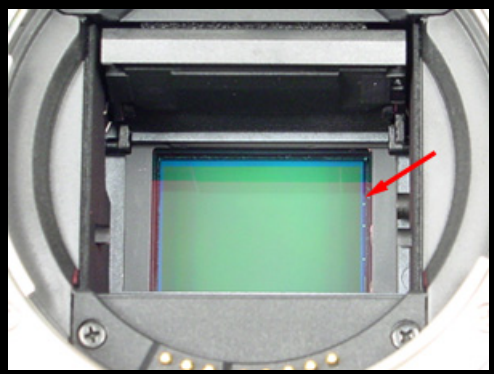


Price:
$1895 (Canon filter removed)
$1995 (Astronomical Type I)
$1995 (Clear filter)

Extras you’ll need:
“T” ring adapter
Electronic shutter release
Extra Battery
Compact Flash Memory Card
Lens (for general use)

Digital Cameras for Astrophotography

- Canon Rebel 350D Spectrum Enhanced
  - Two versions available:
    - IR block replaced with clear filter (must use exclusively for astronomy)
    - IR blocker replaced with a “Type I” astronomical filter (use a 2nd filter for general use, or just use white balance adjustment)
    - Modified and warranted by Hutech
  - 8.2 Mega Pixel



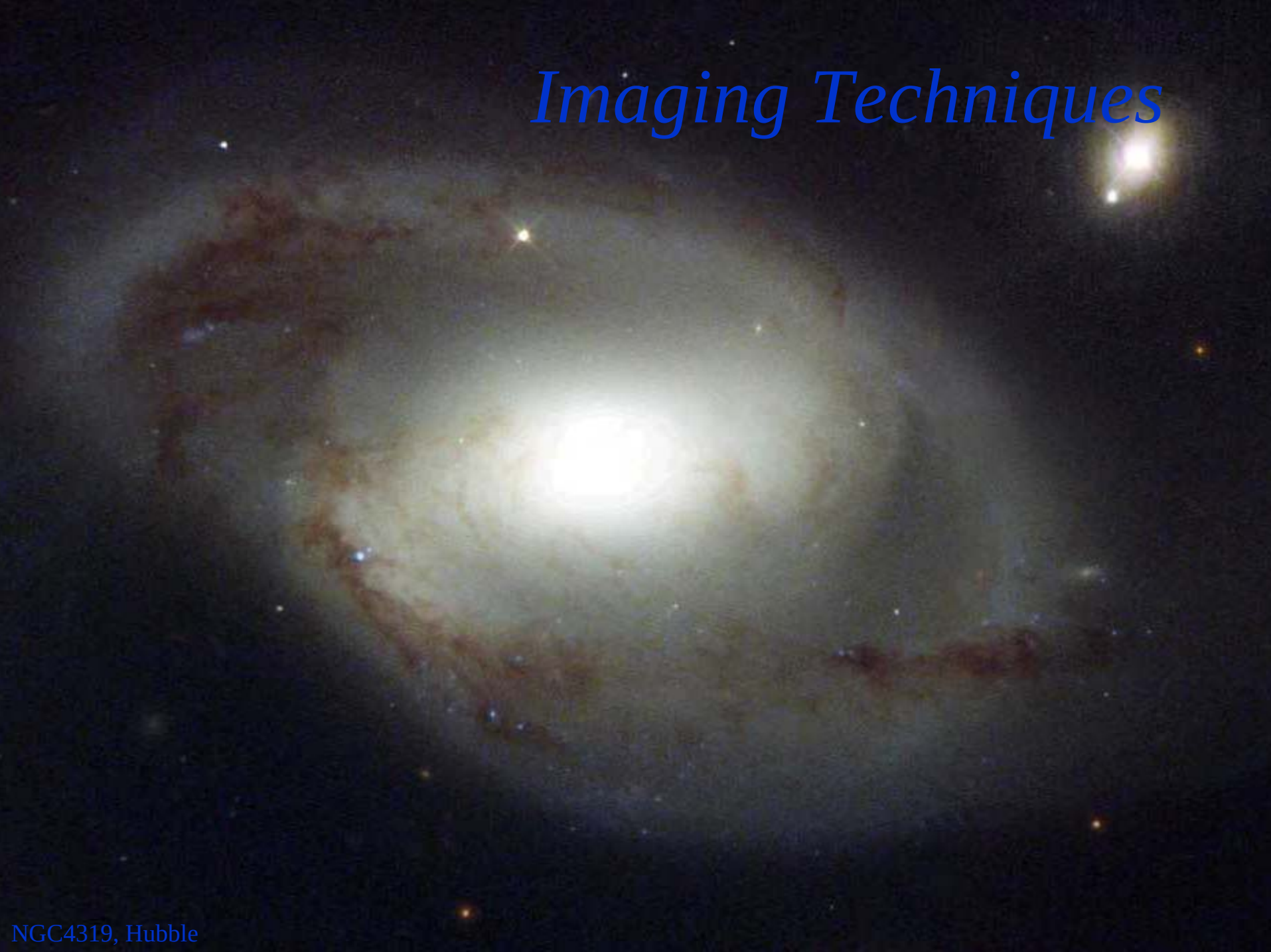
Price:
$1250 (Canon filter removed)
$1350 (Astronomical Type I)
$1350 (Clear filter)

Extras you’ll need:
“T” ring adapter
Electronic shutter release
Extra Battery
Compact Flash Memory Card
Lens (for general use)

Digital Cameras for Astrophotography

- Canon Spectrum Enhanced Cameras
  - Adirondack Video Astronomy
  - http://www.astrovid.com/
- Canon 20Da
  - Ocean Side Photo and Telescope (OPT)
  - http://www.optcorp.com/

Imaging Techniques



NGC4319, Hubble

Imaging Techniques

- Focusing Techniques
  - DSLR Focus
    - Software that controls your camera from a laptop
    - Allows you to fine tune focus before long exposures
    - Controls the camera via USB and a special cable (must have a parallel printer port)
    - But, eliminates the advantage of not requiring a laptop
  - Lens Marking
    - Through the lens focusing is difficult at night
    - Focus at FULL APERTURE, image a couple of stops higher
    - Must manually focus
    - Use view finder magnifier
    - With telephotos or other lenses
      - Focus on moon, mark focus point with silver Sharpie
        - Zoom lenses – mark focus for several zoom settings
        - Never assume that focus is the same
  - Through Telescope
    - Use view finder magnifier, focus on bright star NEAR Target
    - Verify focus with LCD using magnified view (carefully)

Imaging Techniques

- Exposures
  - DSLR sensors are not cooled
  - In warm weather, may need to limit exposure to 3-5min
    - This minimizes heat induced bright areas near edges
    - Stack several short exposures
  - In cold weather, 5-10 minute exposures are possible
  - Take as many exposures as you can
    - Stacking will add the exposure times to make a much better image
    - With bright objects, take several very short exposures to capture detail in brighter areas.
      - Luminance Layering can be used later to add detail
- ISO Settings
  - Determines the gain or sensitivity of sensor
  - High settings (1600 or 3200) can get grainy
  - Use lower settings for most deep sky (400-800)
  - Meteor showers – ISO 200, leave shutter open 10min or more
  - Experiment – determine best settings for different situations and different cameras

Imaging Techniques

- Guiding (correcting for tracking errors)
  - Use of a polar aligned mount – tracking never perfect
    - If you don't have a polar aligned mount – you need one
  - Use guide scope manually with illuminated reticle eyepiece or an autoguider system (such as SBIG STV - $2000)
  - Usually not necessary for wide angle lens shots (meteor showers or Milky Way) – mount piggy-back on scope
  - A must through any high power telephoto or telescope
  - Can use "easy guiders" instead of guide scope
  - Not necessary for star trail shots
    - All you need is a tripod

Image Processing

N44C, Hubble