Night Photography

• Why is it hard?
  • Not much light
  • Huge dynamic range
  • Framing is difficult
  • Not obvious how photo will look
Twilight
Twilight
Cities at Night
Cities at Night
Early Morning
Starry Nights
Starry Nights
Starry Nights
Starry Nights
Starry Nights
Astrophotography

• Capturing images of the sky
• There are amazing things out there!
• Good targets: star clusters, nebulas, galaxies
• Requires tripod and bulb mode
**Challenges**

- Extremely dark, hard to focus, cold...
- Want to track the earth’s rotation
- Small objects require big lens/telescope
- Worry about all kinds of image noise
- Light pollution! Clouds! Atmosphere!
• Earth rotates 360 degrees in 24 hours
• Equatorial Mount compensates for this
• Anywhere from $100 to $1,000,000
• Rule of thumb: without tracking, trails are visible at 1000sec / focal length
Different Scales

• Some objects are tiny:
  ~10,000mm

• Some objects are bigger:
  ~1,000mm

• Some “objects” are huge:
  ~25mm
Image Stacking

- Averaging multiple images reduces read and shot noise
- Dark frame subtraction reduces dark current noise (essential!)
- Alignment sometimes necessary
  - Can be done by hand or automatically
Post Processing

- Need to transform a histogram where almost everything is near-back to a pleasing image
- Can use Levels / Curves in Photoshop
- I wrote a program to do this automatically
My Program

- Bucket sort pixels by brightness
- Separately for each color channel
- Generate output image with desired histogram
- Monotonic transformation
Winter Milky Way from Sea Level, Hawaii
Canon 5DII, 1 image with Zeiss 21/2.8 at f/4, 6 min
Winter Milky Way from Sea Level, Hawaii
Canon 5DII, 10 images with Zeiss 21/2.8 at f/4, 6 min each
Andromeda: Single Image
Andromeda: Auto Levels
Andromeda: Stack, Process
Histogram Comparison

Original

Final
HORSEHEAD NEBULA
Panoramas!

- You can stack, but probably don’t need to
- Alignment can be hard
Milky Way from Mauna Kea Summit, 14,000 feet
Canon 1Ds, 4 images with 85/1.2L at f/2.5, 5 min each