



AN INTRODUCTION TO
ASTROPHOTOGRAPHY
WITH DSLR CAMERAS

ASTROPHOTOGRAPHY WITH CAMERA AND TRIPOD



Photo by Ram Vishwanathan

Canon 5DII w/14mm f2.8 lens
180 subs 30sec each



Photo by Bill Albert

30 sec. Canon t2i with 18-55 stock lens

BASIC EQUIPMENT

- Camera
- Tracking device
- Lens/Telescope



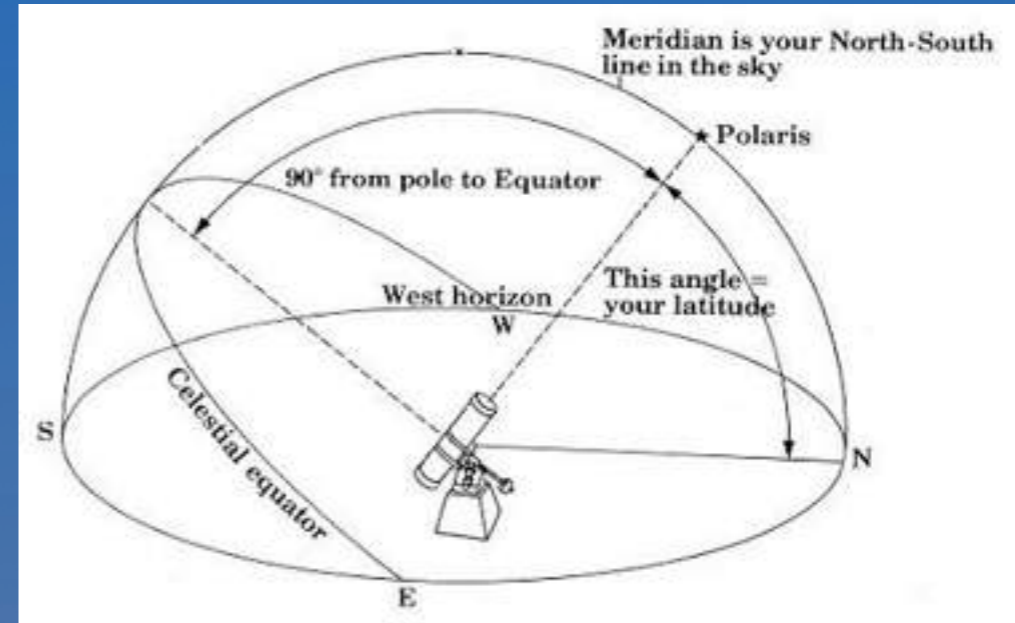
WHAT CAMERA?

- Capable of doing “bulb” exposure with manual settings
- Capable of saving in “raw” format
- Low noise sensor (any modern DSLR will do)
- With built in intervalometer or an external one if necessary



"POLAR ALIGNMENT AND TRACKING"

- North celestial pole and apparent motion of object in the sky.
- How to polar align
- Tracking, periodic error, effect of accurate polar alignment.



WHAT OPTICS?

- Short Focal Length to medium telephoto - Easiest
- Longer focal length telephoto - More difficult
- Telescope - Most difficult



60mm Zeiss Orthoplanar



200mm Canon Lens



750mm Refractor telescope

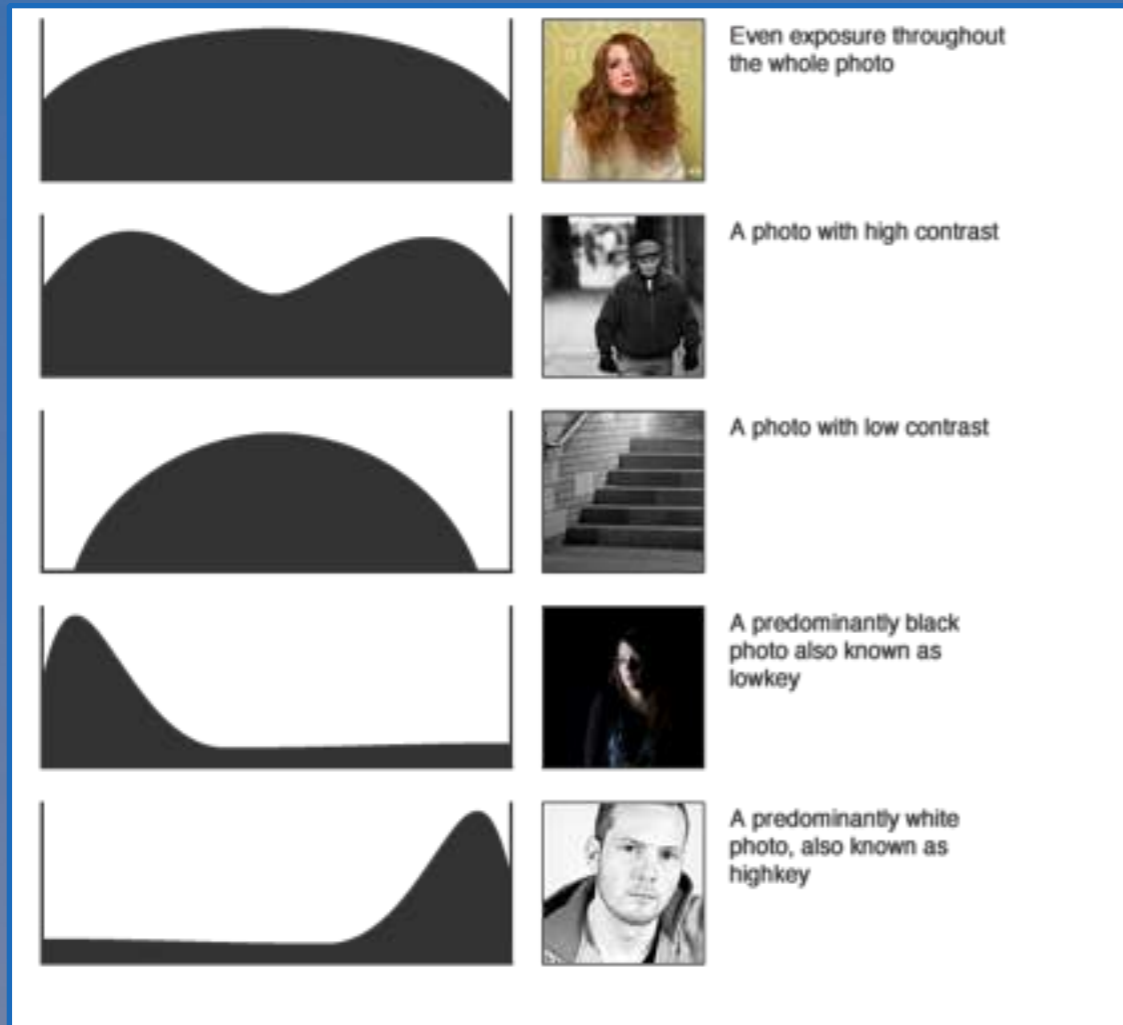
FRAME AND FOCUS

- Red dot finder
- Focus mask (Bahtinov Mask)
- Learn the sky
- Tethered shooting helps with framing



BASIC CONCEPTS

- Astrophotography captures very faint objects, so faint that the signal level is very close to the noise level. The goal is to separate our signal from the noise as much as possible.



BASIC CONCEPTS

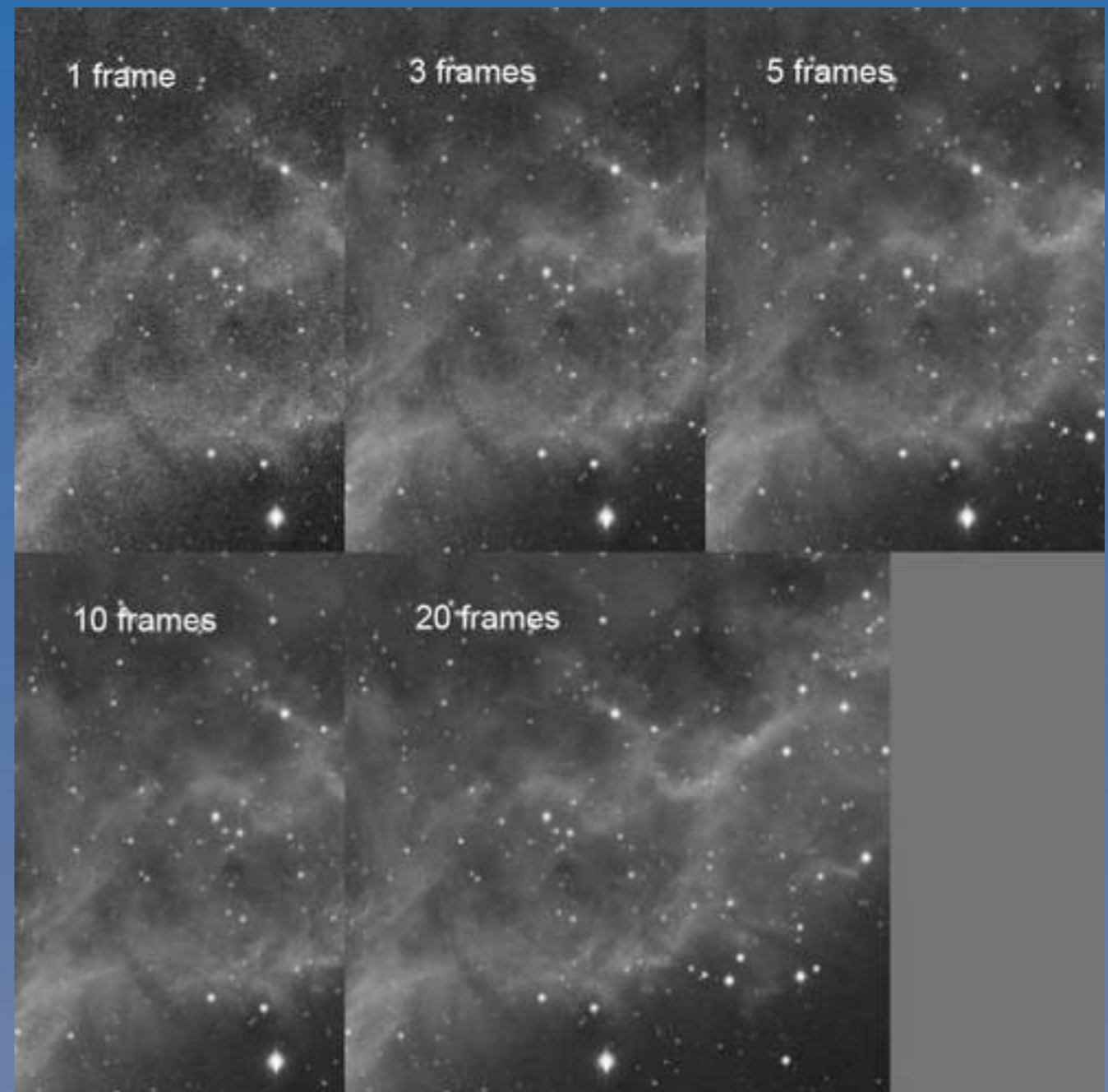
- S/N ratio
- Sources of noise
- Since we can't increase the signal, we need to reduce noise. That means improve the signal to noise ratio.

MORE ON NOISE

- Sources of noise:
 - Dark Current
 - Shot noise
 - Read noise

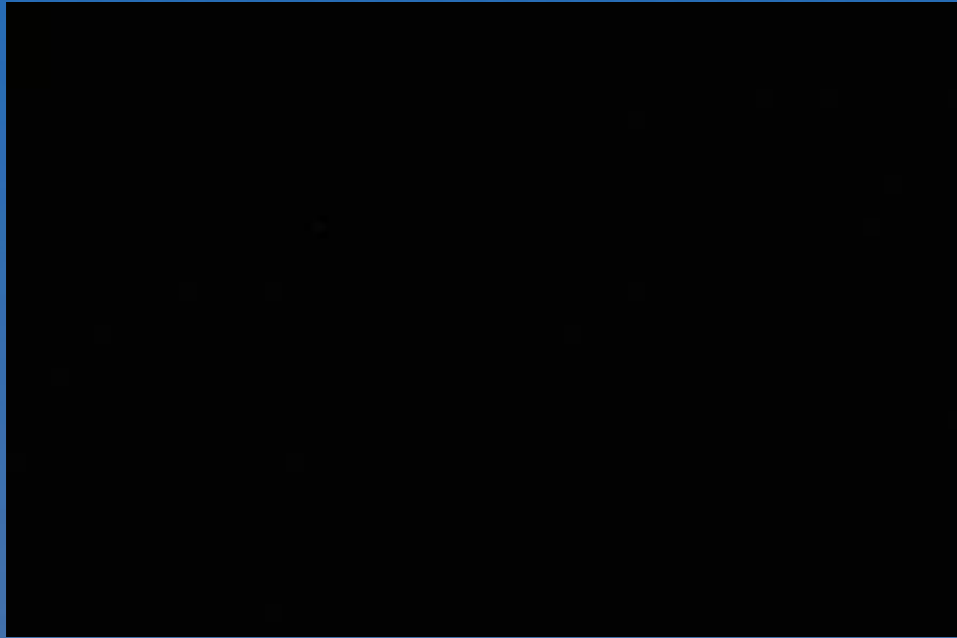
IMPROVING S/N RATIO

- In camera noise reduction is a good way to start (takes care of dark current)
- The concept of stacking to reduce shot noise
- We will ignore read noise for now



Examples of stacking

WHAT THE IMAGES WILL LOOK LIKE



Single 2min frame unstretched



Same frame stretched

FINAL STACK - PROCESSED



(43) 4minute subs
Photo by Andy Ermolli

SOFTWARE

- Deep Sky Stacker
 - Image alignment
 - Image stacking
- Final 32 or 16 bit image
- Photoshop or other image processing software
 - Stretch
 - Curves
 - Noise reduction
 - Increase color saturation
 - etc...

WEB RESOURCES

- www.cloudynights.com (Where the astronomy community hangs out)
- <http://www.stark-labs.com> (Good papers on basic concepts)
- <http://www.astropix.com> (Good book by Jerry Lodriguss on how to get started)
- www.astrobin.com (good resource for looking at images from other amateur astrophotographers)

SOFTWARE

- EOS Utility or software that came with camera (for shooting tethered)
- Sequence Generator pro (More advanced camera control software)
- Backyard EOS/Nikon
- Deep Sky Stacker (Image calibration and stacking) Free!
- Photoshop (other image processing software will do)
- Pixinsight (More advanced image processing for astronomy)

MORE ELABORATE SETUPS



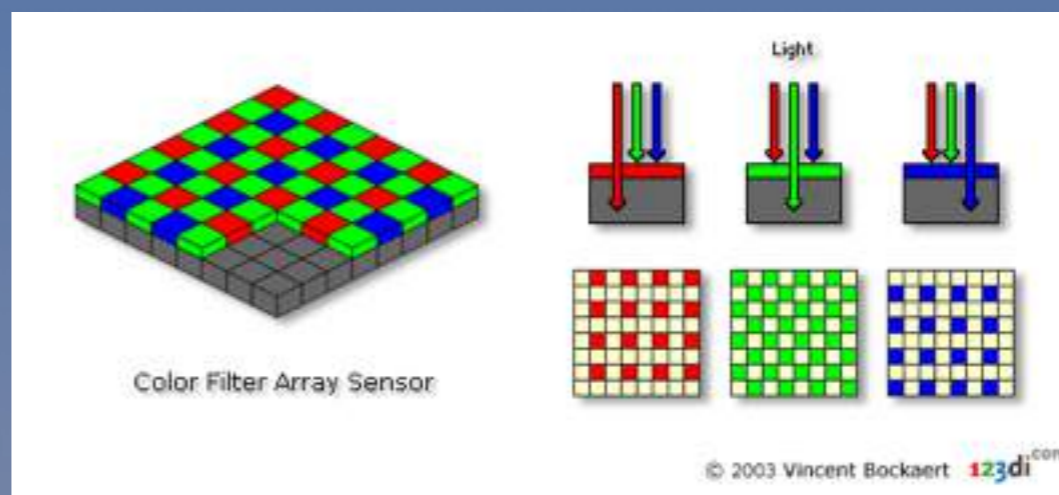
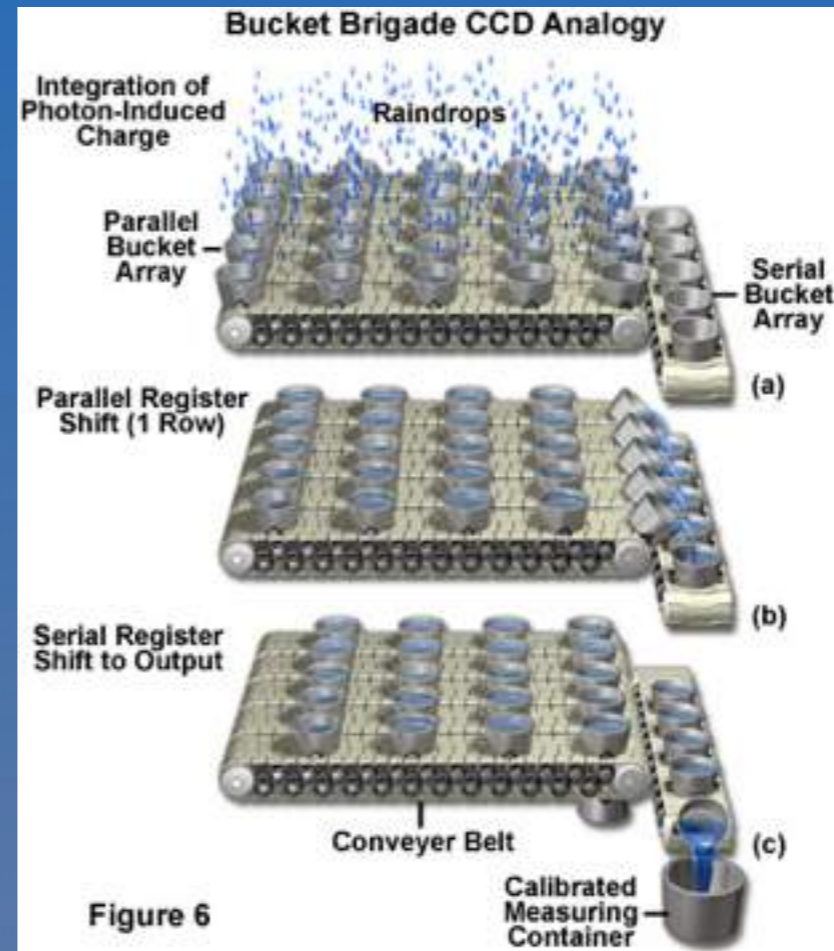
MONOCHROME CCD CAMERA

- Requires capturing channels separately
 - Red
 - Green
 - Blue
 - Luminance
- Two to Three times more sensitive than a DSLR
- Can not be used for daytime photography
- Needs a computer to be operated
- Has built in cooling system



HOW DIGITAL SENSORS WORK MONOCHROME VERSUS COLOR

- Converts photons to voltage and eventually to ADU's.
- Bayer matrix - Color.
- Monochrome sensor has no Bayer matrix and captures more photons in given wavelength.



SOME OF MY WORK



The Witch Head Nebula

SOME OF MY WORK



Markarian's Chain in Virgo

SOME OF MY WORK



M81 the Bode's Galaxy

SOME OF MY WORK



From m78 to the Horse Head Nebula

SOME OF MY WORK



NGC 4565 the Needle Galaxy

SOME OF MY WORK



The Cocoon Nebula

SOME OF MY WORK



NGC5033

SOME OF MY WORK



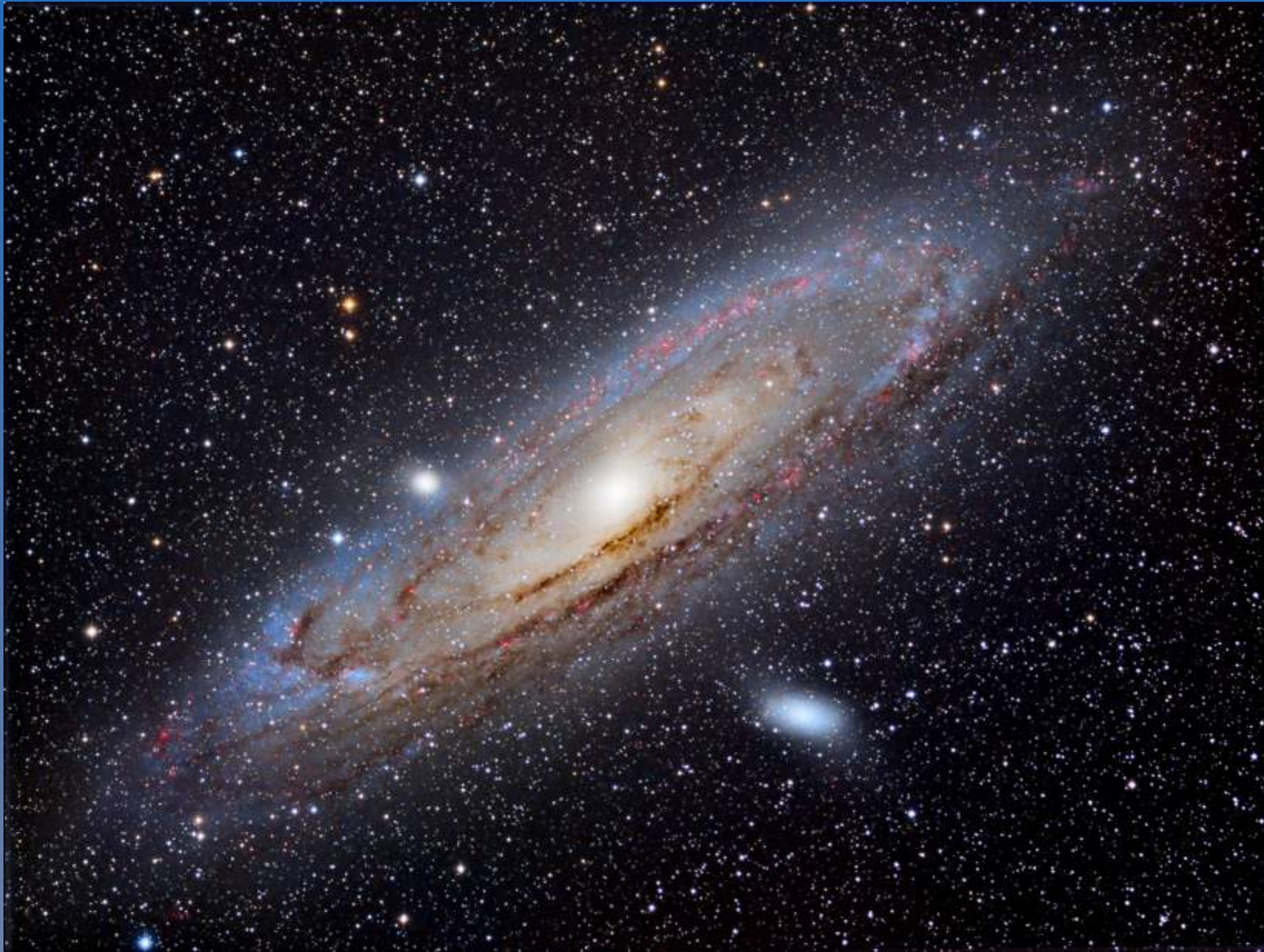
NGC1333 and Perseus Molecular Cloud

SOME OF MY WORK



M51 the Whirlpool Galaxy

SOME OF MY WORK



M31 the Andromeda Galaxy

MY FLICKR GALLERY

<https://www.flickr.com/photos/andyinsea/>

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