

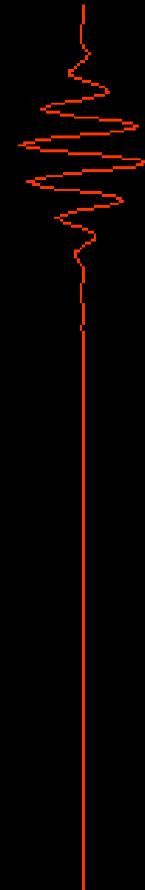
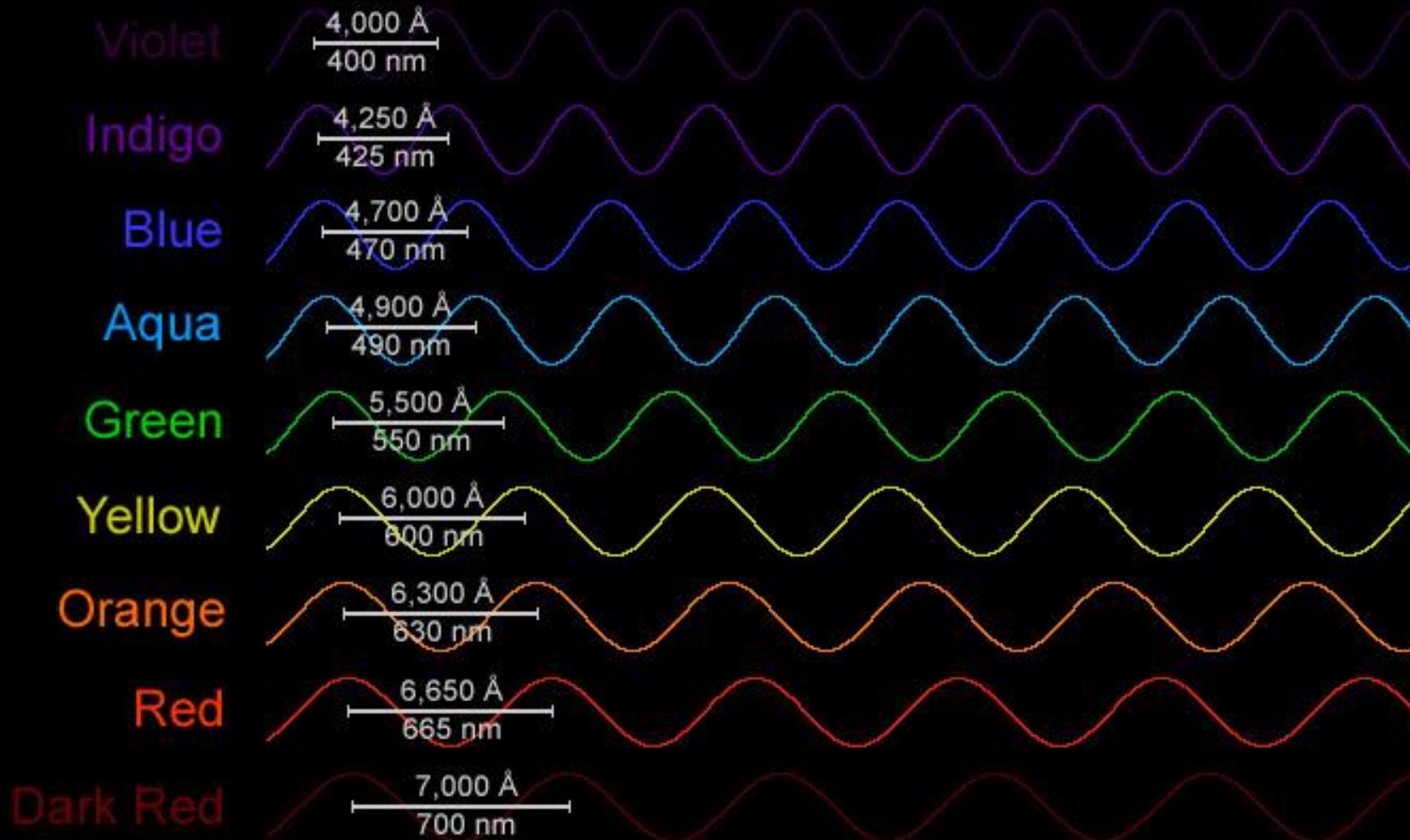


A UNIVERSE OF COLOUR

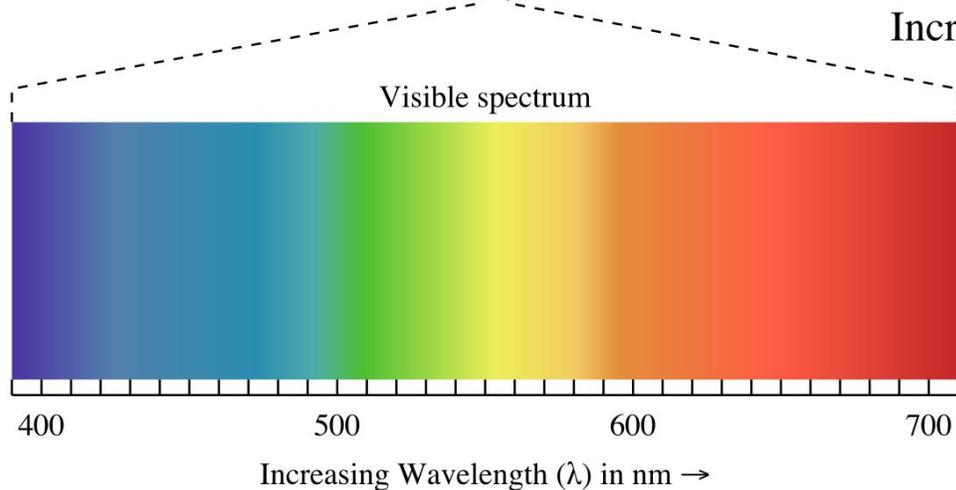
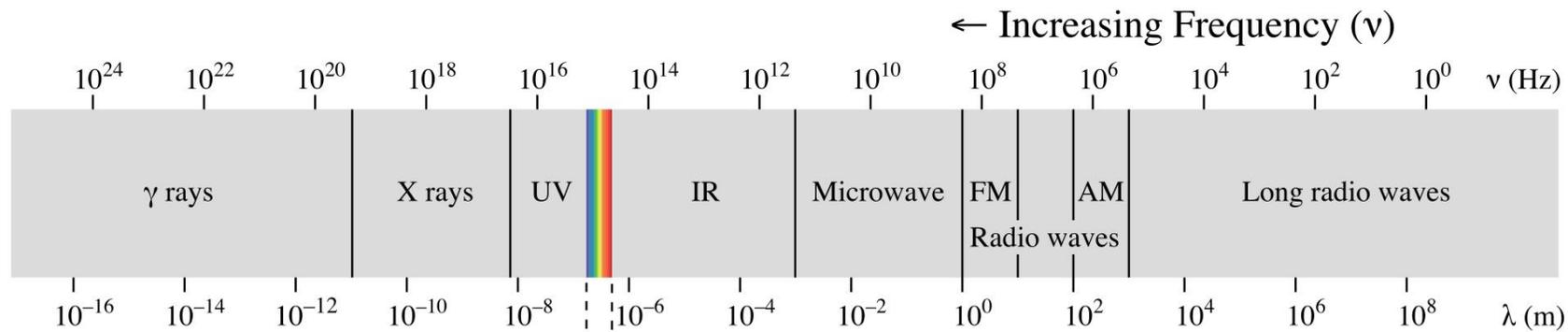
From raw images of galaxies and nebulae to the camera in your phone.

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- What is colour?
 - Wait... raw images are black and white?
 - Imaging with filters
 - Reconstructing natural colour
 - Funky things we can do with colour

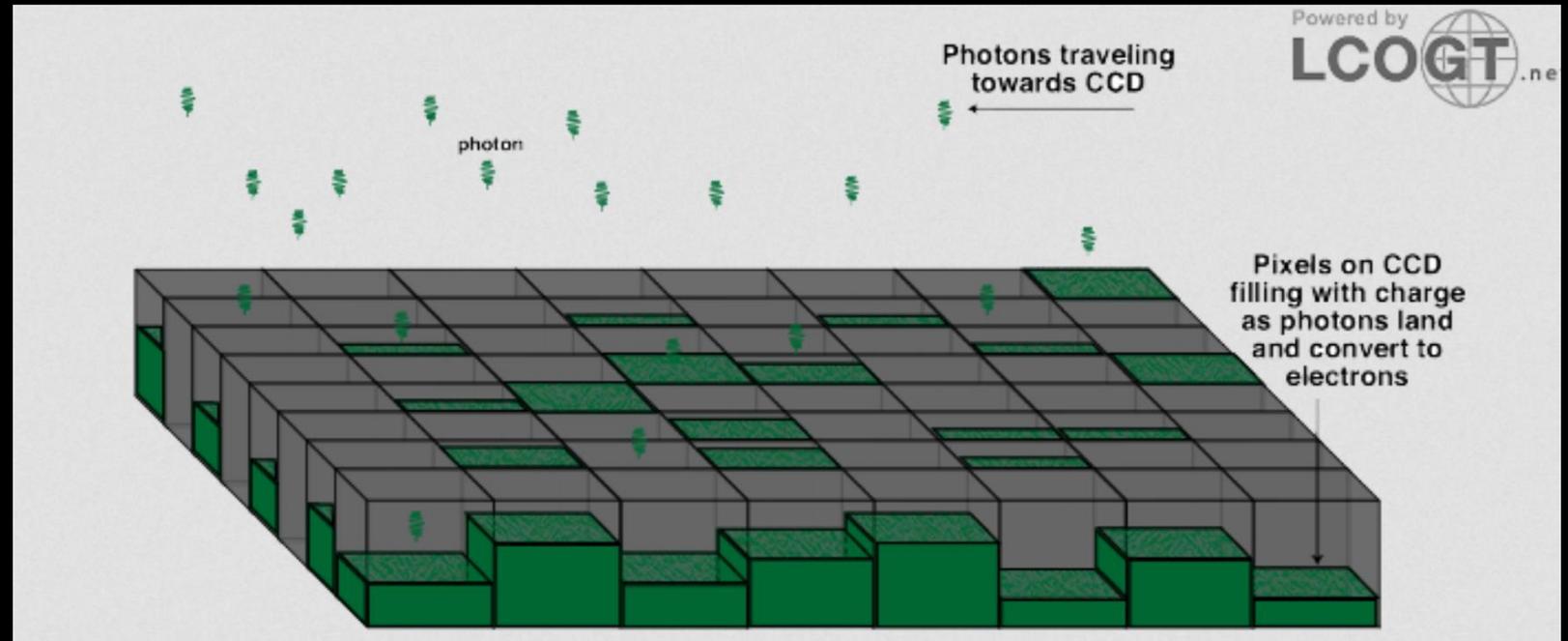
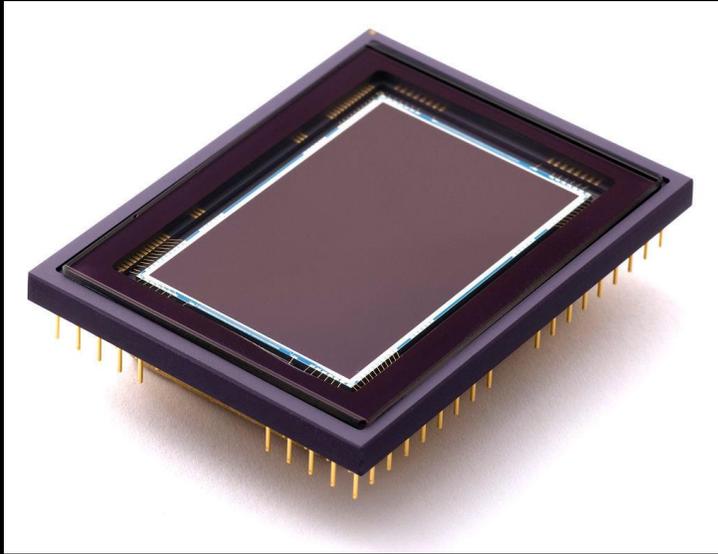
WHAT IS COLOUR?



BUT THAT'S JUST PART OF A WIDER SPECTRUM



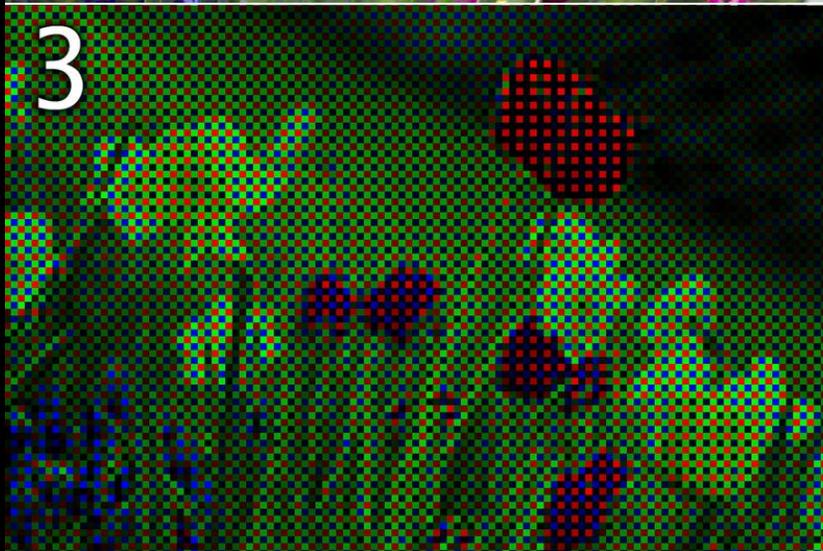
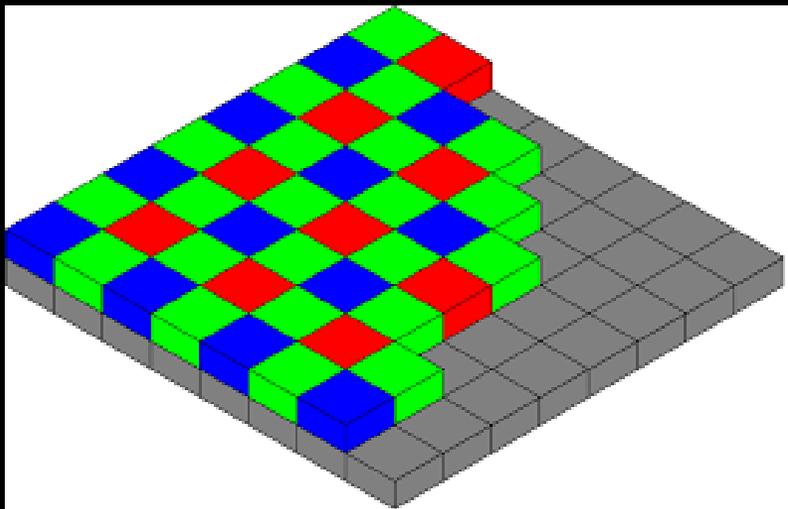
THE CCD CAMERA: A PHOTON COUNTER



BUT HERE'S THE CATCH

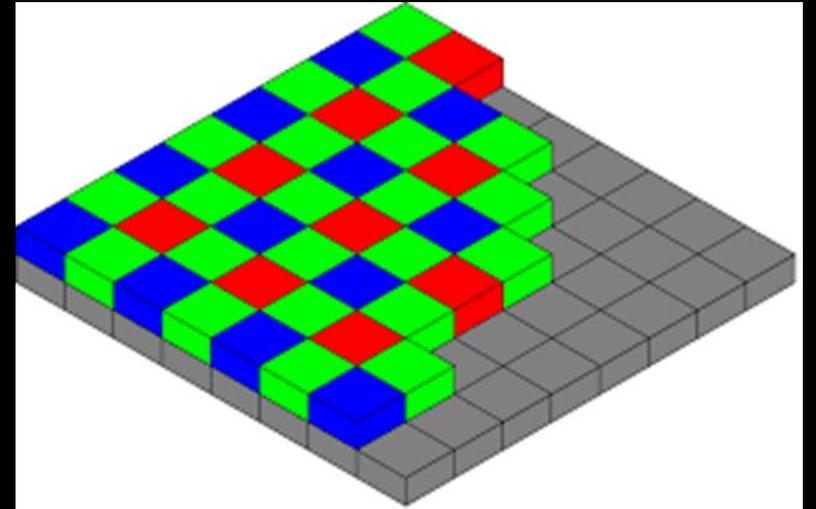
- A CCD can be designed out of a material that reacts to certain wavelengths better.
- But ultimately all it does is count photons over some range of wavelengths.
- The output is a number between 0 (dark) and a pixel capacity (bright).
- How do you know what kind of photon made a particular count?

COLOUR CAMERA'S: BAYER FILTER



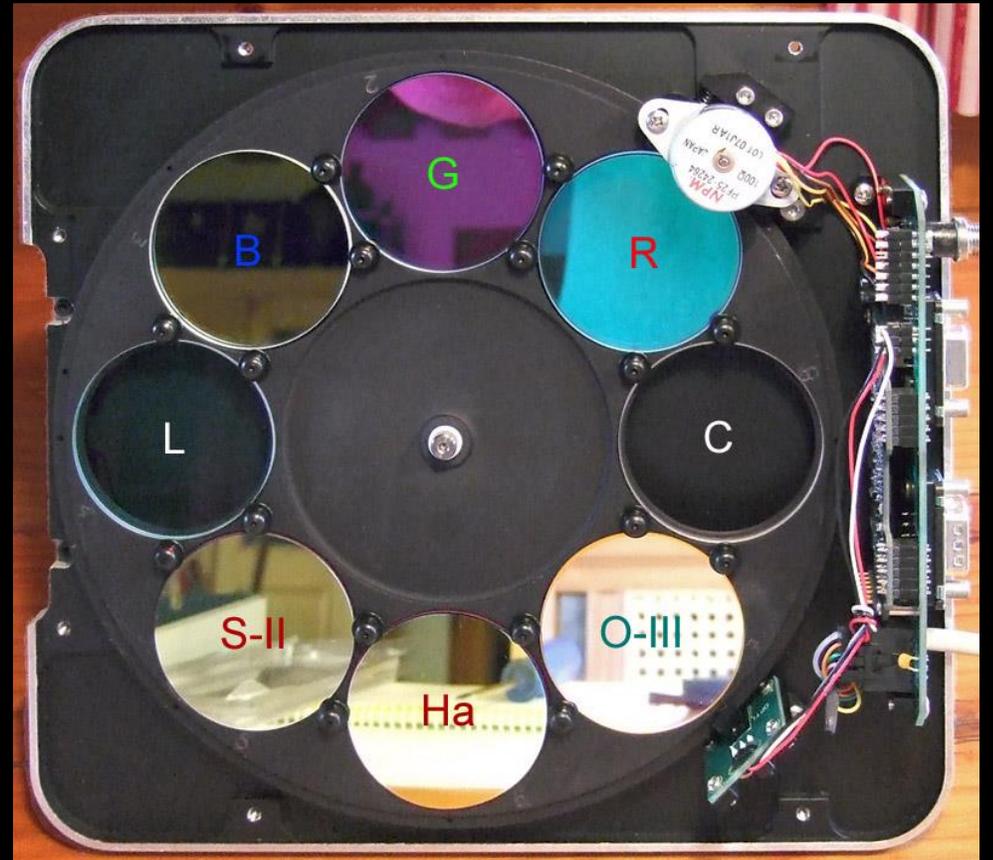
WHY ISN'T THIS USEFUL IN ASTRONOMY?

- We don't want a filter to be a limitation if we can help it.
- We'd prefer to know how many red, blue, green, whatever photons hit each and every pixel exactly.
- Data > pretty picture
- Rather not rely on smoothing processes seen in colour camera's
- Can we be more detailed than just RGB?



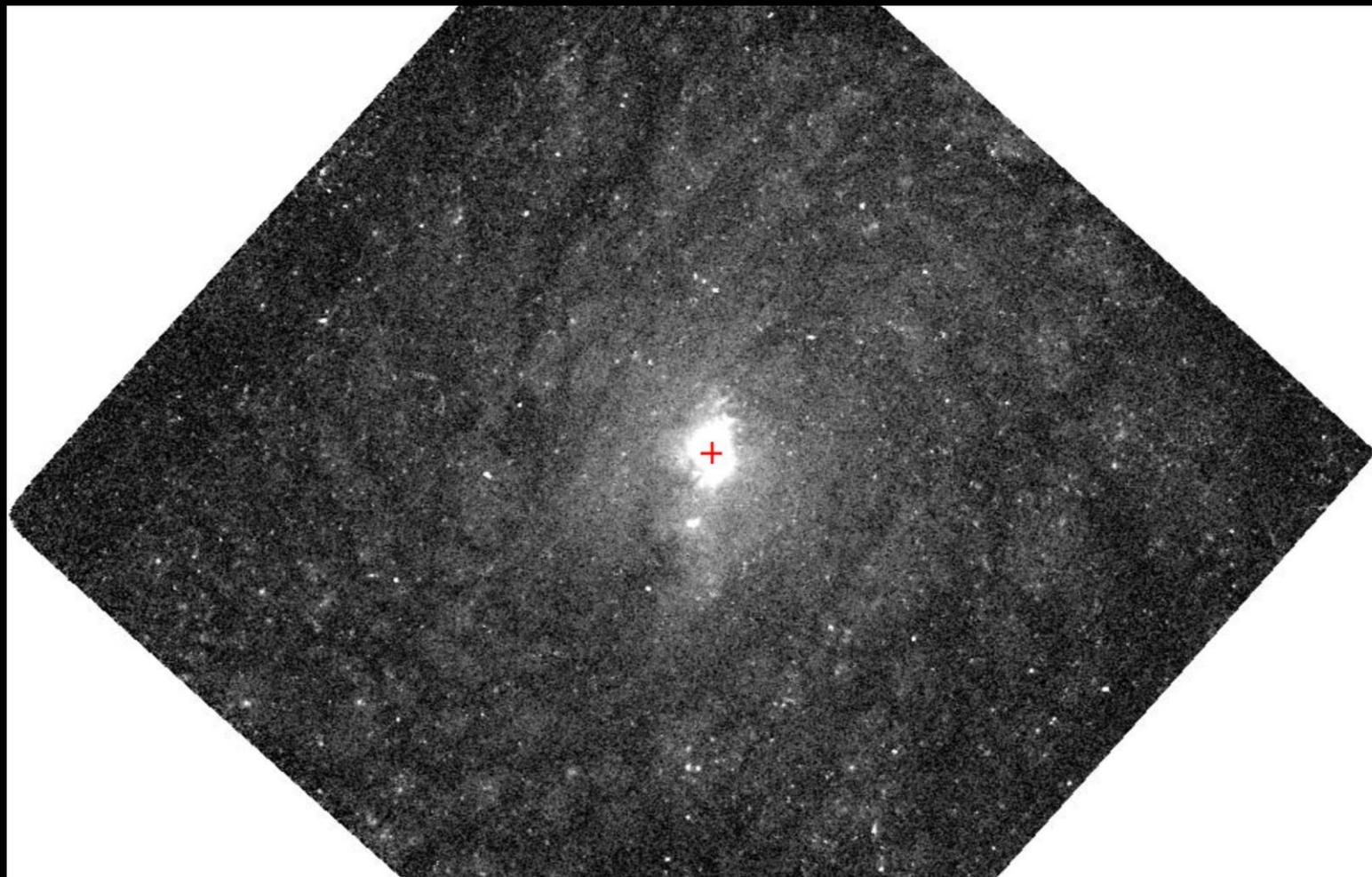
SOLUTION: FILTER WHEEL

- Solves issues on previous slides.
- Requires separate exposures for each filter (slow)
- Allows for more than 3 generic colours.
- Image element emissions (O-III, 500.7nm)
- More bang for your buck.



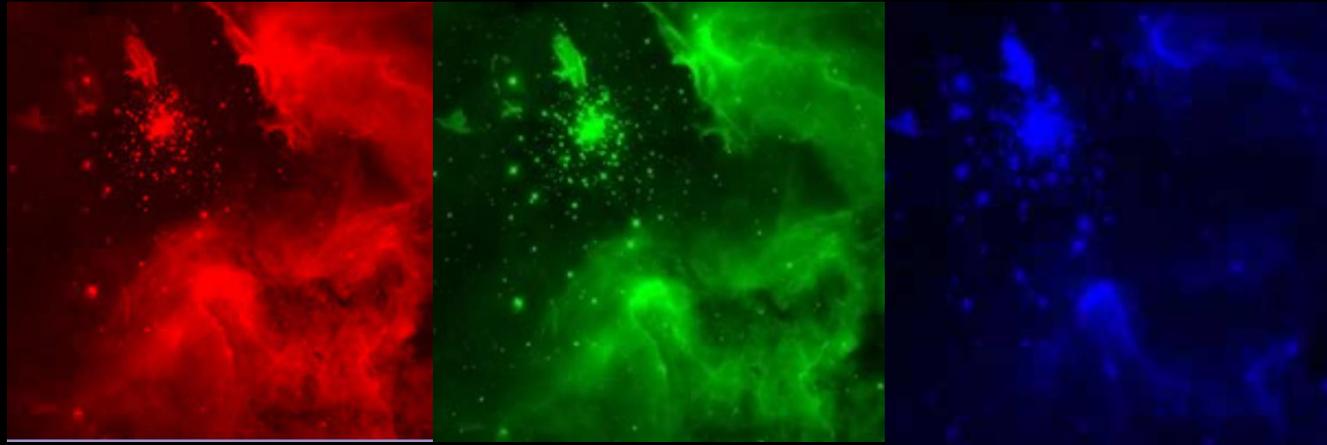
RAW HUBBLE IMAGES

- Raw images can be found on the online database for any spacecraft.
- Hubble Legacy Archive for Hubble pics.
- Can be .FITS, .TIFF, .GeoTIFF file formats, large and non standard.



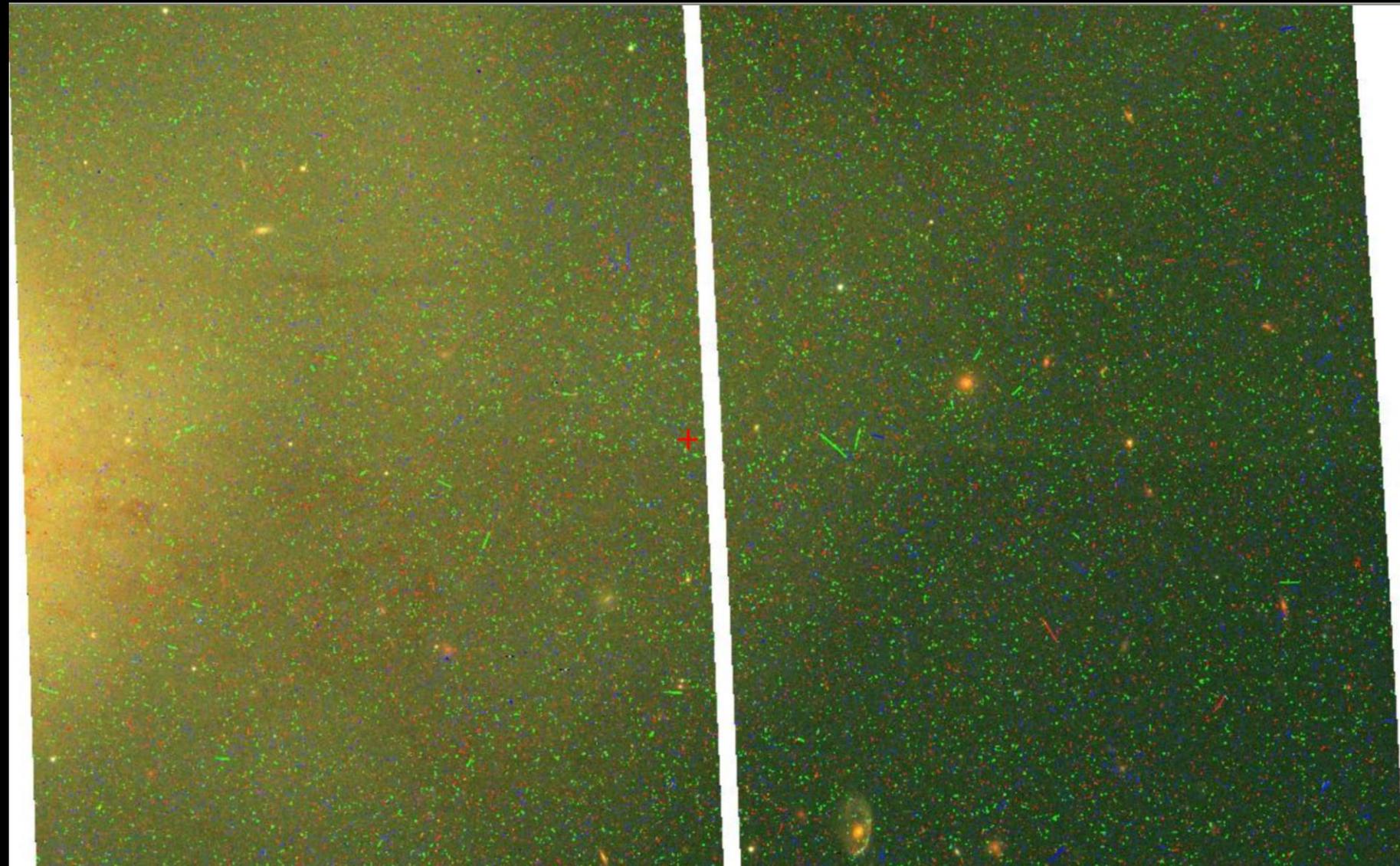
REPRODUCING REAL COLOUR

- Similar to a colour CCD, once you know how bright an object is in 3 colours you can produce a colour image.
- Requires a computer to combine 3 images and call them red, green, blue.
- Decide these and weighting depending on filters used



VERY QUICK EXAMPLE

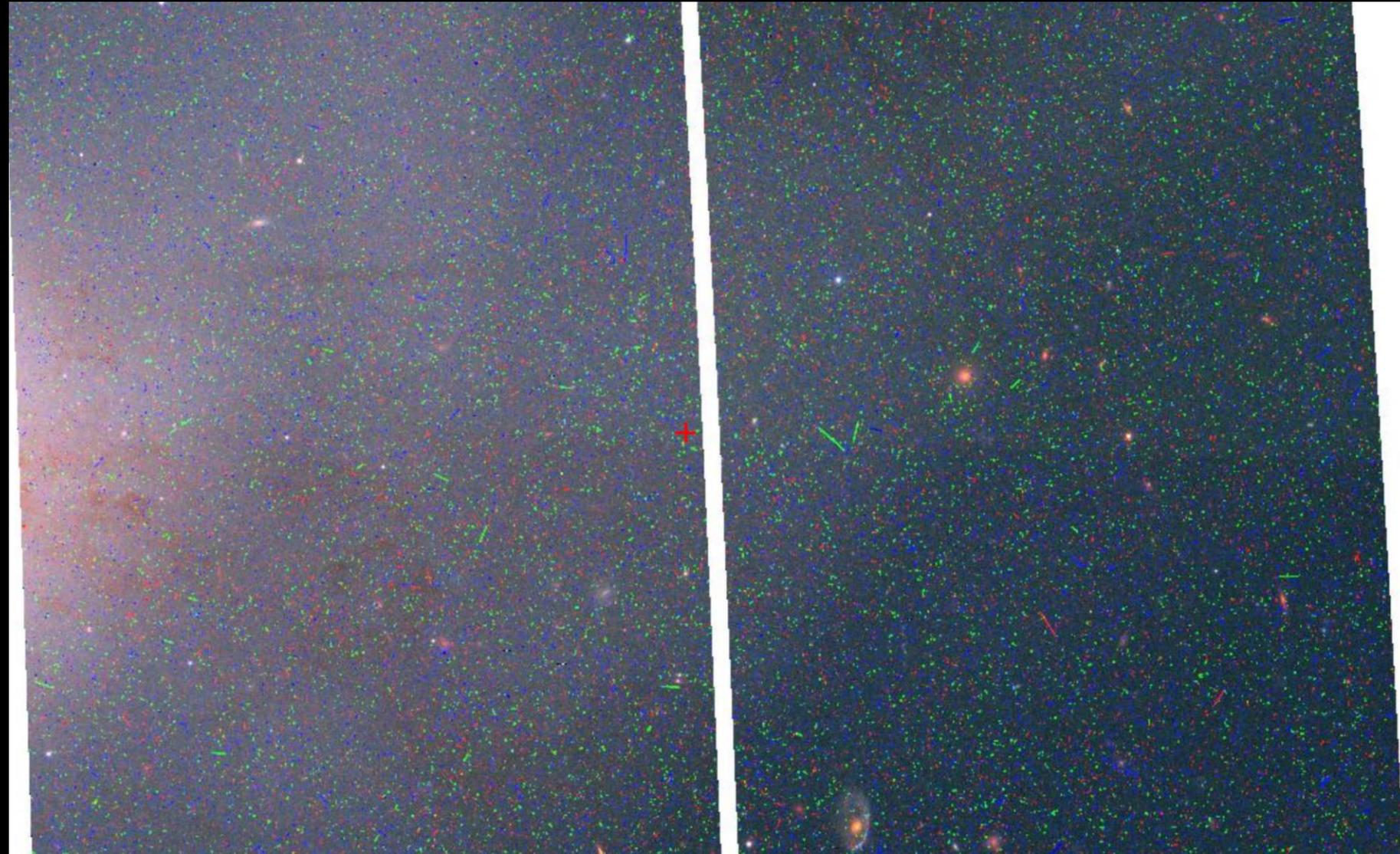
3 colour images
thrown together of
rim of M51 galaxy



VERY QUICK EXAMPLE

A rough attempt at weighting the colours (black is more black, not as much a green hue)

Image not been cleaned from noise or cosmic rays (streaks)



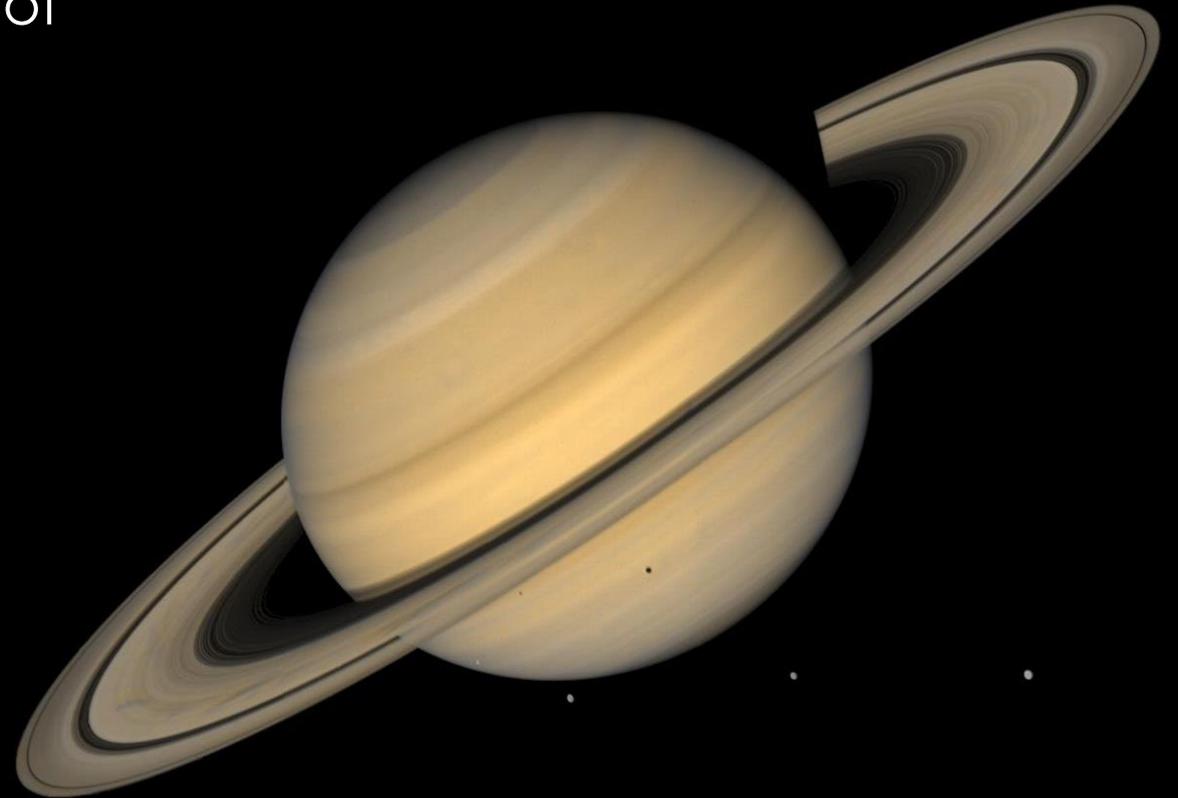
EVENTUALLY

With a lot of pictures stitched together



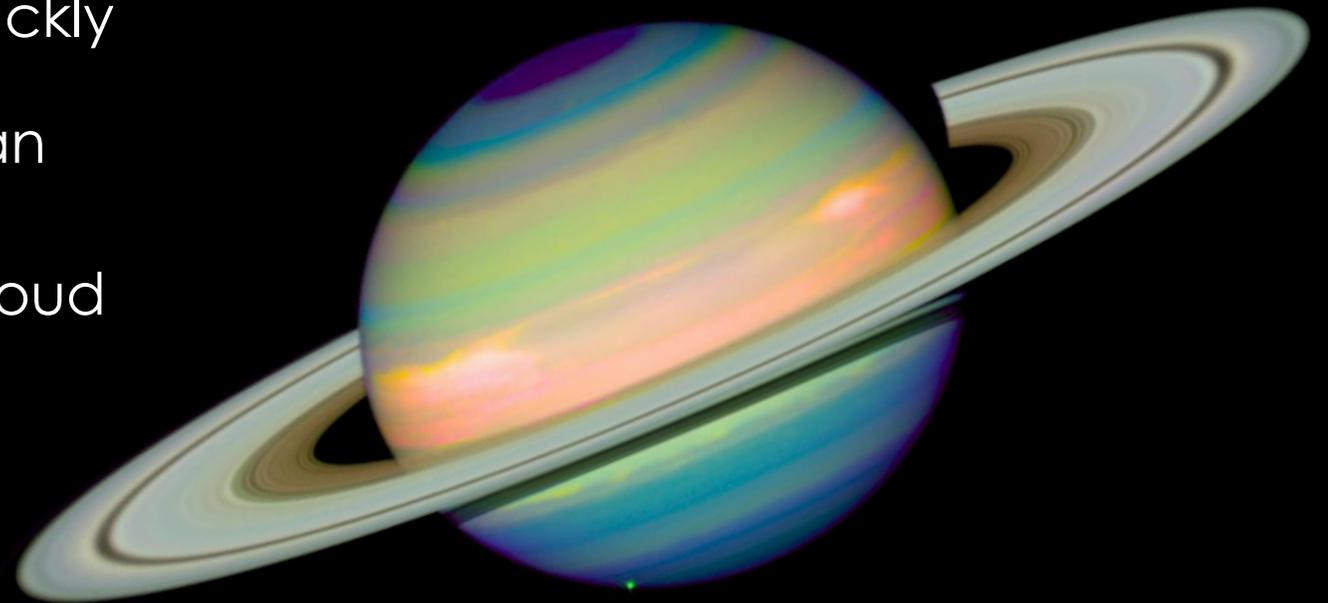
FALSE COLOUR

- Take a standard, real colour image of Saturn.
- Clouds are various shades of dusty yellow.
- What if we take 3 images in slightly different yellow filters and call those red, green, blue?



FALSE COLOUR

- Ooo that's quite a bit different.
- False colour allows scientists to quickly discern finer details and identify potentially interesting regions on an object.
- Like in this example highlighting cloud structures.



TO CONCLUDE

- We've had a look at what "colour" is.
- Seen how camera's work at a basic level.
- Seen how everyday camera's produce colour images.
- Seen how Astronomers do it.
- Had a play with some examples.
- Seen how false colour can help emphasise interesting features.