Astronomical image processing for public outreach use

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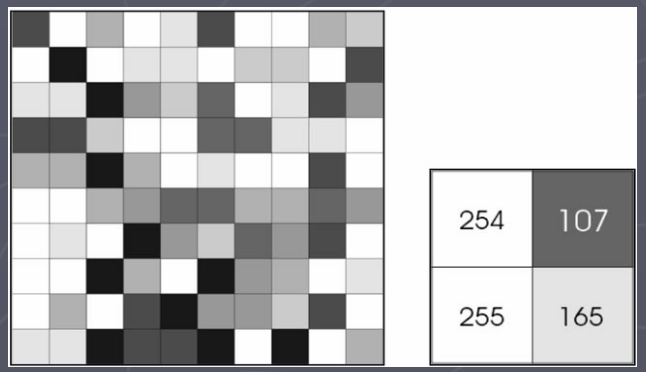
- Digital images
- Dynamic range
- Astronomical images
- How to handle FITS
- How to deal with the dynamic range
- How to make a colour image
- Final steps

Digital images

- Array of pixels arranged in columns and rows



- Pixel intensity has a limited range



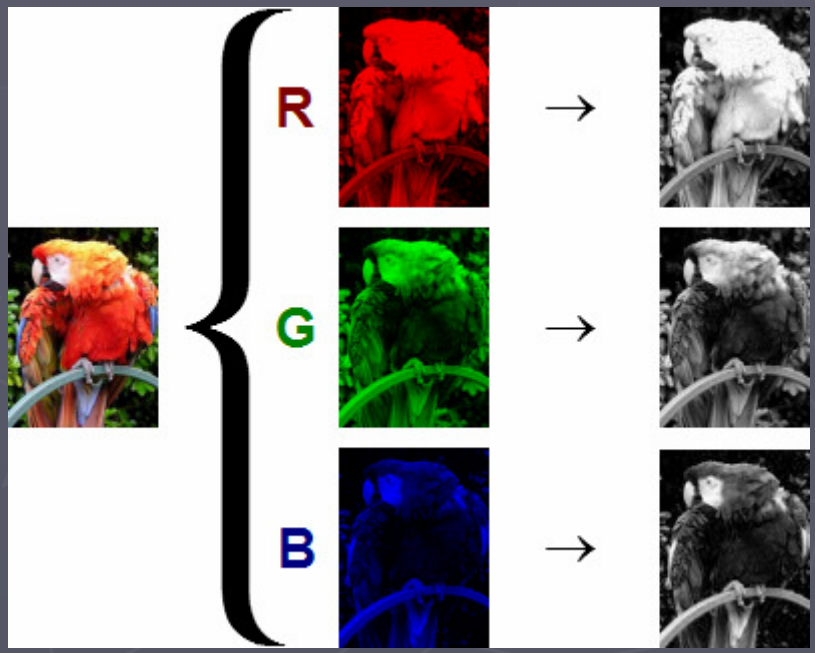
Digital images

- A colour image comes from the composition of three greyscale images
- In principle three 16-bit greyscale images can create a colour image with 281.474.976.710.656 colours



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- In principle three 16-bit greyscale images can origin a colour image with 281.474.976.710.656 colours

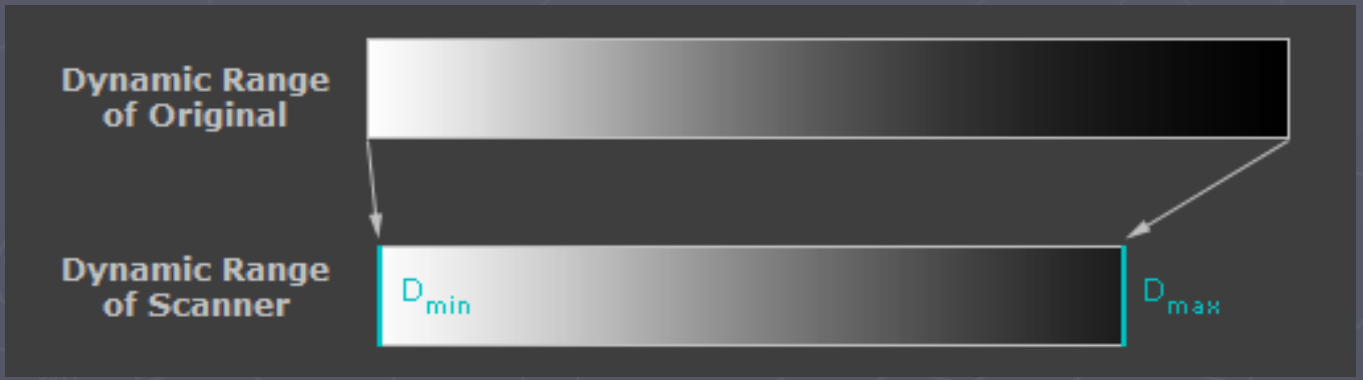


Dynamic range

- Dynamic range is the ratio between the maximun and minimum values of a physical measurement
- Dynamic range of human eye without any pupil adjustment is 1.000 - 10.000

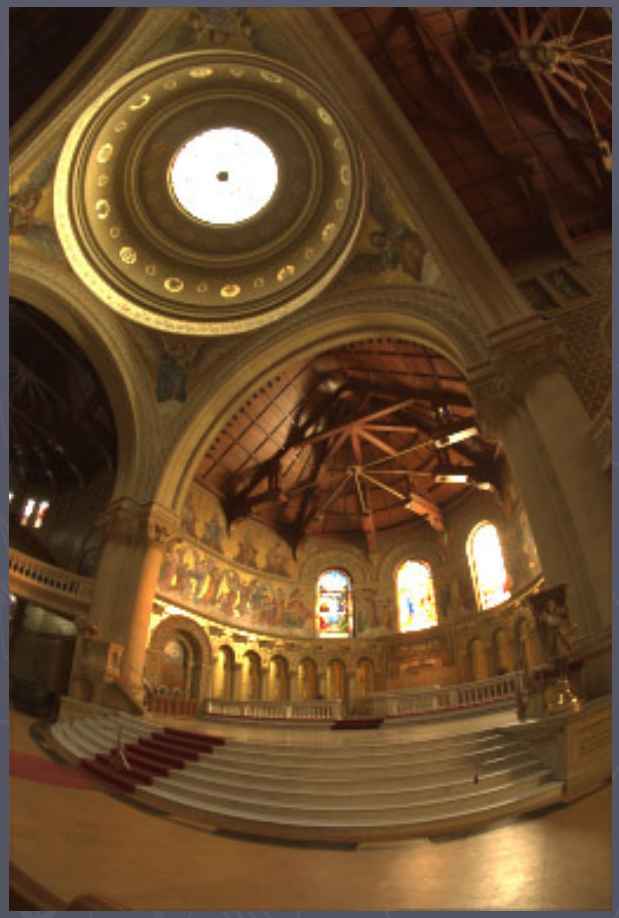
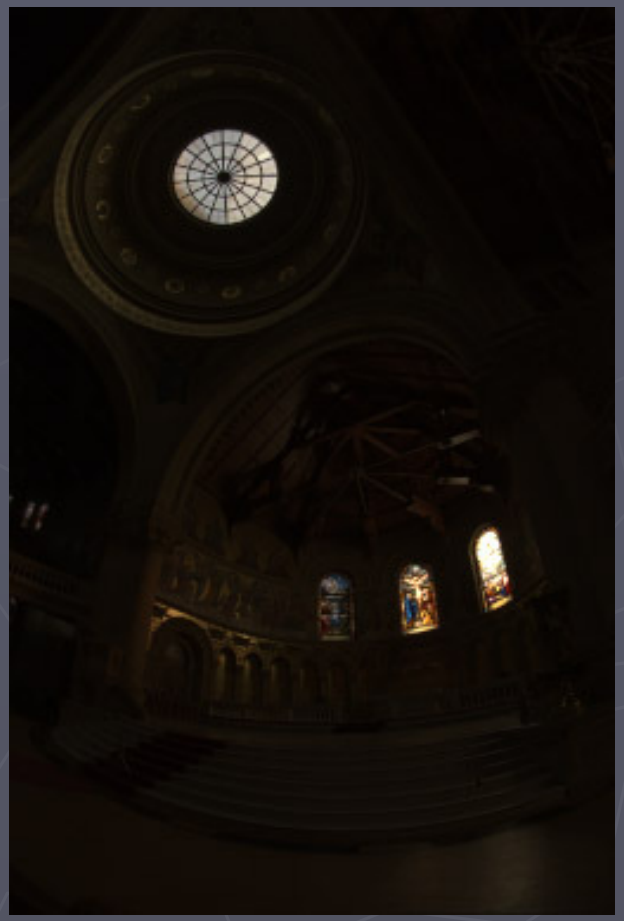
Dynamic range compression

- Astronomical data has a huge dynamic range
- Output devices have a limited dynamic range

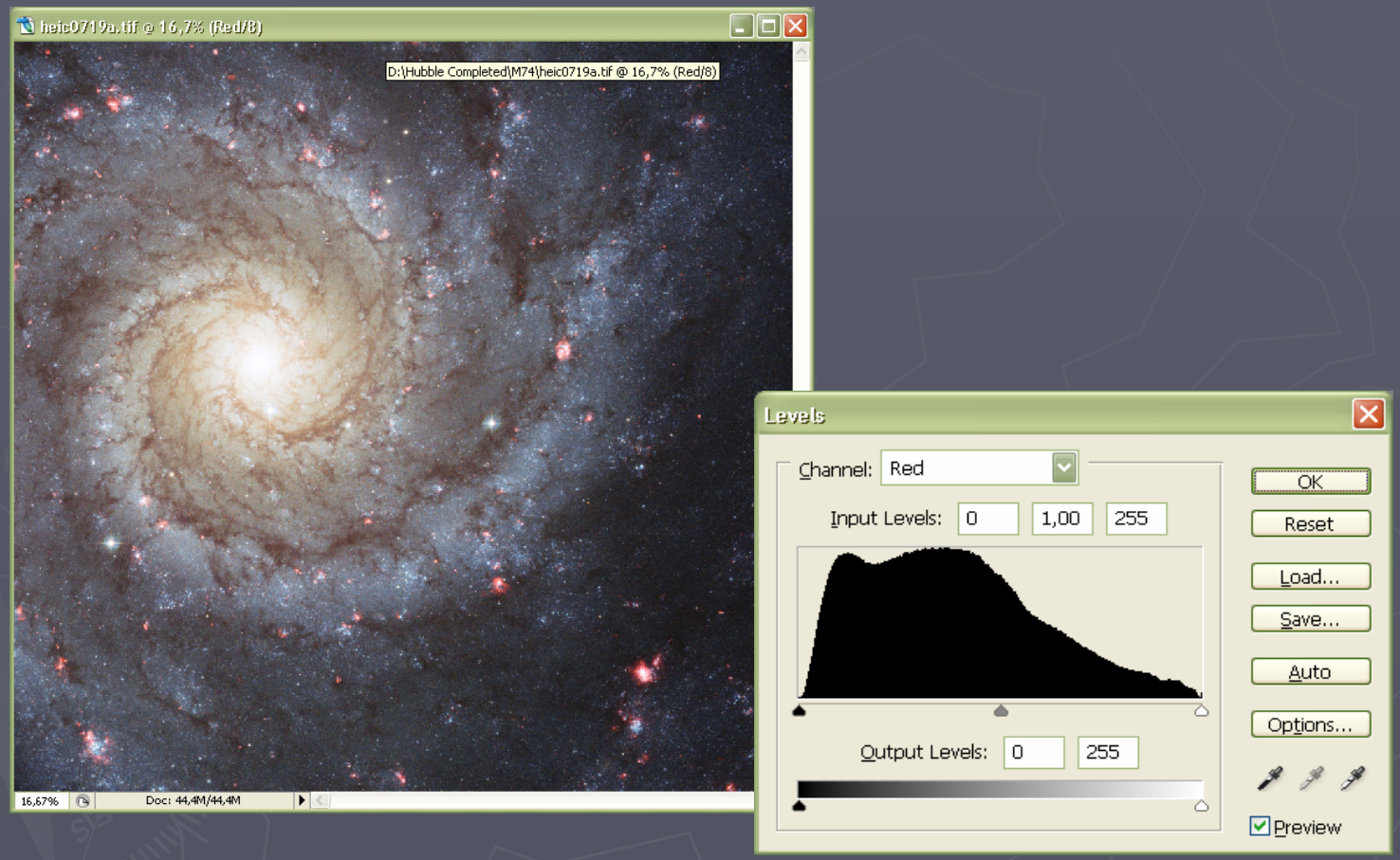


- Dynamic range compression

Dynamic range


Dynamic range
Intensity histogram

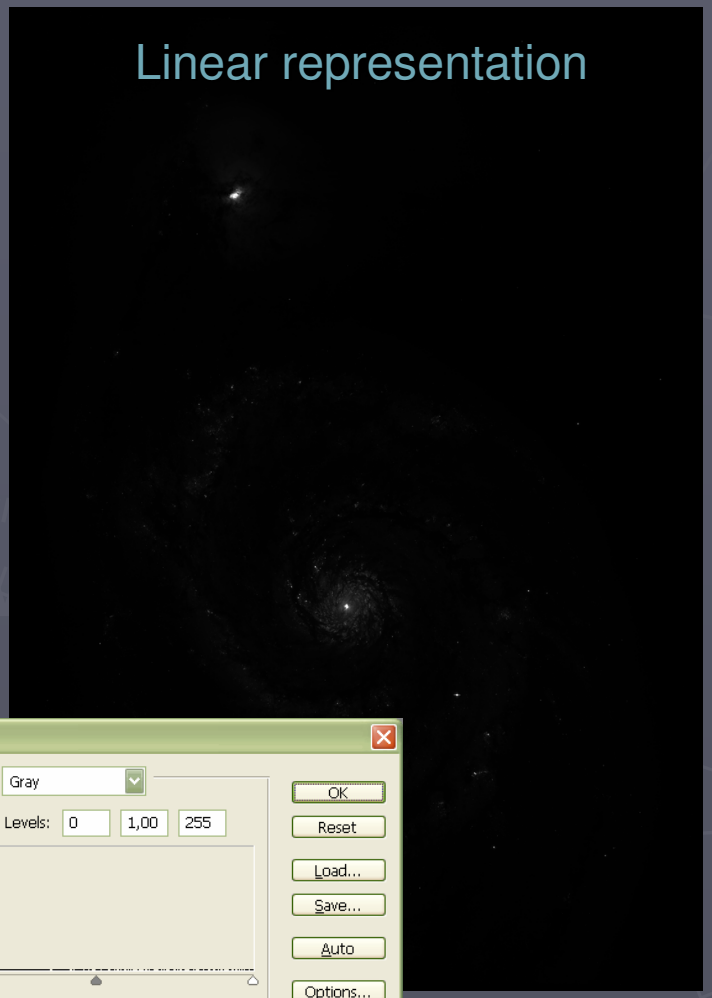


Astronomical images

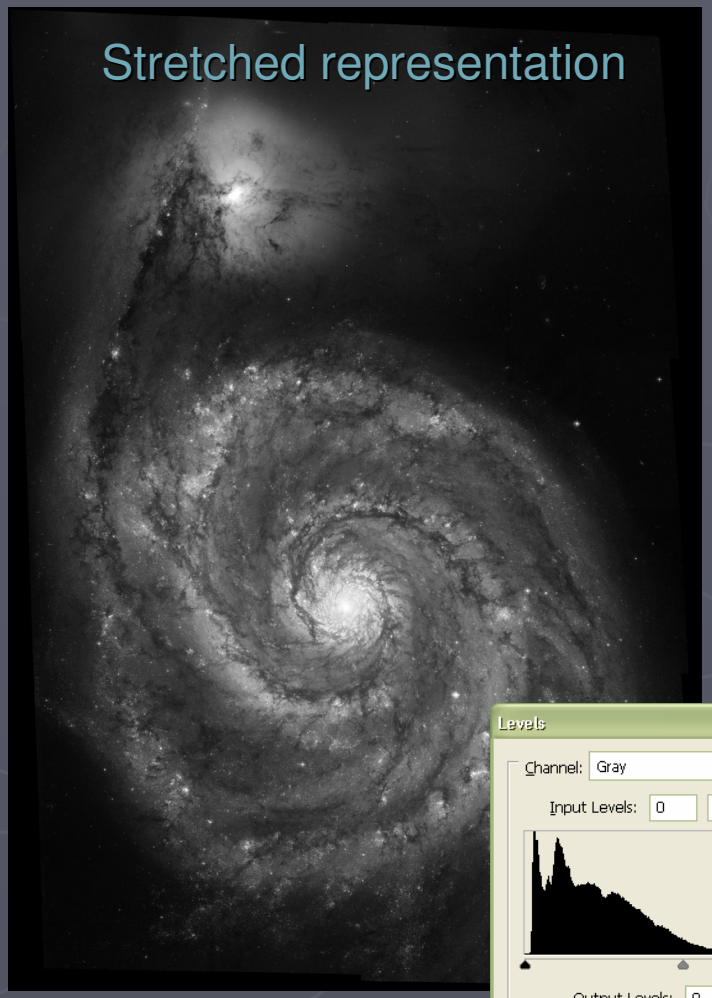
- Usually taken with CCD
- (Nearly) Always greyscale
- Colour information is carried by filters
  - Broad band
  - Narrow band
- Image format: FITS
- Huge dynamic range
  - Need of a non-linear transformation, or stretch, of the data

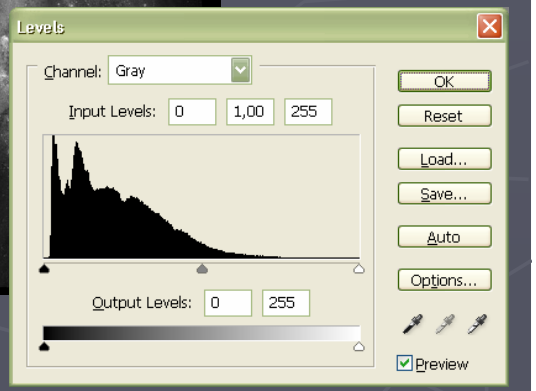
Astronomical images

Linear representation

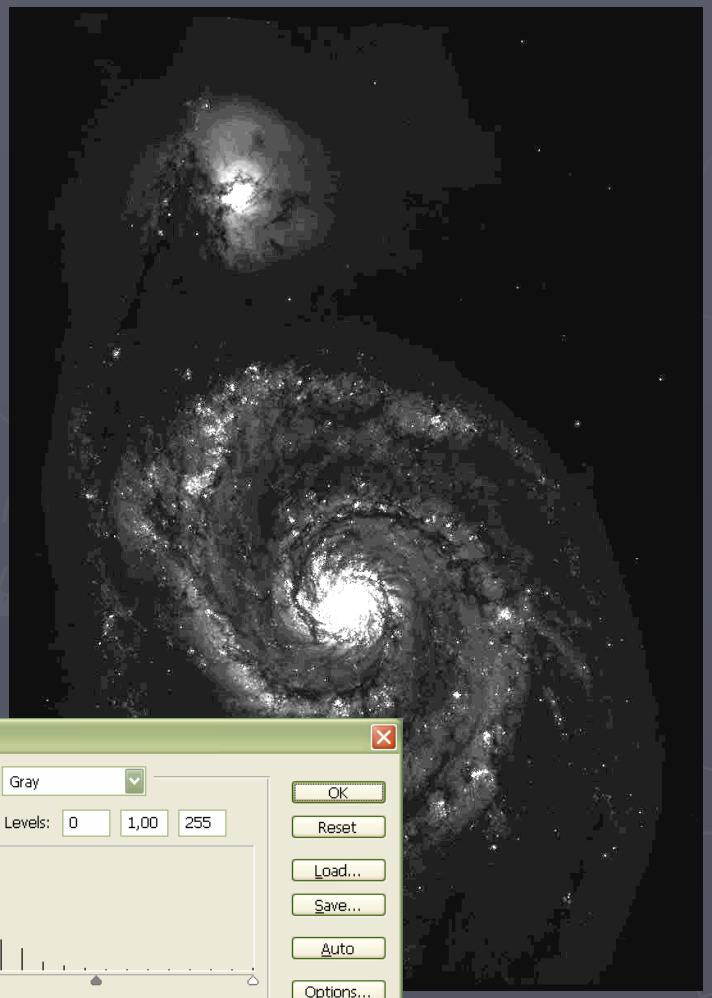


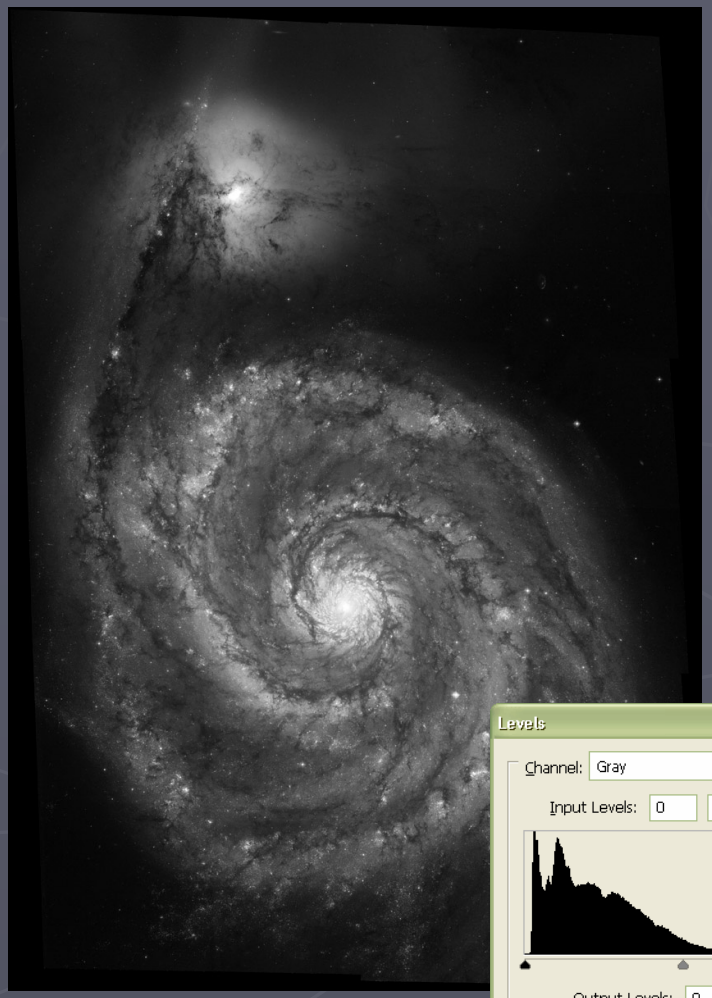
Stretched representation

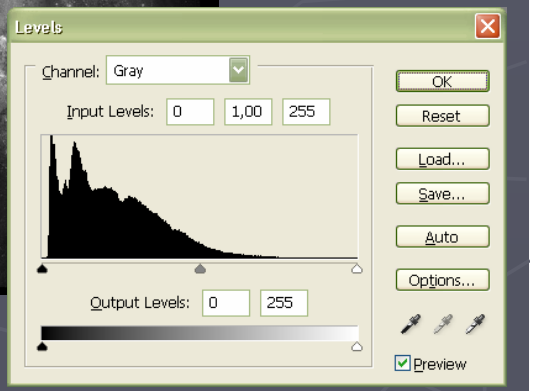




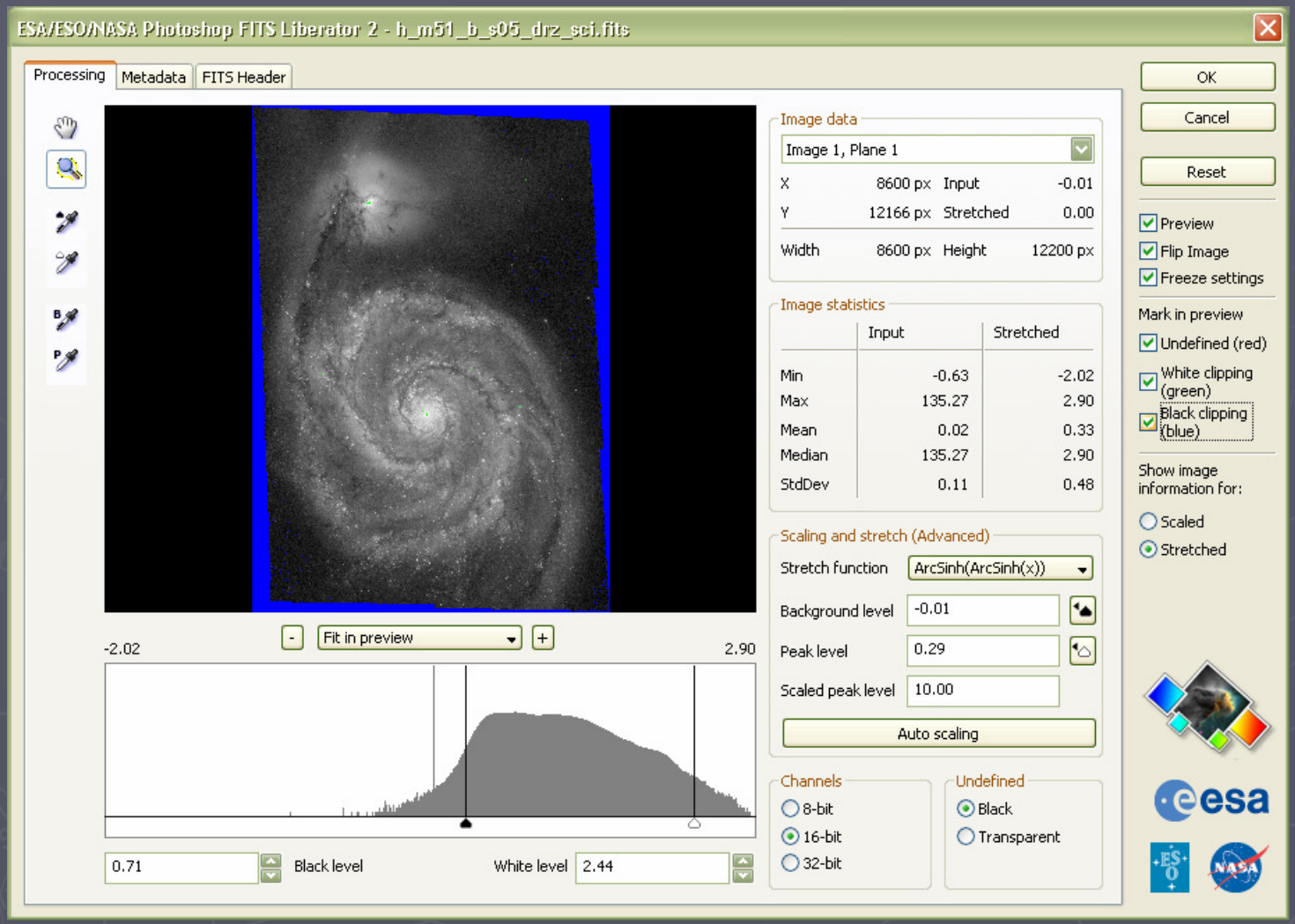
Astronomical images



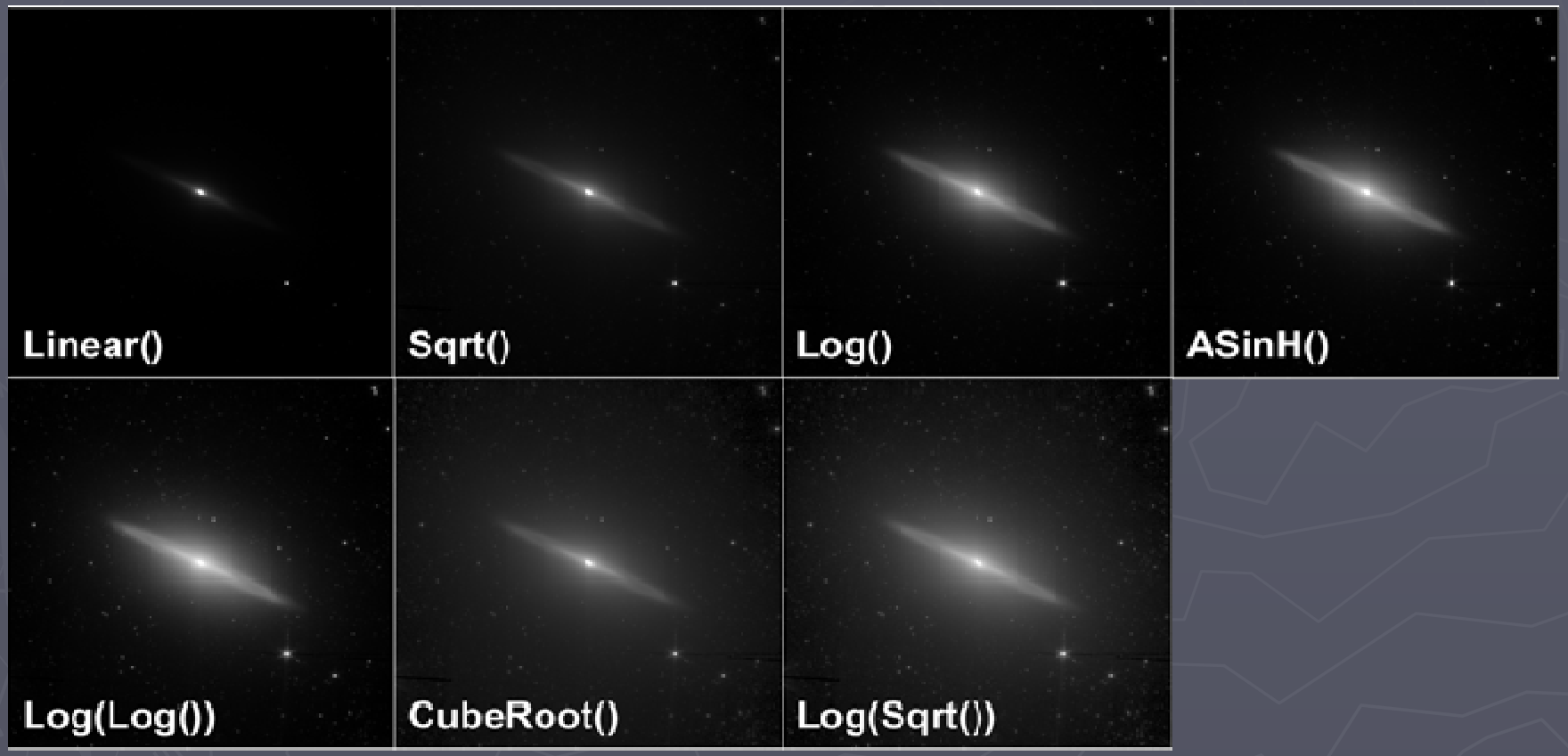




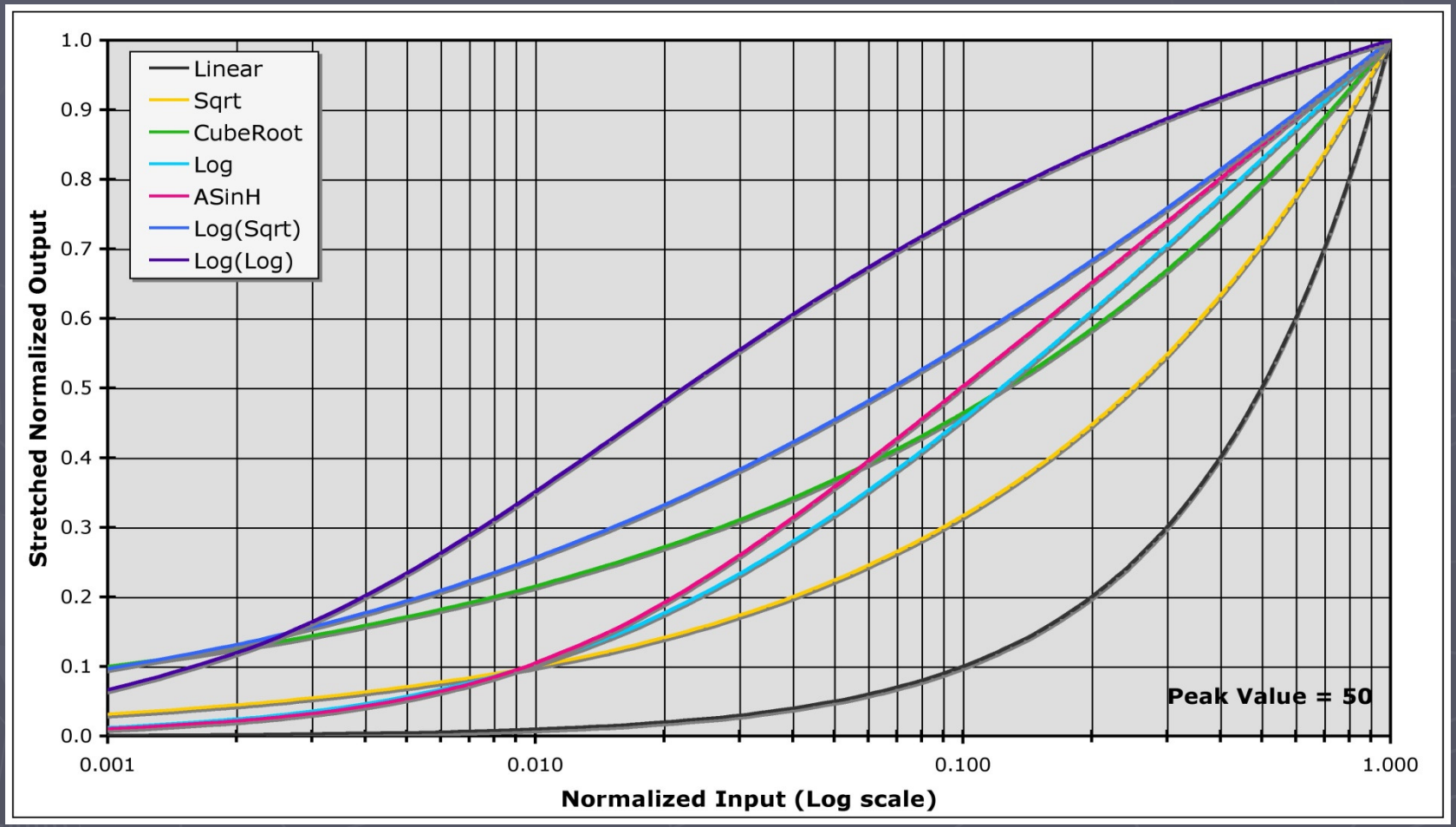
ESO/ESA/NASA Photoshop FITS Liberator



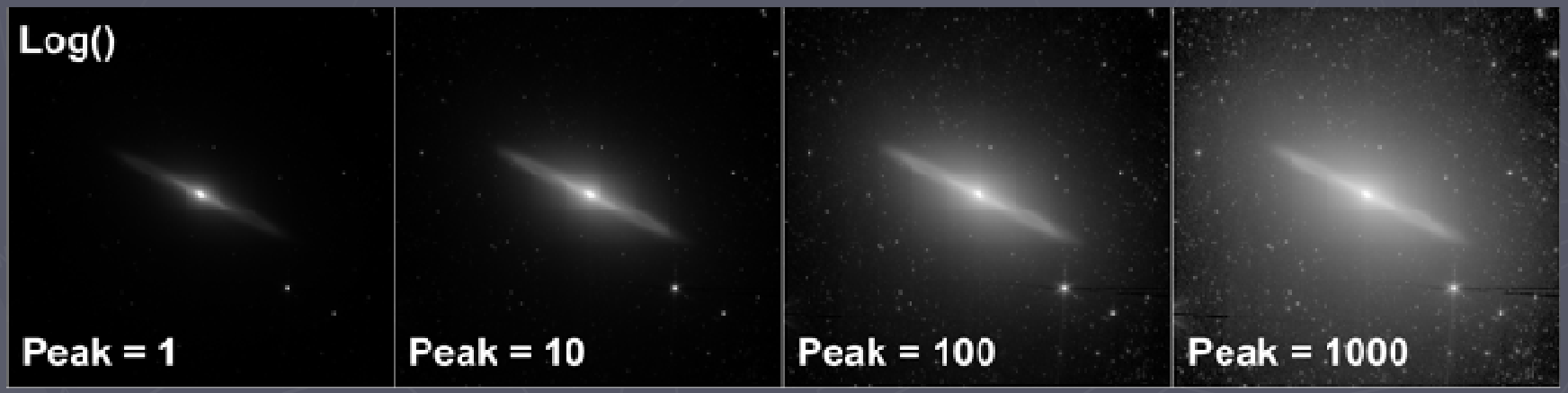
Different stretches



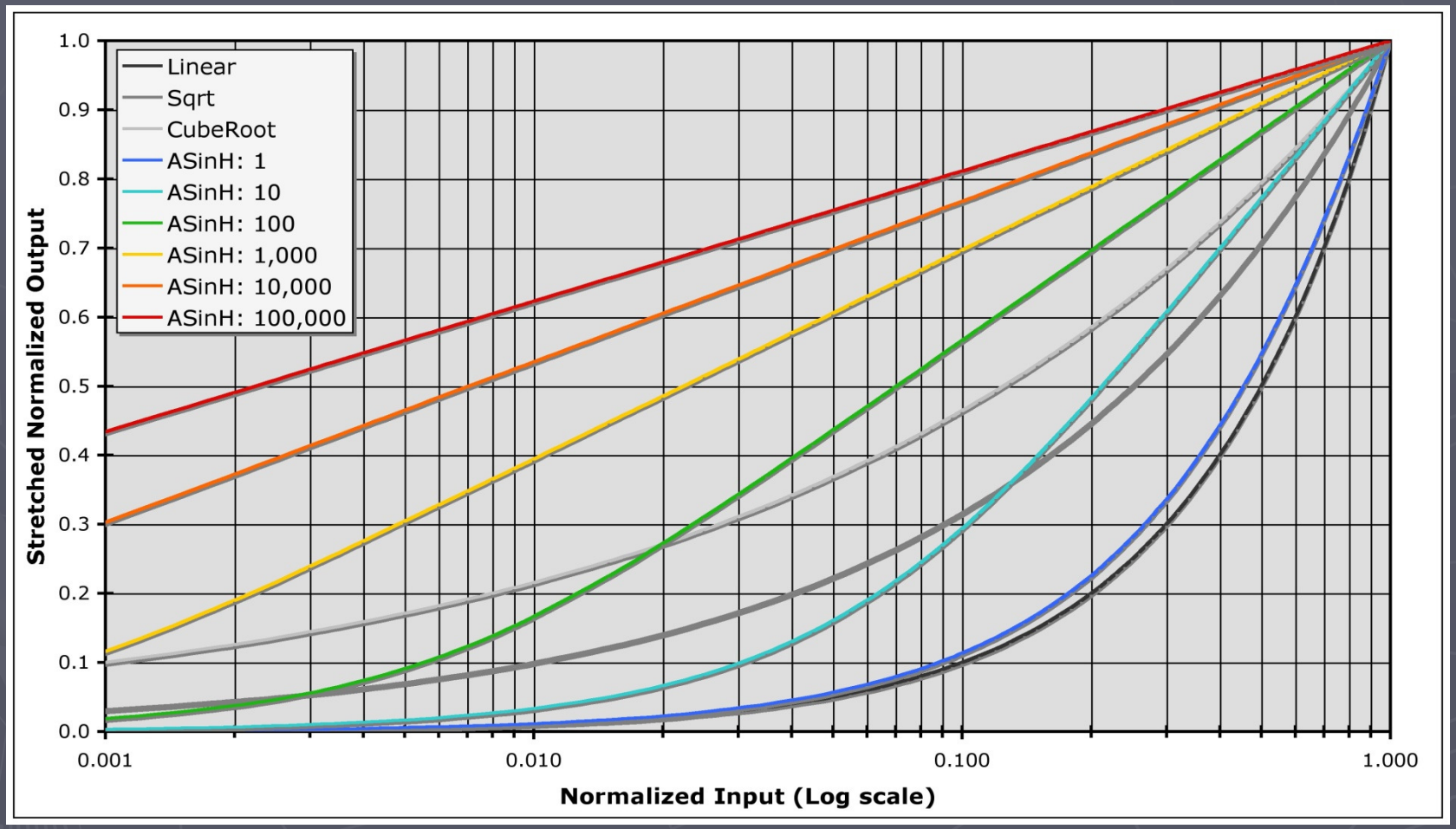
Stretch functions – logarithmic plot



Log(1+x) with different scaling



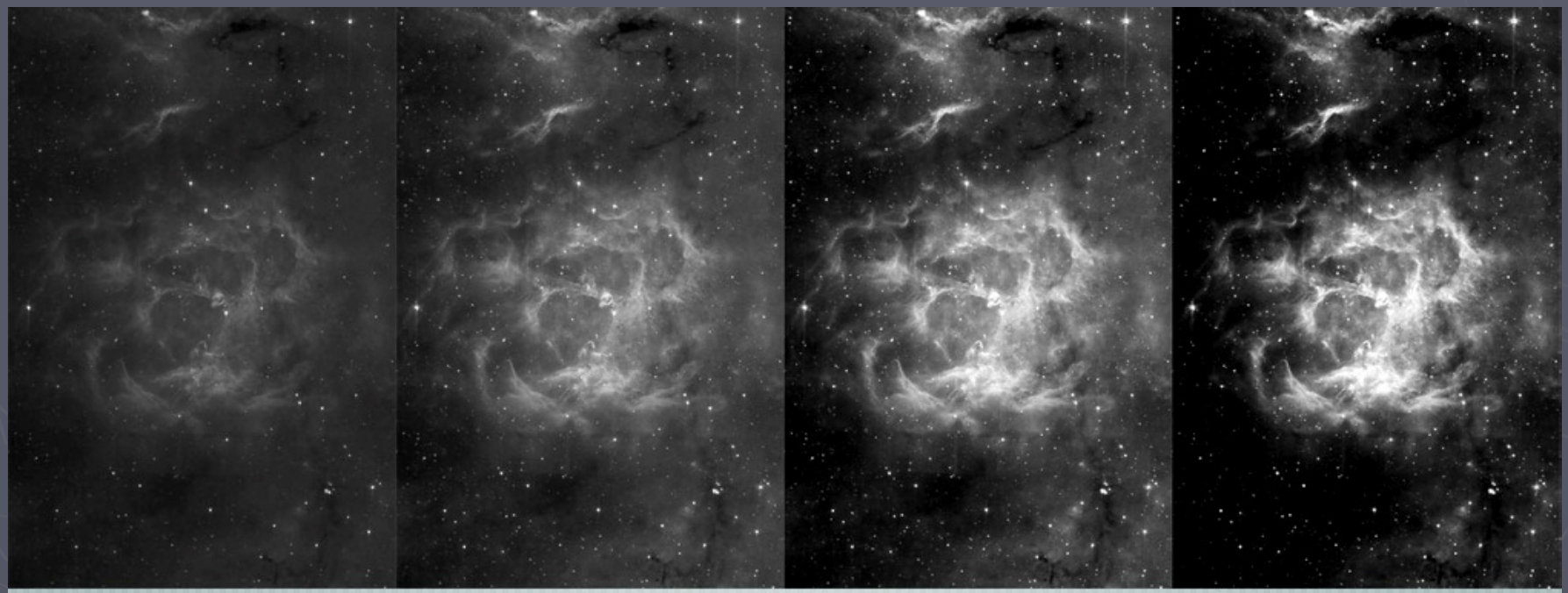
ASinH(x) with different scaling



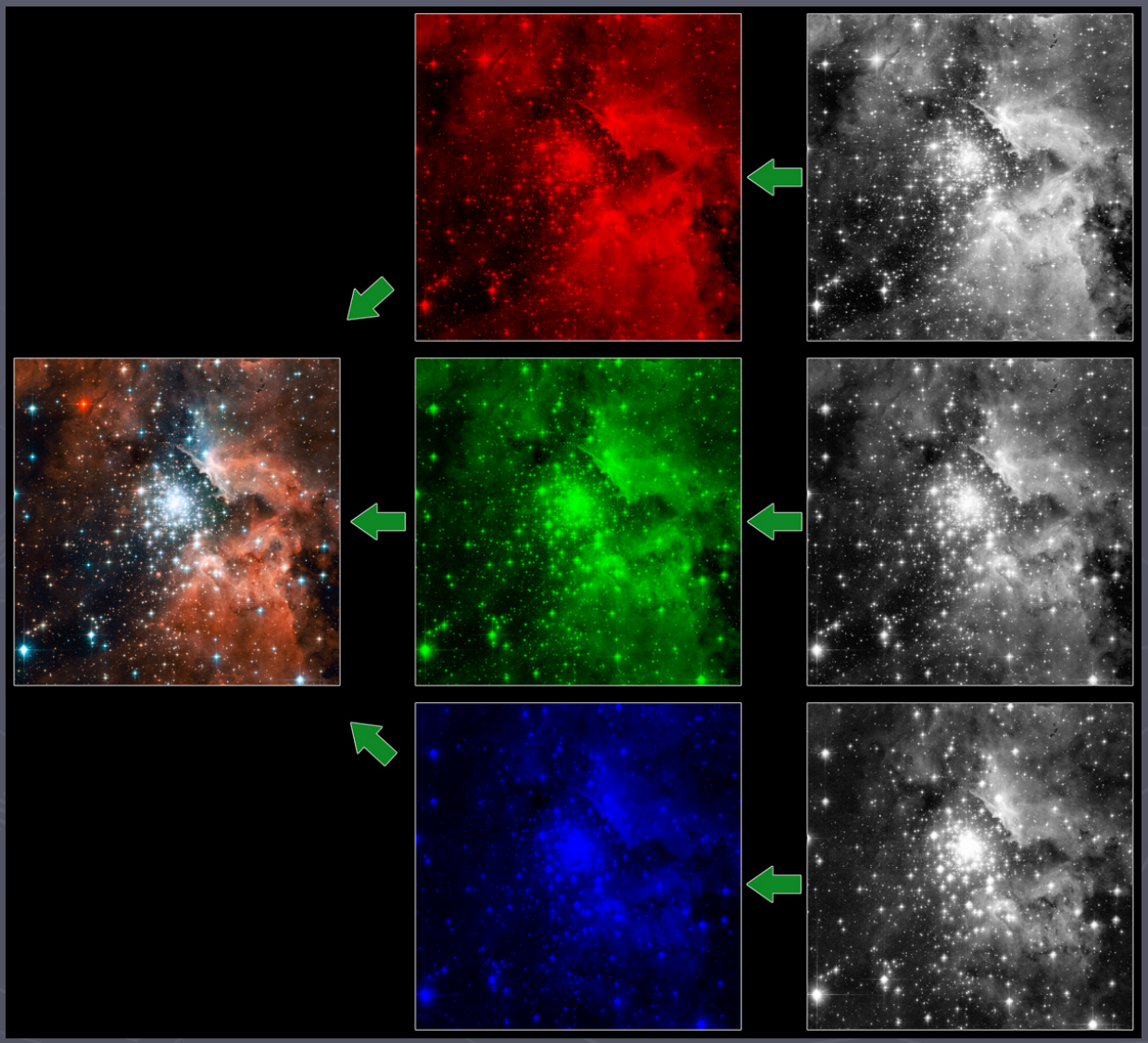
Points of attention

- Strike the contrast balance
- Show interesting structure
- Noise has to be visible, but not much
- Avoid burned areas
- Avoid black areas

Strike the contrast balance

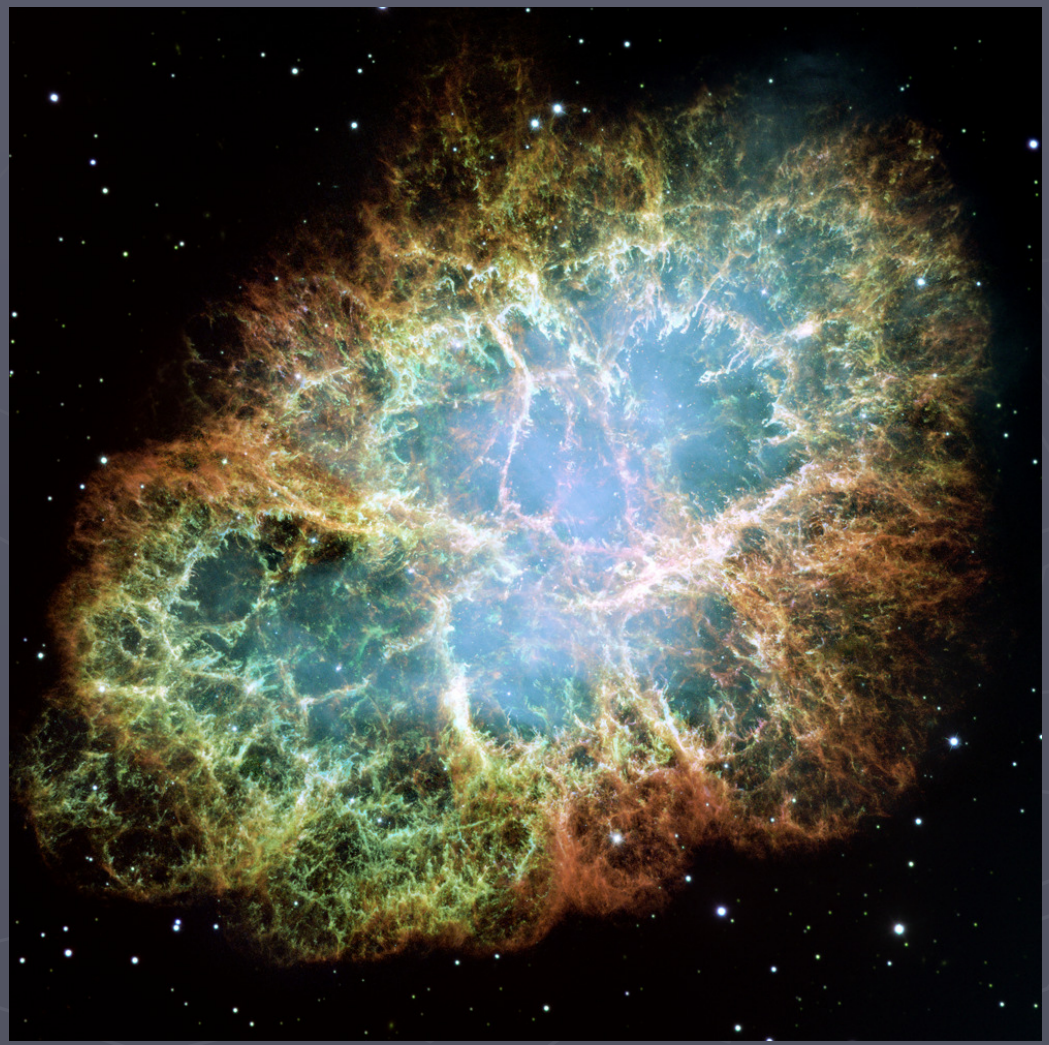


How to make a natural colour image

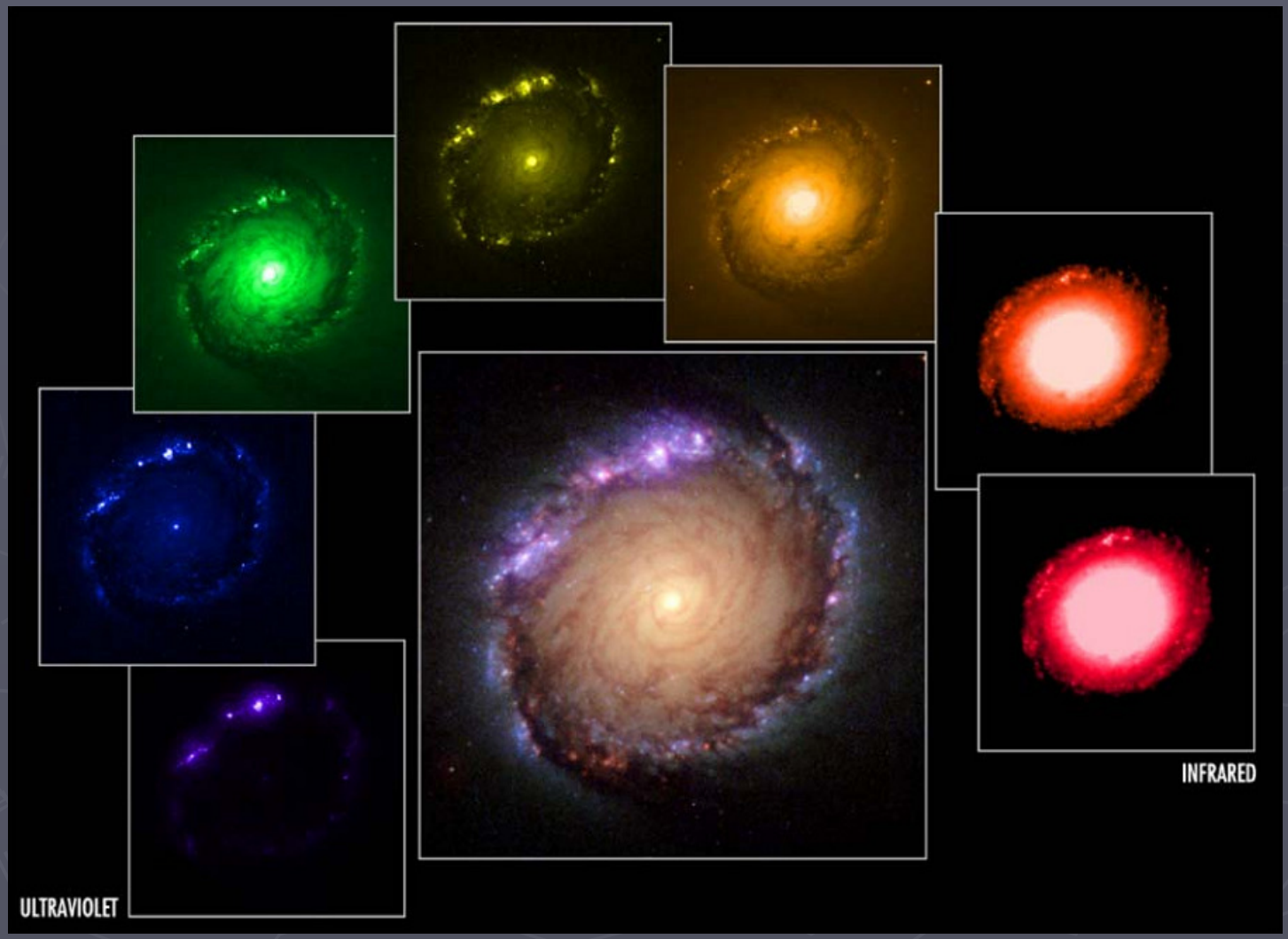


Other cases

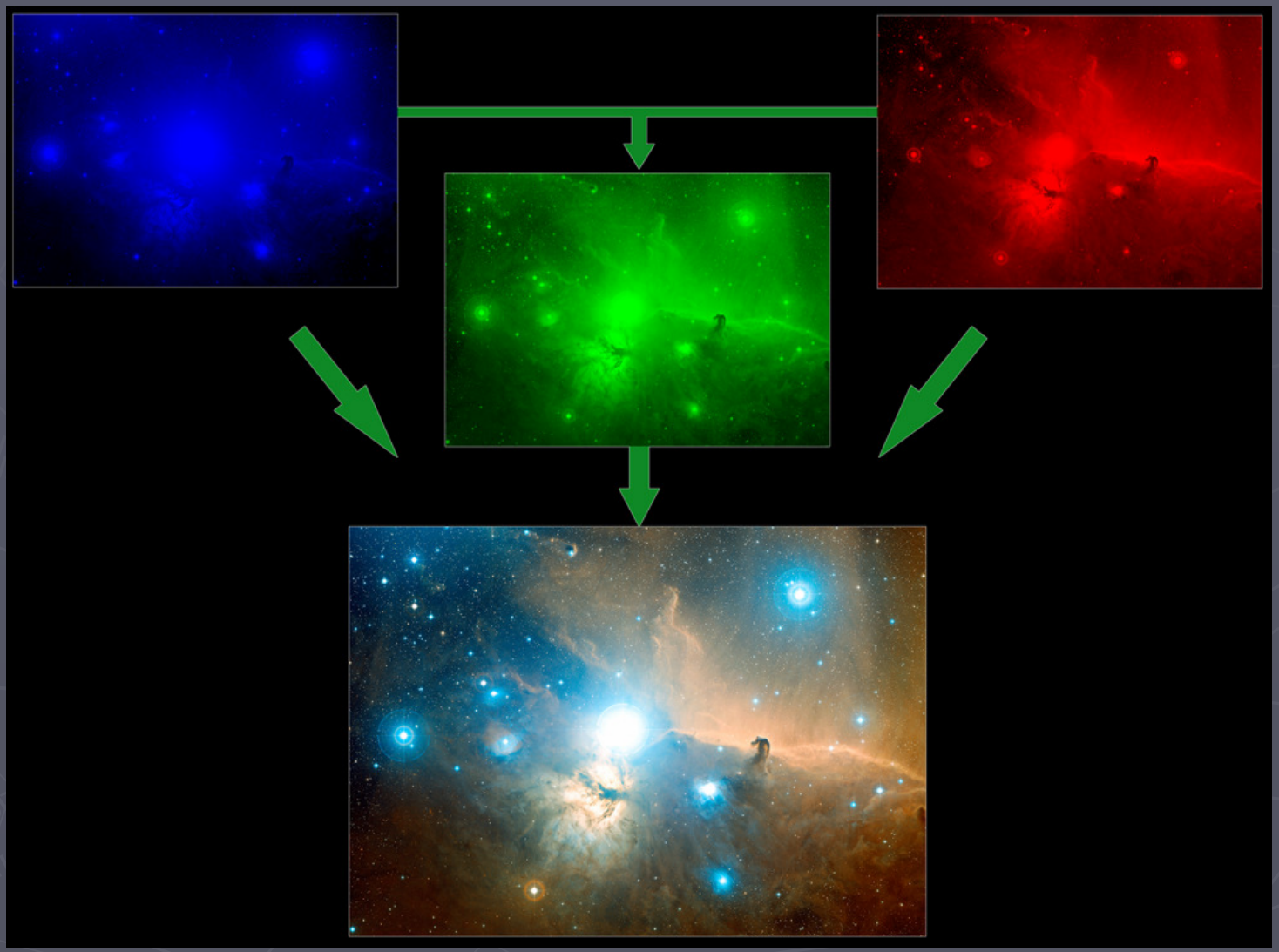
- Representative colour images
  - Narrow band images
- Enhanced colour images
  - Un-orthotox chromatic order



What to do with more than three filters



What to do with less than three filters



Final steps

- Cleaning
- Tuning
  - Colour tuning
  - Contrast tuning
- Judge the result
- Delivery
- Enjoy