Astronomical image processing for public outreach use
Contents

- 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
A colour image comes from the composition of three greyscale images.

In principle three 16-bit greyscale images can create a colour image with $2^{24} = 16,777,216$ colours.
Digital images

- A colour image comes from the composition of three greyscale images.

- In principle three 16-bit greyscale images can origin a colour image with $2^{16} \times 2^{16} \times 2^{16} = 2^{48} = 281.474.976.710.656$ colours.
Dynamic range

- Dynamic range is the ratio between the maximum 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
Different stretches
Stretch functions – logarithmic plot

![Graph showing various stretched functions on a logarithmic plot.](image)

- Linear
- Sqrt
- CubeRoot
- Log
- ASinh
- Log(Sqrt)
- Log(Log)

Peak Value = 50
Log(1+x) with different scaling

- Peak = 1
- Peak = 10
- Peak = 100
- Peak = 1000
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