

Example calculation for optimal exposure time

It applies (Source: <https://www.youtube.com/watch?v=3RH93UvP358>):

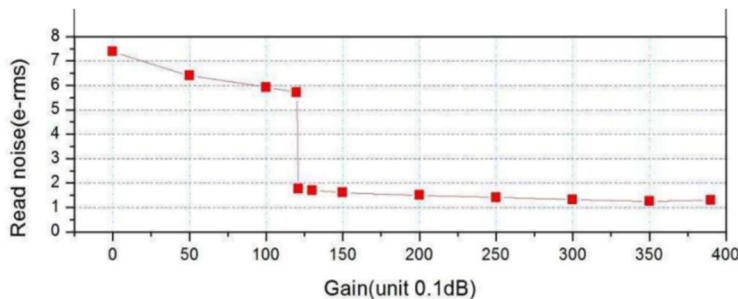
$$\text{optimal single exposure time} = C * \frac{R^2}{P} \quad \text{whereby } C = \frac{1}{\left(\frac{100 + E}{100}\right)^2 - 1}$$

R – readout noise of the camera

P – light pollution rate (electrons extracted by sky glow per pixel per second. [e/pixel/s])

E – percentage deviation from unavoidable smallest possible noise

From the data sheet of the camera the following diagram for the readout noise R is available:



Source: <https://astronomy-imagina-camera.com/product/asi294mc-pro-color>

Since a low readout noise is useful, but the gain should not be set so high (see section (ISO/Gain)), a gain of about 120 is used and it results in a readout noise of about 1.9. The quantum efficiency of the camera is over 75 %.

On the page <https://tools.sharpcap.co.uk/> the light pollution rate is calculated and it is also entered at the same time which focal ratio the telescope setup has, whether it is a mono or color camera and which filter is used.

On the page <https://www.lightpollutionmap.info> you can also check the required light quality (SQM - Sky Quality Meter) for your own region.

Your Sky Brightness

Sky Magnitude magnitude per arcsec² ← <https://www.lightpollutionmap.info>

or Bortle Number (Rural/suburban transition)

or Naked Eye Limiting Magnitude

Your Telescope

F Ratio

Your Camera

Pixel Size microns ← Data sheet of the camera

Quantum Efficiency %

Monochrome Colour

Your Filter

Selected Filter

Bandwidth nm

The Result

Sky Electron Rate **1.02 e/pixel/s** ← This results in a light pollution rate of 1.02 e/Pixel/s.

If a deviation of 5 % noise from the optimum is allowed, the following formula results:

$$\text{optimal single exposure time} = \frac{1}{\left(\frac{100 + 5}{100}\right)^2 - 1} * \frac{1,9^2}{1,02} = 34,5s$$