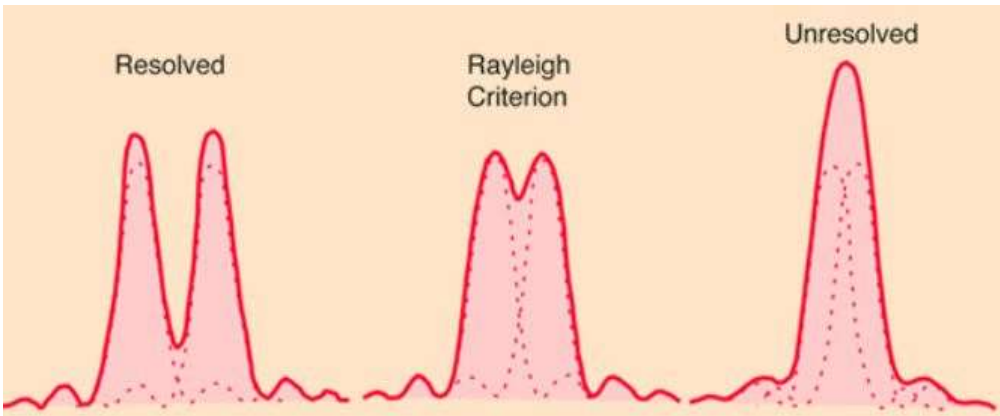
Resolution

Diffraction limits resolution

Two point sources far from the aperture each produce a diffraction pattern. The light from the objects is diffracted by the aperture of the viewing instrument.

Resolution refers to the ability to distinguish the images of two objects that are close together.

If the angle subtended by the sources at the aperture is large enough, the diffraction patterns are distinguishable, described as 'resolved'. If the angle is small, the diffraction patterns can overlap so that the sources can become 'unresolved'.



Rayleigh criterion

Two neighbouring objects can be resolved provided that the peak from the central maximum of one is no closer than the first minimum of the other (and vice versa). This is called the Rayleigh Criterion.

For a circular aperture, lens, or mirror, the Rayleigh criterion states that two images are just resolvable when the centre of the diffraction pattern of one is directly over the first minimum of the diffraction pattern of the other.

This occurs for two point objects separated by the angle θ:

$$\theta=1.22\lambda D$$

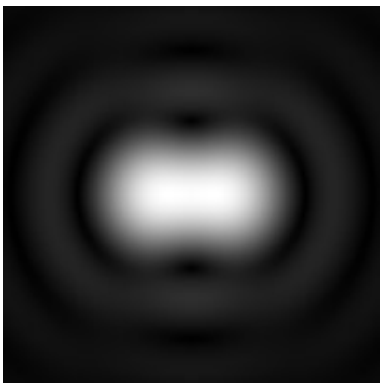
where λ is the wavelength of light (or other electromagnetic radiation) and D is the diameter of the aperture, lens, mirror, etc. This equation also gives the angular spreading of a source of light having a diameter D.

Dawes Limit

Dawes Limit is the first point at which a double star is elongated enough to suspect the presence of two stars. Like Rayleigh, it is not a measure of separation required to see a black space between the stars.

Dawes Limit (arc seconds) = 4.56 / D inches = 116/Dmm.

The Dawes Limit is the maximum resolving power of the telescope, in units of arc seconds. This is an angle measurement between the two stars and the observer.



Two close stars are just detectable as separate stars by a telescope at the Dawes Limit.

The Dawes limit shows that a larger diameter telescope has greater resolving power.
An optical or other reception system must be able to resolve the intended images. This has implications for satellite transmissions, radio astronomy and many other applications in physics and technology.

Scientists are testing the resolution limits set by Dawes and Rayleigh to see if they can be surpassed by the construction of high quality telescopes.