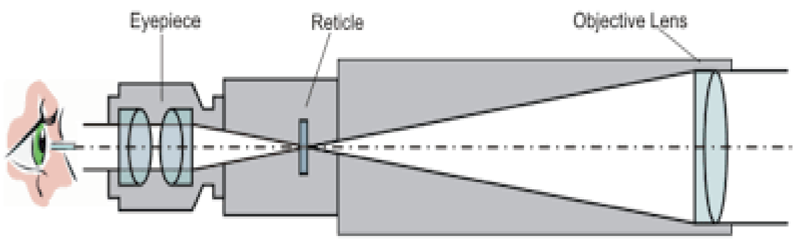
ANGLE TELESCOPE

Angular resolution or spatial resolution describes the ability of any image-forming device such as an optical or radio telescope, a microscope, a camera, or an eye, to distinguish small details of an object, thereby making it a major determinant of image resolution. In physics and geosciences, the term *spatial resolution* refers to the precision of a measurementwith respect to space.



The imaging system's resolution can be limited either by aberration or by diffraction causing blurring of the image. These two phenomena have different origins and are unrelated. Aberrations can be explained by geometrical optics and can in principle be solved by increasing the optical quality — and consequently the cost — of the system. On the other hand, diffraction comes from the wave nature of light and is determined by the finite aperture of the optical elements. The lens' circular aperture is analogous to a two-dimensional version of the single-slit experiment. Light passing through the lens interferes with itself creating a ring-shape diffraction pattern, known as the Airy pattern, if the wavefront of the transmitted light is taken to be spherical or plane over the exit aperture.

The interplay between diffraction and aberration can be characterised by the point spread function (PSF). The narrower the aperture of a lens the more likely the PSF is dominated by diffraction. In that case, the angular resolution of an optical system can be estimated (from the diameter of the aperture and the wavelength of the light) by the Rayleigh criterion defined by Lord Rayleigh: two point sources are regarded as just resolved when the principal diffraction maximum of one image coincides with the first minimum of the other. If the distance is greater, the two points are well resolved and if it is smaller, they are regarded as not resolved. Rayleigh defended this criteria on sources of equal strength

Considering diffraction through a circular aperture, this translates into:

where θ is the *angular resolution* (radians), λ is the wavelength of light, and D is the diameter of the lens' aperture. The factor 1.220 is derived from a calculation of the position of the first dark circular ring surrounding the central Airy disc of the diffraction pattern. This number is more precisely 1.21966989... (A245461), the first zero of the order-one Bessel function of the first kind divided by π.

The formal Rayleigh criterion is close to the empirical resolution limit found earlier by the English astronomer W. R. Dawes who tested human observers on close binary stars of equal brightness. The result, $\theta = 4.56/D$, with D in inches and θ in arcseconds is slightly narrower than calculated with the Rayleigh criterion: A calculation using Airy discs as point spread function shows that at Dawes' limit there is a 5% dip between the two maxima, whereas at Rayleigh's criterion there is a 26.3% dip.[3] Modern image processing techniques including deconvolution of the point spread function allow resolution of binaries with even less angular separation.

The angular resolution may be converted into a *spatial resolution*, $\Delta\ell$, by multiplication of the angle (in radians) with the distance to the object. For a microscope, that distance is close to the focal length f of the objective. For this case, the Rayleigh criterion reads:

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