Angular Resolution

ASTR 288C: Lecture 6

Astronomical “Instruments”

Naked Eye

Typical size: 3-9 mm diameter pupil

extremely portable

cheap

subject to blinking

Best for bright, large-field observing

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Refracting Telescopes

Largest: Yerkes 102-cm (40-in) diameter lens

Typical amateur: 60-mm diameter lens

little maintenance

reliable

best image quality

expensive per aperture size

heavy and bulky – size limit

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Reflecting Telescopes

Largest single-mirror: Subaru & VLT 8.2-m diameter mirror
Largest segmented-mirror: GTC 10.4-m diameter "mirror"

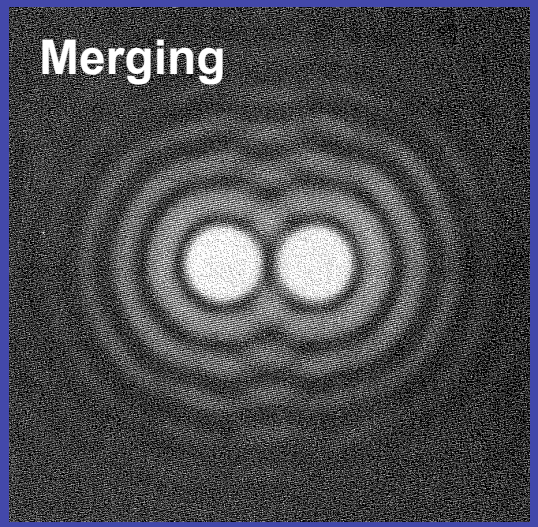
cheaper per aperture size
good image quality
lighter – larger sizes

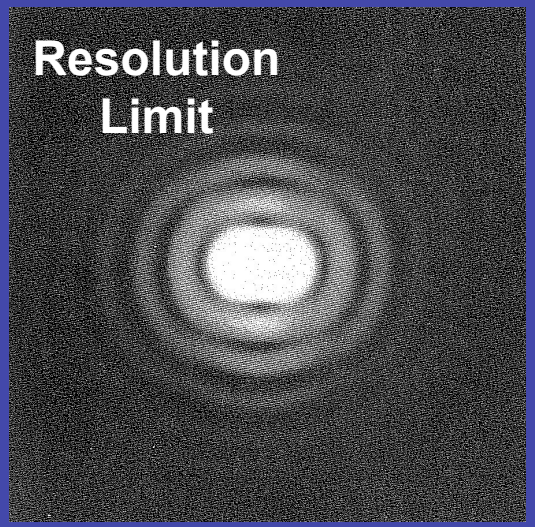
slight light loss
maintenance required

Best for (extra-)galactic observing

Diffraction and Angular Resolution

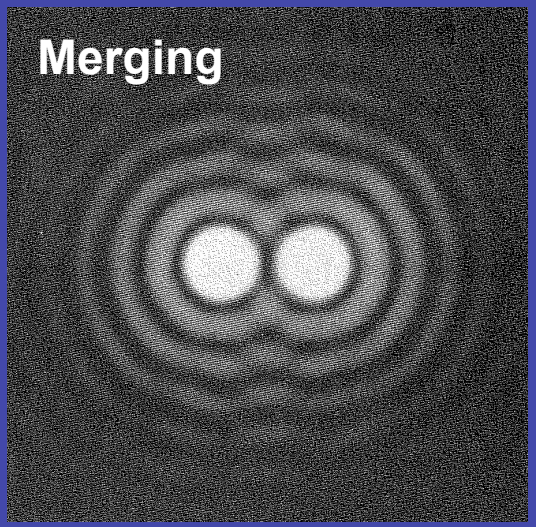
Airy Pattern

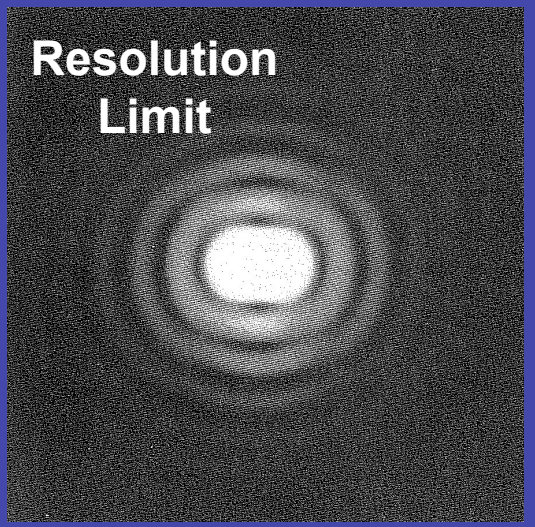




Diffraction and Angular Resolution

Airy Pattern

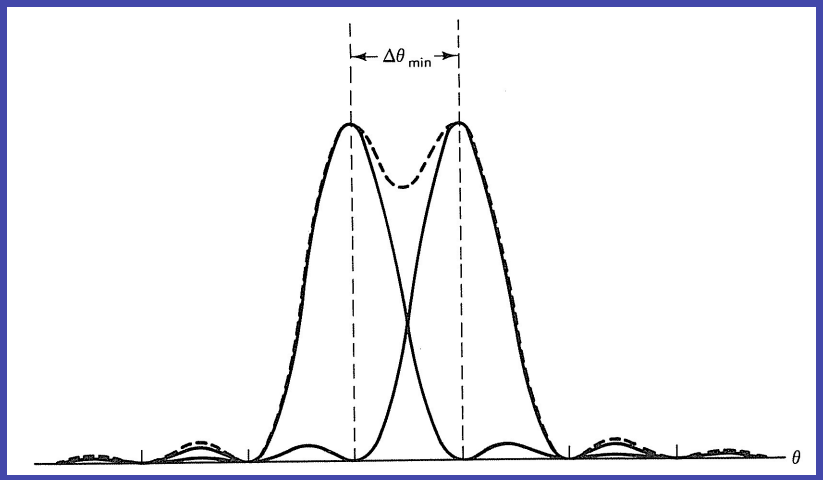




Rayleigh's Criterion

Two "point" (unresolved) sources are resolved from each other when separated by at least the radius of the airy disk.

$$\Theta = 1.22 \frac{\lambda}{D} \text{ rad}$$



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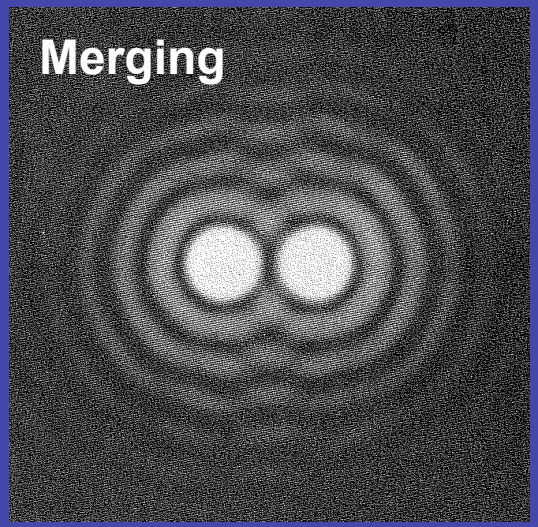

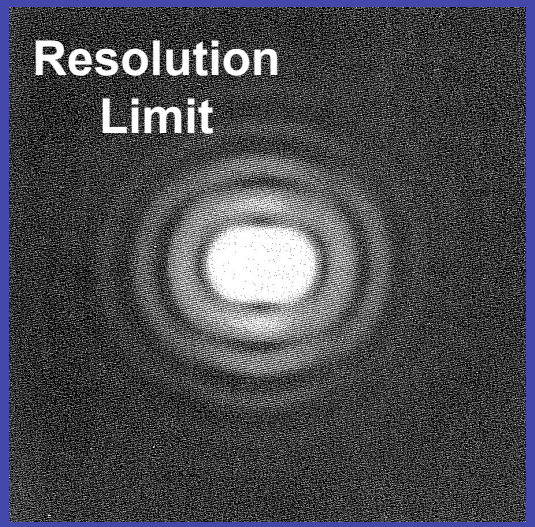

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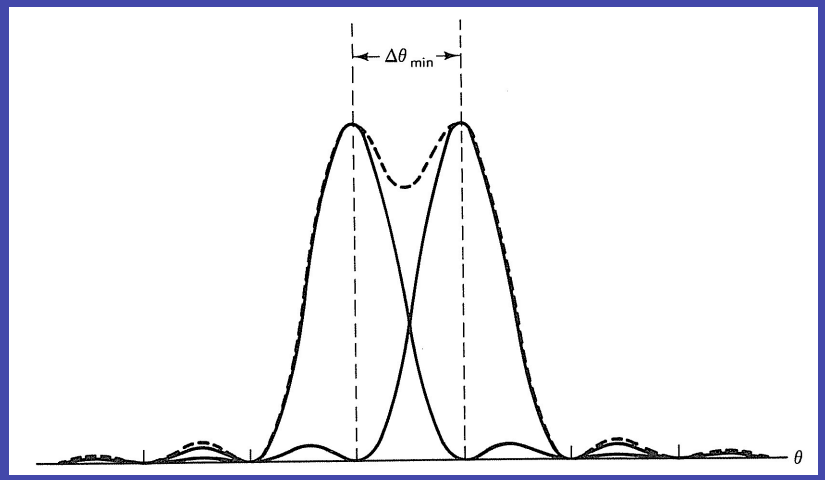
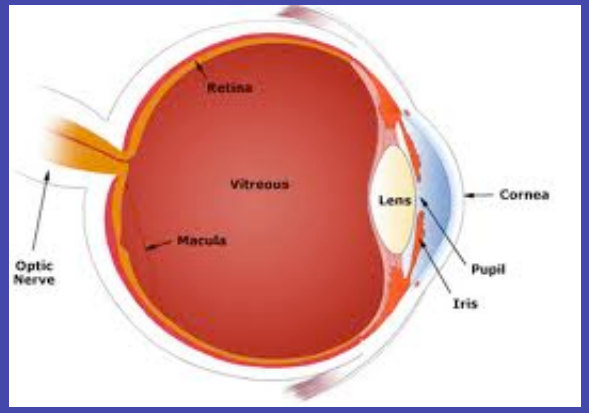


Careful! λ and D are naturally measured in different units

Also note: 360 deg = 2 π rad

Angular Resolution: Human Eye



Pupil diameter: 3-4 mm (day)
5-9 mm (night)

Optimal sensitivity: ~0.55 μm (V band)

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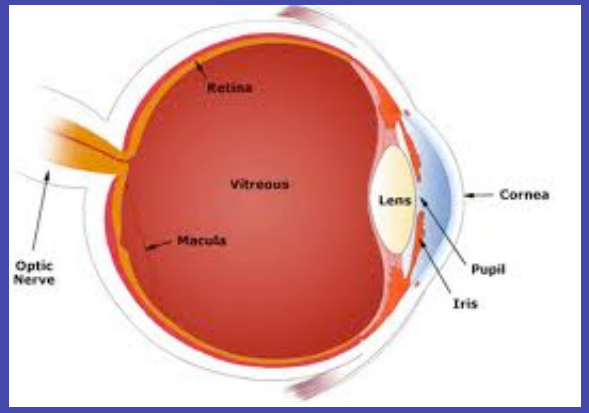

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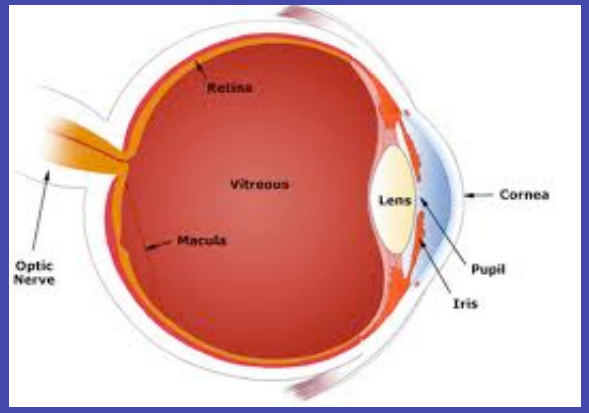

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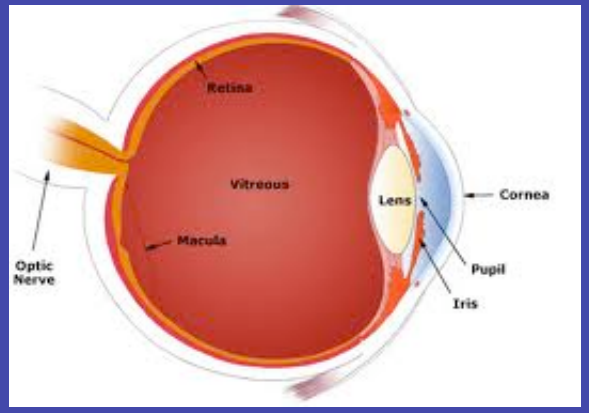

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$$= 0.0128\ \text{deg} \frac{3600''}{1\ \text{deg}}$$

$$= 50'' \text{ (day)}$$


Moon
3 mm pupil
30’


Moon
9 mm pupil
30’


Moon
telescope
30’