# A Short Tutorial on Optical Telescopes 

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## Types of Optical Telescopes

## The Optics

Refracting Telescope
Newtonian Reflecting Telescope Schmidt-Cassegrain Telescope (SCT) Others

## The Mount

Altazimuth
Dobsonian
Equatorial

## Optical Telescopes

Fejisccitisg TEl=scop

Objective Lens


## Optical Telescopes




## Optical Telescopes


Corrector Plate (a type of lens)


Convex (Secondary) Mirror (Spherical Curvature)

# Some Optical Telescope Characteristics 

Light-Gathering Power
Resolution (Resolving Power) Magnification

## Detectors

Human Eye
Photographic Film
Digital Detectors

## Light-Gathering Power




Brightness Of Image $=\underset{=}{4 \times I}$
$I \propto D^{2}$
The image is $4 x$ brighter if the aperture is $2 x$ larger, ...

## Resolving Power

Resolying power ( $\theta_{\text {min }}$ ) is the angular separation (in seconds of arc) befween objecis which are just barely distinguistiable.

I second of anc is l/goui of 1/gow of a degree
looking

## $\theta=$ angular separation

 from herecan distinguish

$\theta>\theta_{\text {min }}$
barely distinguish

$\theta=\theta$ imin
can't distinguish


## Resolving Power

## A Formula...

looking

$\theta=$ angular separation
from here

For Visible Light ( 600 nm )

$$
\theta_{\min } \equiv \frac{0.15}{D}
$$

$\mathrm{D}=$ Diameter of Aperture in Meters
$\theta_{\text {min }}=$ Angular Resolution in Seconds of Arc
Recall: $600 \mathrm{~nm}=600 \times 10^{-9} \mathrm{~m}=6 \times 10^{-7} \mathrm{~m}$

## Resolving Power

## For Visible Light (600 nm) <br> $$
\theta_{\min }=\frac{0.15}{D}
$$

| $D$ | $\theta_{\text {min }}$ | comment |
| :--- | :--- | :--- |
| $5 \mathrm{~mm}=5 \times 10^{-3} \mathrm{~m}$ | $30^{\prime \prime}$ | human eye* |
| 2.5 inch $=0.064 \mathrm{~m}$ | $2.3^{\prime \prime}$ | low-price telescope |
| 8 inch $=0.2 \mathrm{~m}$ | $0.75^{\prime \prime}$ | nice telescope |
| 200 inch $=5 \mathrm{~m}$ | $0.03^{\prime \prime}$ | Hale telescope |

* Actual human-eye resolution is about 1 " $=60^{n "}$


## Resolving Power

*Actual human-eye resolution is about 1 ' $=60$ (one are minute) For a large crater on the Moon ( 50 miles):

$$
\begin{aligned}
\theta & \equiv \frac{50 \text { miles }}{240,000 \text { miles }}=0.000208 \text { radians } \\
& =0.000208 \text { radians } \times \frac{360 \text { degrees }}{2 \pi \text { radians }}=0.012^{\circ} \\
& =0.012^{\circ} \times \frac{60 \text { arc minutes }}{1}=0.7 \text { arc minutes }
\end{aligned}
$$

## Magnification

## Magnification $=\frac{\text { focal length of objective }}{\text { focal length of eyepiece }}$

