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Introduction to Telescopes

- What is a telescope?
- Purpose and basic components.
- Example of how telescopes magnify distant objects.

B

Working of Telescopes

- How the objective and eyepiece function.
- Magnifying power and its formula.
- Example calculation for magnifying power.

C

Terrestrial vs Astronomical Telescopes

- Terrestrial Telescopes
- Astronomical Telescopes
- Light-Gathering & Resolving Power

D

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- Issues with Large Lenses
- Chromatic Aberration
- Switch to Reflecting Telescopes

E

Reflecting Telescopes & Examples

- Why Reflecting Telescopes?
- Cassegrain Telescope
- Notable Telescopes

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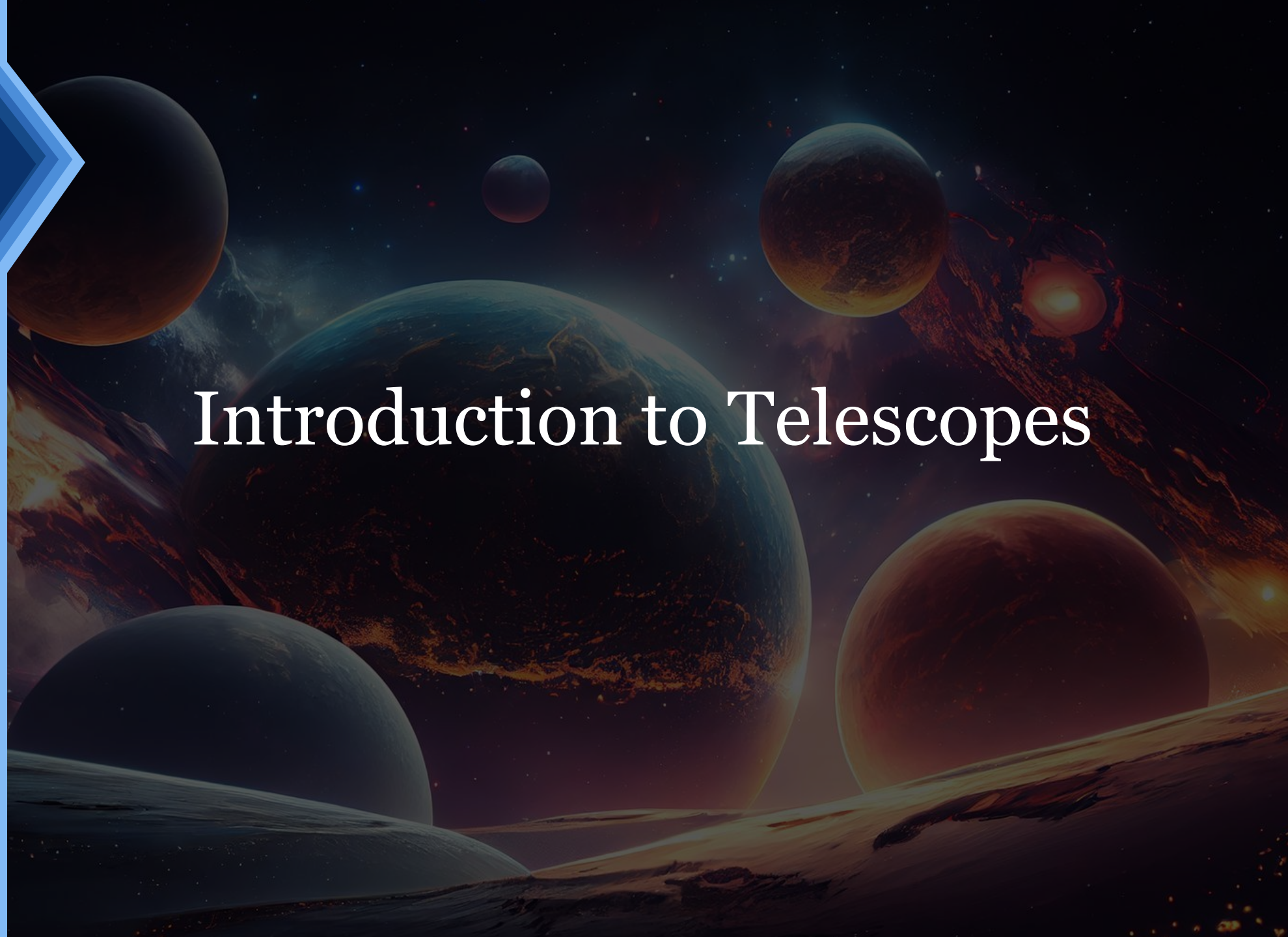

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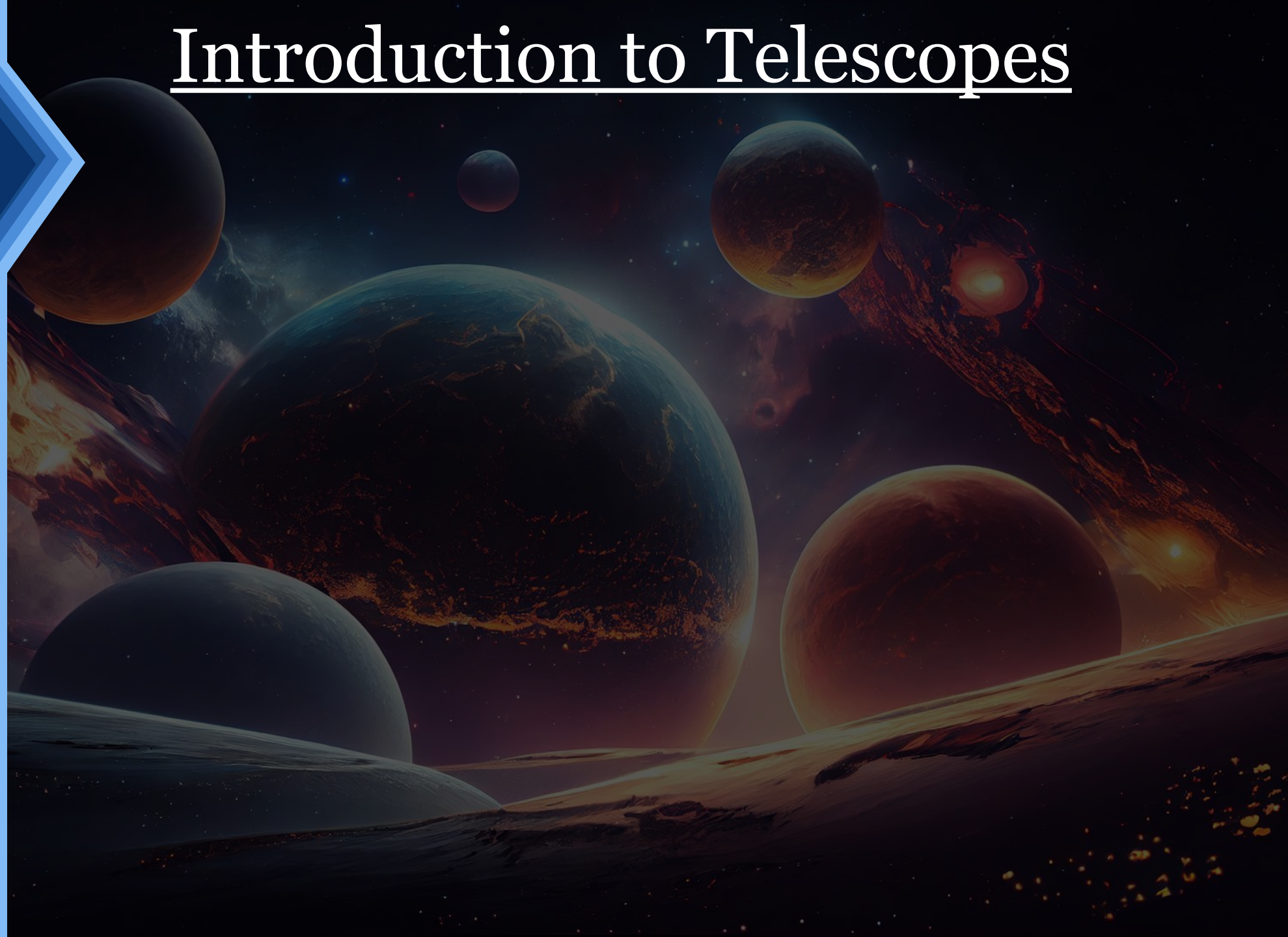

Introduction to Telescopes

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- Hubble Space Telescope Over the Earth

Introduction to Telescopes

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➢ What is a Telescope ?

- A device designed to magnify distant objects.
- Widely used in **astronomy** to study celestial objects and in **terrestrial** observations.

Introduction to Telescopes

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- What is a telescope?
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What Does a Telescope Do?

- Magnifies distant objects, making them appear closer and clearer.
- Used in astronomy to observe celestial objects and in terrestrial applications like wildlife spotting.

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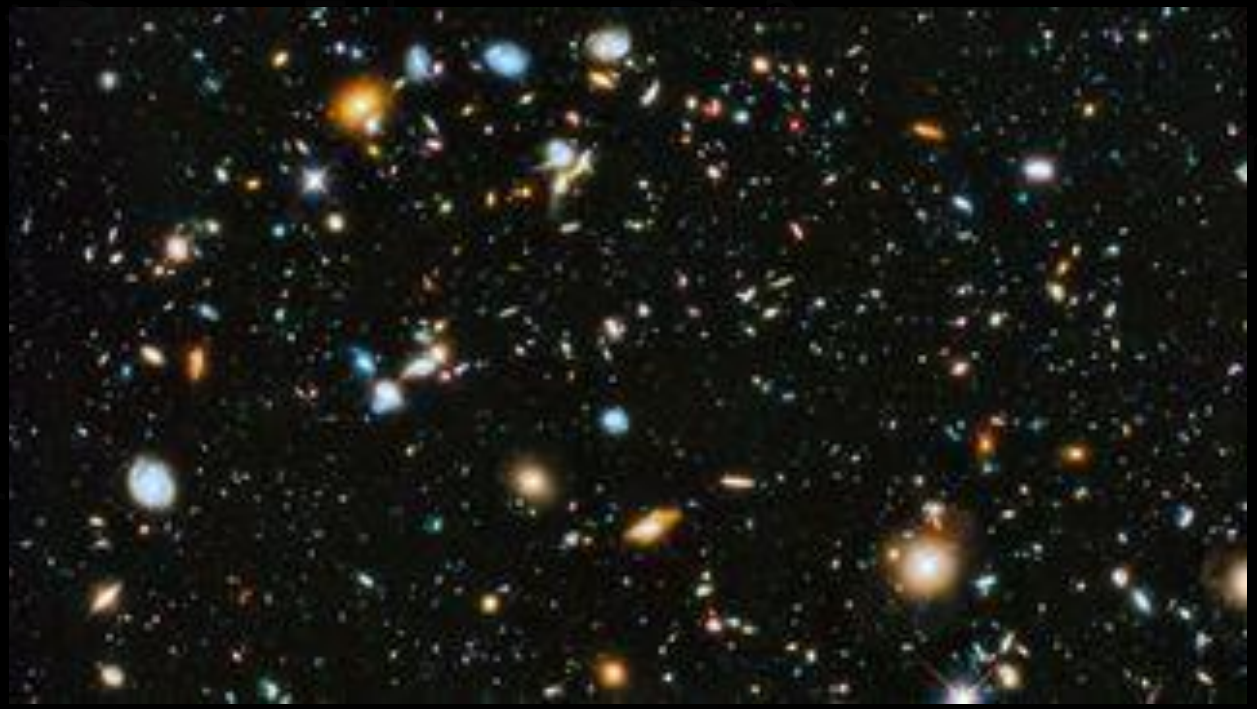

Hubble Ultra Deep Field:
One of the Hubble Telescope's most iconic images, capturing about 10,000 galaxies up to 10 billion light-years away. Released in 2014, this improved composite reveals the universe's origins using advanced imaging technology.

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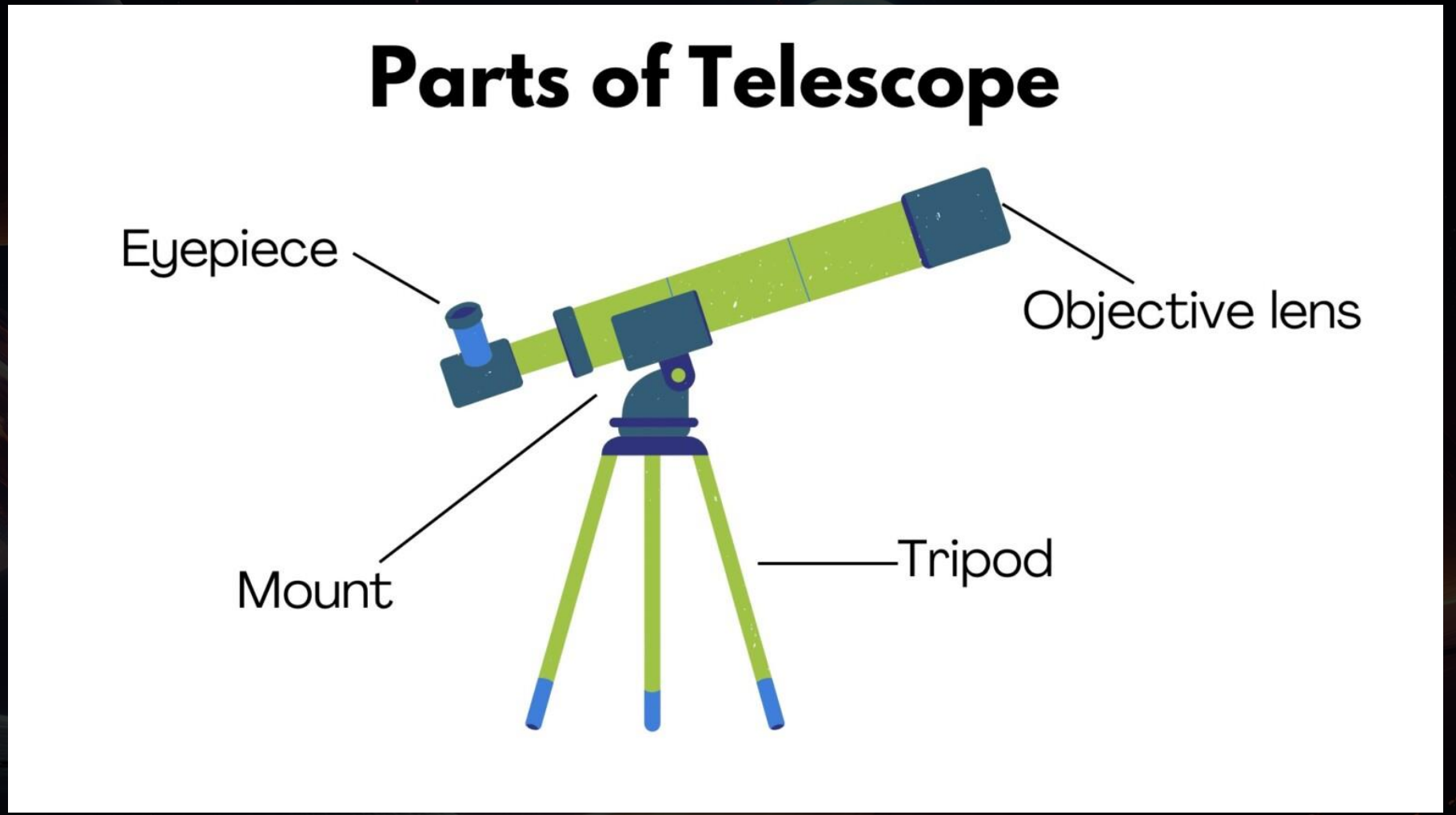

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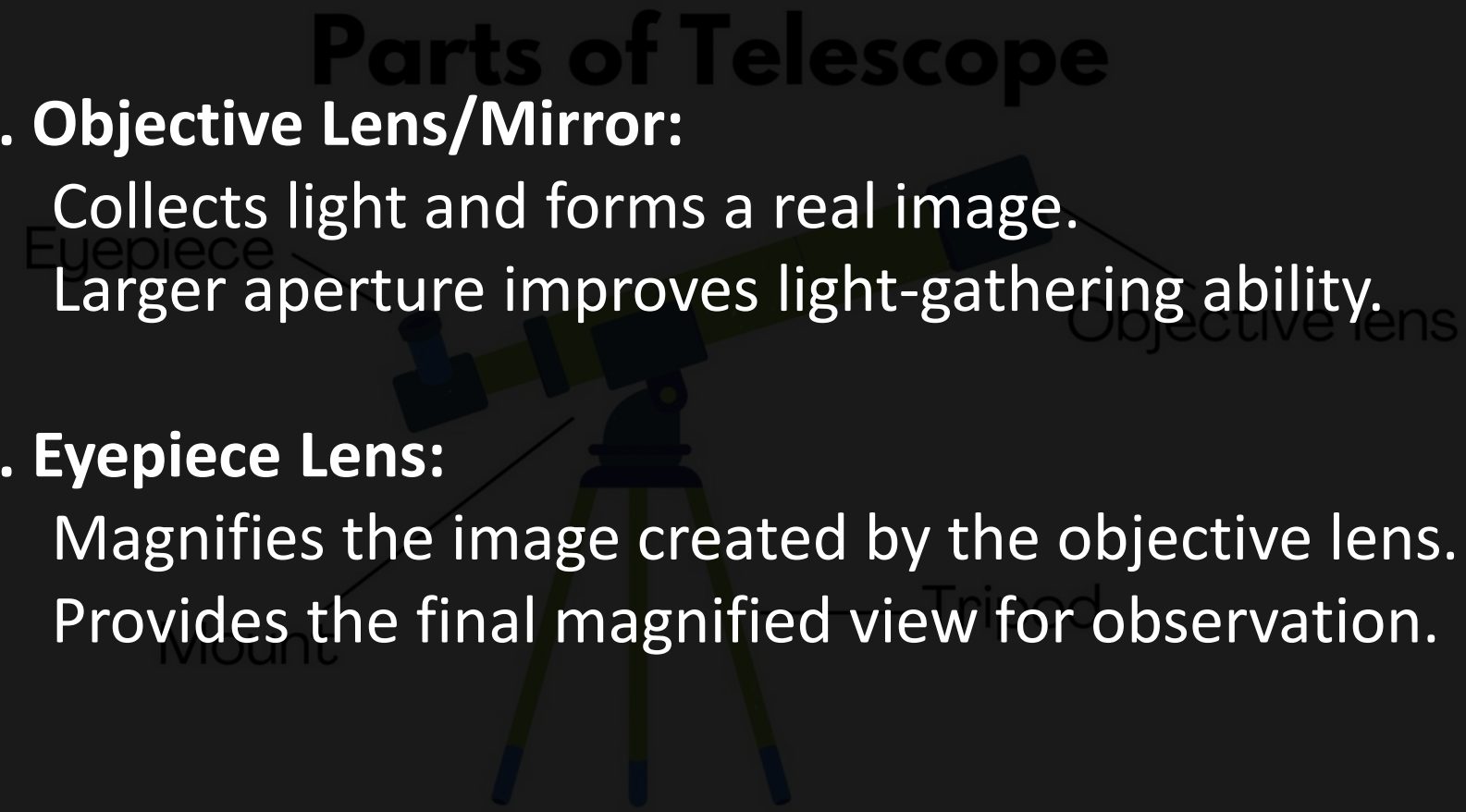

1. Objective Lens/Mirror:

- Collects light and forms a real image.
- Larger aperture improves light-gathering ability.

2. Eyepiece Lens:

- Magnifies the image created by the objective lens.
- Provides the final magnified view for observation.

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Working of Telescopes

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Working of Telescopes

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Working of Telescopes

➢ Objective Lens/Mirror

- Captures light from a distant object.
- Forms a real, inverted image inside the telescope tube.
- Larger aperture allows gathering more light, making distant objects brighter.

➢ Eyepiece Lens

- Magnifies the real image formed by the objective lens.
- Allows the observer to see a clearer, magnified view.

Working of Telescopes

B

Working of Telescopes

- How the objective and eyepiece function.
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➢ Magnifying Power & Example Calculation

- The ratio of the angular size of the image to the angular size of the object.
- Formula: $m = \frac{fo}{fe}$
- where fo is the focal length of the objective and fe is the focal length of the eyepiece.

Working of Telescopes

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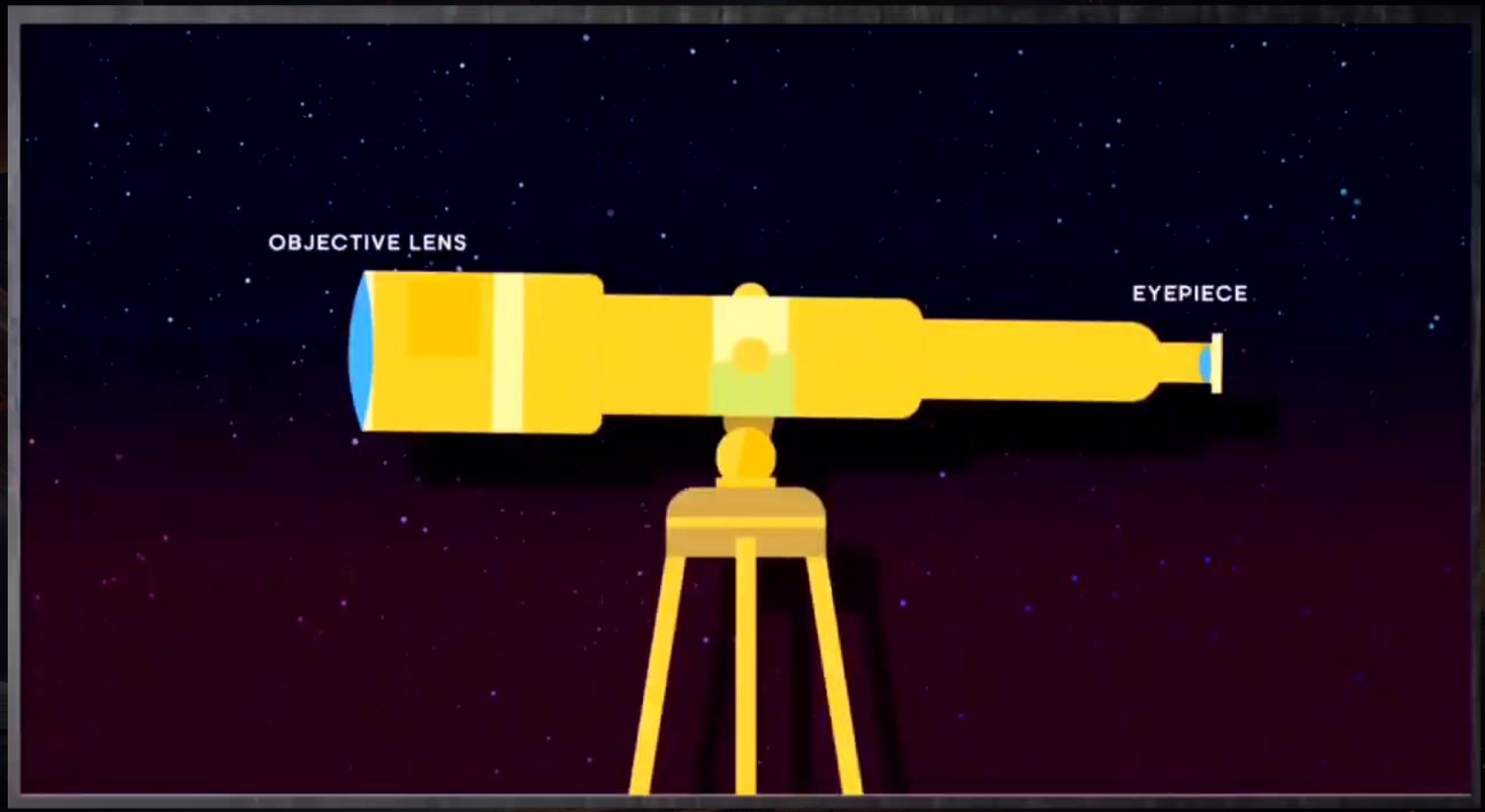

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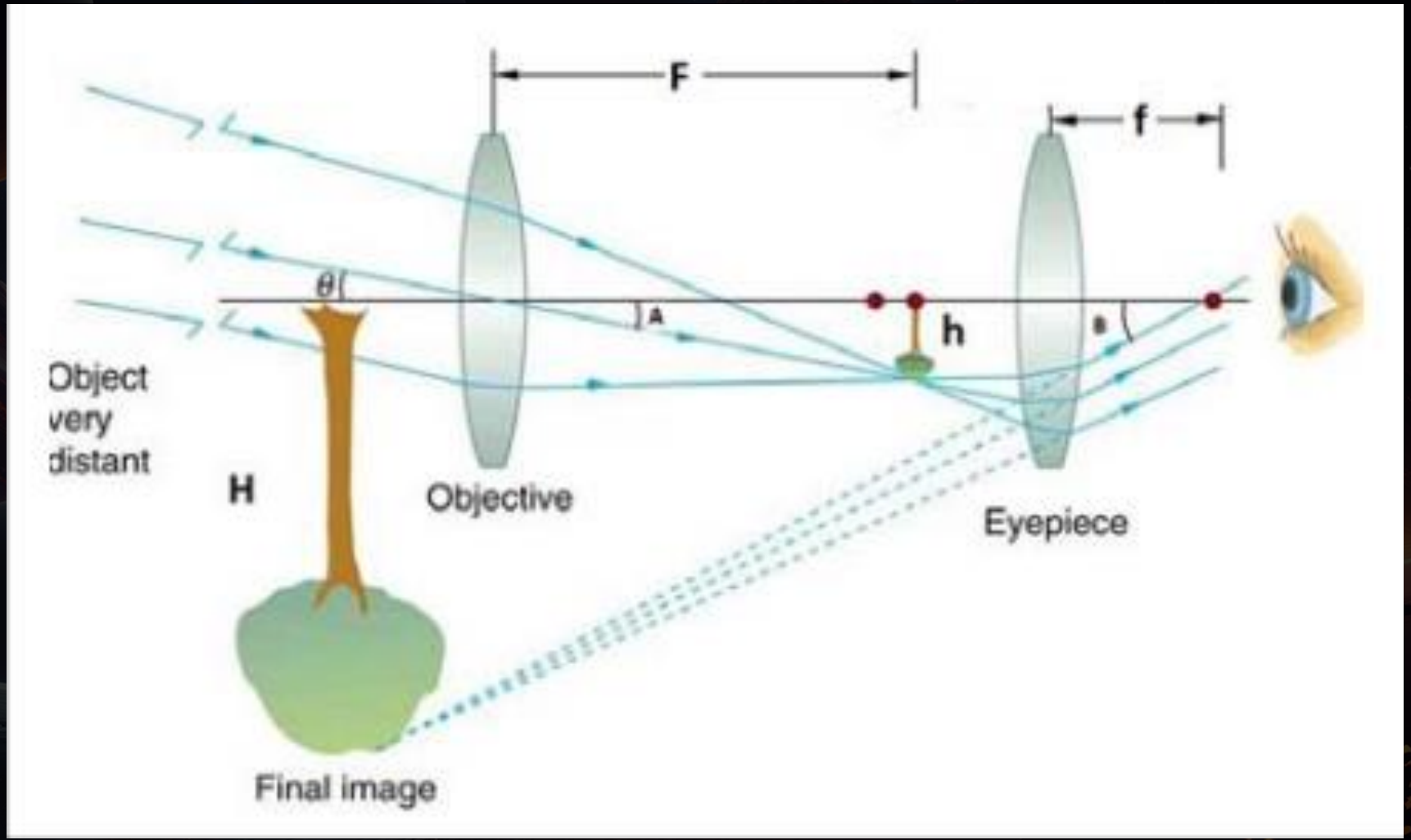

Working of Telescopes

B

Working of Telescopes

- How the objective and eyepiece function.
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- Example calculation for magnifying power.

Q) A telescope has an objective focal length of 100 cm and an eyepiece focal length of 1 cm. What is its magnifying power?

Using the formula:

$$m = \frac{fo}{fe}$$

$$m = \frac{100}{1}$$

Answer: The telescope magnifies the object 100 times.

B

Working of Telescopes

- How the objective and eyepiece function.
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Working of Telescopes

C

Terrestrial vs Astronomical Telescopes

- Terrestrial Telescopes
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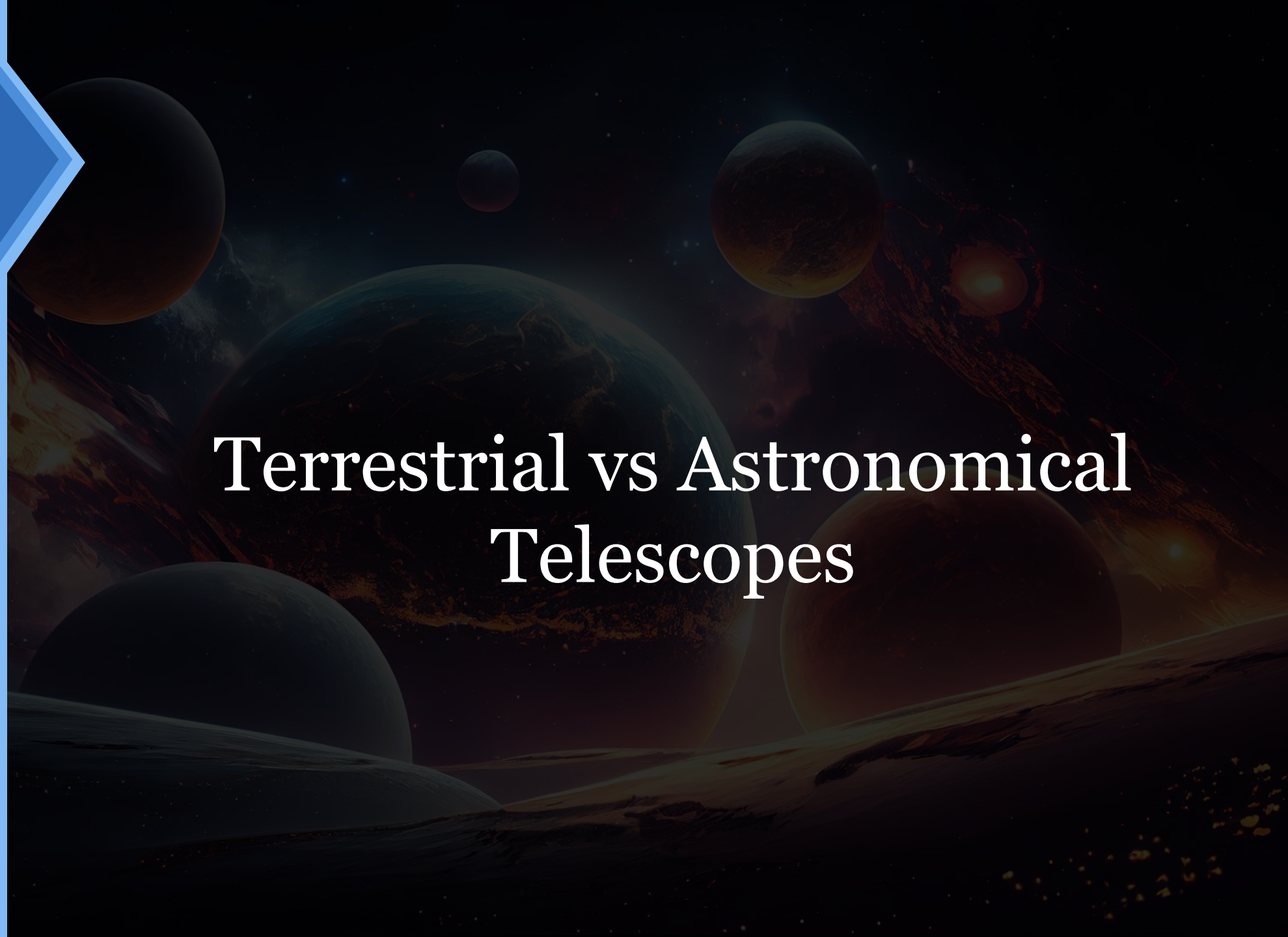
- Light-Gathering & Resolving Power



Terrestrial vs Astronomical Telescopes

Terrestrial vs Astronomical Telescopes

C

Terrestrial vs Astronomical Telescopes

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➢ Terrestrial Telescopes

❖ Purpose:

- Used for viewing objects on Earth.
- Ideal for terrestrial observations like landscapes or ships at sea.

❖ Key Feature:

- Inverting Lenses:

  Additional lenses correct the image orientation, making the final image erect.

❖ Applications:

- Navigation, surveillance, and nature observation.

Terrestrial vs Astronomical Telescopes

Terrestrial vs Astronomical Telescopes

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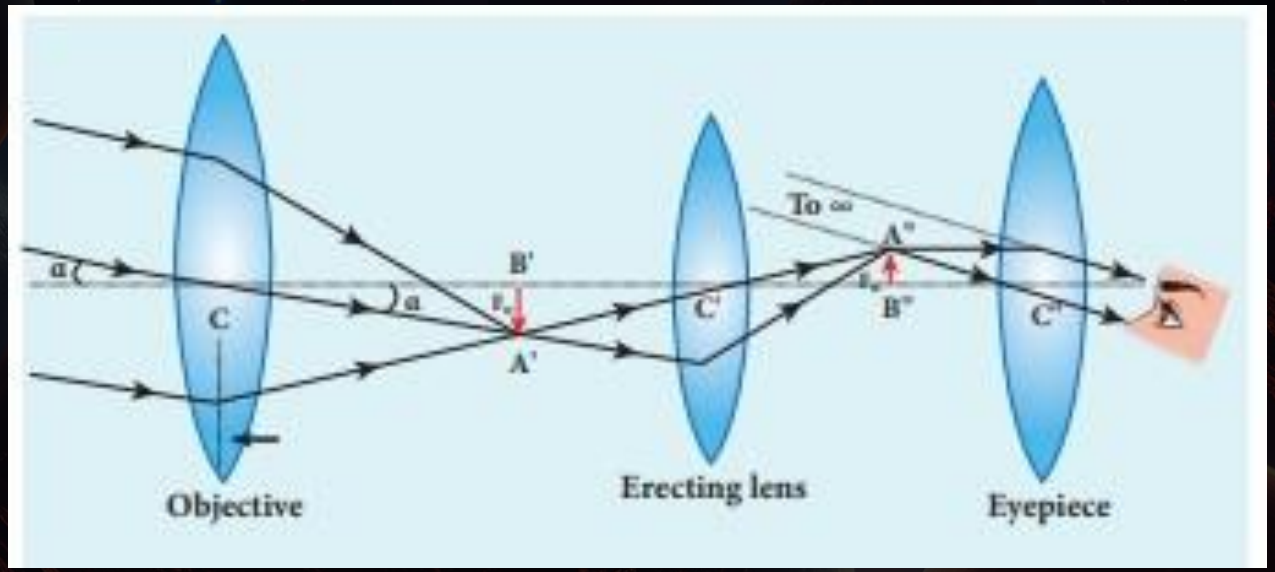
➢ Terrestrial Telescopes



Terrestrial vs Astronomical Telescopes

C

Terrestrial vs Astronomical Telescopes

- Terrestrial Telescopes
- Astronomical Telescopes
- Light-Gathering & Resolving Power

➢ Astronomical Telescopes

❖ Purpose:

- Designed for observing celestial objects like stars, planets and galaxies..

❖ Key Feature:

- Light-Gathering Power:
  Larger objective lenses or mirrors collect more light, allowing observation of faint objects.

❖ Resolution:

- High resolving power distinguishes objects that appear very close together, revealing details in space.

Terrestrial vs Astronomical Telescopes

C

Terrestrial vs Astronomical Telescopes

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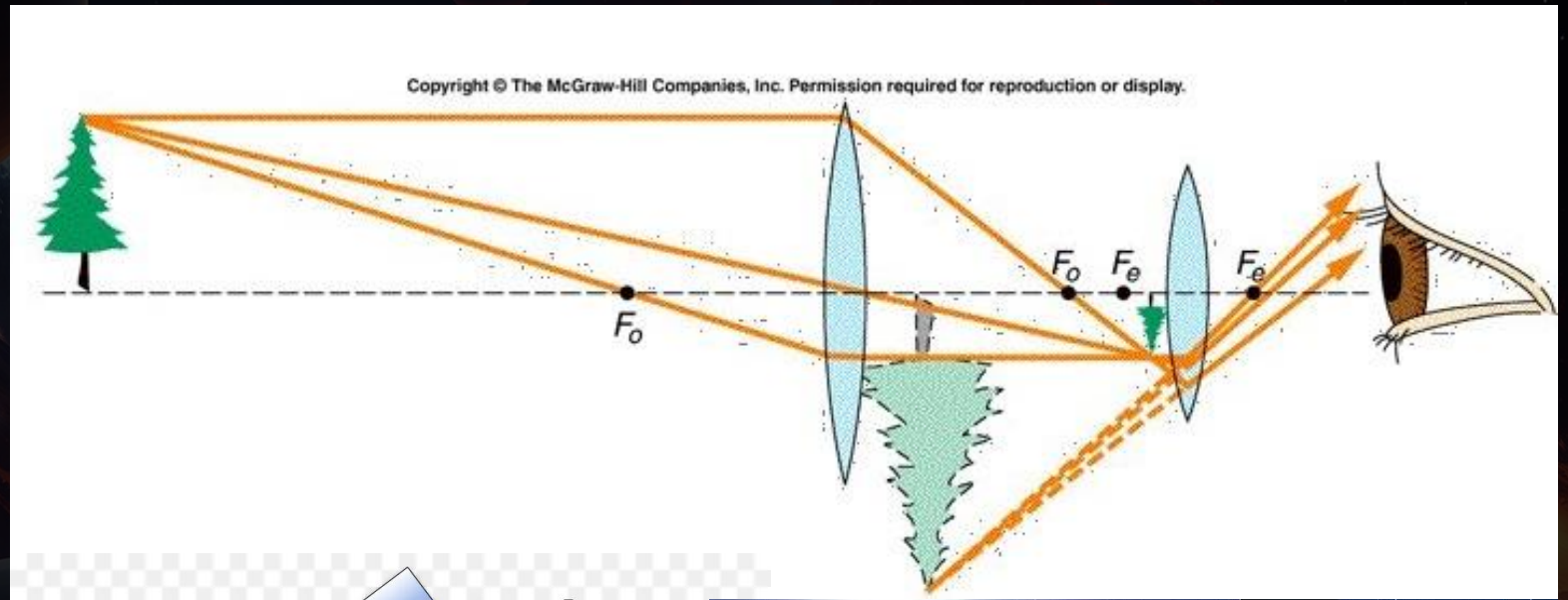
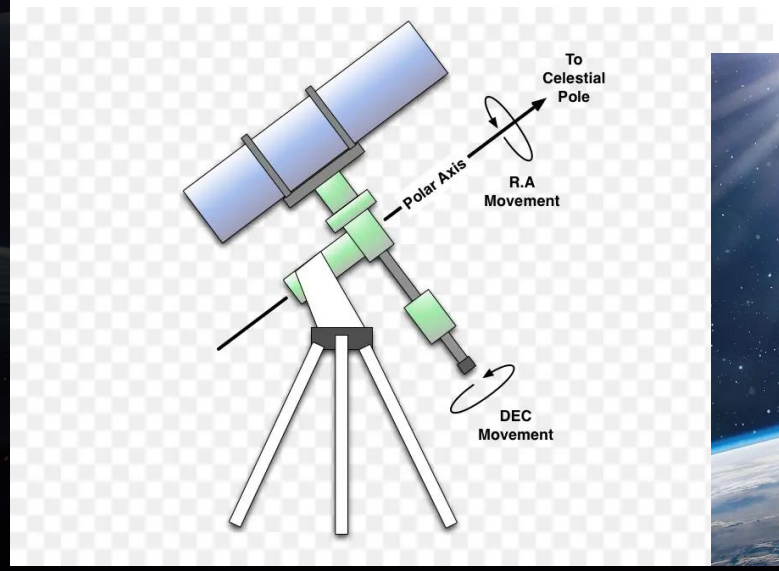
➢ Astronomical Telescopes





Terrestrial vs Astronomical Telescopes

C

Terrestrial vs Astronomical Telescopes

- Terrestrial Telescopes
- Astronomical Telescopes
- Light-Gathering & Resolving Power

➢ Comparison

Terrestrial vs Astronomical Telescopes

C

Terrestrial vs Astronomical Telescopes

- Terrestrial Telescopes
- Astronomical Telescopes
- Light-Gathering & Resolving Power

Feature	**Terrestrial Telescopes**	**Astronomical Telescopes**
Objective Size	Smaller objectives suitable for Earth-based viewing.	Larger objectives to gather more light for faint celestial objects.
Image Orientation	Produces erect images using additional lenses or prisms.	Produces inverted images; orientation doesn't matter for astronomy.
Primary Use	Observing landscapes, wildlife, and other Earth-based objects.	Observing distant stars, galaxies, and other celestial phenomena.
Light-Gathering Ability	Focused on providing a wide field of view for closer objects.	Maximizes light collection to observe faint and distant objects.
Special Features	Includes features for natural orientation and ease of terrestrial use.	Optimized for high resolution and light capture, often digitally corrected.

C

Terrestrial vs Astronomical Telescopes

- Terrestrial Telescopes
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Terrestrial vs Astronomical Telescopes

D

Limitations of Refracting Telescopes

- Issues with Large Lenses
- Chromatic Aberration
- Switch to Reflecting Telescopes

Limitations of Refracting Telescopes

Limitations of Refracting Telescopes

D

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➢ Heavy and Expensive Lenses

❖ Manufacturing and Cost:

Large refracting telescopes require high-quality, expensive lenses. The larger the lens, the higher the cost and difficulty in manufacturing.

❖ Weight Issues:

Larger lenses are heavier and require stronger support structures, increasing cost and complexity.

❖ Structural Challenges:

The precise mounting of large lenses adds engineering challenges, raising the overall telescope cost.

Limitations of Refracting Telescopes

D

Limitations of Refracting Telescopes

- Issues with Large Lenses
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➢ Chromatic Aberration

❖ **Color Distortion:**

Chromatic aberration causes light of different wavelengths to focus at different points, resulting in blurry images with color fringes, especially on bright objects.

❖ **Impact on Image Quality:**

It reduces clarity, making fine details difficult to discern, particularly with stars and planets.

❖ **Solution in Refracting Telescopes:**

Special coatings or compound lenses help reduce chromatic aberration but cannot completely eliminate it.

Limitations of Refracting Telescopes

D

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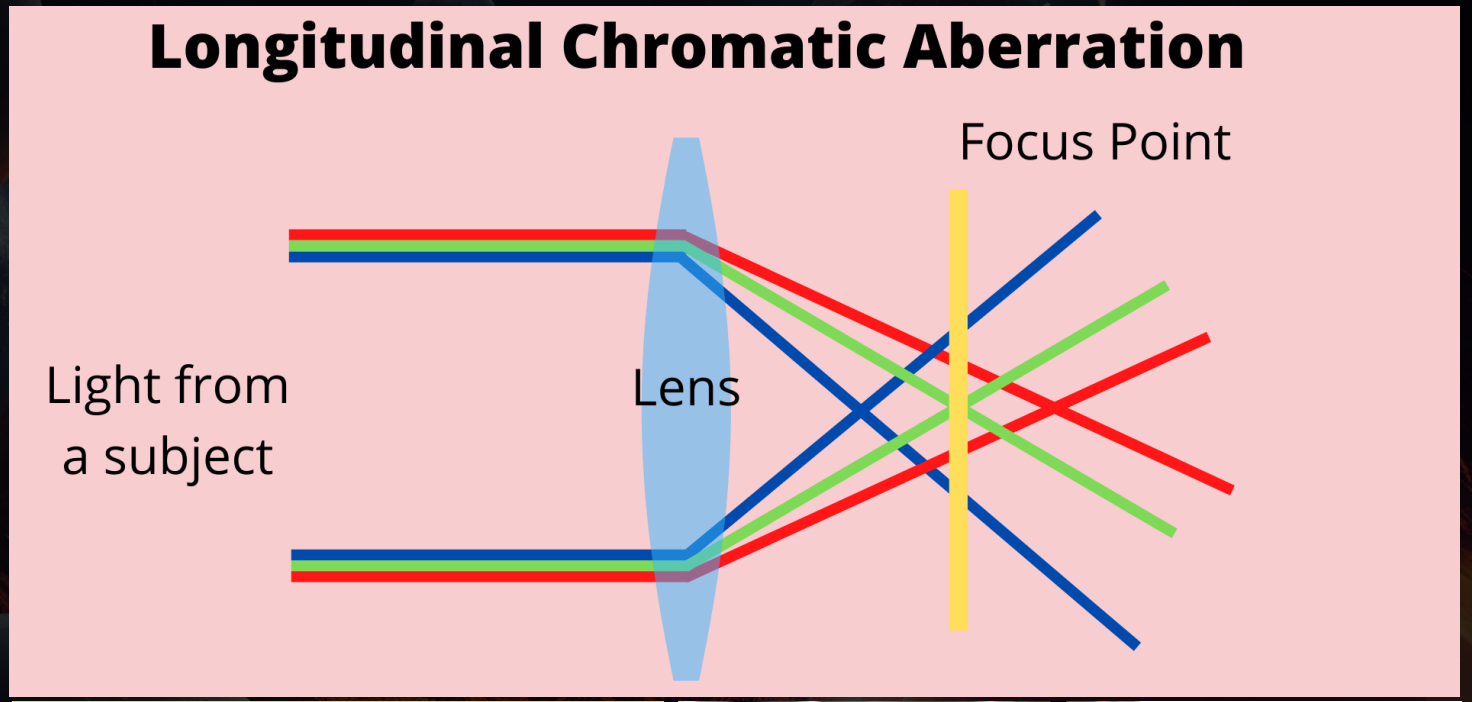
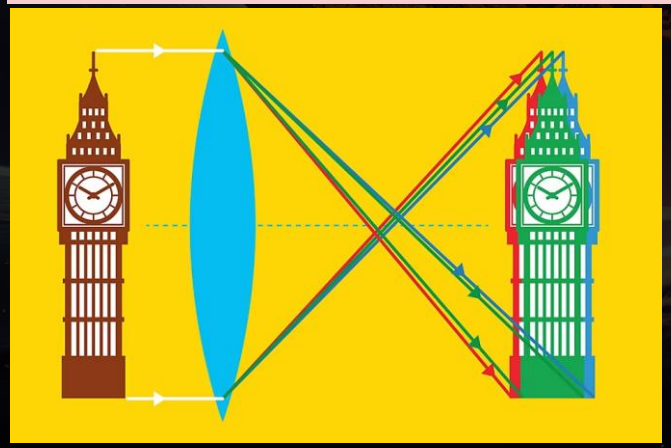
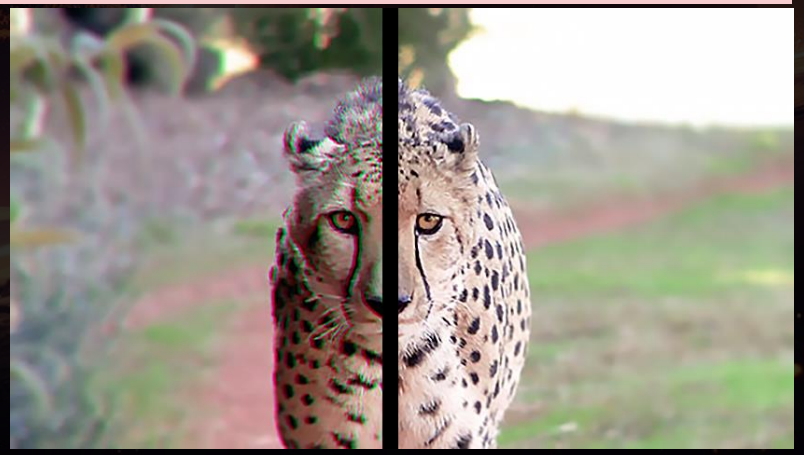
➢ Chromatic Aberration







Limitations of Refracting Telescopes

D

Limitations of Refracting Telescopes

- Issues with Large Lenses
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- Switch to Reflecting Telescopes

➢ Mechanical Challenges

❖ **Structural Support for Heavy Lenses:**

Large refracting telescopes need strong support to prevent lens flexing, which distorts the image.

❖ **Deformation and Flexing:**

The lens can bend under its weight, causing alignment issues.

Limitations of Refracting Telescopes

D

Limitations of Refracting Telescopes

- Issues with Large Lenses
- Chromatic Aberration
- Switch to Reflecting Telescopes

➢ Mechanical Challenges

❖ **Solution in Engineering Challenges:**

A precise mounting system is needed to keep the lens stable, adding complexity and cost.

❖ **Transition to Reflecting Telescopes:**

A precise mounting system is needed to keep the lens stable, adding complexity and cost.

D

Limitations of Refracting Telescopes

- Issues with Large Lenses
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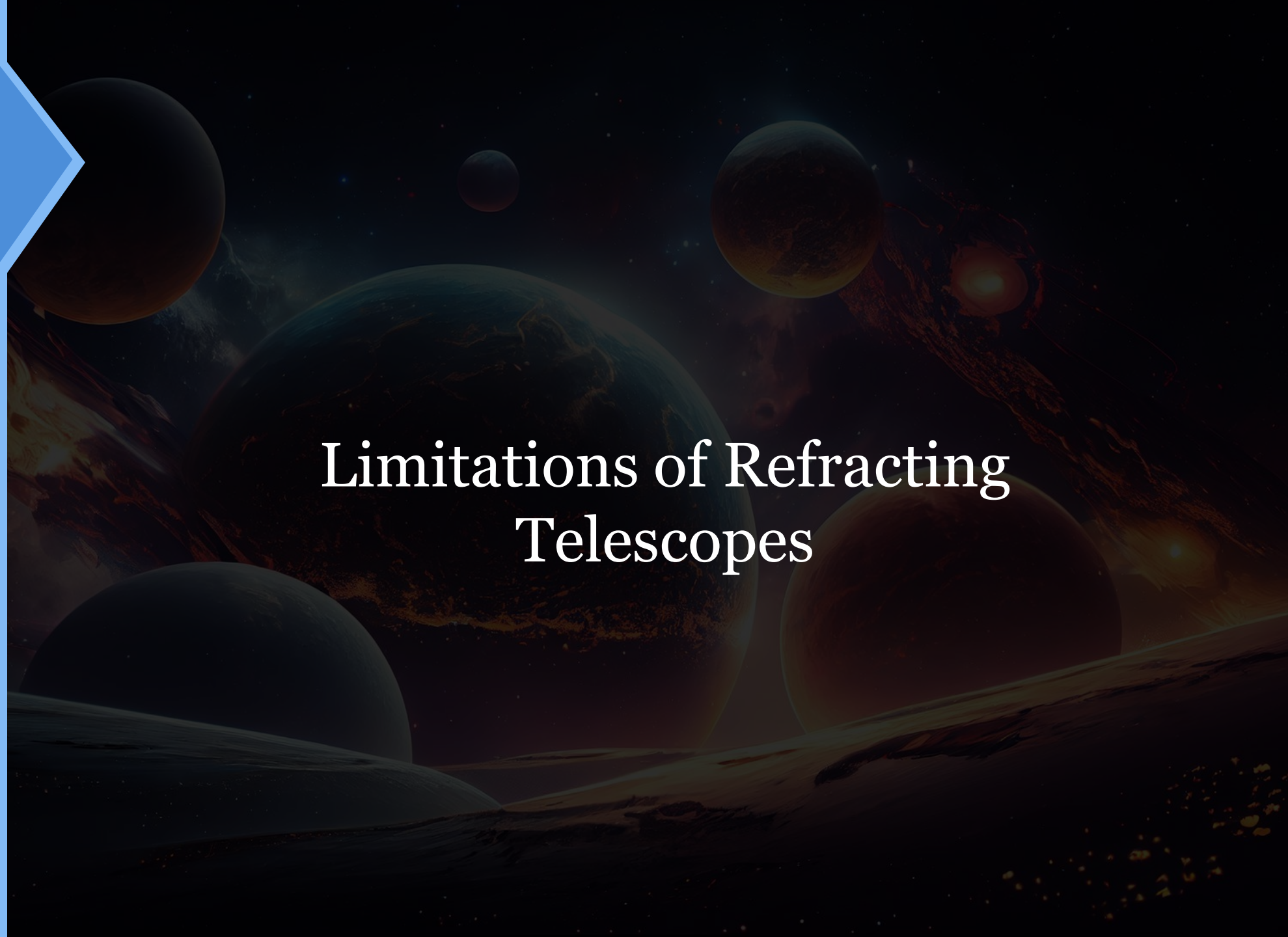
- Switch to Reflecting Telescopes



Limitations of Refracting Telescopes

Reflecting Telescopes & Examples

Reflecting Telescopes & Examples

- Why Reflecting Telescopes?
- Cassegrain Telescope
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Reflecting Telescopes & Examples

Reflecting Telescopes & Examples

➢ Why Reflecting Telescopes?

❖ **Introduction:**

Reflecting telescopes use mirrors instead of lenses to gather an focus light.

❖ **Advantages Over Refracting Telescopes:**

- No Chromatic Aberration: Mirrors reflect all wavelengths equally.
- Larger Size Possible: Mirrors are lighter and easier to support than large lenses.
- Lower Cost: Easier to manufacture large mirrors compared to large lenses.
- Durability: Mirrors don’t bend under their own weight like lenses.

Reflecting Telescopes & Examples

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➢ How Reflecting Telescopes Work

❖ **Key Components:**

Primary Mirror: Large, concave mirror that gathers and focuses light.

Secondary Mirror: Smaller mirror redirects light to the eyepiece or detector.

Light Path:

- Light enters the telescope and strikes the primary mirror.
- The mirror focuses light onto the secondary mirror.
- The secondary mirror directs the light to the eyepiece or camera for observation.

Reflecting Telescopes & Examples

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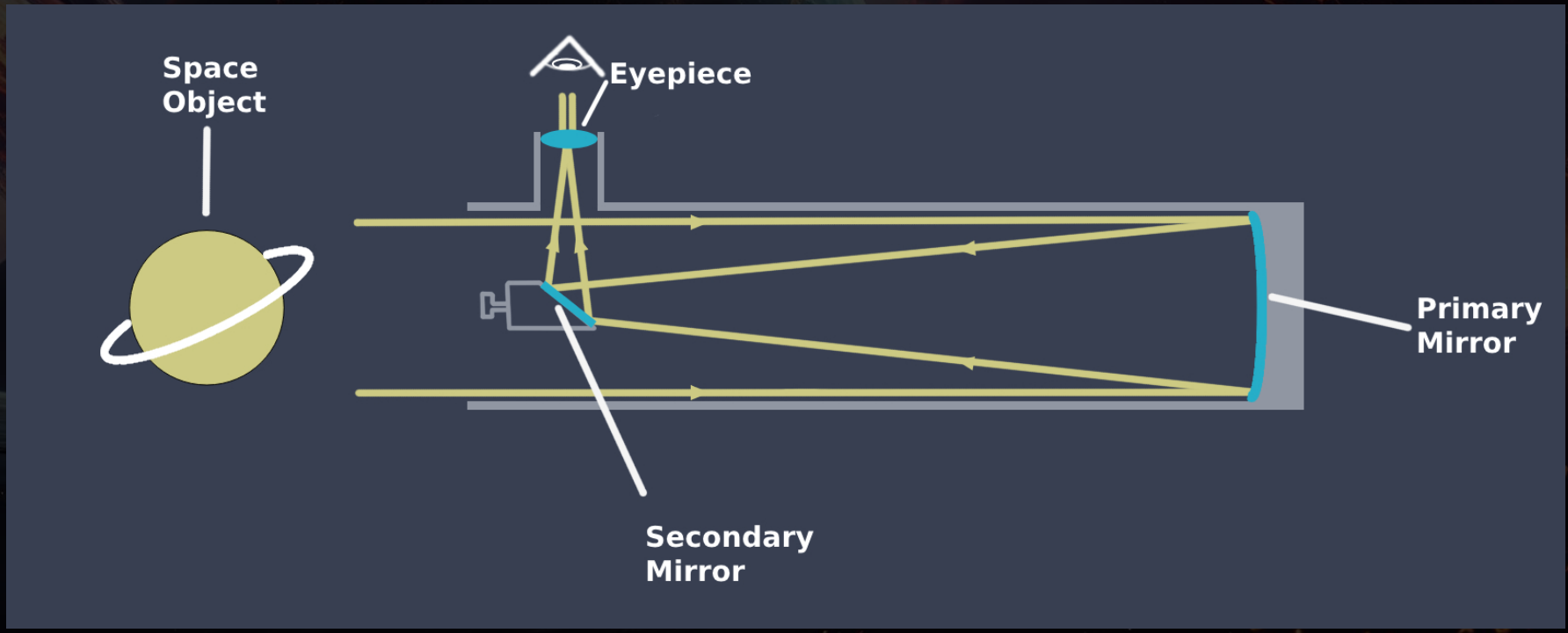
How Reflecting Telescopes Work

Advantages of Mirrors:

Reflect light without distortion.

Easy to shape and polish for precision.



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➢ Cassegrain Telescope

❖ How It Works:

- A type of reflecting telescope.
- Uses a parabolic primary mirror and a hyperbolic secondary mirror.
- Light is reflected back through a hole in the primary mirror to the eyepiece.

❖ Benefits of Cassegrain Design:

- Compact Size: Long focal length in a shorter tube.
- Ideal for both astronomical and terrestrial use.
- Popular in amateur and professional astronomy.

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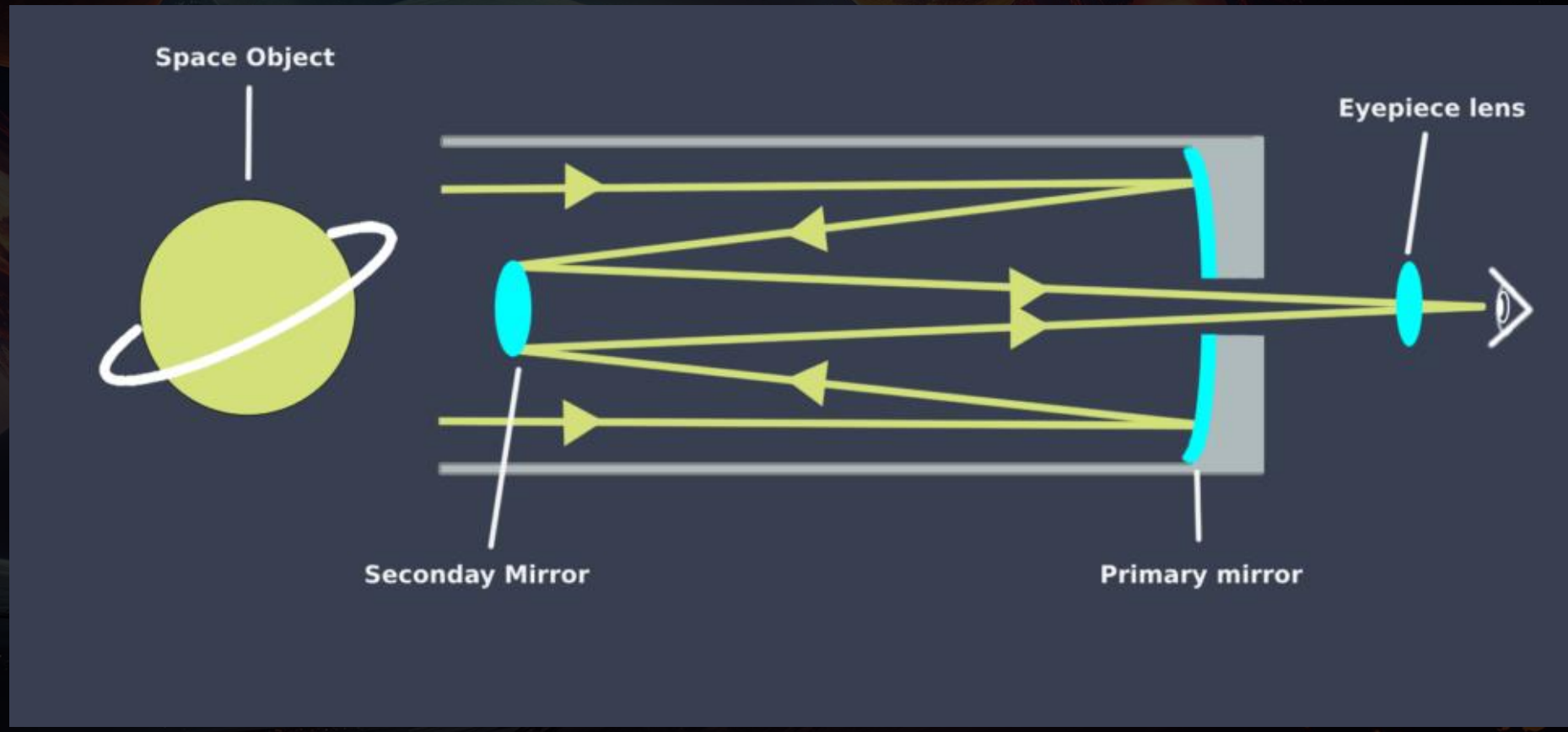

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➢ Notable Reflecting Telescopes

Vainu Bappu Observatory (Kavalur, India):

- Houses a 2.3-meter reflecting telescope.
- Used for studying stars, galaxies, and comets.

Keck Observatory (Hawaii, USA):

- Features twin 10-meter reflecting telescopes.
- Among the largest optical telescopes in the world.

Reflecting Telescopes & Examples

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Nezil Rasheed

Abdul Warees

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TEACHER

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SOURCES

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