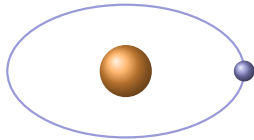


Space Physics

IGCSE Physics ■ Topic 6

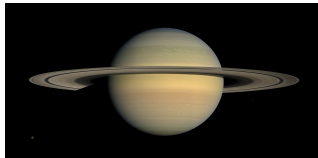
IGCSE Physics



Space Physics

What we will cover

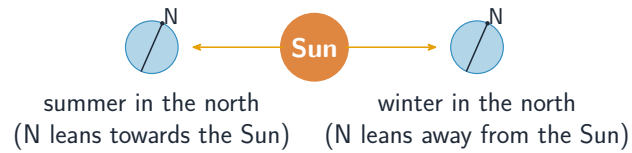
- 1 Earth Sun & Moon
- 2 The Solar System
- 3 The Sun & the stars
- 4 Life cycle of a star
- 5 The expanding Universe
- 6 Recap



1

Earth, Sun and Moon

Earth, Sun and Moon



tilt → **seasons** 季节

Day (spin) < month (Moon's orbit) < year (Earth's orbit).

Orbital speed

For one orbit, distance = $2\pi r$:

$$v = \frac{2\pi r}{T}.$$

Works for planets, moons and satellites.

Station: $r = 7000 \text{ km}$, $T = 5800 \text{ s}$

$$v = \frac{2\pi(7.0 \times 10^6)}{5800} \approx 7600 \text{ m/s}$$

2 The Solar System

The Solar System

- four inner **rocky** 岩石 planets; four outer **gaseous** 气态 planets
- Jupiter & Saturn: **gas giants** 气态巨行星; Uranus & Neptune: **ice giants** 冰巨行星
- plus dwarf planets, moons, **asteroids** 小行星, **comets** 彗星

The Sun's **gravity** 引力 holds the system together.

Orbits and gravity

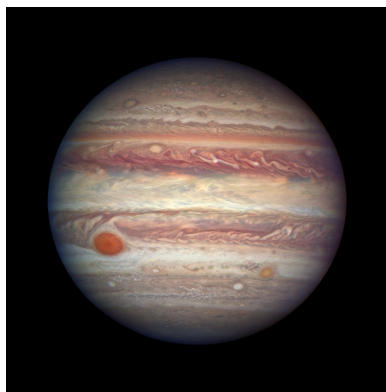
Gravity is the centripetal force for an orbit. Closer in $\Rightarrow$ stronger field $\Rightarrow$ faster orbit.

Most orbits are **ellipses** 椭圆. A comet speeds up when closer to the Sun: E_p falls, E_k rises.

How the Solar System formed

The **accretion** 吸积 model: gravity pulled a spinning cloud of gas and **dust** 尘埃 into a disc.

- most matter formed the Sun
- planets grew from the leftover disc
- hot inner $\rightarrow$ rocky; cold outer $\rightarrow$ gaseous



3 Stars

Space Physics
└ Stars

The Sun and the stars

Stars fuse hydrogen to helium in the core. The Sun is a **main-sequence** 主序 star.

Colour is temperature: blue-white is hotter; red is cooler.

Space Physics
└ Stars

The life cycle of a star

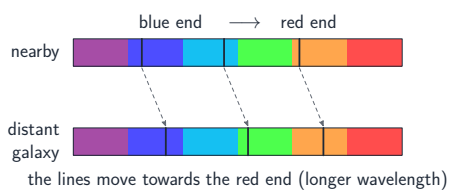
- nebula → protostar → main sequence
- Sun-like: red giant → planetary nebula → **white dwarf** 白矮星
- massive: red supergiant → **supernova** 超新星 → neutron star or black hole

The star's **mass** decides how it dies.

4 The expanding Universe

Space Physics
└ The expanding Universe

The expanding Universe



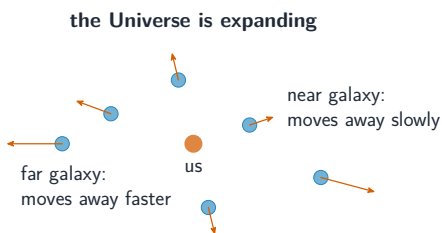
redshift 红移: lines shift red

Distant galaxies show redshift – space itself is stretching.

Redshift $\Rightarrow$ the Universe is expanding $\Rightarrow$ it began in a hot dense state (the Big Bang).

Space Physics
└ The expanding Universe

Hubble and the age of the Universe



$$H_0 = \frac{v}{d}, \quad \text{age} \approx \frac{1}{H_0}.$$

$$H_0 = 2.2 \times 10^{-18} \text{ s}^{-1}$$

$$\frac{1}{H_0} \approx 4.5 \times 10^{17} \text{ s} \approx 14 \text{ billion yr}$$

5

Recap

Space Physics
└ Recap

Topic 6 – key takeaways

1 Orbits

$v = 2\pi r / T$; ellipses, faster when closer

2 Solar System

rocky inner, gaseous outer; Sun's gravity

3 Stars

fusion; mass decides the death

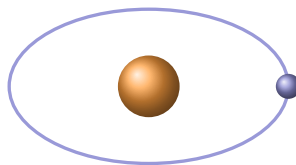
4 Universe

redshift → expanding → Big Bang

Space Physics
└ Recap

Check yourself

- 1 Why do we have seasons?
- 2 Are the outer planets rocky or gaseous?
- 3 What powers a star?
- 4 What does redshift tell us about the Universe?



Answers 1. the tilted axis 2. gaseous 3. nuclear fusion 4. it is expanding