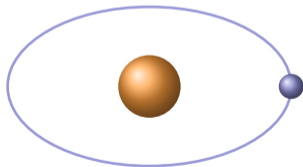


Space Physics

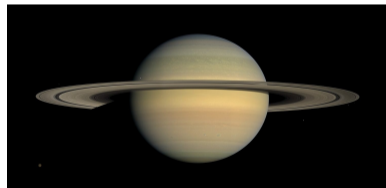
IGCSE Physics ■ Topic 6

IGCSE Physics

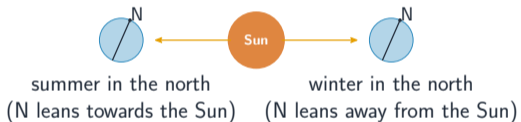


What we will cover

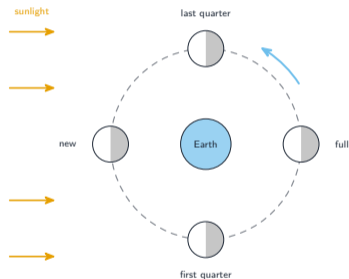
- 1 Earth Sun & Moon
- 2 The Solar System
- 3 The Sun & the stars
- 4 Life cycle of a star
- 5 The expanding Universe
- 6 Recap



Earth, Sun and Moon



tilt → **seasons** 季节



lit half → **phases** 月相

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

Orbital speed

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

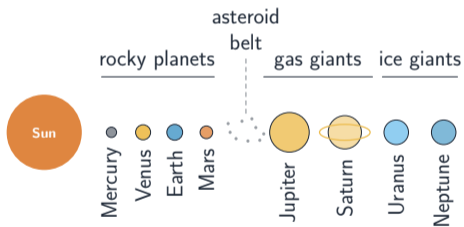
$$v = \frac{2\pi r}{T}.$$

Works for planets, moons and satellites.

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

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

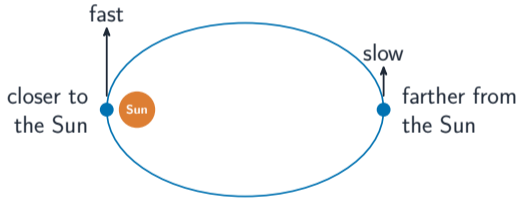
The Solar System



Eight **planets** 行星 round the Sun:

- four small **rocky** 岩石 (inner)
- four large **gaseous** 气态 (outer)
- plus **dwarf planets** 矮行星, **asteroids** 小行星, **comets** 彗星

Orbits and gravity



The Sun's **gravity** 引力 holds the planets; it weakens further out, so outer planets move slower.

Orbits are **ellipses** 椭圆: an object speeds up when closer (GPE \rightarrow KE).

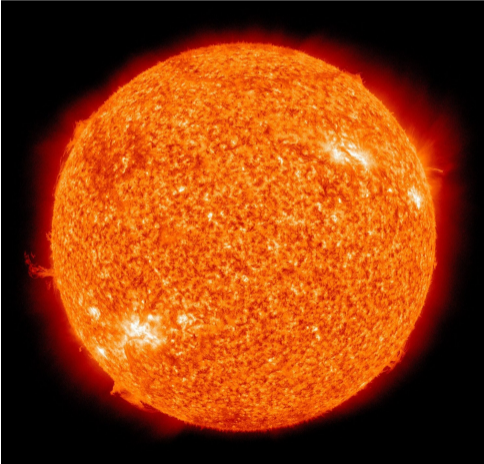
How the Solar System formed

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 → rocky; cold outer → gaseous

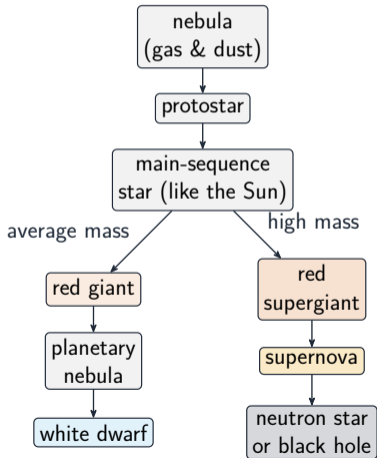


The Sun and the stars



A **star** 恒星 is powered by **nuclear fusion** 核聚变 – hydrogen joins to helium. A **galaxy** 星系 (our **Milky Way** 银河系) holds billions of stars; distances are in **light-years** 光年.

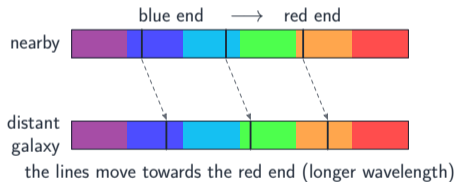
The life cycle of a star



A **nebula** 星云 → **protostar** 原恒星 → stable star.

- Sun-like: red giant → **white dwarf** 白矮星
- heavy: **supernova** 超新星 → neutron star / **black hole** 黑洞

The expanding Universe

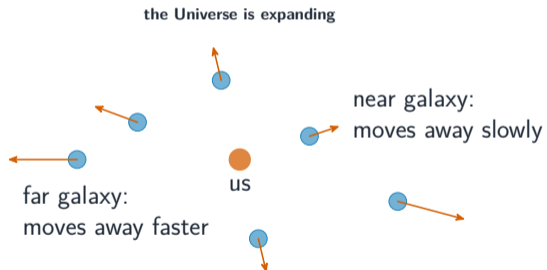


redshift 红移: *lines shift red*

Distant galaxies are redshifted – and the further, the more. So galaxies move apart: the Universe is **expanding**.

Run it backwards \Rightarrow the **Big Bang** 大爆炸 (also: the **CMBR** 宇宙微波背景辐射).

Hubble and the age of the Universe



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

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

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

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

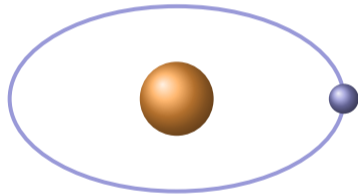
fusion; mass decides the death

4 Universe

redshift → expanding → Big Bang

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