A-LEVEL PHYSICS • HOLIDAY HOMEWORK 假期作业

25 Standard candles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
standard candle	标准烛光			
Cepheid variables	造父变星			
Type Ia supernovae	超新星			
parallax	视差			

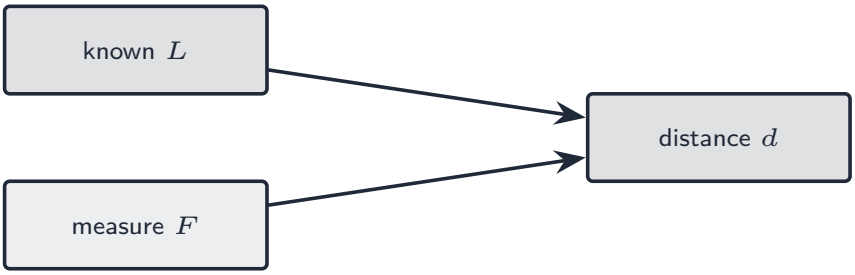
Recall

If we know a star's true luminosity *and* measure how bright it looks, we can work out its distance.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

■ 1 Standard candles



$$d = \sqrt{L/(4\pi F)}$$

A **standard candle** 标准烛光 is an object whose luminosity L is known from its type. Measuring the flux F then gives the distance: $d = \sqrt{L/(4\pi F)}$.

Worked example. We know a certain supernova reaches a luminosity L from its type. We measure the flux F arriving here, then rearrange $F = L/(4\pi d^2)$ to get $d = \sqrt{L/(4\pi F)}$ — the distance to it, and so to its galaxy.

2 Two examples

The two standard candles to know:

- **Cepheid variables** 造父变星 — pulsating stars whose pulse period reveals their luminosity;
- **Type Ia supernovae** 超新星 — exploding white dwarfs that always reach about the same peak luminosity.

They reach far beyond **parallax** 视差.

Worked example. For a Cepheid, time how long its brightness takes to pulse; the period gives L. For a Type Ia supernova, the peak is always nearly the same L, so even one in a distant galaxy can be used.

Watch out: a standard candle works only because its luminosity is *known* from its type. Parallax, by contrast, can measure only nearby stars — the angle becomes too small further out.

Practice

Try these in order.

25.1 What is a *standard candle*? [1]

25.2 Once you know L and measure F, what can you work out? [1]

25.3 What does a *Cepheid variable*'s pulse period reveal? [1]

25.4 Why are *Type Ia supernovae* useful standard candles? [1]

25.5 Write the formula for the distance to a standard candle. [1]

25.6 Explain why a standard candle can measure distances that parallax cannot reach. [2]

25.7 Challenge. Astronomers used Type Ia supernovae to study how the Universe expands. Explain why a *known* luminosity is essential for this, rather than just measuring how bright the supernovae look. [2]