AQA GCSE Space Physics

Red Shift Notes and Questions

Light travels as waves. Different colours of visible light have different wavelengths. Red light has a longer wavelength than blue light.

When scientists look at light from most distant galaxies, they see that the wavelength has increased. The light has been stretched towards the red end of the spectrum. This is called red-shift.

Red-shift tells us that a galaxy is moving away from us. As the galaxy moves away, the light waves are stretched out, so the wavelength becomes longer.

The bigger the red-shift, the faster the galaxy is moving away. Scientists have found that the most distant galaxies have the biggest red-shift.

This means that the further away a galaxy is, the faster it is moving away from us. This pattern is evidence that the universe is expanding.

The important idea is that space itself is expanding. The galaxies are not simply flying through empty space from one central point. Instead, the space between galaxies is stretching.

A useful way to picture this is dots on the surface of a balloon. As the balloon is blown up, the dots move further apart because the surface stretches. In a similar way, galaxies move further apart because space is expanding.

Red-shift supports the Big Bang theory. If galaxies are moving apart now, then in the past they must have been closer together.

The Big Bang theory says the universe began from a very small region that was extremely hot and dense. The universe has been expanding ever since.

Scientists use observations as evidence. They measure the light from distant galaxies and compare the amount of red-shift with the distance to the galaxies.

The pattern they found was clear: more distant galaxies are moving away faster. This helped scientists develop the theory that the universe is expanding.

Since 1998, observations of distant supernovae have suggested that the expansion of the universe is speeding up. This means distant galaxies are not just moving away, but receding ever faster.

A supernova is an exploding star. Some supernovae are useful because their brightness helps scientists estimate how far away their galaxies are.

There is still a lot that scientists do not understand about the universe. The Big Bang theory explains a lot of the evidence, but it does not answer every question.

Dark matter is matter that cannot be seen directly, but its gravity appears to affect galaxies. Scientists think it exists because galaxies behave as if there is more mass than we can see.

Dark energy is the name given to whatever may be causing the expansion of the universe to accelerate. Scientists do not yet fully understand what dark energy is.

A simple way to remember this topic is: light from distant galaxies is red-shifted, so the galaxies are moving away; the further away they are, the faster they move away; this is evidence that the universe is expanding and supports the Big Bang theory.

Questions

1. What happens to the wavelength of light from most distant galaxies?
2. What is red-shift?
3. What does red-shift tell scientists about the motion of most distant galaxies?

4. Complete the sentence: the further away a galaxy is, the faster it is…
5. Why does light from a galaxy become red-shifted when the galaxy is moving away from us?
6. What does the link between distance and red-shift suggest about the universe?
7. Scientists say that space itself is expanding. What does this mean?
8. Explain how red-shift provides evidence for the Big Bang theory.
9. How do observations help scientists develop theories such as the Big Bang theory?
10. Since 1998, observations of distant supernovae suggest that the universe's expansion is accelerating. Explain what this means and why scientists still do not fully understand ideas such as dark matter and dark energy.