

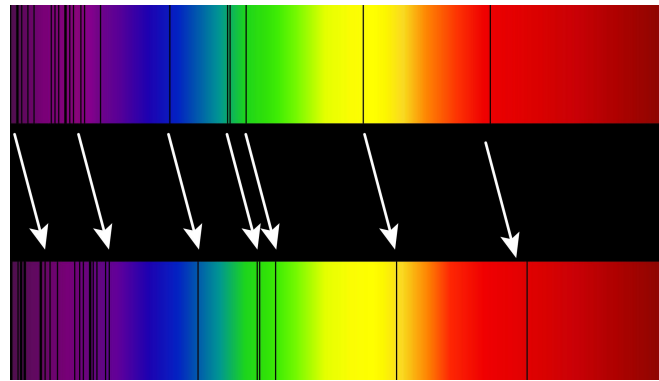


The Big Bang

The Big Bang

- The universe as we know it started with a small singularity.
- The universe inflated over the next 13.8 billion years to the cosmos that we know today.
- When the universe began, it was just hot, tiny particles mixed with light and energy. As everything expanded and took up more space, it cooled down.
- The tiny particles grouped together. They formed atoms. Then those atoms grouped together. Over lots of time, atoms came together to form stars and galaxies.

Redshift



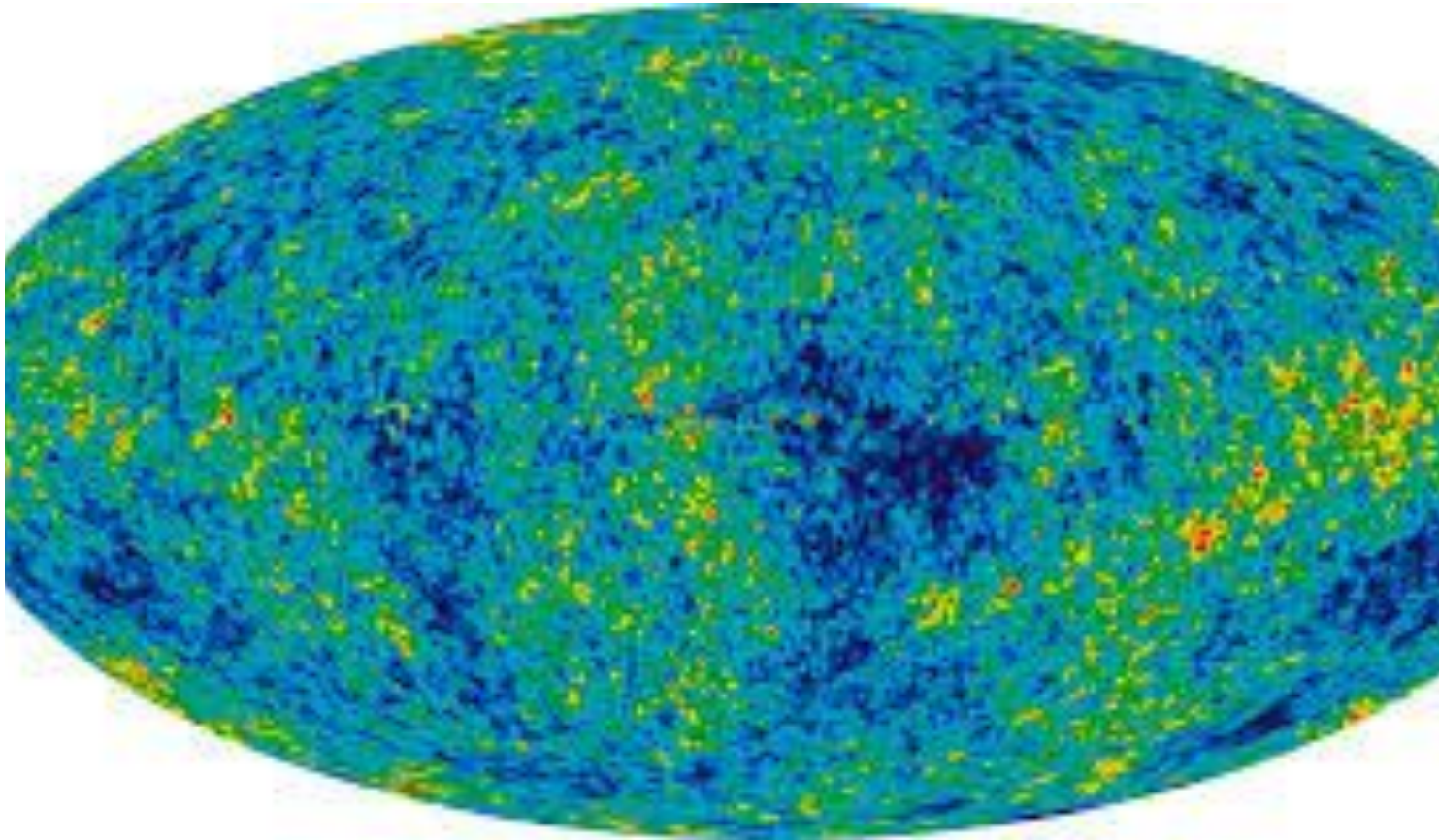
- Light from a star does not contain all the wavelengths of the electromagnetic spectrum. Elements in the star absorb some of the emitted wavelengths, so dark lines are present when the spectrum is analysed.
- Astronomers can observe light from distant galaxies. When they do this, they see it is different to the light from the Sun.
- The dark lines in the spectra from distant galaxies show an increase in wavelength. The lines are moved or shifted towards the red end of the spectrum. This effect is called red-shift.
- Astronomers see red-shift in virtually all galaxies. It is a result of the space between the Earth and the galaxies expanding. This expansion stretches out the light waves during their journey to us, shifting them towards the red end of the spectrum.
- The more red-shifted the light from a galaxy is, the faster the galaxy is moving away from Earth.

Blue Shift

- A blueshift is any decrease in wavelength; so it is opposite to red shift.
- In visible light, this shifts the color from the red end of the spectrum to the blue end.
- If the light from one planet is blue shifted when it reaches another, this means that the first planet is moving towards the other planet.
- The greater the blue shift, the faster the planet is moving to the other.

Evidence of redshift supporting the big bang theory

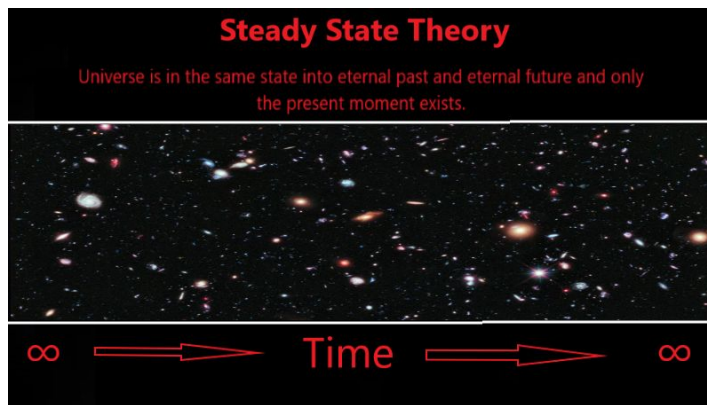
- Astronomers have discovered that, in general, the further away a galaxy is, the more red-shifted its light is. This means that the further away the galaxies are, the faster they are moving.
- This is similar to an explosion, where the bits moving fastest travel furthest from the explosion. Red-shift data provides evidence that the Universe, including space itself, is expanding.



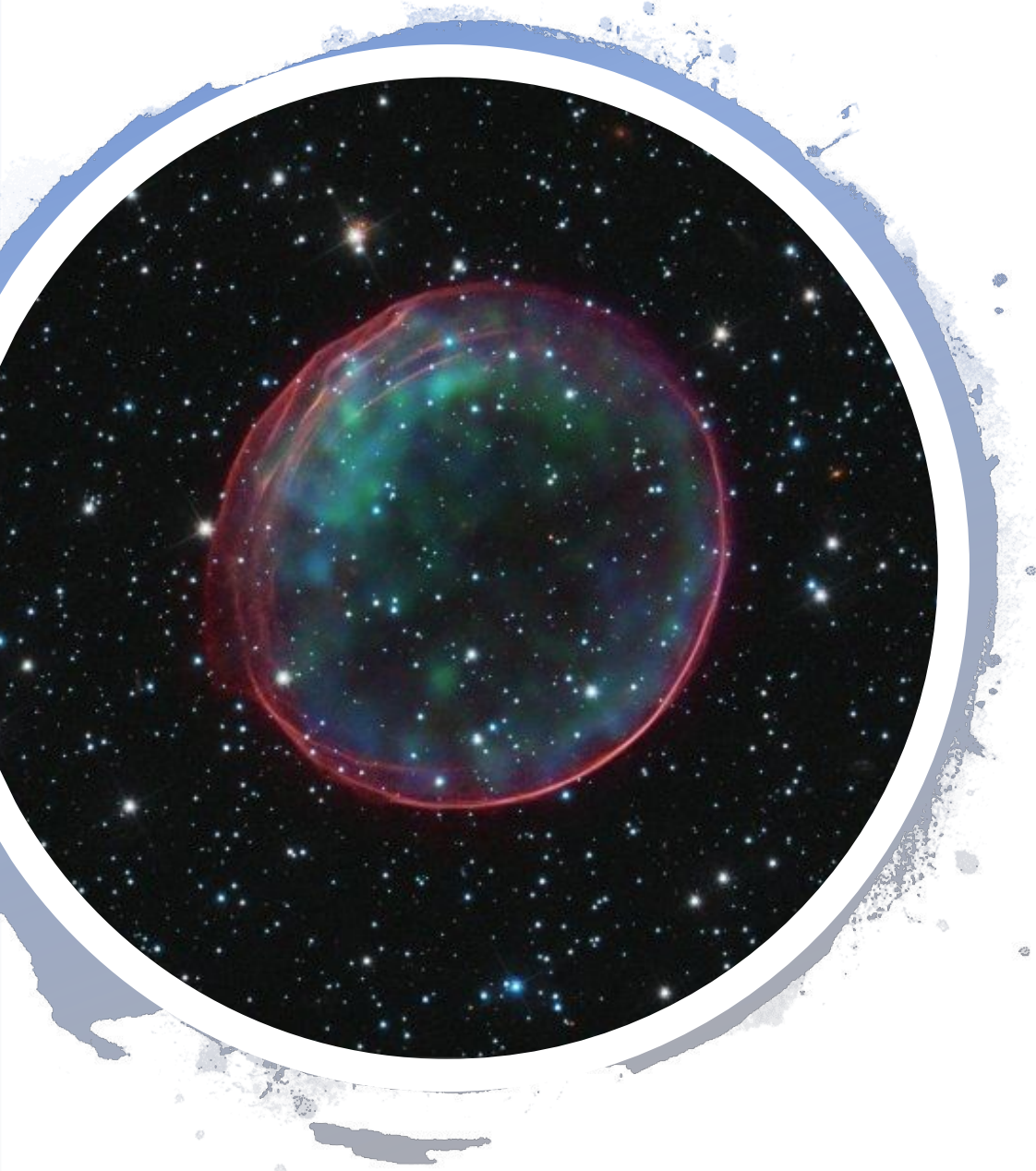
Cosmic Microwave Background Radiation (CMBR)

- Astronomers discovered cosmic microwave background radiation (CMBR) in 1964.
- This comes from all directions in space.
- The CMBR is the remains of the thermal energy from the Big Bang, spread thinly across the whole Universe.
- The discovery of the CMBR, after it had been predicted by the theory, provided very strong support for the Big Bang theory, and led to the Big Bang becoming the currently accepted model of the development of the Universe.

Steady State Theory



- Another theory about the Universe is called the Steady State theory. This was proposed in 1948 by 3 Oxbridge professors: Fred Hoyle, Thomas Gold, and Hermann Bondi
- It states that the Universe has always existed, and that the Universe is expanding and is constantly creating matter as the Universe expands.
- This idea is supported by the red shift evidence, but not by the CMBR.
- After the discovery of the CMBR, the Steady State theory lost support and is no longer considered likely.



Future of the universe

- Since 1998, astronomical observations of supernova have suggested that distant galaxies are moving away increasingly faster. The expansion of the Universe appears to be accelerating.
- Scientists do not entirely understand how this could happen, but they have come up with an idea called dark energy.
- The nature of dark energy is still a complete mystery, but it is thought to cause the Universe to expand faster all the time.
- Another recently discovered anomaly is that galaxies seem to rotate too quickly for the mass of their stars. This suggests that there is mass in the Universe that is invisible to the instruments used by scientists.
- Scientists only know it is there because it has gravity that affects objects nearby. This unknown material has been called dark matter.