THE UNIVERSE

The universe exists. How was it created?

Two possibilities:

- The **universe has always existed**, it has an infinite past (and maybe an infinite future). If so, how the material came into being? What about a time which has no beginning?
- The **universe was born** at a definite moment in time. If so, who is "responsible" for the **"Big Bang"**? How the Big Bang was caused. What was before?

Today science tends to believe that the universe was born in a **"Big Bang"**, around 15 billion years ago.

But: Big Bang was not a "bang" like an explosion. It just marks the beginning of our universe, a state in which our universe was extremely hot and consisted mostly of energy in form of radiation milliseconds later electrons, protons and neutrons came into being. In that moment also **time** and **space** were created. There was no time and no space before, no space "outside".

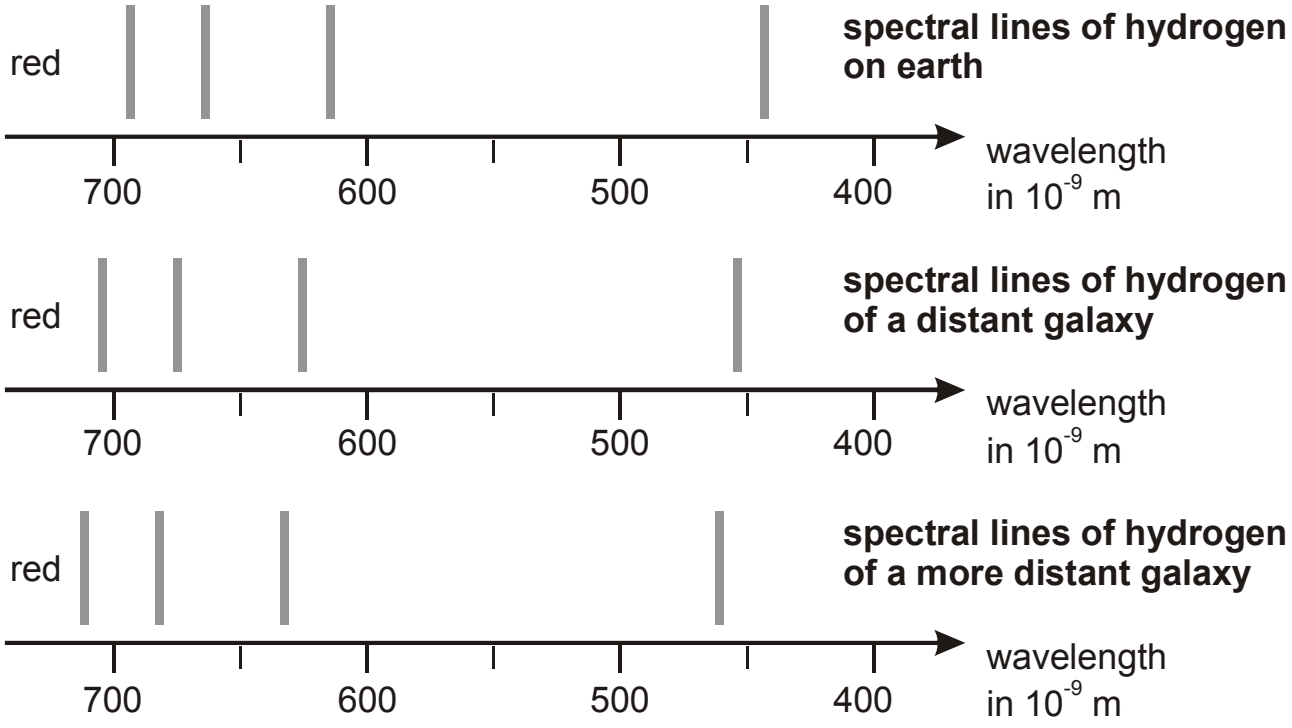
The facts:

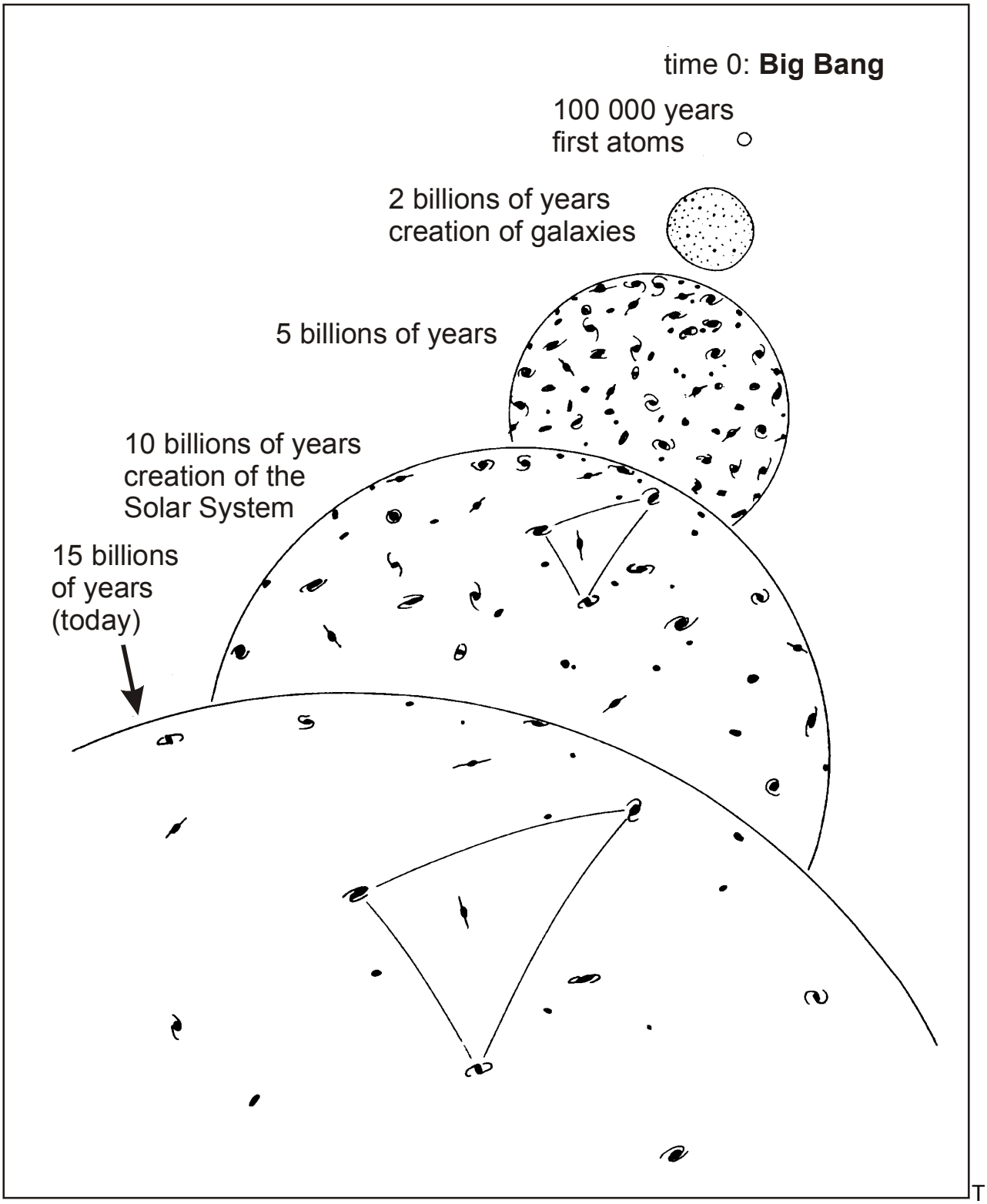
- The **universe is expanding.** We can calculate the time of its origin.
- There is a weak **cosmic background radiation** reaching us from all directions all the time. This indicates an overall temperature for the universe of about three degrees above zero (absolute zero at –273 °C). This radio emission could be the "echo" of the Big Bang, sounding through the universe. Since the universe is expanding, the **wavelength of light** (photons) also is expanding.

The universe is expanding

All distances between galaxies are increasing at a distinct rate.

All galaxies show **red shift** in their spectra.





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The velocity of the expansion is not constant. At the beginning it was quite faster, its very likely that it decreases in time.

15 billions of years: Big Bang
10 billions of years
5 billions of years
Milky Way
ENERGY
(photons, protons
neutrons, electrons)
FIRST STARS
FIRST GALAXIES
(hydrogen, helium)
NEW GENERATIONS OF STARS
(hydrogen, helium, elements up to uranium)

About past and future.

Quantum physic tells us: There is no possibility to predict the future. **The future is uncertain.** In quantum physics the law of cause and effect is no longer valide.

But we can know the past. Even we can look into the past:

- If you are observing something on the Sun, it happened eight minutes before. Because the light, who carries the information, needs eight minutes to travel from the sun to the Earth.
- If you are observing Jupiter and his moons, it would have happened 45 minutes before. Because the light needs 45 minutes to travel from Jupiter to the Earth.
- If an astronomer is observing a star exploding within our galaxy, it could have happened a 100 000 years ago, because the diameter of our Milky Way is about 100 000 light years.
- If an astronomer is observing a galaxy at a distance of 5 billions of light years, he looks at the galaxy as it was 5 billions years ago.
- If an astronomer is observing a galaxy at a distance of 12 billions of light years, he looks at the galaxy as it was 13 billions years ago. This would be the time, when the first galaxies have been built.

As the age of our universe is about 15 billion years, then, if we had telescopes big enough, could we observe the Big Bang?

No, we could not. Because in its first seconds the universe was so dense and full of energy, that no photons were able to escape and to bring the message of the Big Bang to us.

Is the universe finite or unbounded? Does it have a border?

Objects in a distance of 15 billion years are speeding away with the speed of light. So we never can be able to see behind this distance. We never will be able to know what is behind our visible universe.

Is there a centre of the universe?

No, there is no centre of the universe. Every galaxy ca be regarded as a centre of the universe.

What is the future of the universe?

There are two possibilities:

- **Open universe:** The universe will expand forever. The galaxies would get farther and farther apart, and the universe would continue to cool, it would become cold and dark.
- **Closed universe:** If there is enough matter within the universe, the gravitational forces would stop the expanding. The universe would expand to a finite size, stop and slowly start to contract. The galaxies would approach each other and the temperature would rise, the universe finally would end in a **"Big Crunch"** and this could be the start of a new Big Bang and a new universe.

Scientists rather believe the universe to be open than to be closed.

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