THE NOBEL PRIZE

Speaker's manuscript – Physics Prize 2019
New perspectives on our place in the universe

The Nobel Prize in Physics

- The Nobel Prize in Physics is one of the five prizes founded by Alfred Nobel and awarded on December 10 every year.
- Before Alfred Nobel died on December 10, 1896, he wrote in his will that the largest part of his fortune should be placed in a fund. The yearly interest on this fund would pay for a prize given to "those who, during the preceding year, shall have conferred the greatest benefit to humankind."
- The interest would be divided into five equal parts, with one part awarded to those who "shall have made the most important discovery or invention within the field of physics".

Who is rewarded with the Physics Prize?

- This prize rewards important discoveries or inventions in the field of physics.
- Guglielmo Marconi and Karl Ferdinand Braun received the Physics Prize in 1909 for the development of radio ("wireless telegraphy"). Subramanyan Chandrasekhar received the 1983 prize for studying processes of importance to the structure and evolution of the stars. Pierre and Marie Curie for pioneering research on radiation, awarded 1903.

The 2019 Physics Prize

- The 2019 Nobel Prize in Physics is all about the universe and its history. One part of the prize is about theories of how the universe evolved and what it consists of. For example, there seems to be "dark matter" and "dark energy" that we don't yet know anything about.
- The other part of the prize is about planets in other solar systems. The discovery of a planet orbiting around a star similar to our own sun raises questions about whether there may be life elsewhere in the universe.

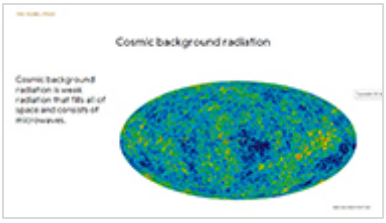
The Nobel Laureates

- One half of the prize was awarded to James Peebles for his theories about the universe and its evolution. Peebles was born in 1935 in Canada. He has been affiliated with Princeton University in the United States.
- The other half of the prize was awarded jointly to Michel Mayor, who was born in 1942, and to Didier Queloz, born in 1966. Both are from Switzerland and are affiliated with the University of Geneva.

The Big Bang

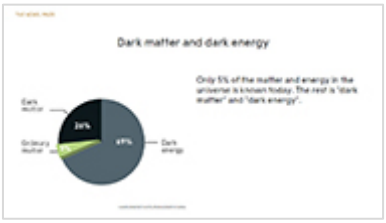
- How was the universe formed? The universe that we can perceive began as an enormously dense gas, made up of various kinds of particles that collided with each other. This gas originated about 14 billion years ago and rapidly grew in size. This is called the Big Bang.
- Eventually everything cooled. Protons, neutrons and electrons began to clump up and form the matter that stars, planets and we ourselves consist of.

Cosmic background radiation



- Since the 1960s, James Peebles has developed theories that have increased our understanding of how the universe evolved. Among other things, his theories are about "cosmic background radiation".
- According to these theories, when the universe cooled after the Big Bang it should have released radiation in the form of microwaves – a kind of light with less energy than visible light. This weak background radiation should exist everywhere in space even today. When such radiation was discovered in 1964, this confirmed the theories of Peebles and his colleagues about this relic of the Big Bang.
- Peebles and his colleagues also said that this background radiation should vary and look a little "lumpy", since clouds of matter had begun to gather into galaxies and galaxy clusters due to gravity. With the aid of satellites, it has been possible since the 1980s to measure background radiation very precisely. The results indeed look a little "lumpy".

Dark matter and dark energy



- Peebles' theories have help clarify our image of the universe, but many questions remain unanswered. For example his theories – combined with measurements of background radiation – show that there must be more matter and energy in the universe than we can see. Only 5% consists of matter that is visible to us.
- Peebles has advanced the concept of "dark matter", which has weight but cannot affect us in any other way. This might explain some of the missing matter, but only around 26% of it. There must also be "dark energy", which today we don't understand at all. Such "dark energy" makes up about 69% of the universe.

Stars and planets

- After the Big Bang, galaxies, stars and planets formed when clouds of dust and gas were drawn together by gravity. For a long time, scientists have suspected that other stars besides our sun also have planets orbiting around them. But it has only been possible to observe them in recent years. Planets in other solar system are called exoplanets.

Searching for exoplanets

- Discovering exoplanets requires precise measuring methods. One method is based on measuring small variations in the colour of the light from the star. This is because a star with planets has a slight wobbling motion.
- The so-called Doppler effect causes an object that is moving away from us to become redder and an object approaching us to become bluer. This enables us to measure the star's wobbling movements and determine whether it has a planet.

The exoplanet 51 Pegasi b

- In 1995 Michel Mayor and Didier Queloz announced that they had discovered a planet that orbits a star similar to our sun. This planet is called 51 Pegasi b and is found in the Pegasus constellation.
- The planet is about 50 light years away from our Earth. It moves rapidly around its star, taking only four days to complete its orbit, and it is very close to its star. As a result, its temperature is 1,000 degrees C and the planet is unlikely to support any life.

Life on other planets?

- Could there be life elsewhere in the universe? This question is waiting for an answer. But before we find the answer, many other questions remain unanswered. What are conditions like on other planets? How hot or cold are they? What are they made of? Are they surrounded by an atmosphere? Is there water and oxygen, which are an important basis for life on our Earth?

- If so, we will start moving closer to answering the question about life elsewhere in the universe. As Didier Queloz said in an interview soon after the prize announcement, "One day, eventually, we will be talking about life."