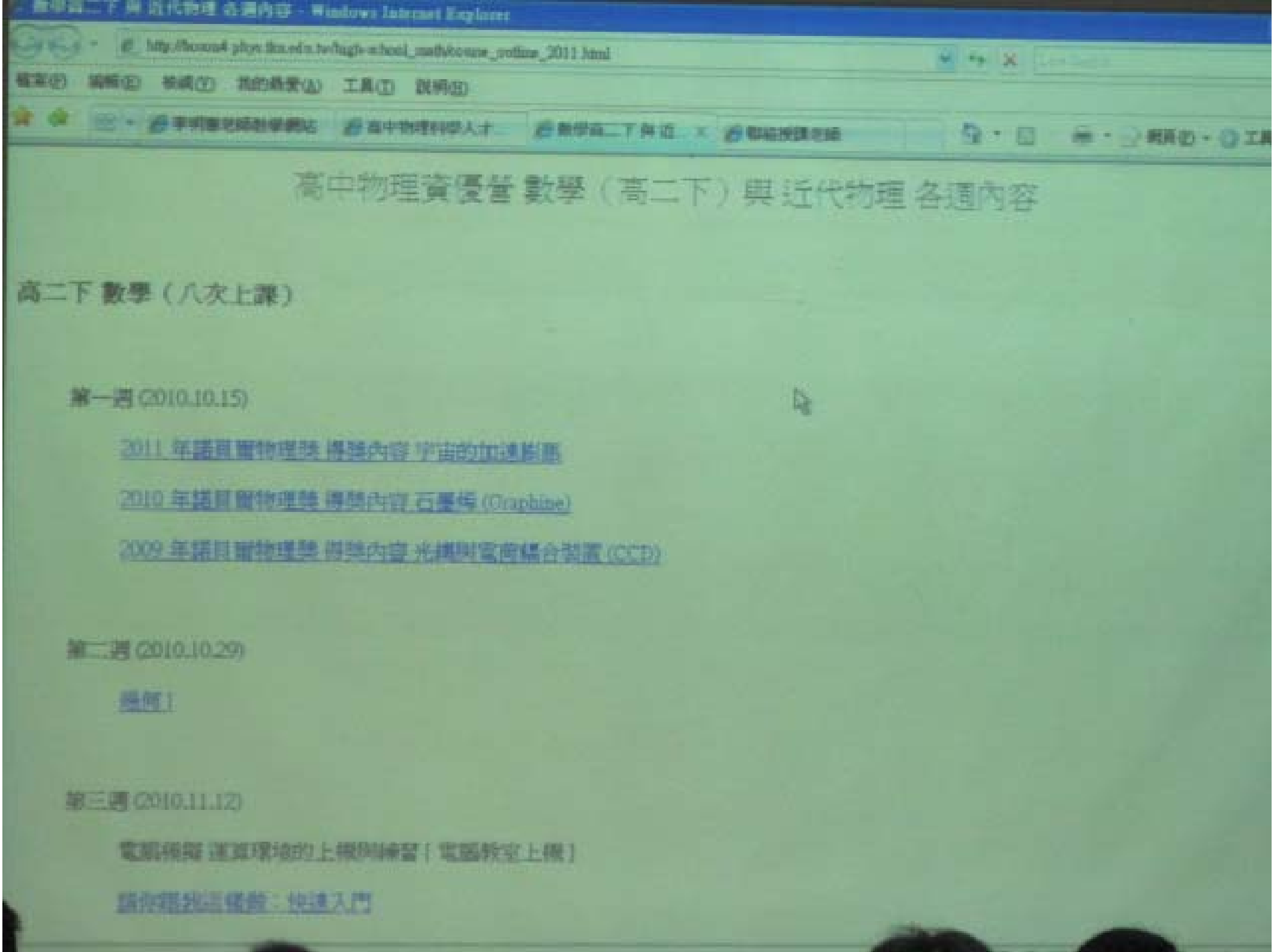
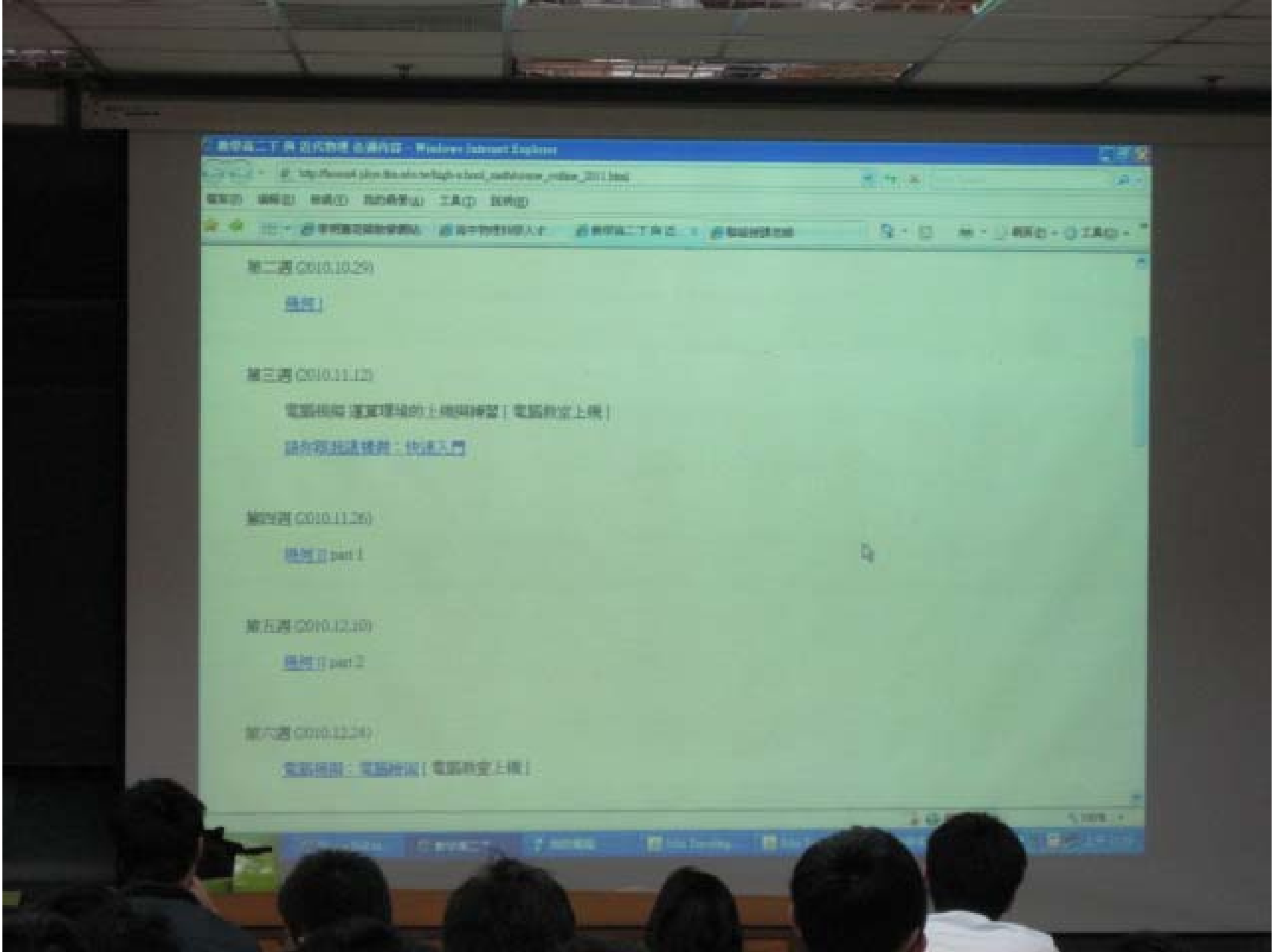

高中物理資優營 數學（高二下）與近代物理 各週內容
高二下 數學（八次上課）
第一週 (2010.10.15)
2011 年諾貝爾物理獎 得獎內容 宇宙的加速膨脹
2010 年諾貝爾物理獎 得獎內容 石墨烯 (Graphine)
2009 年諾貝爾物理獎 得獎內容 光纖與電荷耦合裝置 (CCD)
第二週 (2010.10.29)
極限 I
第三週 (2010.11.12)
電腦視窗 運算環境的上機與練習 [電腦教室上機]
請你搞懂這個數：快速入門

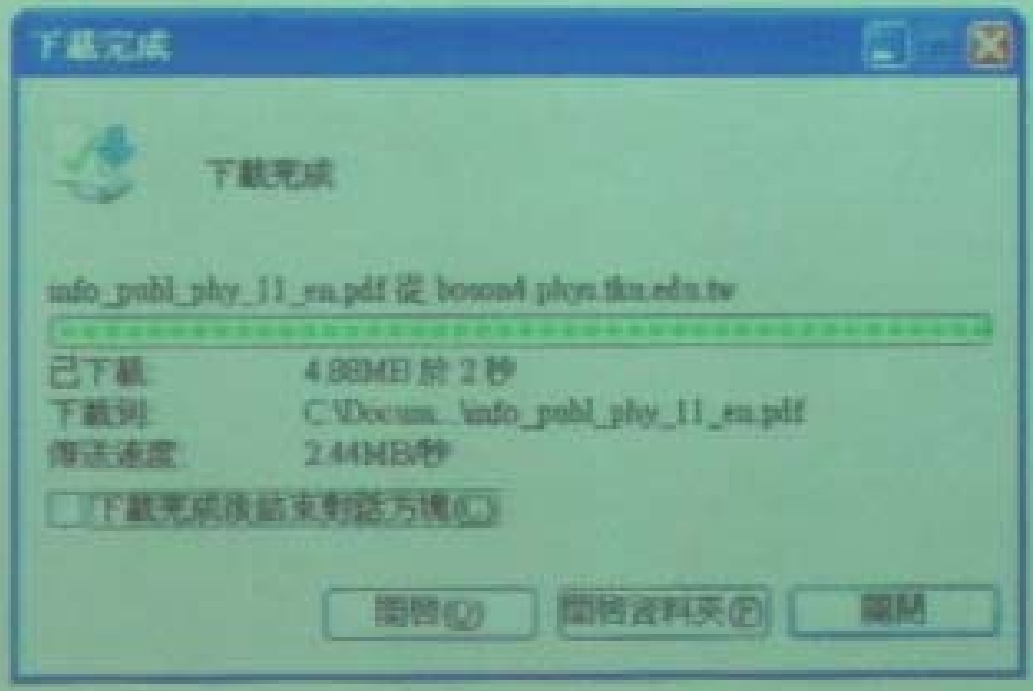

第二週 (2010.10.29)
第三週 (2010.11.12)
第四週 (2010.11.26)
第五週 (2010.12.10)
第六週 (2010.12.24)

2011 年諾貝爾物理獎 得獎內容

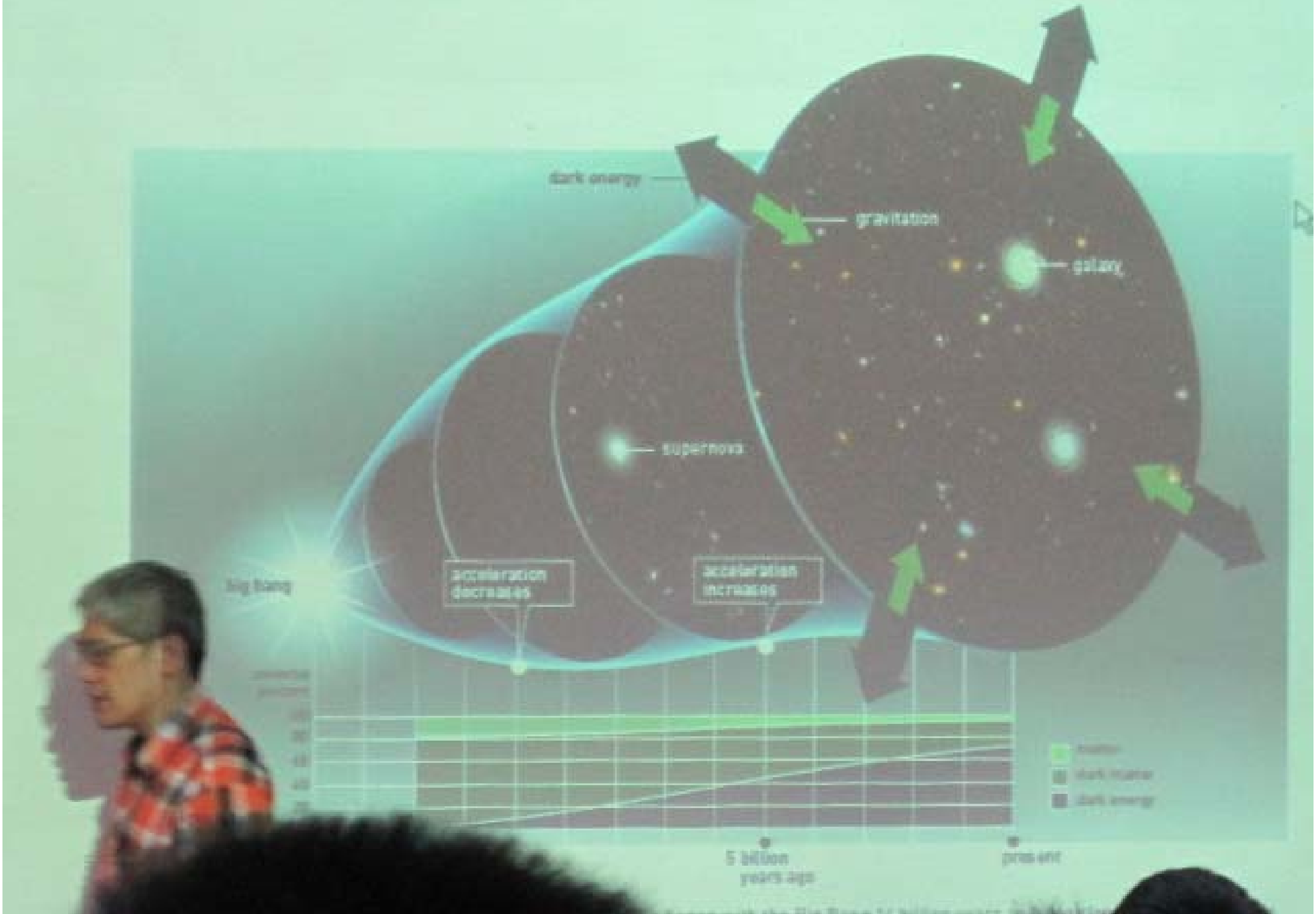
宇宙的加速膨脹

官方檔案

科學背景



lar seemed to be happening across the entire Universe.



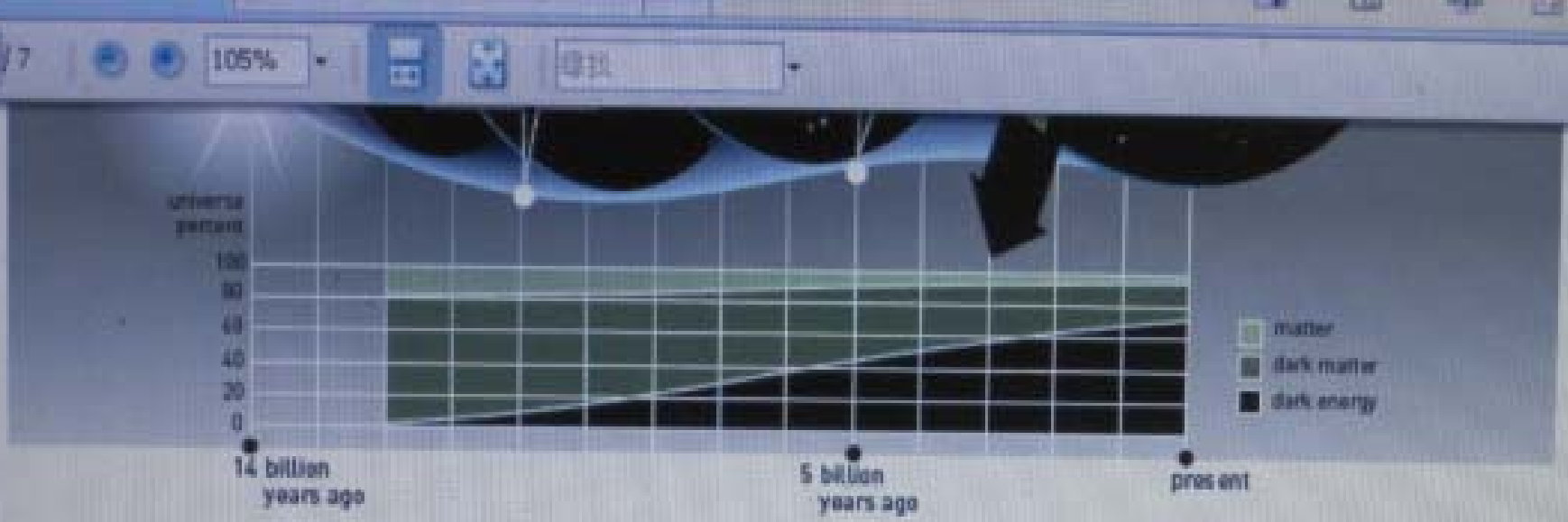


Figure 1. The world is growing. The expansion of the Universe began with the Big Bang 14 billion years ago, but slowed down during the first several billion years. Eventually it started to accelerate. The acceleration is believed to be driven by dark energy, which in the beginning constituted only a small part of the Universe. But as matter got diluted by the expansion, the dark energy became more dominant.

The growing rate of the expansion implies that the Universe is being pushed apart by an unknown form of energy embedded in the fabric of space. This *dark energy* makes up a large part of the Universe, more than 70 %, and it is an enigma, perhaps the greatest in physics today. No wonder, then, that cosmology was shaken at its foundations when two different research groups presented similar results in 1998.

Saul Perlmutter headed one of the two research teams, the Supernova Cosmology Project, initiated a decade earlier in 1988. **Brian Schmidt** headed another team of scientists, which towards the end of 1994 launched a competing project, the High-z Supernova Search Team, in which **Adam Riess** was to play a crucial role.

The two research teams raced each other to map the Universe by finding the most distant supernovae, star explosions in space. By establishing the distance to the supernovae and the speed at which they are moving away from us, scientists hoped to reveal our cosmic fate. They expected to find signs that the expansion of the Universe was slowing down, which would lead to equilibrium between fire and ice. What they found was the opposite – the expansion was accelerating.

Figure 2a. *Twinkle, twinkle, little star, how I wonder where you are...*

Cosmos is growing

Cosmos is growing

It is not the first time that an astronomical discovery has revolutionized our ideas about the Universe. Only a hundred years ago, the Universe was considered to be a calm and peaceful place, no larger than our own galaxy, the Milky Way. The cosmological clock was ticking reliably and steadily and the Universe was eternal. Soon, however, a radical shift would change this picture.

At the beginning of the 20th century the American astronomer Henrietta Swan Leavitt found a way of measuring distances to faraway stars. At the time, women astronomers were denied access to the large telescopes, but they were frequently employed for the cumbersome task of analyzing photographic plates. Henrietta Leavitt studied thousands of pulsating stars, called *Cepheids*, and found that the brighter ones had longer pulses. Using this information, Leavitt could calculate the intrinsic brightness of Cepheids.

If the distance of just one of the Cepheid stars is known, the distances to other Cepheids can be established – the dimmer its light, the farther away the star. A reliable standard candle was born, a first mark on the cosmic yardstick that is still used today. By making use of Cepheids, astronomers would soon conclude that the Milky Way is just one of many galaxies in the Universe. And in the 1920s, the astronomers got access to the world's then-largest telescope Mount Wilson in California, so they were able to show that almost all galaxies are moving away from us. They were studying the so-