PROFESSOR: Hello. In this lecture, we talk about parity and parity violation. So we talk about a discrete symmetry. A little bit of history in particle physics-- Lee and Yang in the 1950s wondered if there's any experiment testing parity invariance.

There are many tests which had to do with a strong interaction and the electromagnetic interaction. But as it turned out, parity invariance had never been tested in the weak interaction. And so Lee and Yang were motivated in this because it was a puzzle at the time, so-called tau-theta puzzle, which turned out to be kaon decays into various articles.

And then that puzzle, they solved the case with the same lifetime, but different spin states. And so they couldn't quite understand this, and were trying to understand whether or not one can have an experiment to test this. The experiments they proposed is one where you look at the nuclei and observe beta decay.

So there's an electron coming out of the beta decay. If you are able to align the spin of the nuclei and put it in front of a mirror, you see that the physics going to the mirror state is not [INAUDIBLE] parity. You see that in the mirror, the spin is the opposite direction, but the momentum of the electrons, the electrons still come out on the bottom. So there's clearly some change in the physics going on in the mirrored state.

So Madame Wu actually took up this idea, and immediately tested this in the same year. She was a Chinese-American physicist, born in China, and then studied in Berkeley together with famous people there. Lawrence is one of them.

After the war or in the war, she joined the Manhattan Project and made very, very important contribution to the Manhattan Project based on her thesis work. As a fun fact, she was married to another Chinese-American, the grandson of the first President of the Republic of China. As I said, in 1956, she conducted the Wu experiment, and in the following year received the Nobel Prize in physics for the finding.

So really briefly, we're going to have another discussion of the Wu experiment later on. What she did here is she studied cobalt 60 decay to nickel, beta decays. And what she was able to do experimentally with the magnetic field, align the cobalt 60, and then just count the number of electrons coming out.

And it turns out that the number of electrons coming out of the bottom and the top are not the same. She did this by reverting a magnetic field. And the experimental data is shown here.

You see as a function of time, you just look at counting, which is a function of time after injecting the probe, and you revert. You do the measurement by reverting the magnetic field. And you see very clearly here that there's asymmetry in the beta decays.

And that asymmetry immediately tells you that there has to be parity violation in beta decays or in weak interaction. So she found that this specific picture here violates parity. And this is a dramatic signature of the weak interaction. And we will later see how we can actually understand it.

Note that parity is conserved in electromagnetic interaction and strong interaction. One more word on parity inversion-- you can define a parity operator. And if you apply this parity operator, for example, on the vector, these x, y, and z components you simply turn the direction over here with a minus sign.