PROFESSOR: If you have potential transmission coefficient for a potential where z0 is equal to 13 pi over 4. That's a square well of certain depth, and we represent it in this way. Remember n must be greater than or equal than 2z0 over pi. So this will be 13/2. And 13/2 means that we can start with n equals 7, 8, 9, and all those.

Remember, this n counts which bound state of the infinite square well you're talking about. And the energy that you must use are your integers, are positive energy. So positive energies mean that you have sufficiently large n, and the n that this sufficiently large is 7 in this case.

So you can then determine from this formula what is the value of e n over v0. So for example E7 over v0 turns out to be 0.15976. E8 over v0 turns out to be 0.514793. And E9 over v0 is 0.91716.

So if you plot it, you have here E, or capital energy, over v0. And you want to plug the transmission probability. And it begins with 0. That was the question a second ago. And then it may reach 1. And it will reach 1 at each one of those values. So if, here is 1, 0.15. There will be 0.15, 0.51, and 0.92. So you get this, and here another one, and here another one. Probability like that.

So that's a typical graph for the transmission probability. It oscillates, and it reaches 1 at several points forever and ever. And the amplitude become smaller, so it's really overall tending to 1.

So these two people we're talking about, Ramsauer and Townsend. They lived from 1860s to 1940s and '50s. And they did their famous experiment in 1921. So their experiment was elastic scattering of low energy electrons off of rare gas atoms. So Ramsauer and Townsend, in 1921, they scattered elastically. That means the particles didn't change their identities. They didn't create more particles. It was just electrons came in and electrons went out. Electrons. And these are low energy electrons, off of rare gas atoms.

So these are noble gases. Their shells are completely filled. And they're rather inert, very unreactive, high ionization energies, no low energy states you can scatter these atoms into. So basically very unreactive atom.

And you can imagine it as a very beautiful spherical cloud. We can draw some electrons, there's some protons, a nucleus here, and an electron cloud. So how does this look to an electron? Well, you know from electrostatics that if you have total charge 0 and it's totally spherically symmetric, no electric field outside. So the electron comes in, feels nothing. And as soon as you penetrate this, at any point here, the electric field points in. Or, well, it actually points out, but the electron will feel a force in. Because the charge in the outside shell doesn't produce any field. But now, the protons in the nucleus beat the effect of the electrons.

So there's a force in, a force in, that goes in. So basically this is like a deep square well, or spherical well, representing the atom. The atom can be some sort of spherical well that attracts the electrons.

So what these people did were throwing these electrons. And they considered that this electron scattered a lot when they bounced back. On the other hand, if they continued, if the electrons pass by, they said nothing has happened. So the reflection coefficient for them, the reflection coefficient. Reflection coefficient is a proxy, a good representation for the scattering cross-section.

So the reflection coefficient, what they found experimentally was a reflection coefficient, R, that as a function of energy was very high. And people thought at this moment, OK, these are like particles colliding with particles. Their energies shouldn't make much difference, you know. You either collide or you don't collide, and you bounce back or you don't bounce back.

So they thought that this would be flat. But nevertheless, it actually went down enormously, and then it went up again. So they found that for electrons with about 1 Ev, that's very low energy electrons, but they were going pretty fast. And E1, Ev electron is going like at 600 kilometers per second.

So the reflection was going like this. And they had no explanation why it was so sensitive with energy, and why there would be a funny effect going on, that the reflection would suddenly go down, and just basically the particles would get transmitted. But if you think of reflection here as a continuous line and transmission as a dotted line, the transmission that must alter the reflection to be 1 would be going up here and would have reached near 1 at this value of the energy.

So the explanation eventually was this effect, that you should do well and there is a resonant effect in the well, and for some energies the resonance is such that it allows the particles to just go through and not scatter.

So this had to wait some time, because the experiment was done in 1921, and Schrodinger and everybody started doing good work in 1925, and of wave mechanics took a while. But eventually it was recognized that basically it's resonant transmission, what is happening there.

Well, if you want to get the numbers right, if you want to get that Ev better, you have to do a spherical model of the square, finite square well, you have this spherical well, and do it a little more precisely. But then the agreement is pretty reasonable.