MARKUS KLUTE: Welcome come back to 8.701. In the previous lectures, we studied how to read Feynman diagrams, how to calculate amplitudes and phase space. And we are able to use this using from Fermi's golden rule in order to calculate lifetimes and [INAUDIBLE] cross-sections.

We exercise this with a toy theory and simple examples. But we focused on leading order or tree-level diagrams. So in this lecture, I just wanted to introduce some features of higher-order diagrams, which are rather important.

So we started off with our toy theory where we have a primitive vertex where three particles that are going into action. The strength of the interaction or the coupling has-- we just label this as g. And then we can use this primitive vertex in order to build up scattering processes.

And here we want to consider the process of two particles A going to two particles B. And they do this by exchanging a particle C. This is the lowest order diagram, or sometimes called the leading order, or sometimes called the tree-level diagram.

So how do higher-order diagrams now look like. Here's the first example. And this example is one where one of the legs involved, or one of the particle involves, has a correction to its own mass and energy. This is the so-called self-energy diagram. And if you do the counting correctly, you find that there's five of those diagrams.

Here shown, we have a correction of particle A. But you could also have a correction of particle C or B in the outgoing legs and obviously also in this particle here.

The second form of diagrams is one where you correct the vertex involved. So here there's two diagrams correcting each of the vertices, and so this is shown here. So apparently this changes then how the vertex actually looks to the outgoing legs.

So instead of directly interacting in this primitive vertex, you have this interaction here in those two additional vertices here. So this changes intrinsically how the interaction, how the strength of the interaction looks like.

And then there's the form of diagrams which we discussed in the context of CP violation, so-called box diagrams where you just go around in a box. That's why they're called box diagrams. And apparently also here you change the strength of the interaction involved.

So those are three varieties of classes of higher-order diagrams. And we will see much more of those when we talk about QED, the weak interaction, or QCD later on. The strength of the individual couplings involved and the particles involved changes in how the resulting features of interaction change using those diagrams.