MARKUS KLUTE: Welcome back to 8.701. In this short section, you're going to look at the weak interaction a little bit more, and specifically discuss neutral currents. We looked in some detail at charged currents-- specifically, the interaction with quarks. So here, I'm going to look at the Z boson specifically, and the weak interaction via the neutral current.

So studying those two processes here, where there is an electron and a positron through some process including a Z boson and a photon and resulting in a muon and an anti-muon-- those processes have been studied in great detail at SLAC and at CERN, at the SLC, and the Large Electron-Positron Collider. So if we want to calculate the cross-section and study the cross-section of the center of mass energy, we see a number of interesting effects.

At low energies, and at very large energies, the cross-section runs with 1 over the energy squared. But at the mass of the Z boson, we see this enormous resonance here. The cross-section at the resonance from the Z boson is about 200 times that of just a photon exchange. So this allows you to study the Z boson with great precision at those colliders. You have sizable cross-section when you are in electron-positron colliders. And then you can, with precision, look at, what is the rate into a muon/anti-muon? What is the rate into a quark/anti-quark? And so on. And you can study the mass, the width of the Z boson with an enormous level of precision.

Again, so I will not go into too much detail here. And please have a look at chapter 9.6 in Griffiths, for example. But there's many other resources where you can learn more about [? neutral ?] currents. Neutral currents, electroweak neutral currents are specifically important in the study of neutrinos, as we will discuss more in the lectures as well.