MARKUS KLUTE: Welcome back to A20 special relativity. In this section, I am going to talk about the deuteron, which is one of the two stable isotopes of hydrogen. The atom is called deuterium.

The nucleus actually contains one proton and one neutron. So it's quite simple. And so we can use this as an example to understand the concept of binding energy and how we can create objects of heavier mass or nuclei of heavier mass.

We can do this by bringing protons and neutrons together. And when we do that, they have a likelihood of binding together to deuterium. And they release an energy in form of a photon of 2.3 mev

So the way to understand is that the combination, the bound combination of the protons and neutrons have more favorable energy state, which is visible in this nuclear potential here. So the deuteron lives as a combination of the proton and the neutron here. In order to now split up the deuteron, which is stable, we have to add energy. We have to add at least 2.3 mev of energy in order to release the proton and the neutron and make them free.

The natural abundance of deuterium in the Earth is rather limited with 0.0115% in the Earth. But, nevertheless, deuterium is extremely useful and extremely important in the evolution of the universe, in the synthesis of more heavier elements, as it's kind of a part of the chain, which allows the creation of helium. And then helium can be used in order to create even heavier nuclei.

To give you a sense in the numbers, the mass of the neutron is 2.01355 in atomic units. The mass of the proton is about one. The mass of the neutron is a little bit bigger, but also about one. So in order to now get the binding energy-- so the energy, which is kind of stored in the deuteron, when it's binding together, the proton and the neutron can be accessed by adding the proton, and the neutron mass, and subtracting the mass of a deuteron.

Again, that's a minimal energy needed in order to free up the proton and the neutron. If you add more energy, then you actually also give kinetic energy to the proton and the neutron in this reaction. The deuteron was discovered in 1934. And it's fundamental also in production of hydrogen bonds, which were produced about 20 years later.

So the deuteron itself is a rather important nuclei. Again, as I said before, it's fundamental. It's stability is fundamentally important in nuclear synthesis after the Big Bang.