Nuclear duo

Business

Throughout our school years students at our school and many other schoolshave done experiments with the forces of gravity and electromagnetism. We made marble roller coasters and electromagnets, both examples of gravity and electromagnetism. However there are four fundamental forces to our knowledge and the other two are the nuclear forces. There is the strong and weak nuclear force. The strong nuclear force holds quarks and the nucleus of atoms together, and the weak force allows particles to be transformed into other particles. The strong nuclear force is much easier to understand than the weak force and almost as simple as gravity.

First off, it is a force, so how strong is it? Well if the strong force's strength was one, then electromagnetism is 1/137 as strong, the weak force is 1 millionth as strong, and finally gravity would be six duodecillionths as strong (HyperPhysics). This immense strength is extremely important as it allows the nucleus of an atom to stay together without being ripped apart by the repulsion between positively charged protons. This force also has a limited range that is about the size of a medium-sized atom's nucleus, however, its strength does not diminish over distance and remains constant (HyperPhysics). Though before we go deeper, we must cover that for a particle to be affected by the strong force it must have a " color" charge and not in the visual way (Particle Adventure). This is similar to how we say things have an electric charge, if they are charged, they are affected by magnetism and electricity.

Now it's time to delve deeper into protons and neutrons. Protons and neutrons are composed of particles called quarks and these quarks have color (Particle Adventure). There are three different " colors" a quark can be red, green, or blue (HyperPhysics). In a particle that is made of quarks there can be only one of each color or else they will not form larger particles (HyperPhysics). Next, these quarks can also have electric charge and thus endow the particles they constitute, like protons, with electric charges (Jefferson Lab). Lastly, the particle that carries the strong force is called the gluon and it is exchanged between quarks (HyperPhysics).

The strong force is just as important as the rest of the forces. It allows for stars to shine by allowing nuclear fusion and stops matter from dissolving into a stew of quarks. The weaker brother of the strong force is the weak force, though the weak force is much less of a force and more like a mechanism. The key property of the weak force is that it can change the color and electric charge of a quark (HyperPhysics). An example is with radioactive materials.

In a certain type of decay called beta positive decay, the weak force will cause an atom to emit two subatomic particles and change a proton into a neutron thus changing the element (Britannica). The weak force is actually responsible for all types of radioactive decay and works with the strong force to make stars shine(HyperPhysics). You may already know that a star is mostly Hydrogen, the type with only a proton and an electron, and by looking on a periodic table you see Helium has ideally two protons and two neutrons (HyperPhysics). Under extreme pressure in a star two hydrogen atoms will fuse forming Deuterium (HyperPhysics). Deuterium has a proton and a neutron and this neutron was created by the weak force converting a proton in one of the original Hydrogen atoms into a neutron (HyperPhysics).

This is key as it allows the strong force to now combine the Deuterium into Helium and this process the produces the majority of a star's energy (HyperPhysics).

Now if you were to take an even closer look at the weak force you would realize it has a secret below its surface. Just as electricity and magnetism are different sides of the same coin, so is electromagnetism and the weak force (Particle Adventure). At extremely short distances, the strength of the weak force and the electromagnetic force are identical (Particle Adventure). The reason for the belief that they are completely different is that the particles that carry the weak force, the W and Z particles, have extremely high masses while the photon has no mass whatsoever (Particle Adventure). And it takes an extreme amount of energy for the two forces to completely unify until they disunify when the energy level begins to drop (HyperPhysics). Without the weak force electromagnetism would not exist since they are one in the same.

This would mean no stars, no complexity to our Universe, and life would certainly not be possible. To sum it all up, the strong and weak force are incredibly important to the world as we know it. The strong force confines quarks inside protons and neutrons and then goes on to hold those particles together making atoms even possible. The weak force allows for the transformation of quarks making decay of unstable elements possible and works hand in hand with electromagnetism and the strong force allowing for complex elements and compounds. If either of these forces ceased to exist we would not be able to exist and the Universe would become fundamentally different. Works Cited “ Forces.

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