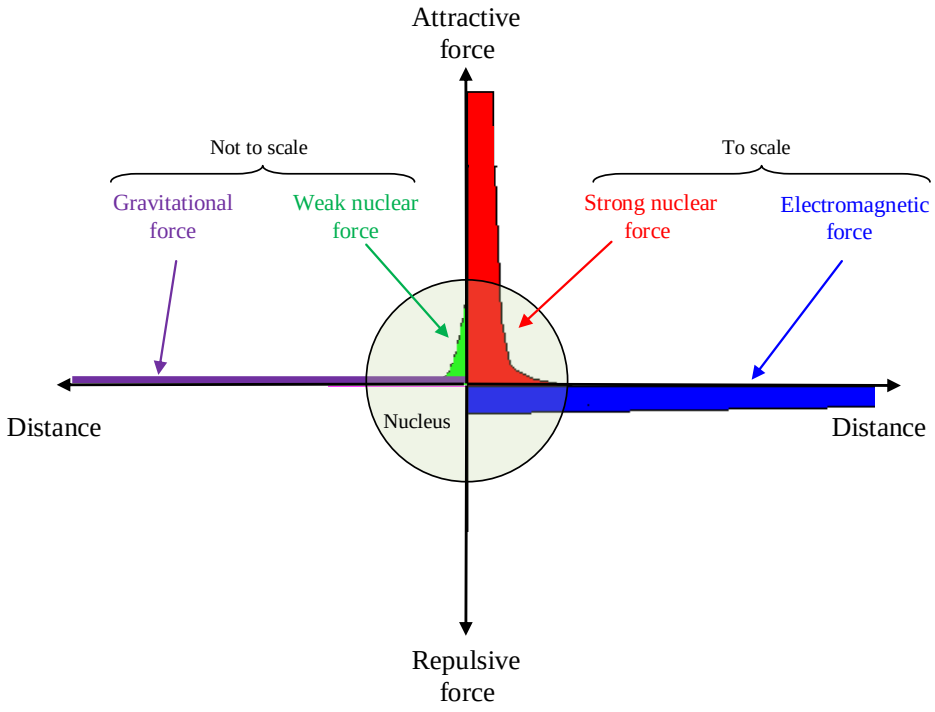
What Keeps the Nucleus Together?

The law of electrostatics says that like charges repel. So, if a nucleus contains two or more positively charged protons, they should repel each other. But in that case, why doesn't the nucleus fly apart? The answer to this question involves the *four fundamental forces* of nature.

We all have a practical familiarity with the first, gravity. Because gravity's attraction depends on the mass of the objects involved, its effect on the very light protons and neutrons in the nucleus is too small to measure. The second force, the one in which chemists are most interested, is the *electromagnetic force.* Existing both inside and outside the nucleus, it acts between electrically charged or magnetic objects and is the source of the 'like charges repel, unlike charges attract' rule.

Both of the other two forces operate only within the nucleus. They are called the "*strong nuclear force*" and the "*weak nuclear force*". The weak force is stronger than gravity, but weaker than an electric force; its presence is only apparent in certain forms of radioactivity. The strong nuclear force pulls together protons and neutrons in the nucleus. At very small distances only, such as those inside the nucleus, this strong force overcomes the electromagnetic force, and prevents the electrical repulsion of protons from blowing the nucleus apart.



Ranges and relative strengths of the four fundamental forces between two protons. The sizes of the colored areas indicate the relative strengths of the forces. For visibility, those for the gravitational and weak nuclear forces are greatly exaggerated. Inside the nucleus, the attractive strong nuclear force between protons outweighs the repulsive electromagnetic force and keeps the nucleus stable. Outside the nucleus, the electromagnetic force is stronger and protons repel each other.