

## 21.1: Electric Charge

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September 24, 2024

Electromagnetic interactions involve particles with electric charges, which is a fundamental attribute of matter.

**Def:** Two same charged particles will repel each other, while two different charged particles will attract each other. This attractive / repulsive force is called the **electromagnetic force**.

The most fundamental charged particles are quarks, the building blocks of matter. Quarks have either  $\pm\frac{1}{3}$  or  $\pm\frac{2}{3}$  charge. These quarks make up charged particles called electrons and protons. An electron has a mass of  $9.109 \times 10^{-31} kg$  and a proton has a mass of  $1.673 \times 10^{-27} kg$ . Electrons are negatively charged, and protons are positively charged.

**The Conservation of Charge:** The sum of all electric charges in any closed system is constant.

Charging an object really means transferring electrons from one object to another. The object losing electrons develops a positive charge, and the object gaining electrons develops a negative charge.

**Quantization of Charge** The smallest unit of charge that can exist in an independent particle is the magnitude of charge of a proton/electron.

Quarks can have fractional charges, but have never been observed independently, only bonded in groups that make a whole charge.