# Electricity

## Static electricity (charges)

## Electrical current (circuits)

## Magnetism

St. Elmos fire (actually a plasma at sharp points on ships mast generated in thunderstorm or near volcanic eruption eruption



## STATIC ELECTRICITY

**Historical.** Amber rubbed with fur attracted light objects; cat fur, paper, polystyrene balls…

Attributed to Greek mathematician Thales of Miletus (624-546 BC) [first philosopher in Greek tradition][used geometry to calculate height of pyramids]

Everyday occurrences:

Lightning, sparks (matches), St. Elmos fire….



## Origin is in the structure of atoms

**Greek:** ἤλεκτρον "**elektron**" for amber

Lightning over central Florida (Universities Research Association)

## Atoms electrons (-ve charge) in outer "orbits" around nucleus (+ve charge)

Rub plastic rod with fur, outer electrons stripped from atoms and end up on rod. Two such rods repel (like charges repel).
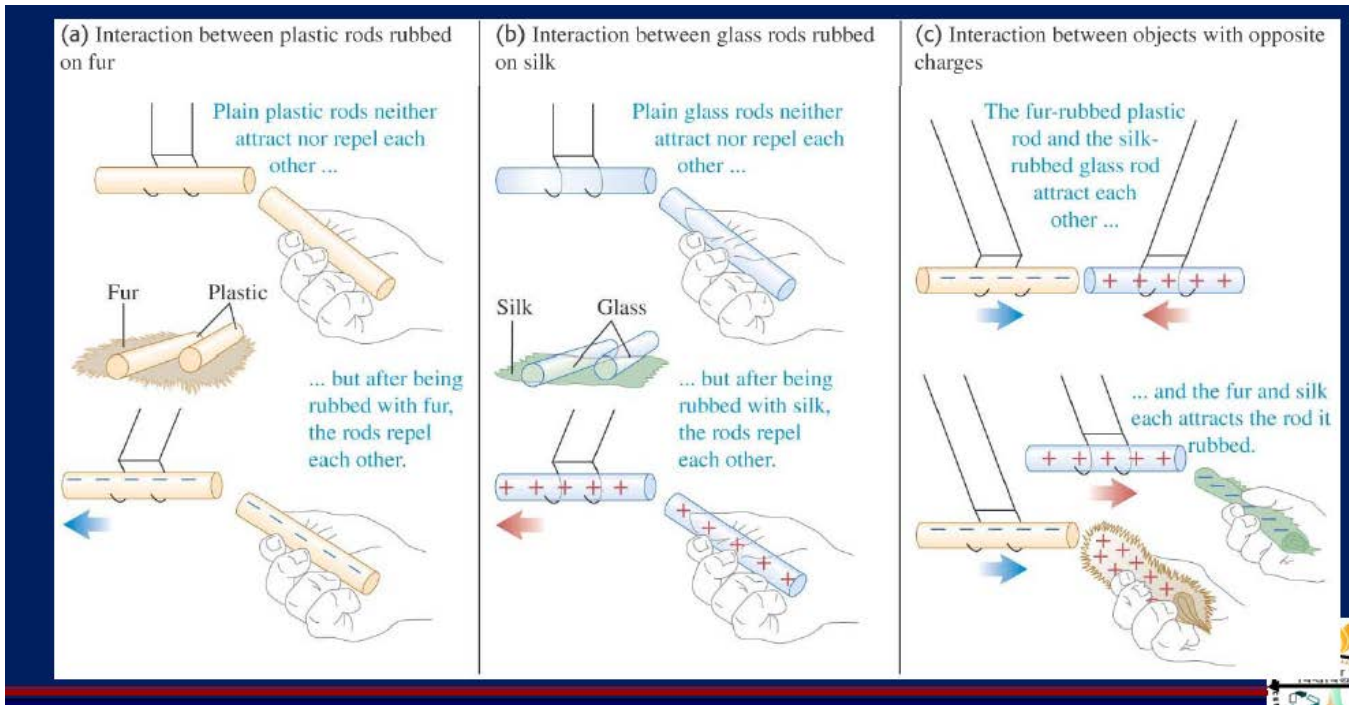
Rub glass rod with silk, electrons stripped from glass, two such glass rods repel but the glass rod and the plastic rod attract. TWO types of charges.

Convention:  electron has negative charge.  Object deficient in electrons will hold a positive charge.

Like charges repel, unlike charges attract.

**(a)** Interaction between plastic rods rubbed on fur

Plain plastic rods neither attract nor repel each other ...

Fur    Plastic

... but after being rubbed with fur, the rods repel each other.

**(b)** Interaction between glass rods rubbed on silk

Plain glass rods neither attract nor repel each other ...

Silk    Glass

... but after being rubbed with silk, the rods repel each other.

**(c)** Interaction between objects with opposite charges

The fur-rubbed plastic rod and the silk-rubbed glass rod attract each other ...

... and the fur and silk each attracts the rod it rubbed.

**Credit: P. Ravindran, PHY041 January 2103xperiments**

**Charles-Augustin de Coulomb (1736-1860), French military engineer, resigned commission at start of French revolution.**



Portrait by Louis Hierle in 1894

**Coulomb's Law**

$$F = K\ \frac{Q_1 Q_2}{R^2}$$

**$Q_1$, $Q_2$ electric charges in coulombs, R distance(meters), F in newtons.**

**Inverse square law like gravitation BUT K (=9*10⁹); huge in comparison**

**Electrical forces are STRONG (Hence value in applications and DANGERS)**

## How do clouds become charged?



Small ice particles move up while larger soft hail (graulen) moves down. The small solid particles lose electrons and become positively charged. Top of cloud +ve and spreads out to anvil shape.

## How does a charged balloon stick to a wall.

Balloon is initially charged negatively by rubbing with fur. As it is moved toward the wall it repels mobile electrons (-ve charges), leaving positive charge at the surface of the wall. Because force proportional to $1/R^2$, attractive force wins and balloon is attracted by force F to ball and sticks there until charge dissipates.