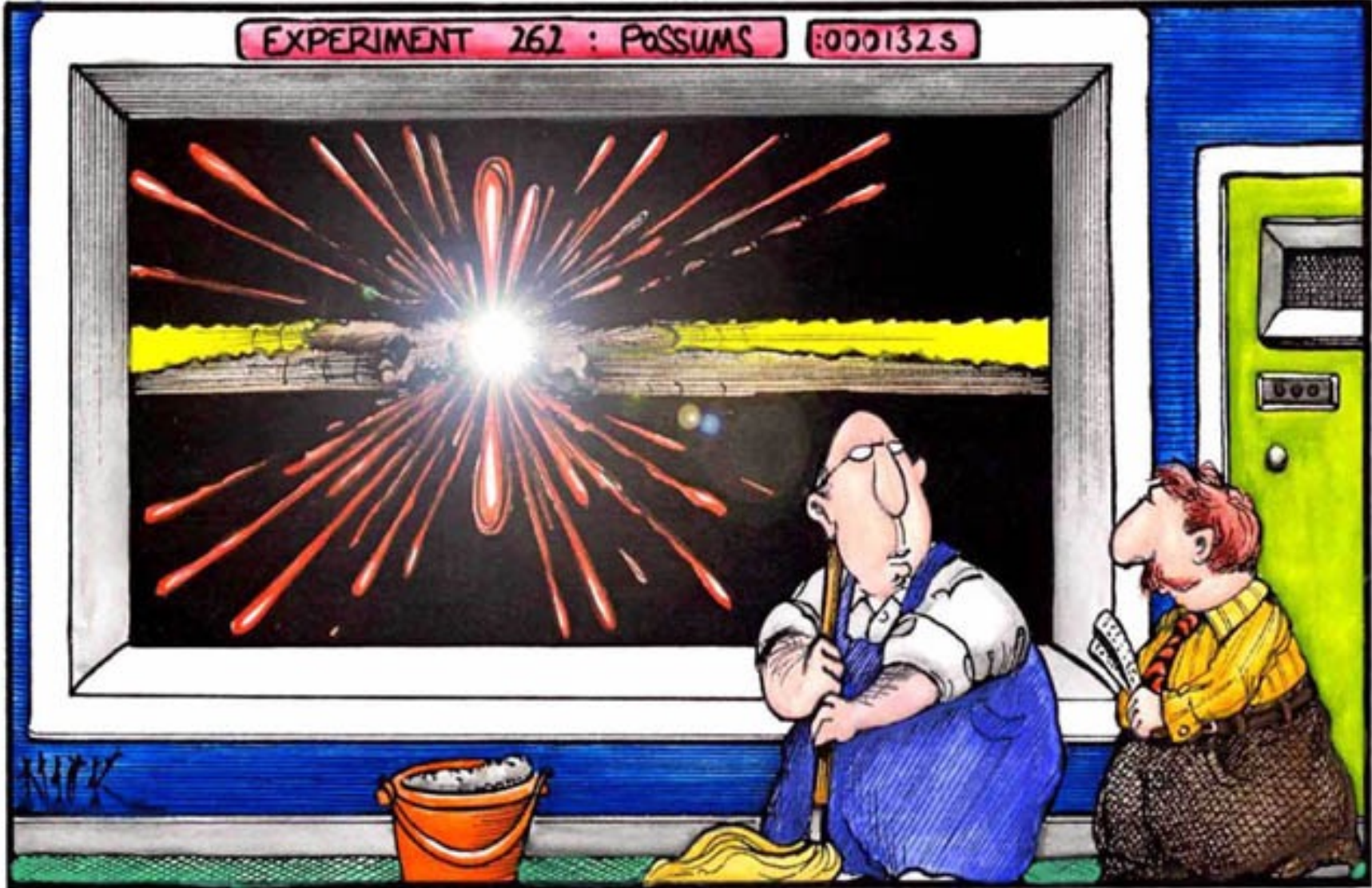


# Atomic Structure



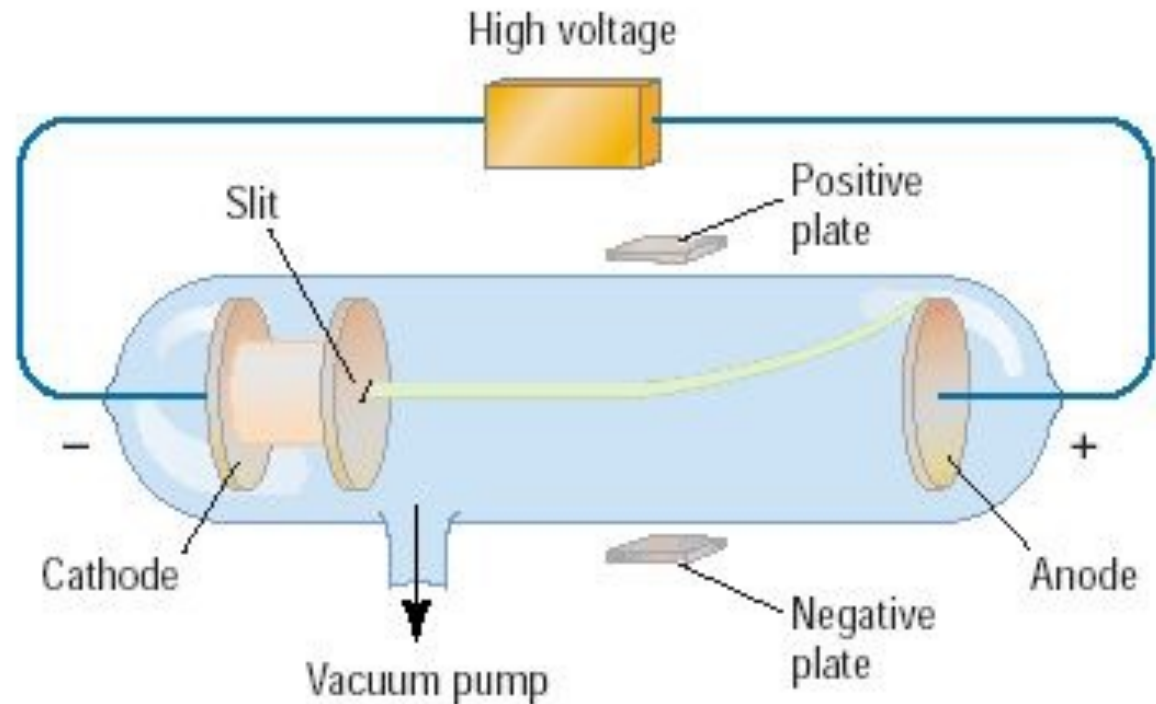
*"Sure been a heap more work for ME around here since those Biologists got granted research time on the ol' Supercollider..."*

# Modern Atomic Theory

- ❖ All matter is composed of atoms
- ❖ Atoms cannot be subdivided, created, or destroyed in ordinary chemical reactions.  
However, these changes CAN occur in nuclear reactions!
- ❖ Atoms of an element have a characteristic average mass which is unique to that element.
- ❖ Atoms of any one element differ in properties from atoms of another element

# Discovery of the Electron

In 1897, J.J. Thomson used a cathode ray tube to deduce the presence of a negatively charged particle.

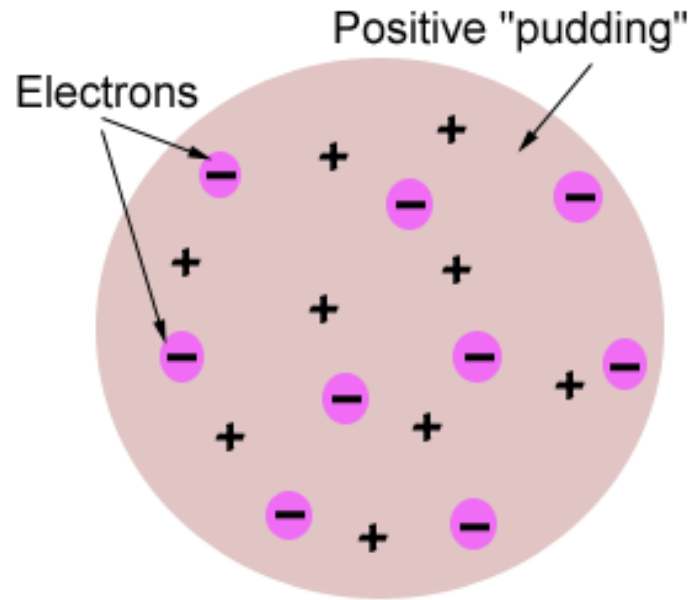


Cathode ray tubes pass electricity through a gas that is contained at a very low pressure.

# Conclusions from the Study of the Electron

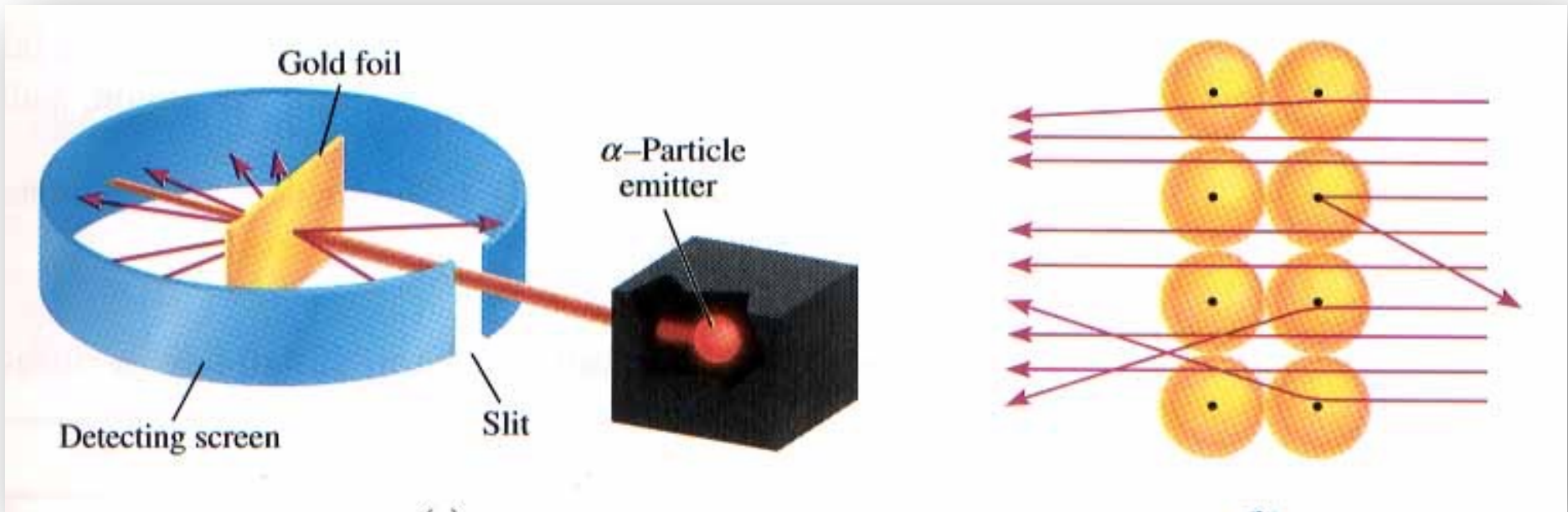
- ❑ Cathode rays have identical properties regardless of the element used to produce them. All elements must contain identically charged electrons.
- ❑ Atoms are neutral, so there must be positive particles in the atom to balance the negative charge of the electrons
- ❑ Electrons have so little mass that atoms must contain other particles that account for most of the mass

# Thomson's Atomic Model



Thomson believed that the electrons were like plums embedded in a positively charged "pudding," thus it was called the "plum pudding" model.

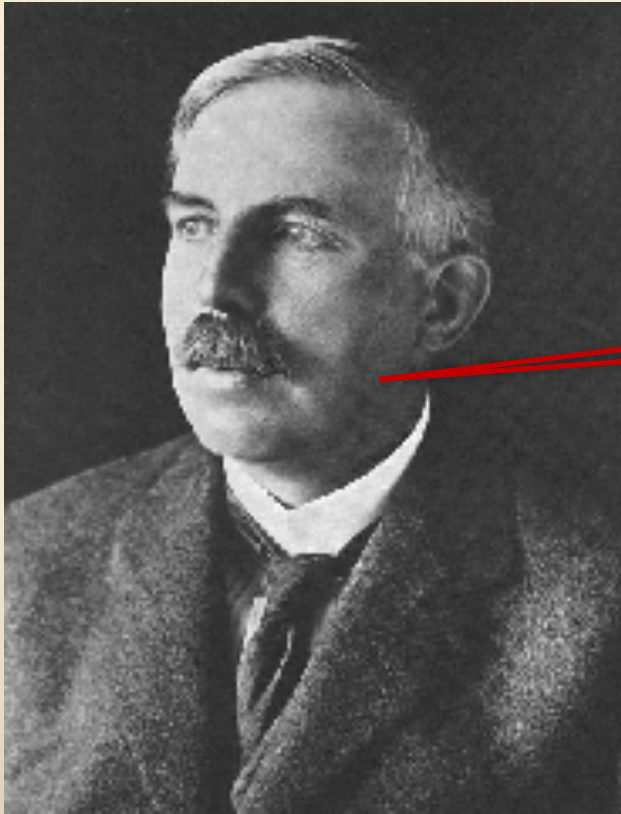
# Rutherford's Gold Foil Experiment



- ❑ Alpha ( $\alpha$ ) particles are helium nuclei
- ❑ Particles were fired at a thin sheet of gold foil
- ❑ Particle hits on the detecting screen (film) are recorded

# Rutherford's Findings

- ❑ Most of the particles passed right through
- ❑ A few particles were deflected
- ❑ VERY FEW were greatly deflected



“Like howitzer shells bouncing off of tissue paper!”

## Conclusions:

- ❑ The nucleus is small
- ❑ The nucleus is dense
- ❑ The nucleus is positively charged

# Atomic Particles

Particle	Charge	Mass #	Location
Electron	-1	0	Electron cloud
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus



# Atomic Number

Atomic Number of an element is the number of protons in the nucleus of each atom of that element.

Element	# of protons	Atomic #
Carbon	6	6
Phosphorus	15	15
Gold	79	79

# Mass Number




Mass number is the number of protons and neutrons in the nucleus of an isotope.

$$\text{Mass \#} = p^+ + n^0$$

Nuclide	$p^+$	$n^0$	$e^-$	Mass #
Oxygen - 18	8	10	8	18
Arsenic - 75	33	42	33	75
Phosphorus - 31	15	16	15	31

# Isotopes

Isotopes are atoms of the same element having different masses due to varying numbers of neutrons.

Isotope	Protons	Electrons	Neutrons	Nucleus
Hydrogen-1 (protium)	1	1	0	
Hydrogen-2 (deuterium)	1	1	1	
Hydrogen-3 (tritium)	1	1	2	

# Atomic Masses

Atomic mass is the average of all the naturally occurring isotopes of that element.

Isotope	Symbol	Composition of the nucleus	% in nature
Carbon-12	$^{12}\text{C}$	6 protons 6 neutrons	98.89%
Carbon-13	$^{13}\text{C}$	6 protons 7 neutrons	1.11%
Carbon-14	$^{14}\text{C}$	6 protons 8 neutrons	<0.01%

**Carbon = 12.011**