

electron:

charge:	$1,602 \cdot 10^{-19} \text{ C}$
spin:	$1/2$
mass:	$9,108 \cdot 10^{-28} \text{ g}$
radius:	$2,8 \cdot 10^{-15} \text{ cm}$

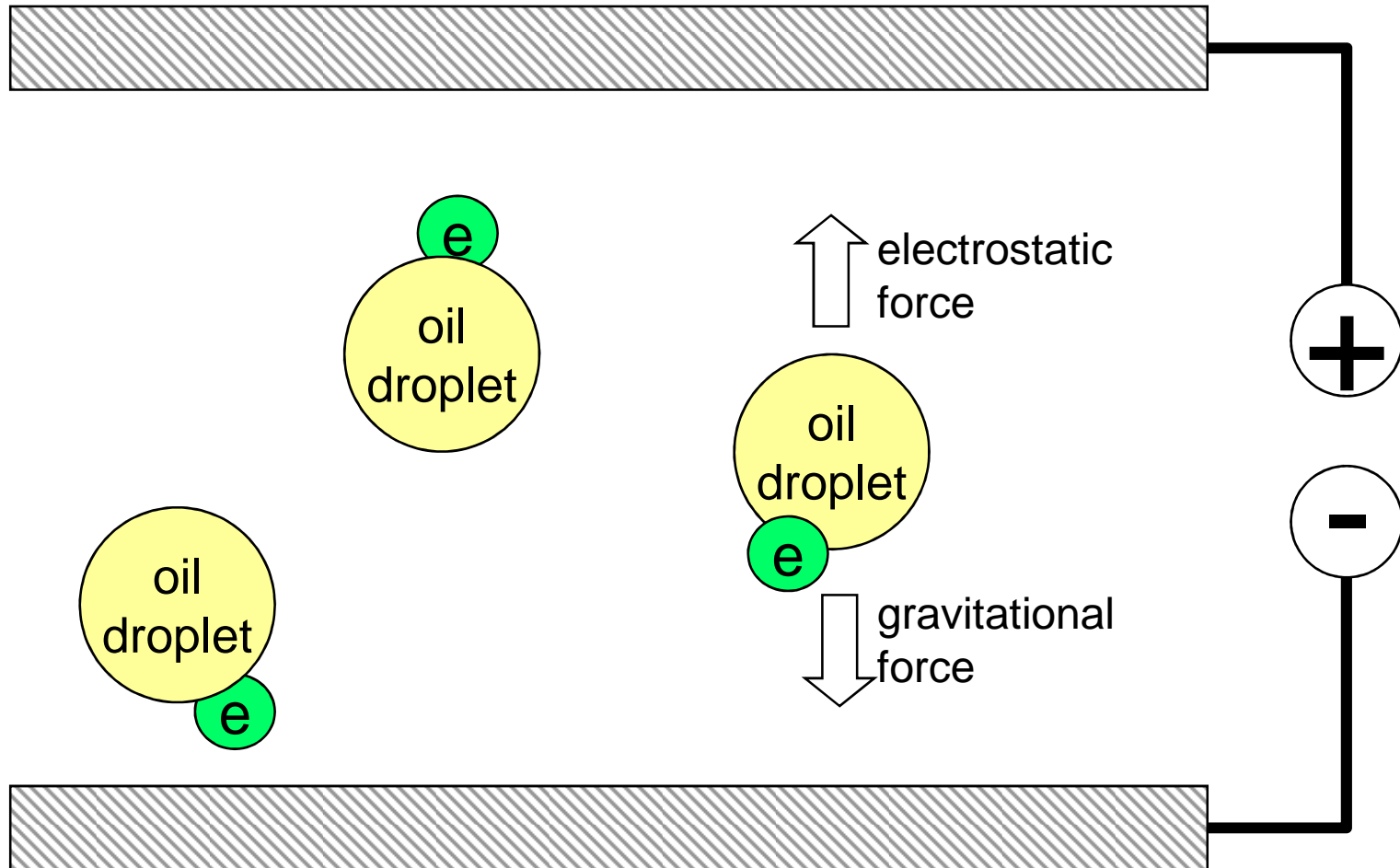
Three Generations of Matter (Fermions)

	I	II	III	
mass→	2.4 MeV	1.27 GeV	171.2 GeV	0
charge→	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	0
spin→	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
name→	u up	c charm	t top	γ photon
Quarks	4.8 MeV	104 MeV	4.2 GeV	0
	$-\frac{1}{3}$	$-\frac{1}{3}$	$-\frac{1}{3}$	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
	d down	s strange	b bottom	g gluon
Leptons	< 2.2 eV	< 0.17 MeV	< 15.5 MeV	91.2 GeV
	0	0	0	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z⁰ weak force
	0.511 MeV	105.7 MeV	1.777 GeV	80.4 GeV
	-1	-1	-1	±1
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
	e electron	μ muon	τ tau	W[±] weak force

Bosons (Forces)

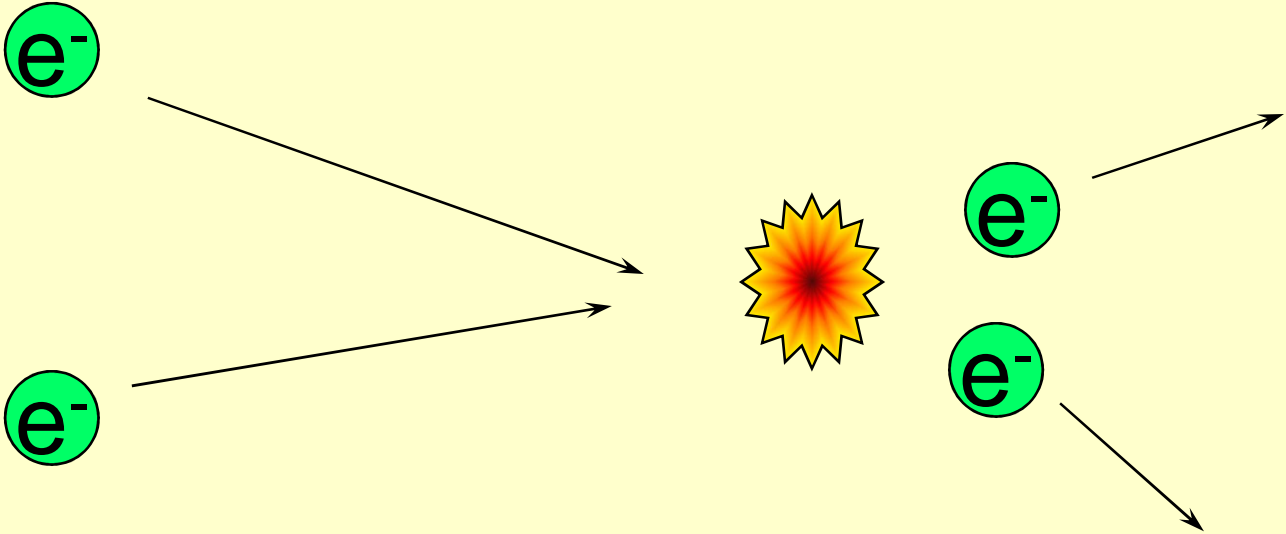
Millikan's experiment (1911, Nobel Prize in 1923):

Oil droplets are sprayed in a chamber between two electrodes and charged by ionizing radiation. Their motion is observed by a microscope.

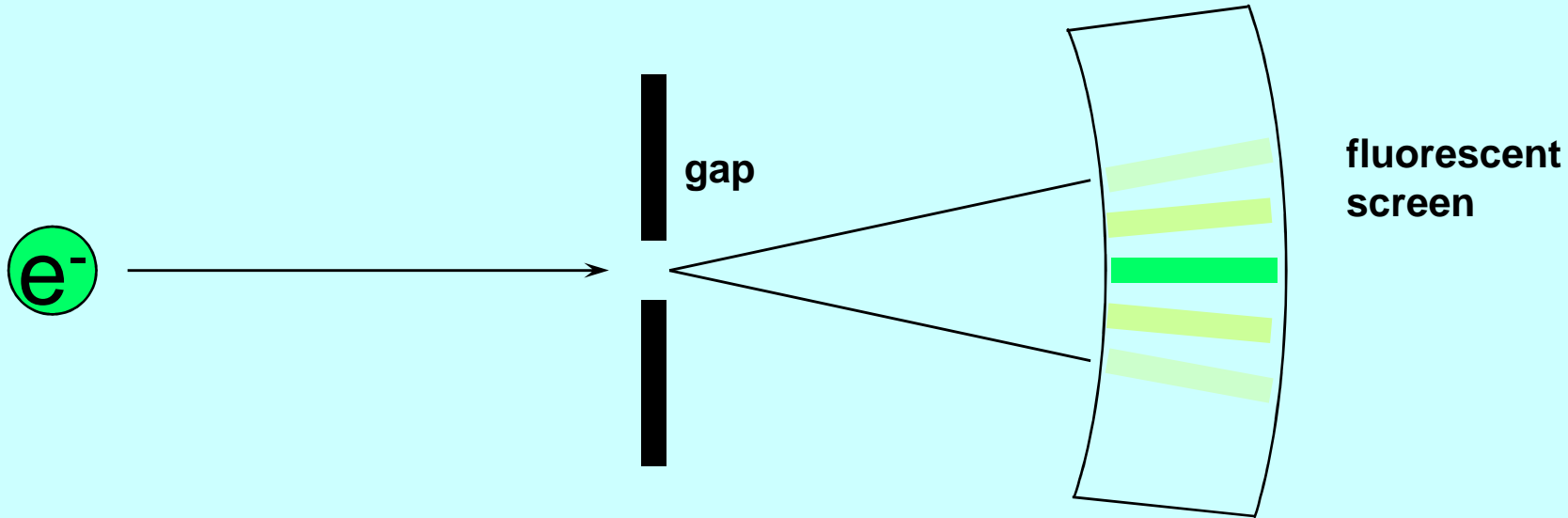


The sinking motion of the droplets caused by the gravitational field can be balanced by the correct adjustment of the voltage in the cell.

electrons behave like particles:

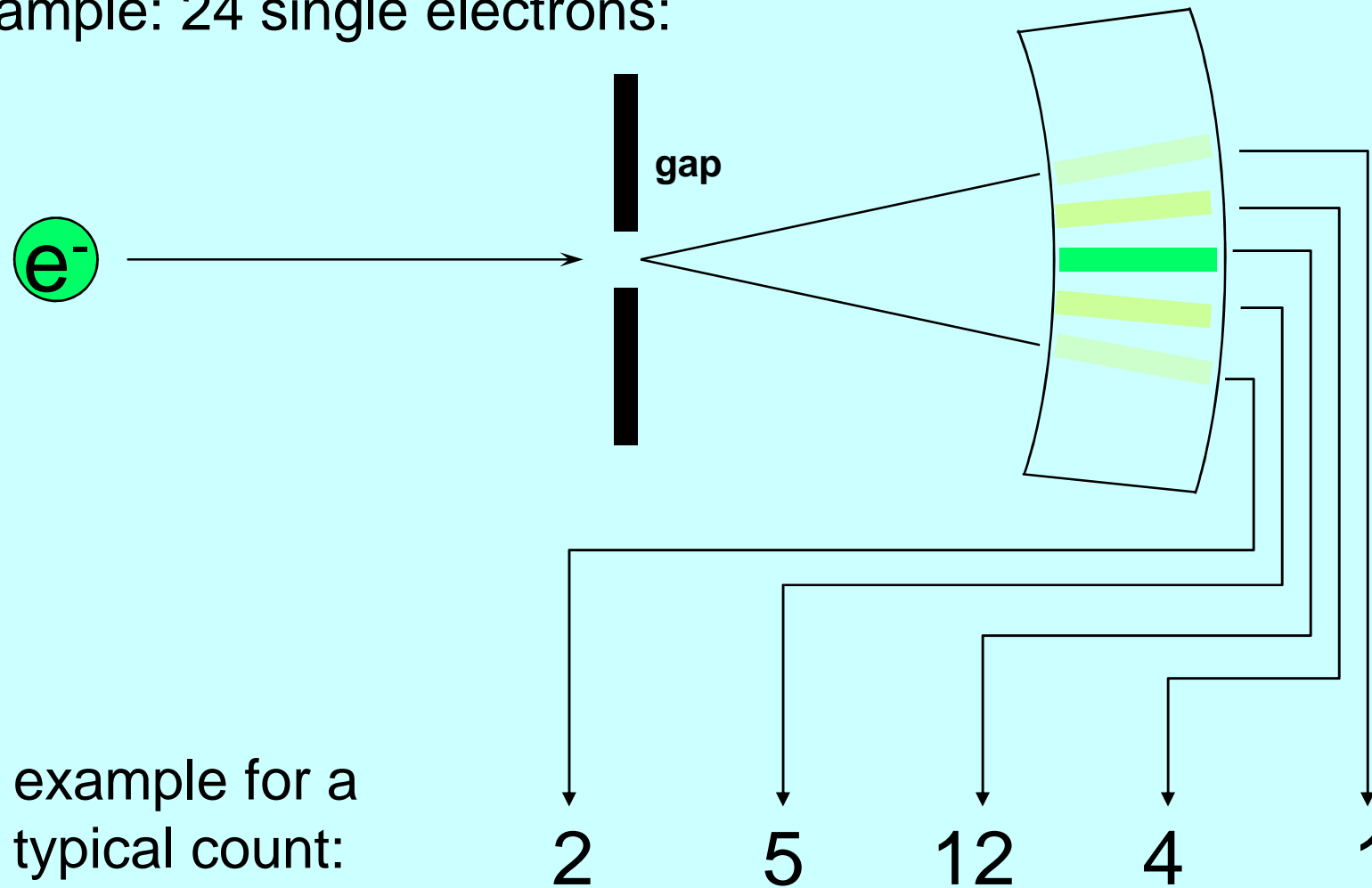


electrons behave like electromagnetic waves:



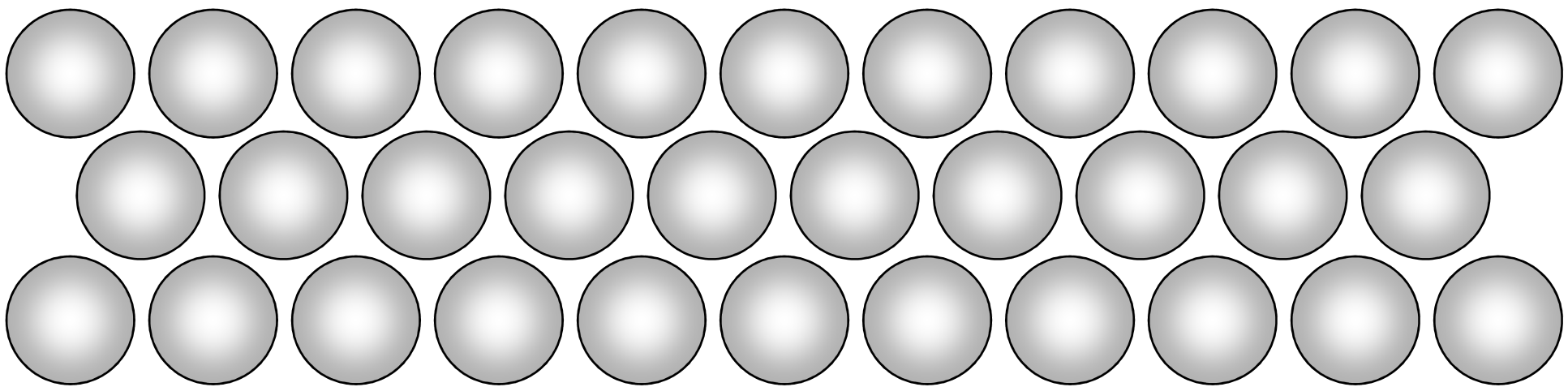
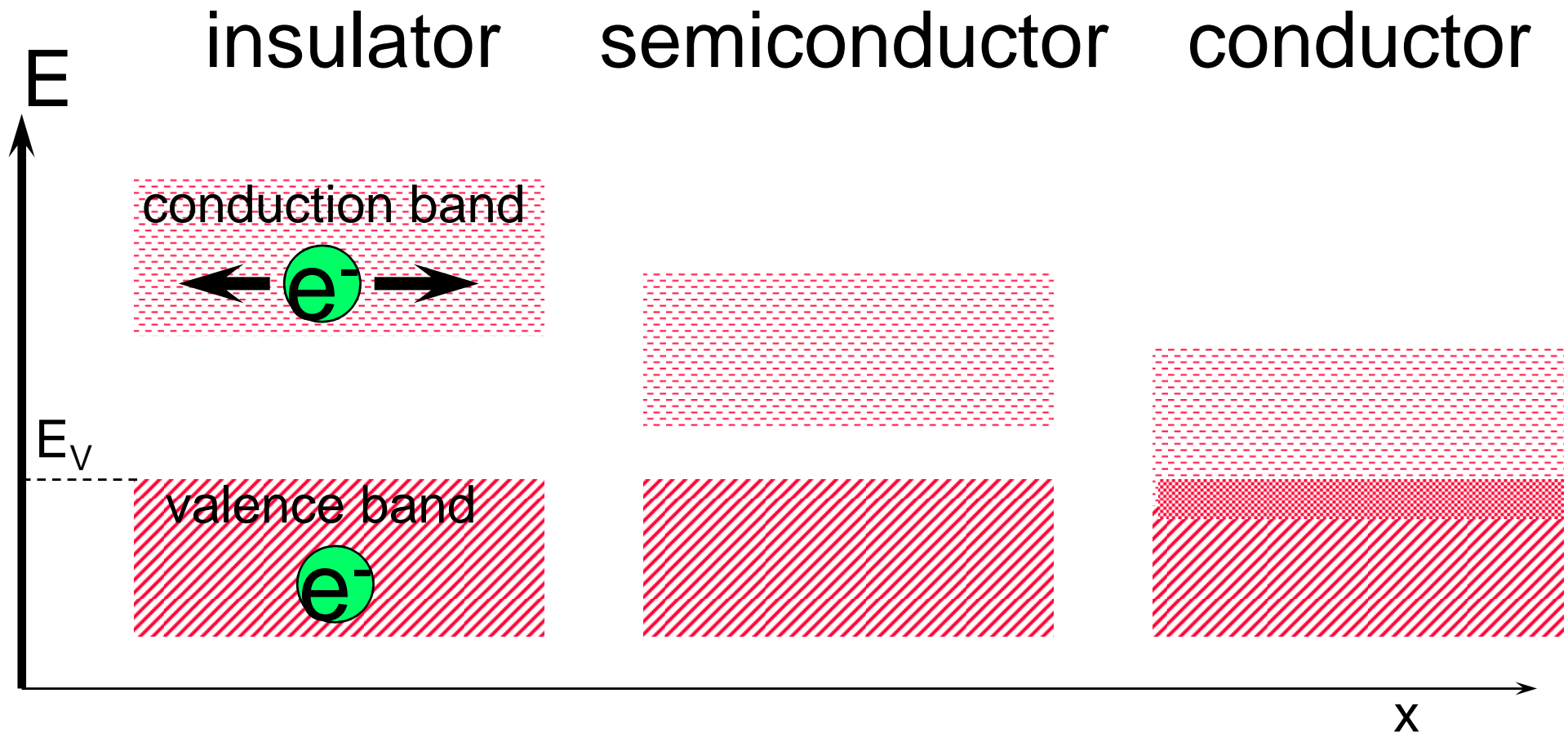
What if single electrons are used instead of an electron beam?

Example: 24 single electrons:

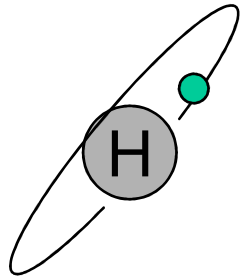


example for a
typical count:

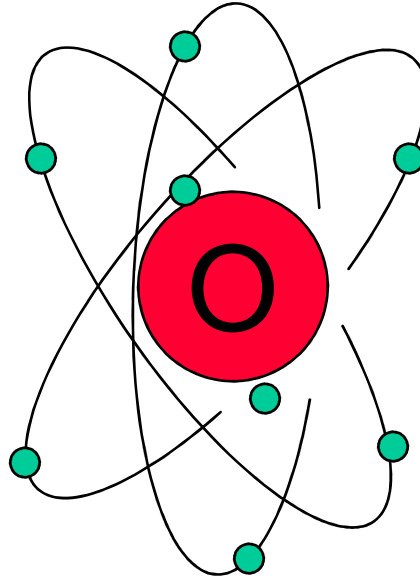
Answer: local intensities of the diffraction pattern are represented by the probabilities to find an electron.



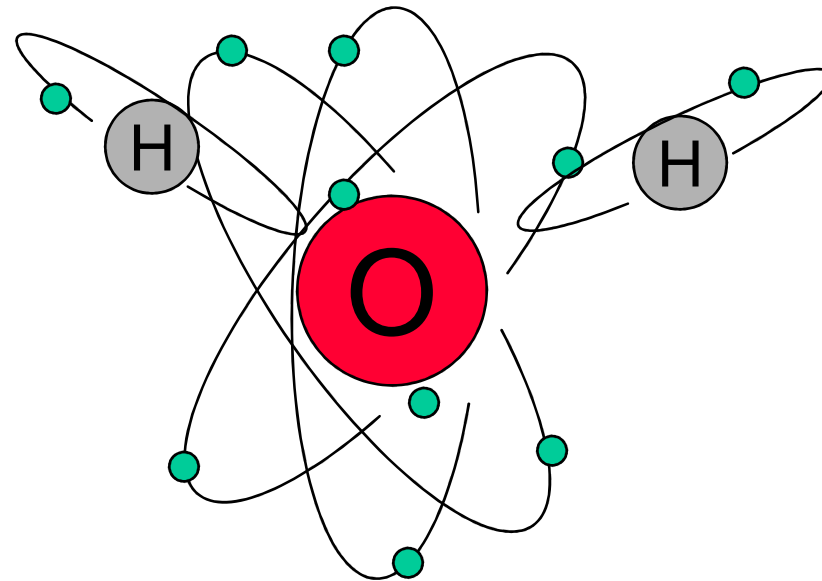
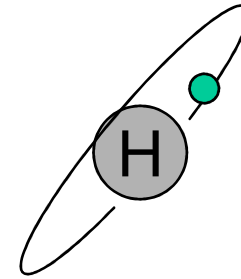
hydrogen



oxygen



hydrogen



+ energy