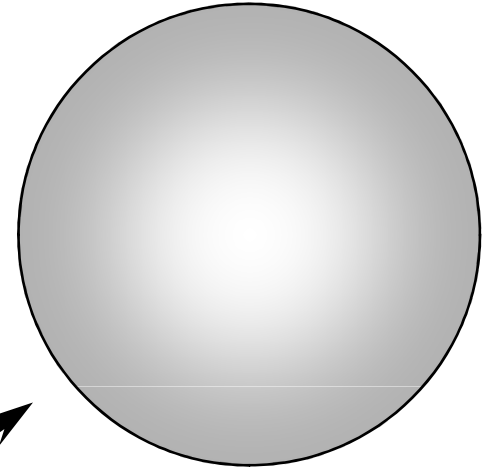
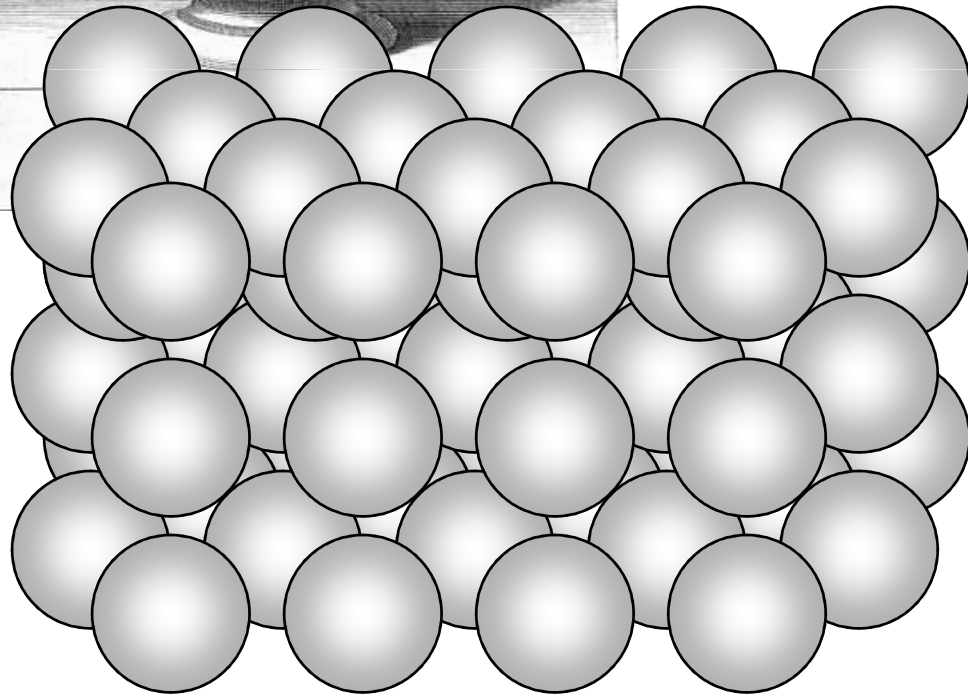
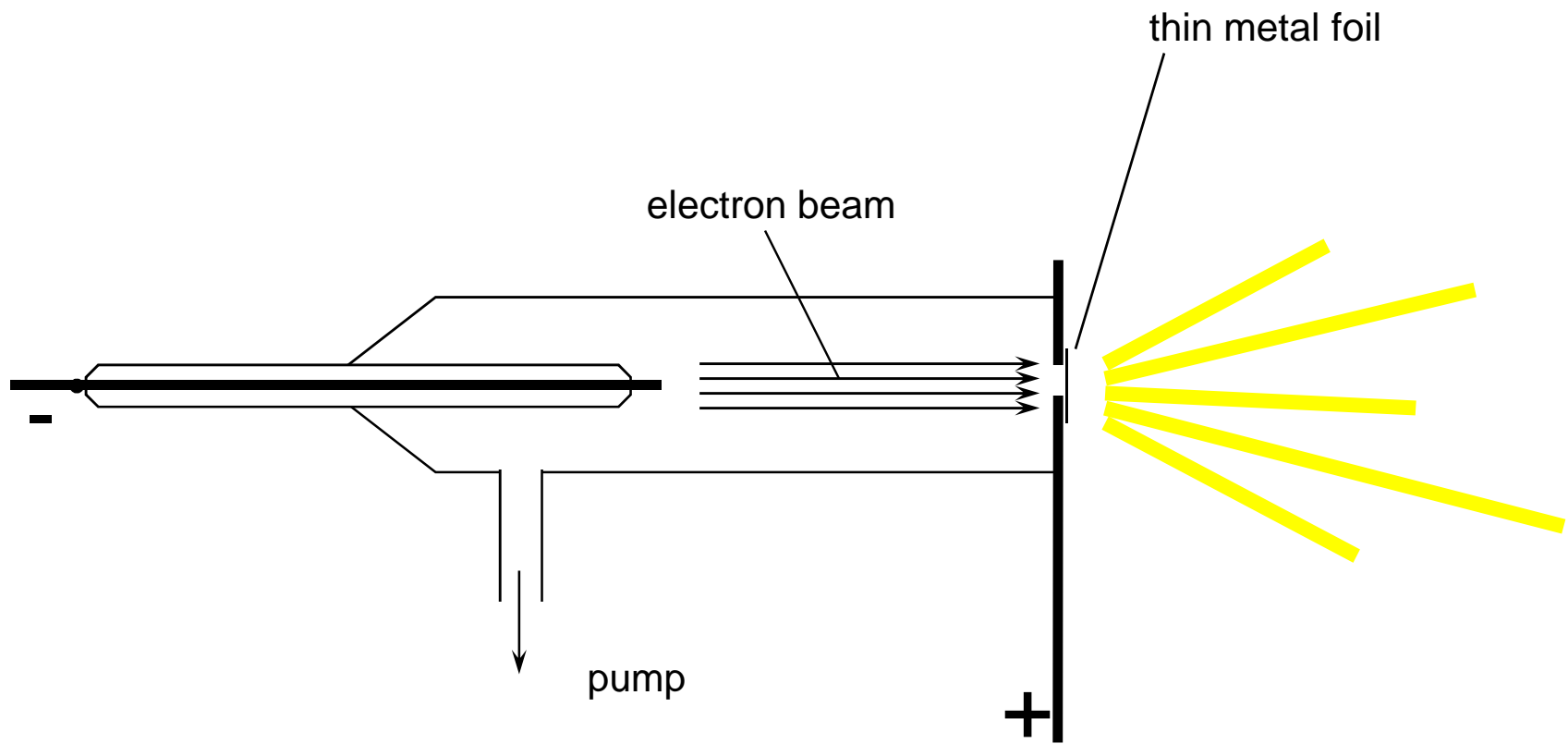


Demokrit

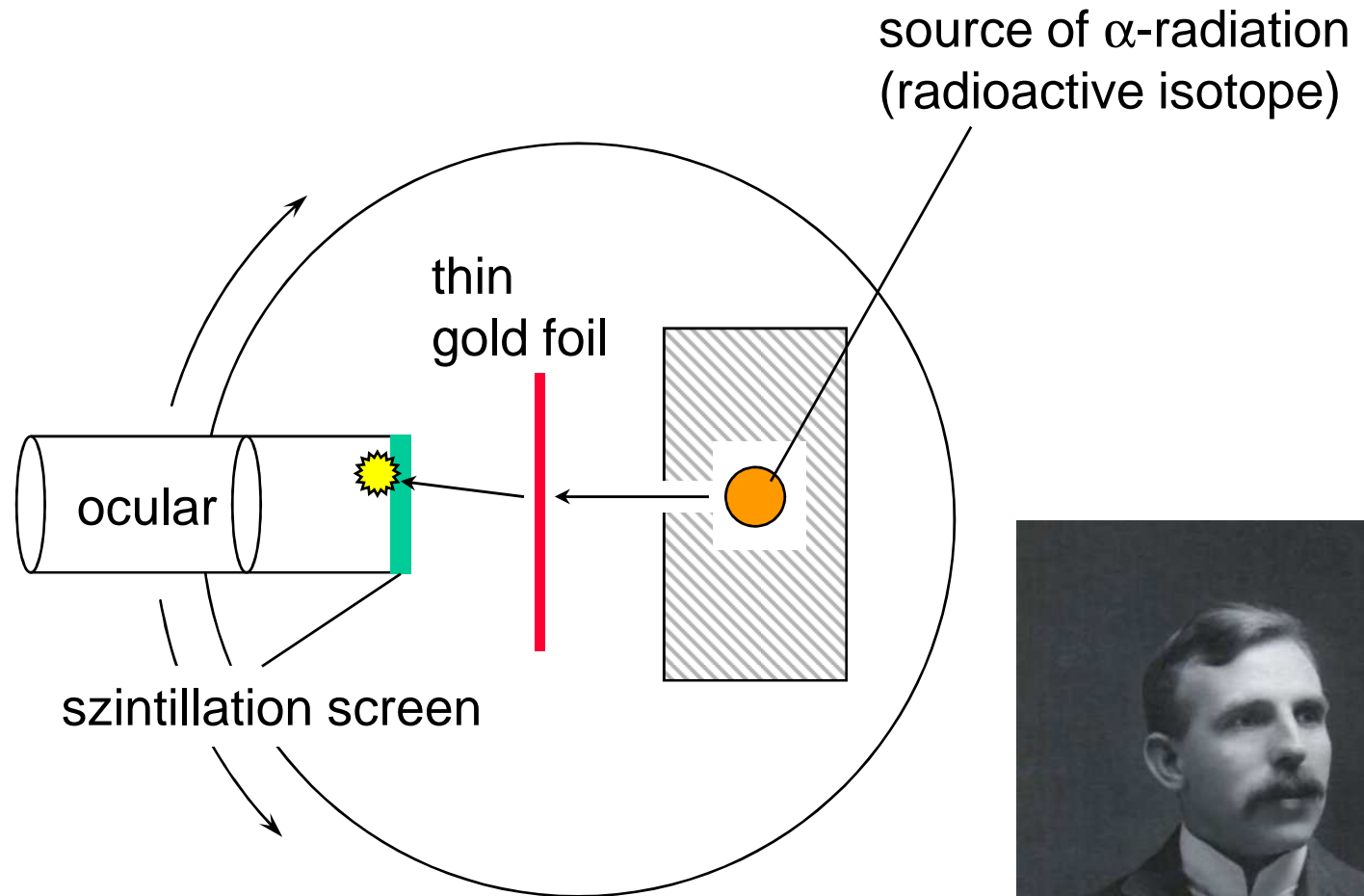


**atom = smallest
undestructible
unit**

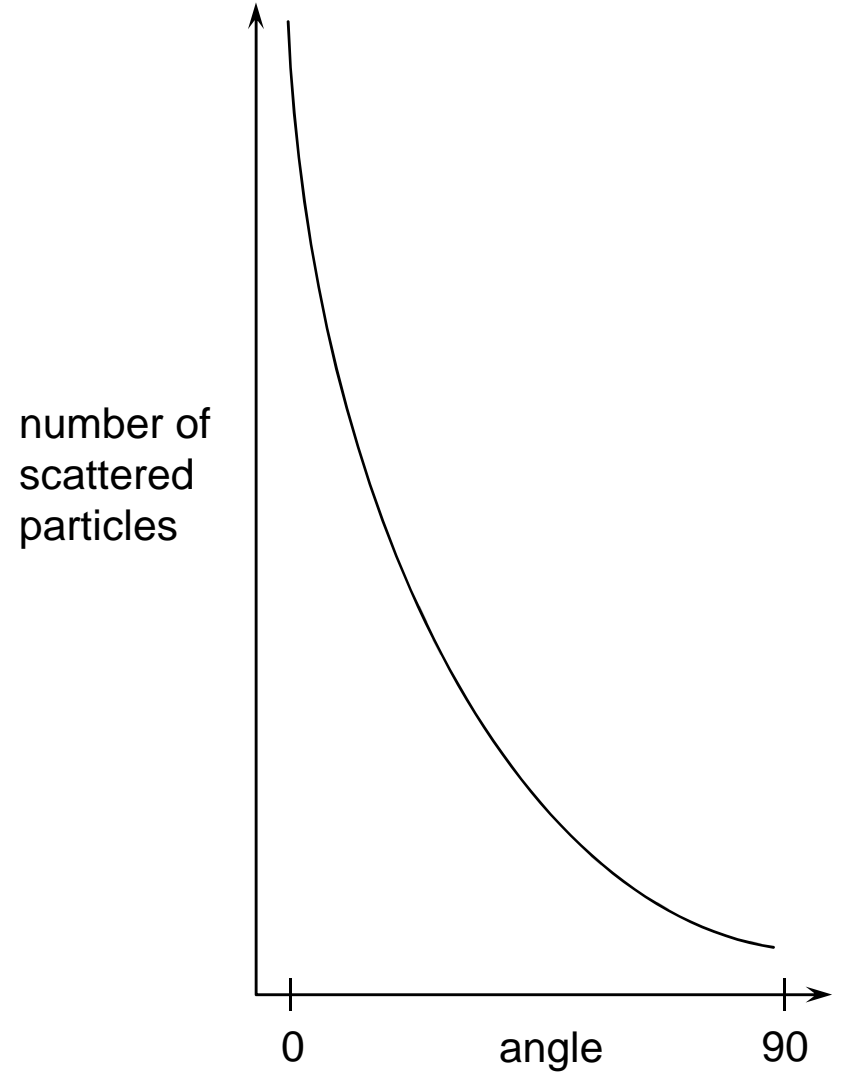
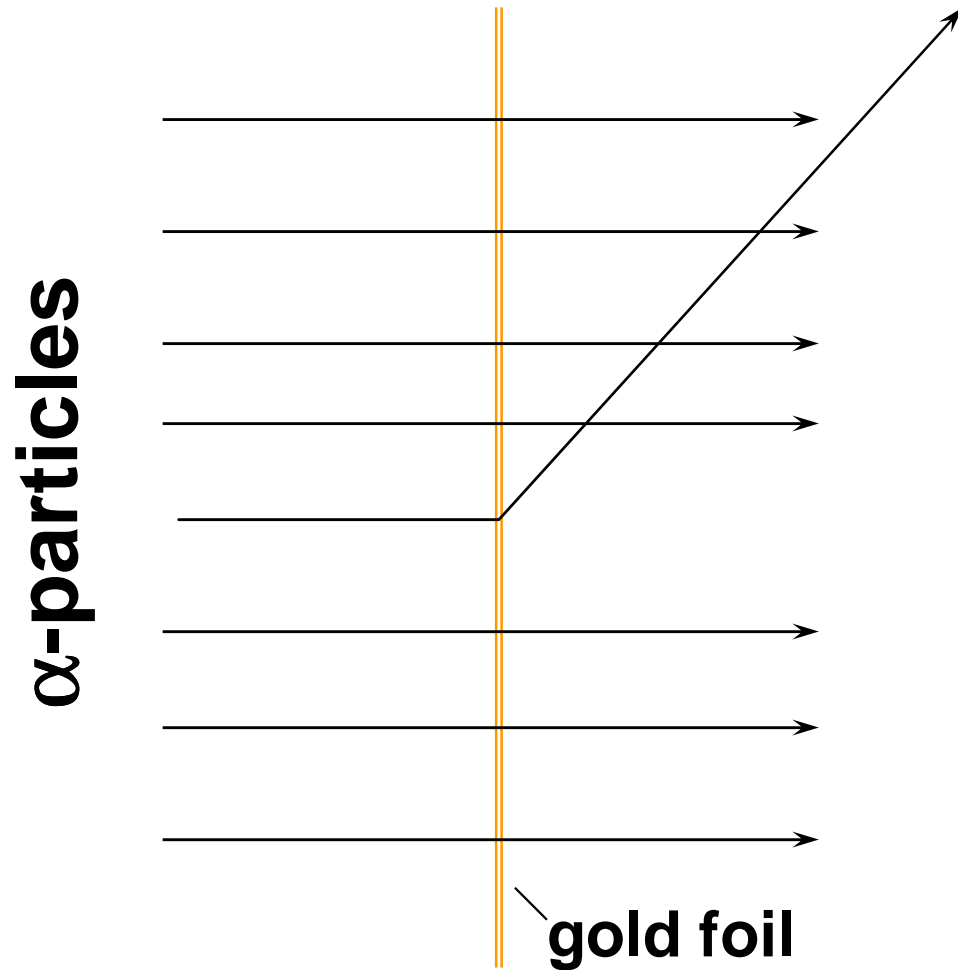
Lenard 1890:



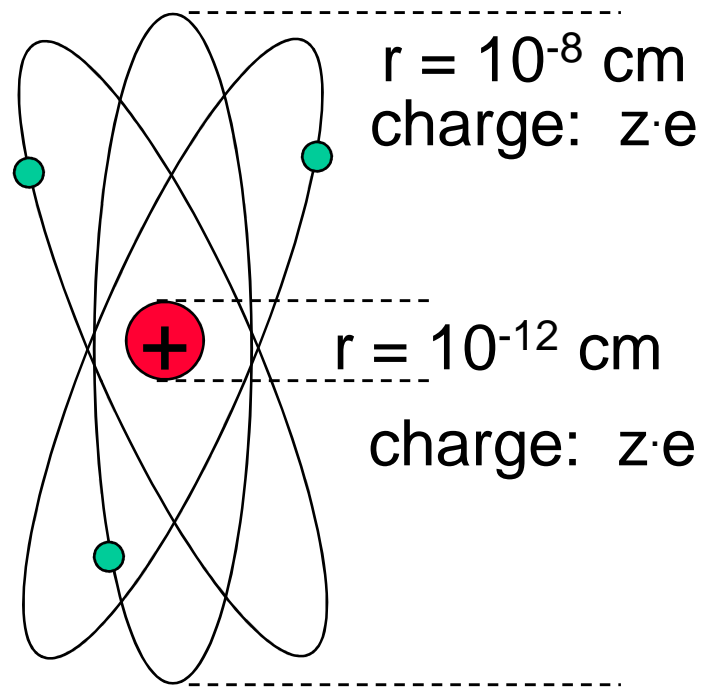
Rutherford 1911:



Rutherford 1911:



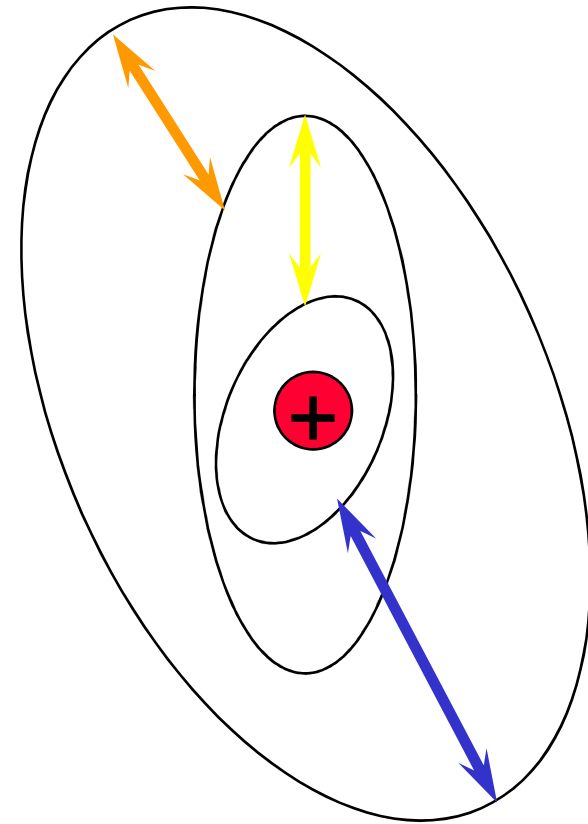
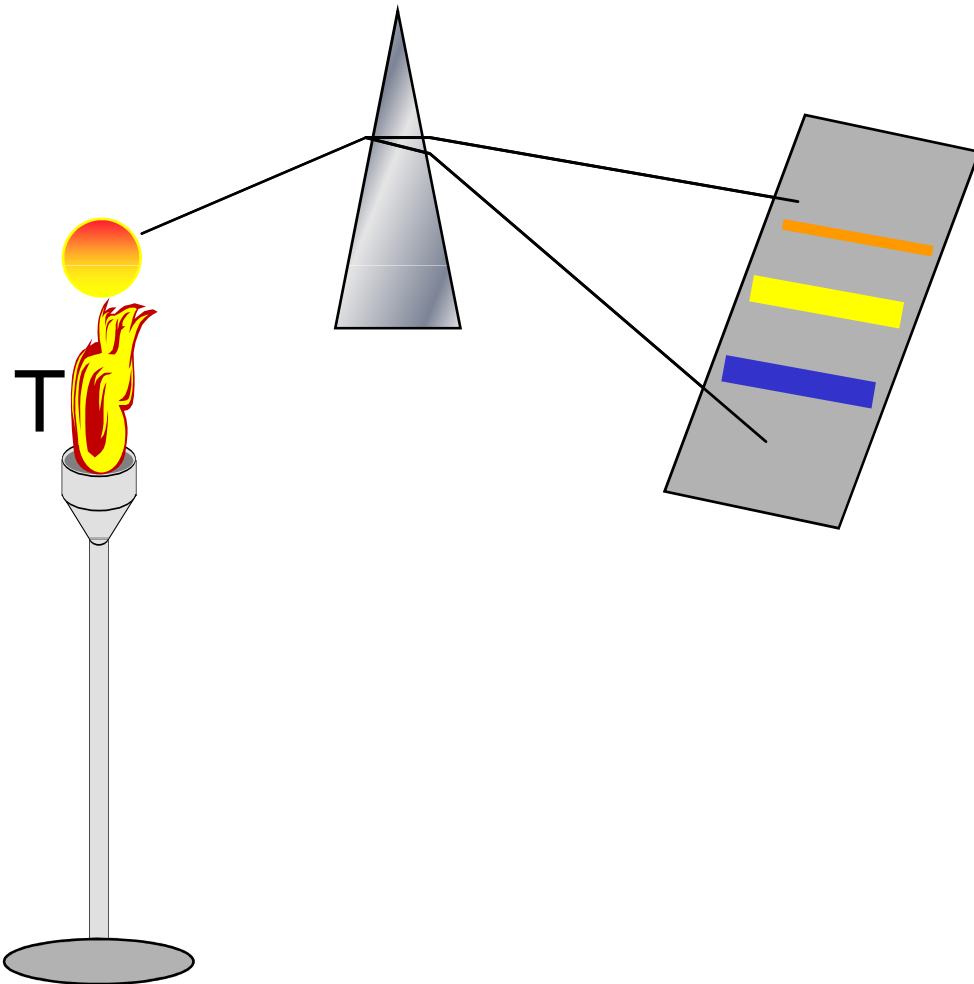
Rutherford



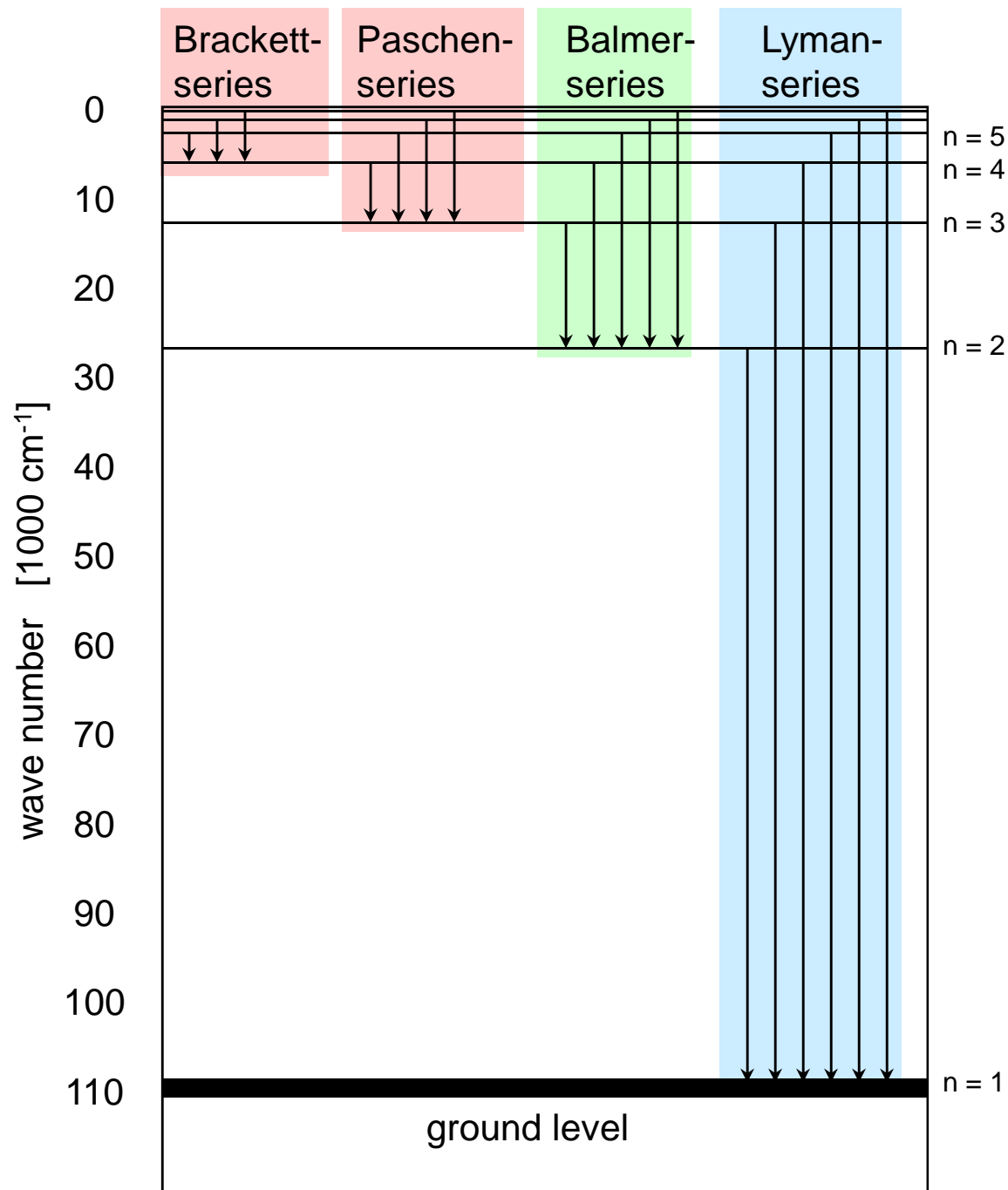
Bohr

1913

- several electron orbits with different energies
- $\Delta E = h\nu$
- no radiation



spectral energy diagram
of hydrogen



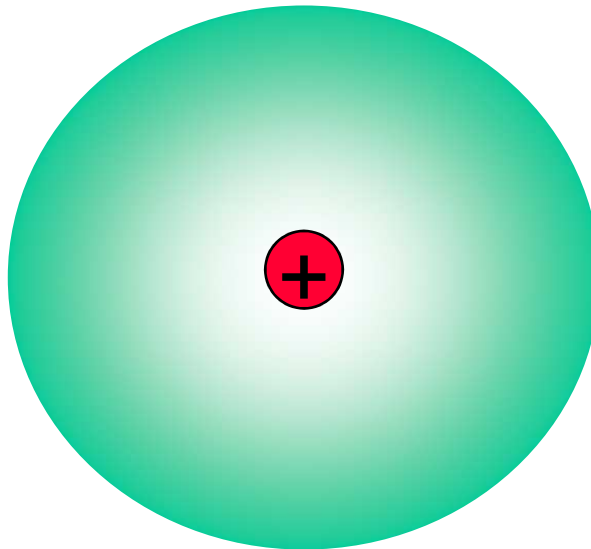
ground state of elements with increasing atomic number

atomic number	name of the element	symbol	n = 1	n = 2	n = 3
1	hydrogen	H	1		
2	helium	He	2		
3	lithium	Li	2	1	
4	beryllium	Be	2	2	
5	boron	B	2	3	
6	carbon	C	2	4	
7	nitrogen	N	2	5	
8	oxygen	O	2	6	
9	fluorine	F	2	7	
10	neon	Ne	2	8	
11	sodium	Na	2	8	1
12	magnesium	Mg	2	8	2
13	aluminum	Al	2	8	3

orbital model

The state of the electron is described by a wave function.
This wave function is defined by the **Schrödinger equation**:

$$-\frac{\hbar^2}{2m} \frac{d^2}{dx^2} \Psi = i\hbar \dot{\Psi}$$



Solutions of the **Schrödinger equation**:

$$\Psi(n, l, m, s)$$

The indices n, l, m, s are the so called quantum numbers.

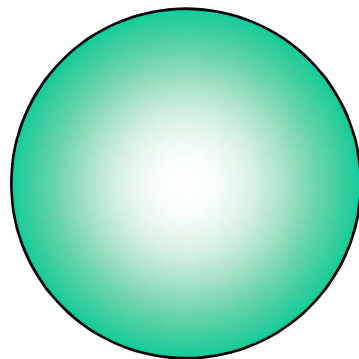
Pauli-principle: in one atom, there is never more than one electron with the same set of quantum numbers n, l, m and s .

Hund's rule: in the ground state, the electrons try to fill the states with the lowest quantum numbers (lowest energy) first.

quantum numbers

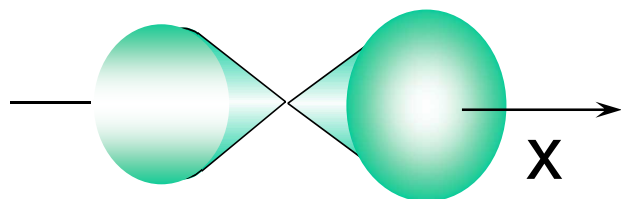
n	l	m	s
principal quantum number	angular momentum quantum number	magnetic quantum number	spin quantum number
1, 2, 3, ...	0, 1, 2, 3, ... (n-1)	-l, ..., 0, ... , +l	+1/2, -1/2

atomic number	name of the element	symbol	n = 1	n = 2 l = 0	n = 2 l = 1	n = 3 l = 0	n = 3 l = 1
1	hydrogen	H	1				
2	helium	He	2				
3	lithium	Li	2	1			
4	beryllium	Be	2	2			
5	boron	B	2	2	1		
6	carbon	C	2	2	2		
7	nitrogen	N	2	2	3		
8	oxygen	O	2	2	4		
9	fluorine	F	2	2	5		
10	neon	Ne	2	2	6		
11	sodium	Na	2	2	6	1	
12	magnesium	Mg	2	2	6	2	
13	aluminum	Al	2	2	6	2	1

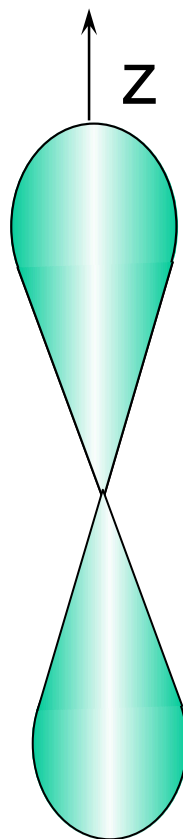


s-orbital

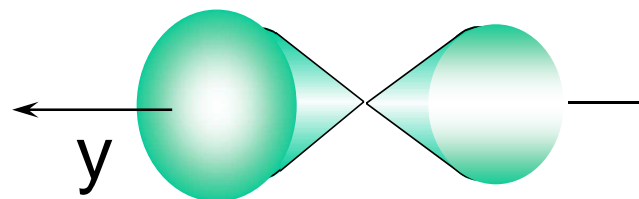
$l = 0$



$l = 1$
 $m = 1$



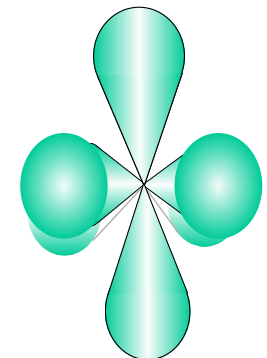
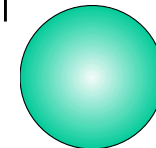
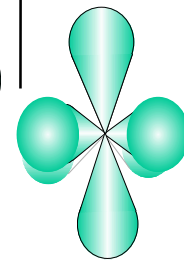
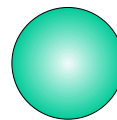
$l = 1$ $m = 0$



$l = 1$
 $m = -1$

p-orbitals

atomic number	name	symbol	$n = 1$	$n = 2$ $l = 0$	$n = 2$ $l = 1$	$n = 3$ $l = 0$	$n = 3$ $l = 1$
1	hydrogen	H	1				
2	helium	He	2				
3	lithium	Li	2	1			
4	beryllium	Be	2	2			
5	boron	B	2	2	1		
6	carbon	C	2	2	2		
7	nitrogen	N	2	2	3		
8	oxygen	O	2	2	4		
9	fluorine	F	2	2	5		
10	neon	Ne	2	2	6		
11	sodium	Na	2	2	6	1	
12	magnesium	Mg	2	2	6	2	
13	aluminum	Al	2	2	6	2	1



neon

