



UNIVERSITÀ
DI TRENTO

Dipartimento di
Fisica



Atomi (quasi) invisibili e divisibili

[modelli quantistici della materia]

ELEMENTI di FISICA MODERNA

[e intelligenza artificiale] 2025

padri fondatori

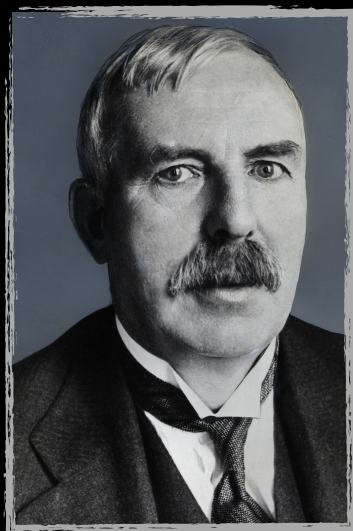
1856-1940



J.J. Thomson

N 1906

1871-1937



E. Rutherford

N 1908

1885-1962



N. Bohr

N 1922

1868-1951



A. Sommerfeld

modelli
atomici

padri fondatori

1887-1961



E. Schroedinger

N 1938

1882-1970



M. Born

N 1954

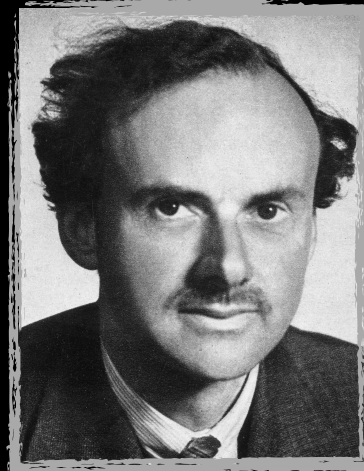
1901-1976



W. Heisenberg

N 1932

1902-1984



P. Dirac

N 1933

1900-1958

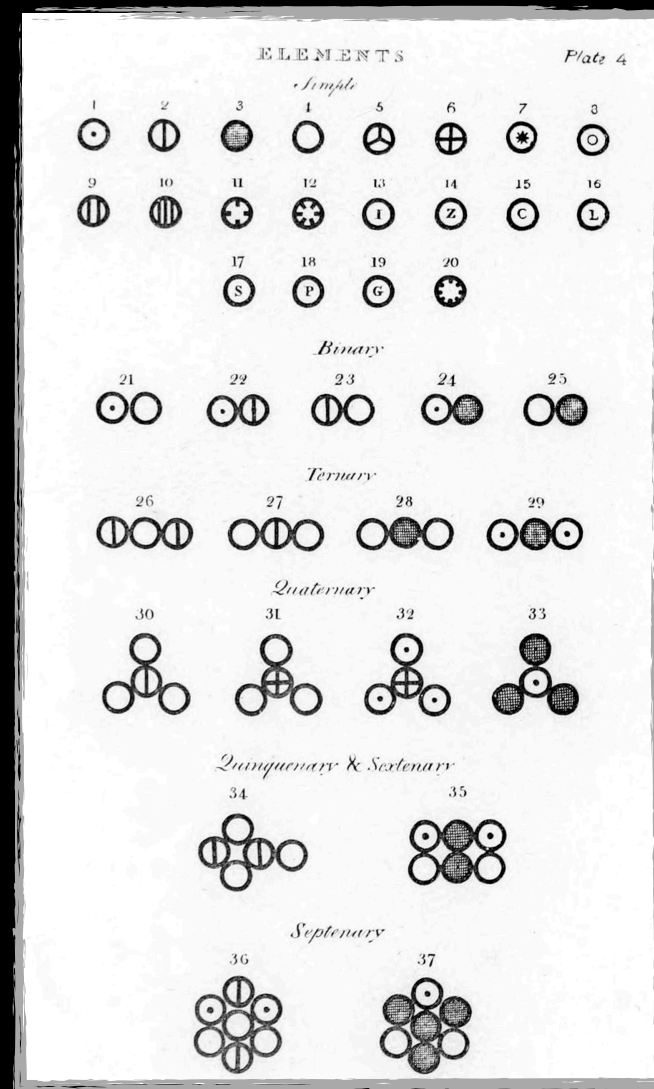


W. Pauli

N 1945

fisica
quantistica

L'atomo, questo sconosciuto

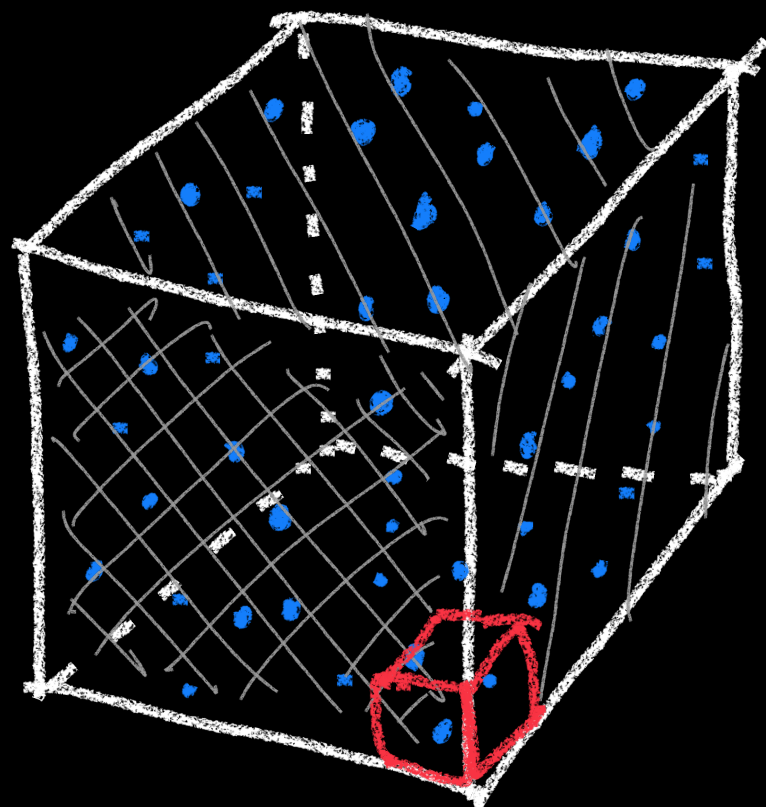


J. Dalton (1808)

Le dimensioni

Ferro

8 g/cm^3



56 g/mole

$1 \text{ mole} \sim 6 \times 10^{23} \text{ atomi}$

$V_{\text{atomo}} \sim 10^{-23} \text{ cm}^3, l_{\text{atomo}} \sim 2 \times 10^{-8} \text{ cm}$

$M_{\text{atomo}} \sim 10^{-25} \text{ Kg}$

Emissioni atomiche e radioattività

1845-1923



W. Roentgen
N 1901

1852-1908



A. Becquerel
N 1903

1867-1937



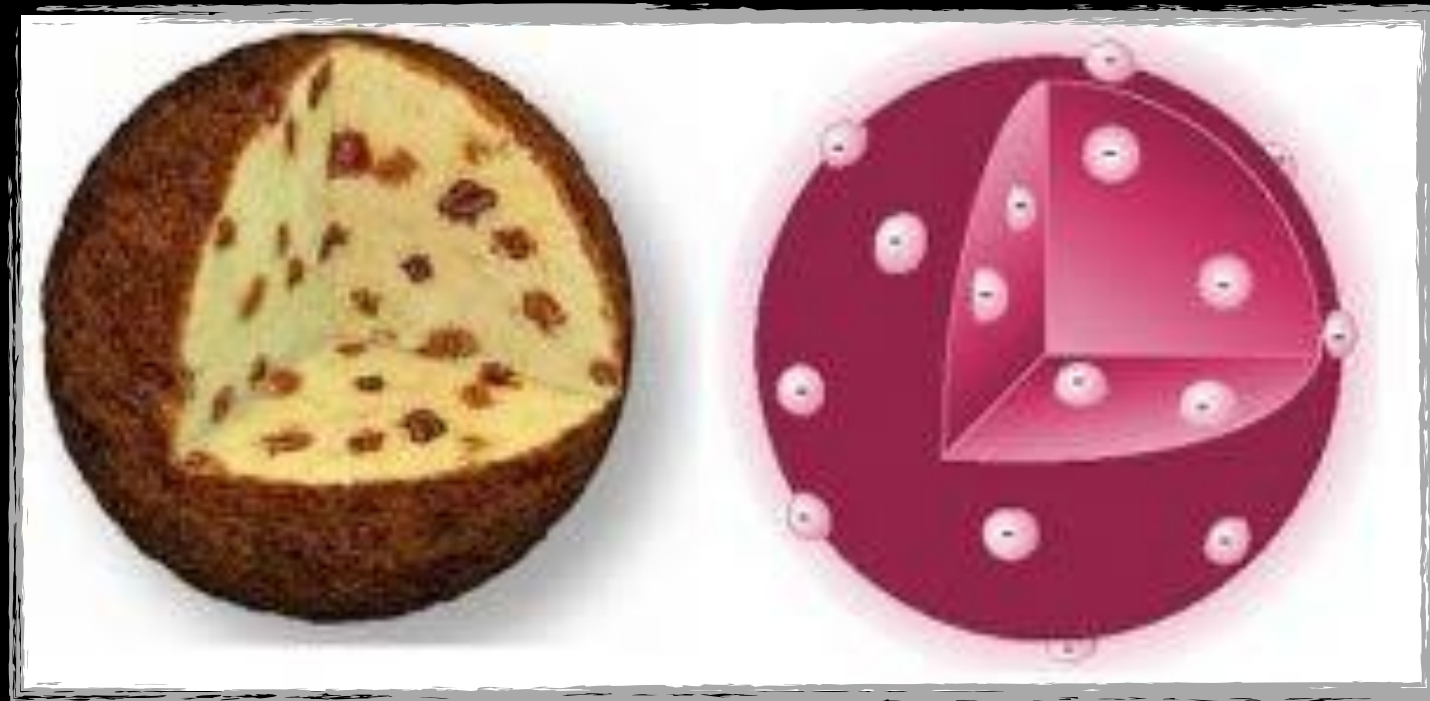
M. Skłodowska
Curie
N 1903
N 1911

1859-1906



P. Curie
N 1903

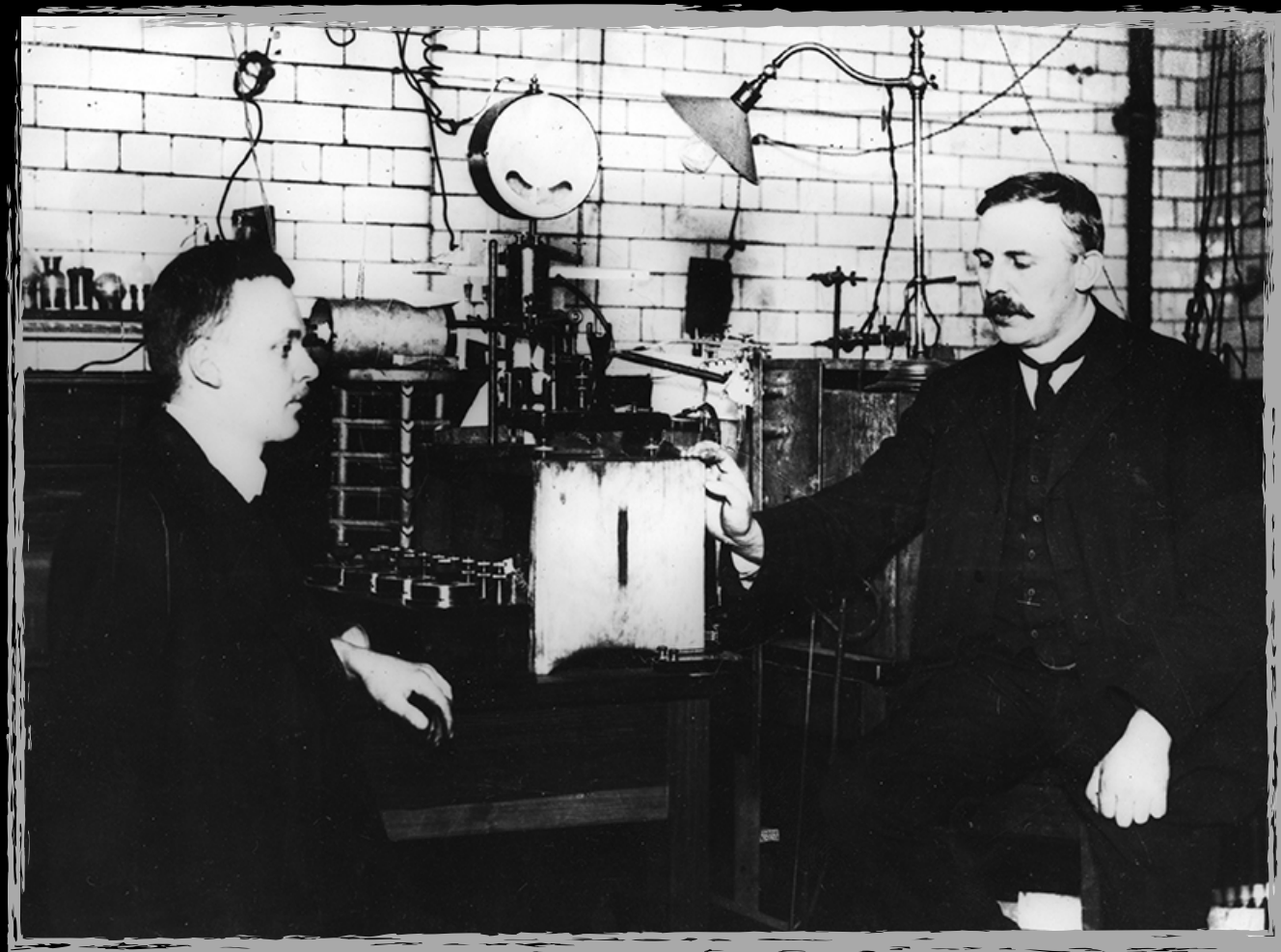
Il modello a panettone



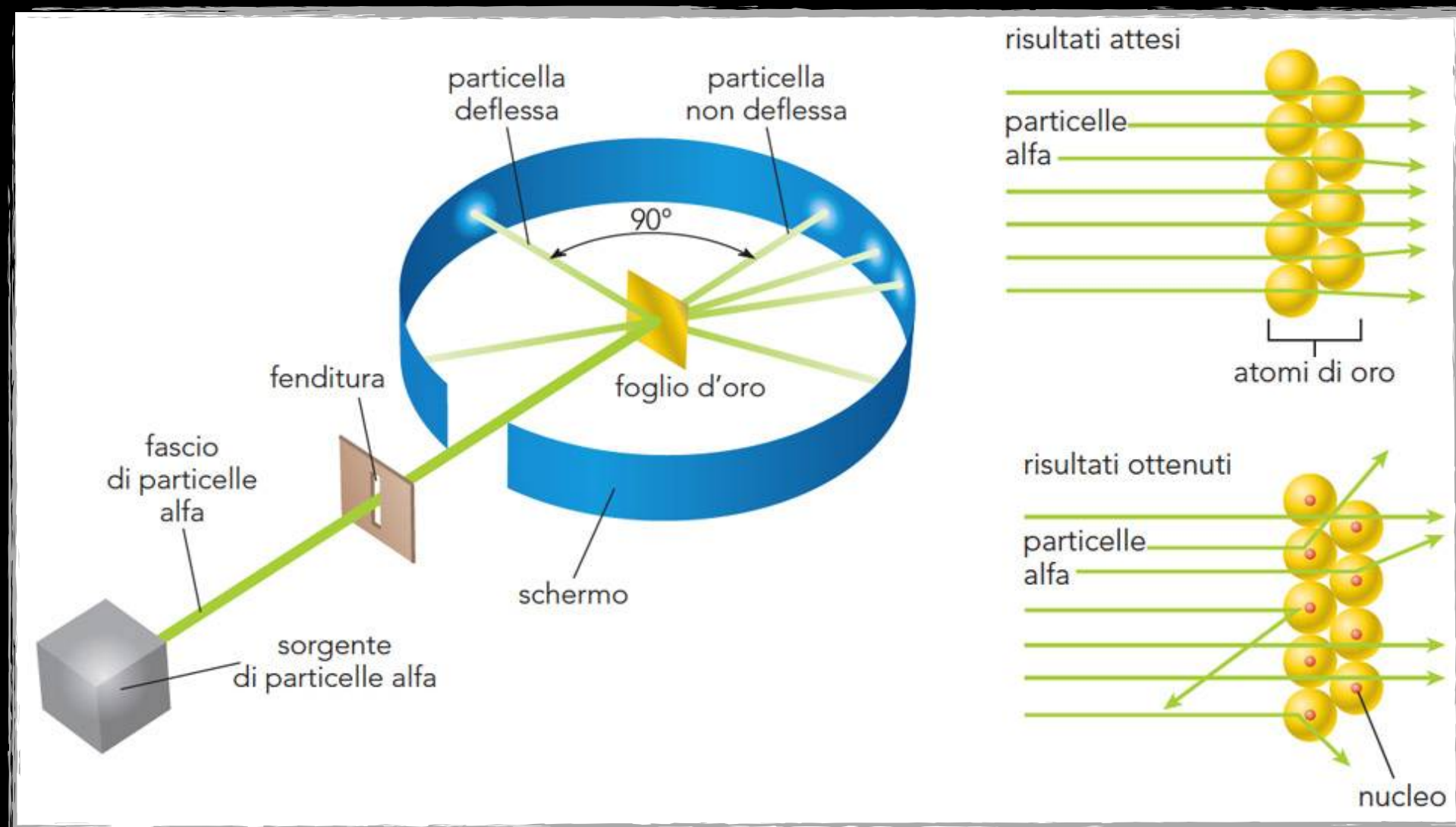
NON FUNZIONA

J.J. Thomson

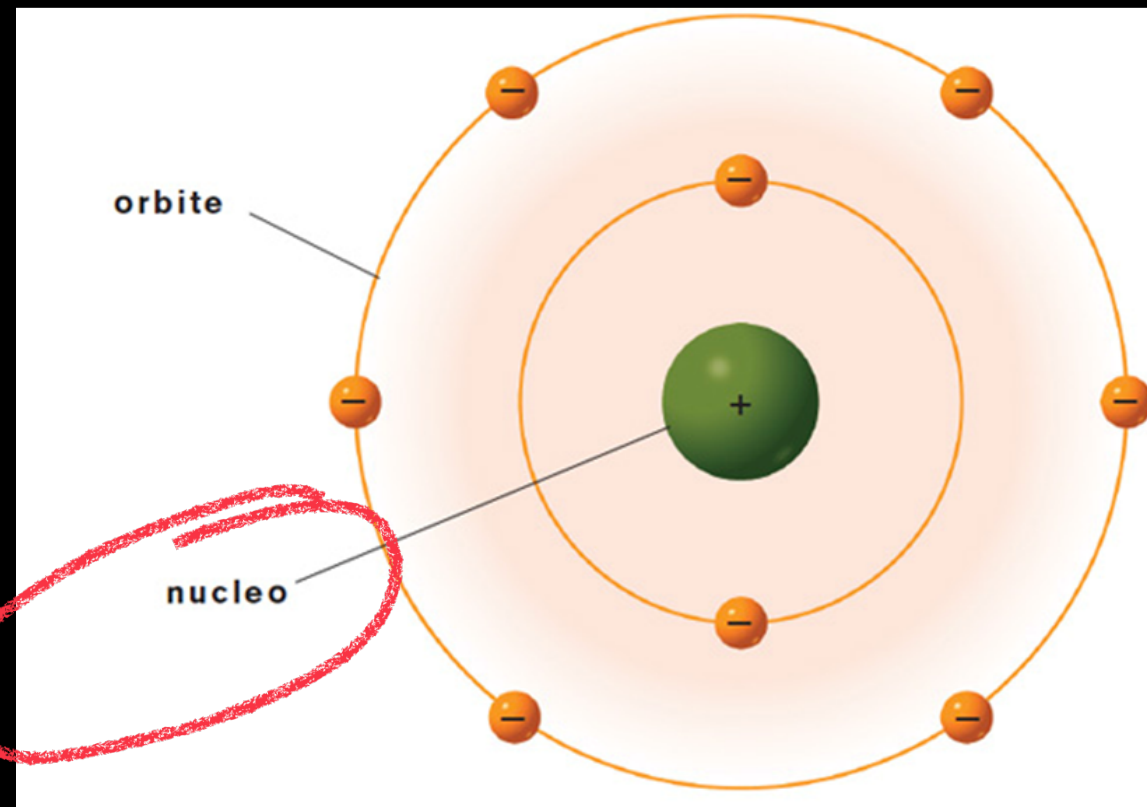
Esperimento di Rutherford (e Geiger, Marsden)



Esperimento di Rutherford (e Geiger, Marsden)

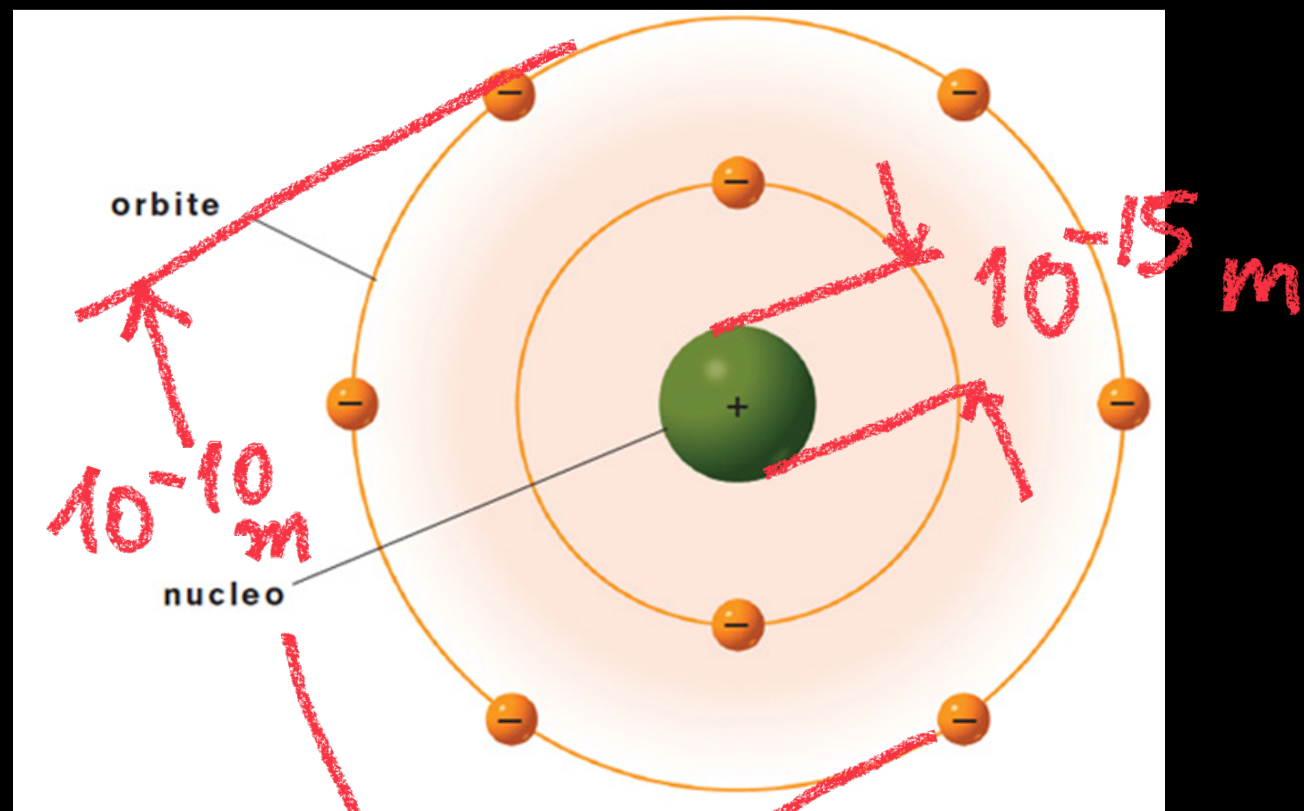


Modello planetario



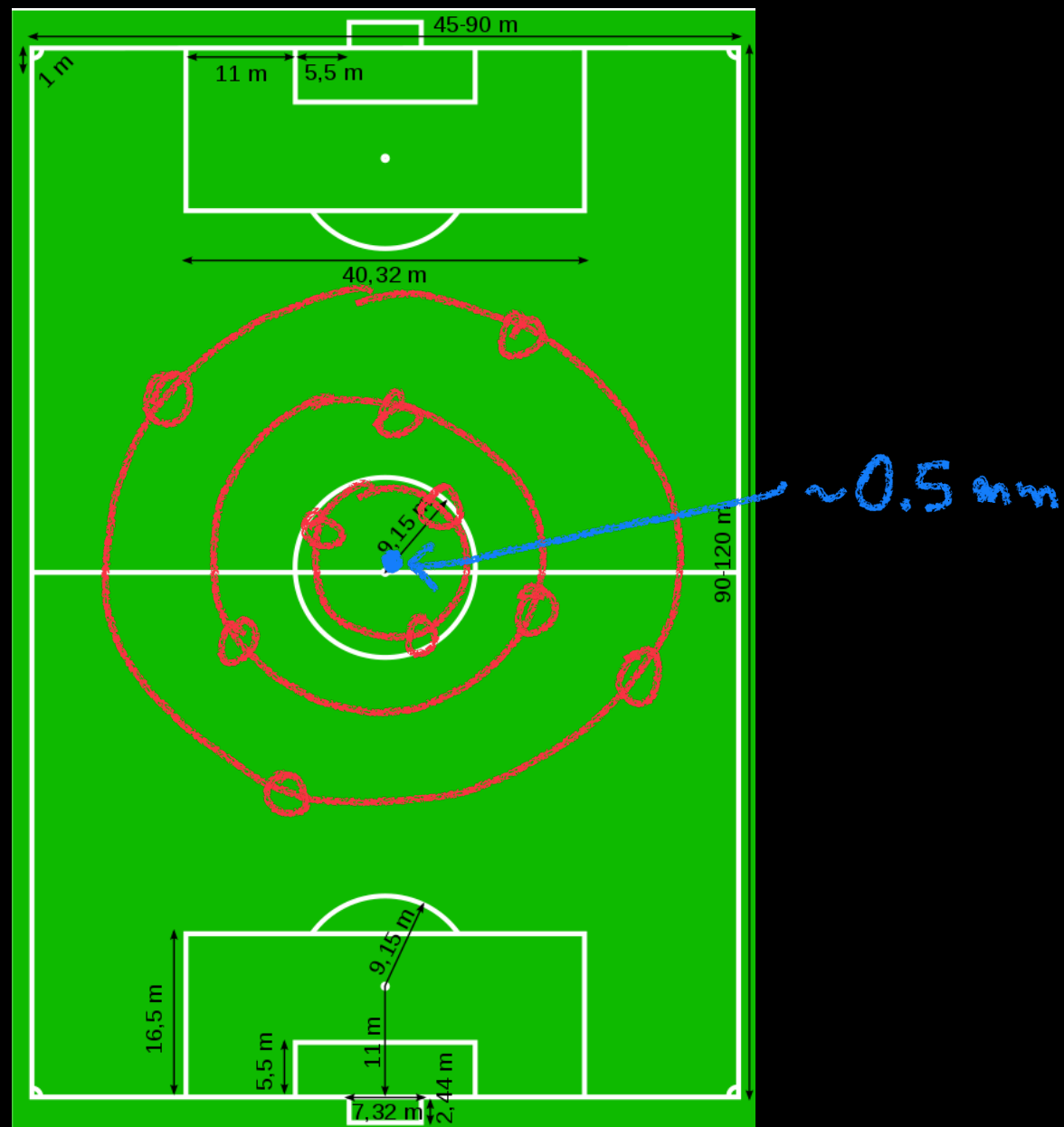
Fisica nucleare

Modello planetario



$$\sim 10^{17} \text{ kg/m}^3$$

Modello planetario

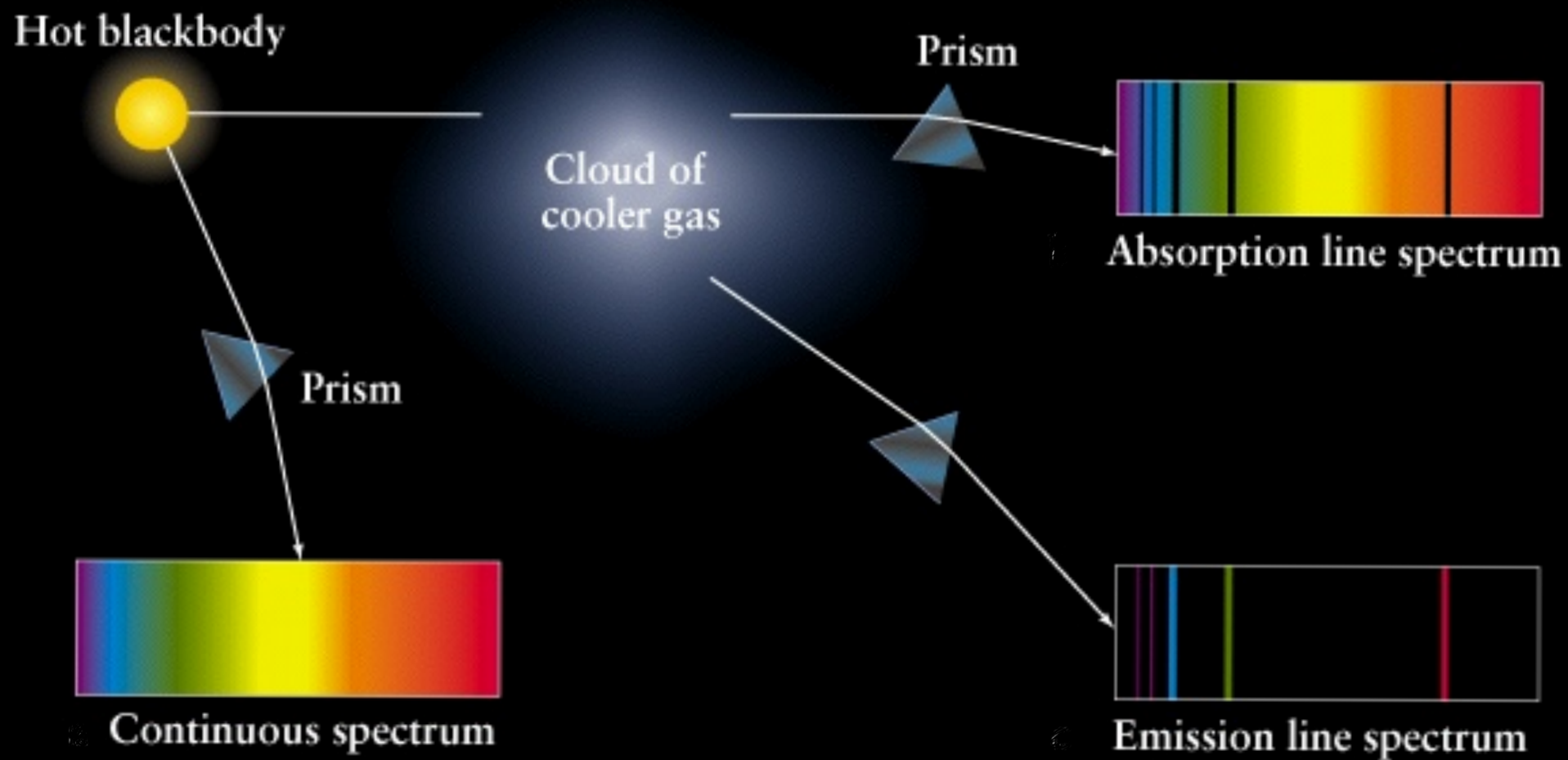


Modello planetario

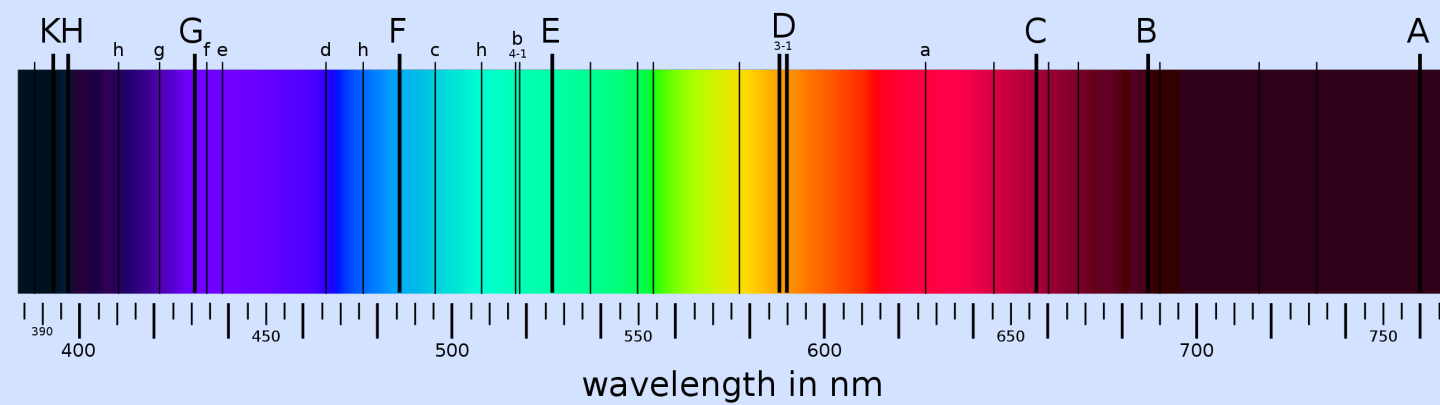
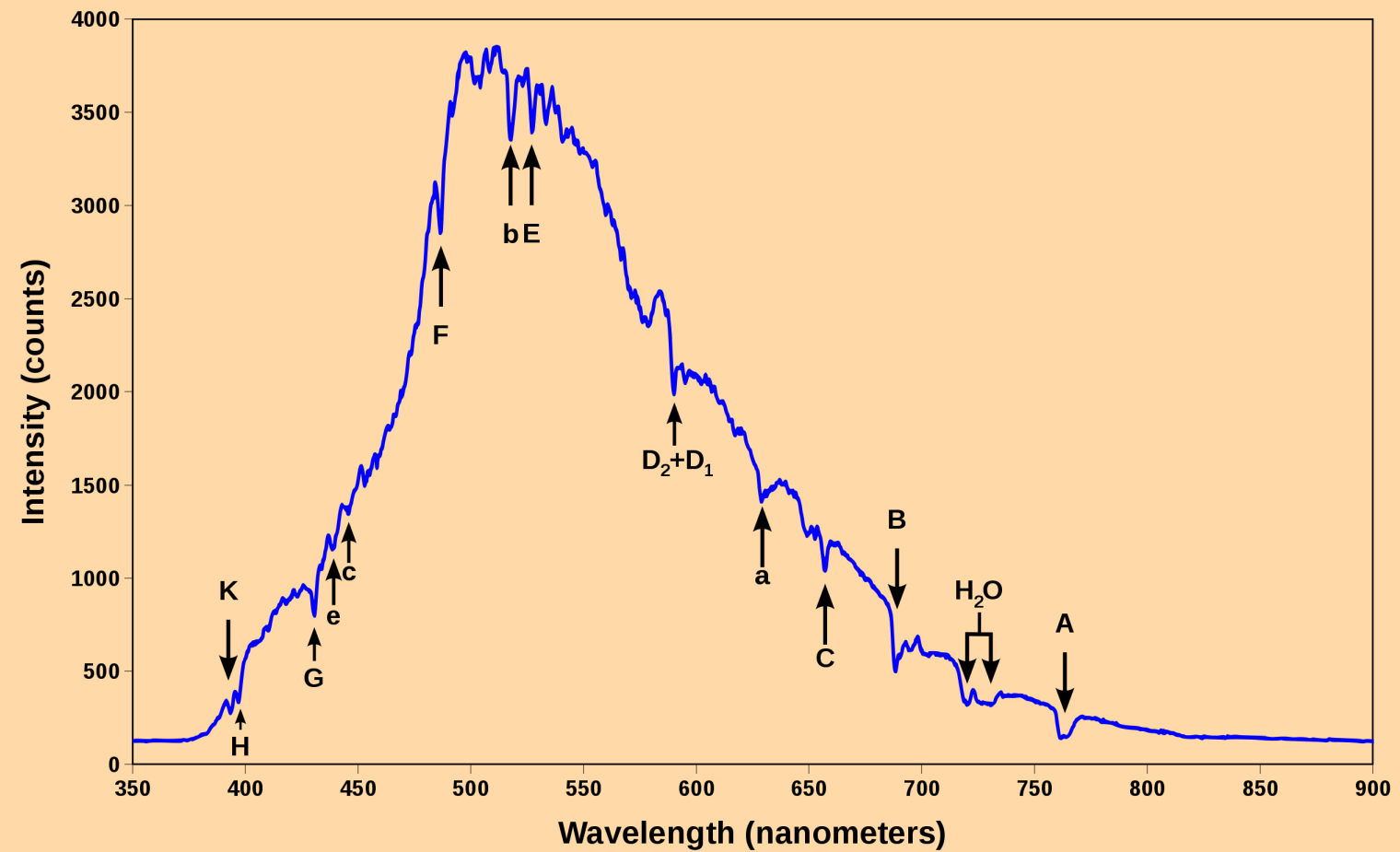
E' INSTABILE

(come minimo)

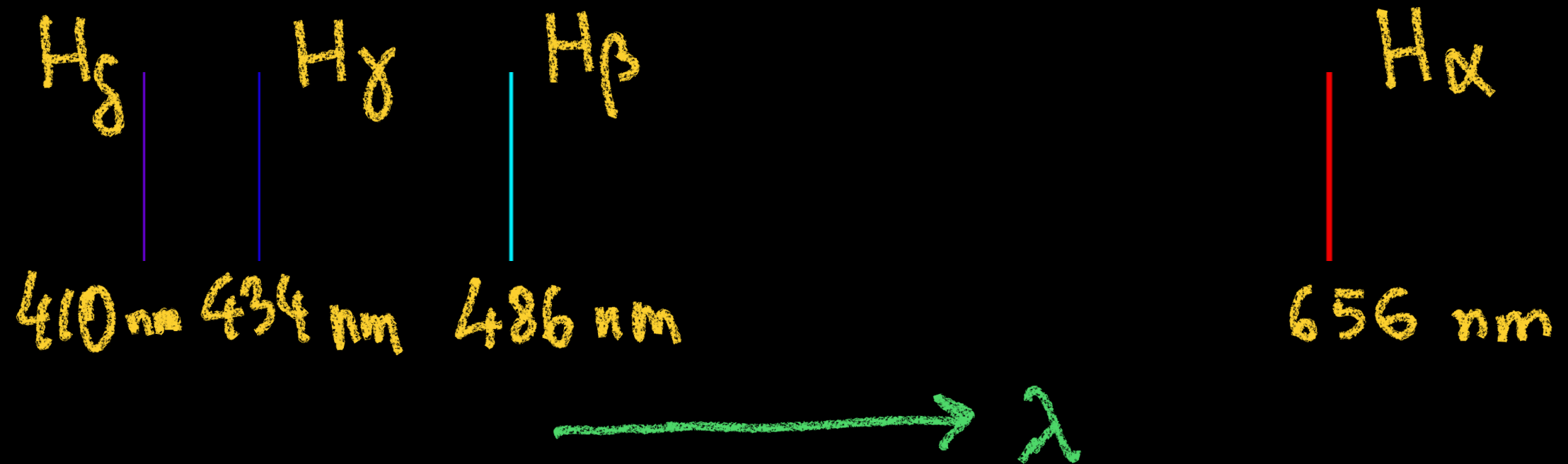
Spettroscopia in { emissione assorbimento



Fraunhofer



Balmer



Quantizzazione e Modello di Bohr per l'atomo di idrogeno



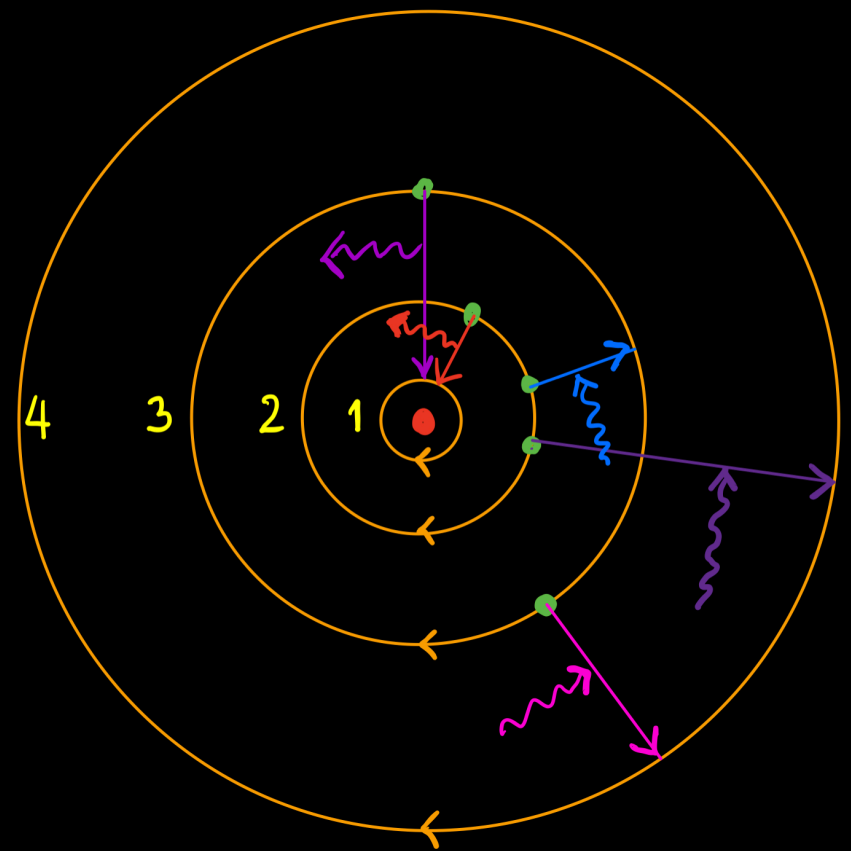
$$L = \frac{nh}{2\pi}$$



$$r = a_0 n^2$$



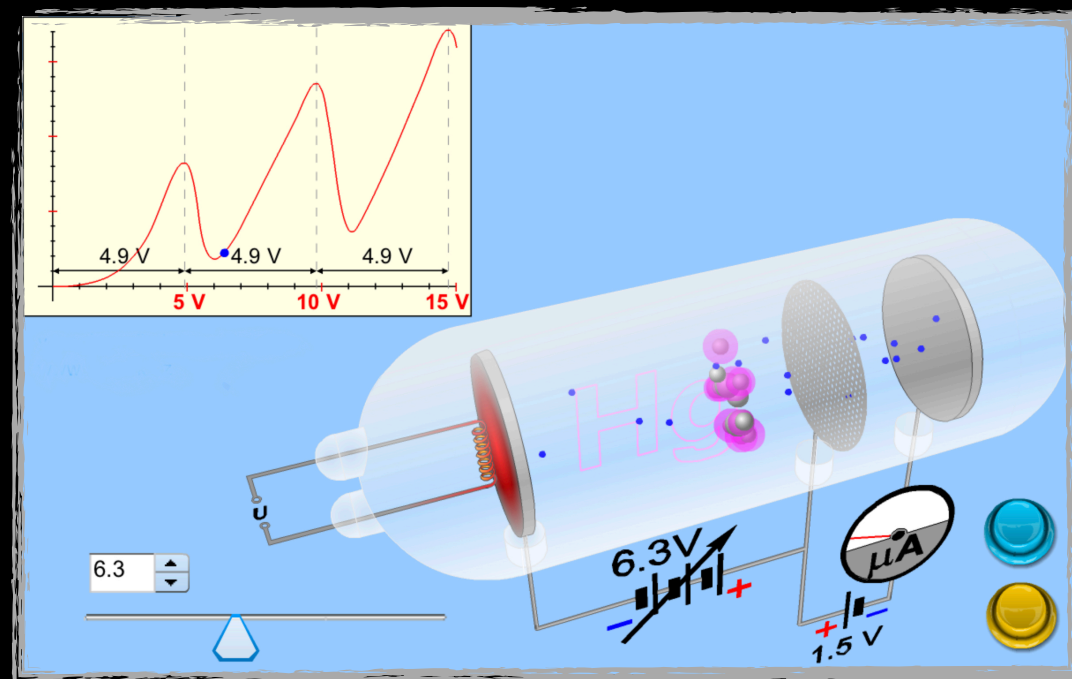
$$E = -E_0/n^2$$



Quantizzazione e Modello di Bohr per l'atomo di idrogeno

altre evidenze sperimentali:

Franck-Hertz (1914)



Quantizzazione e Modello di Bohr per l'atomo di idrogeno

ma ha molti
limiti ed
è « SBAGLIATO »

Altri elementi ...

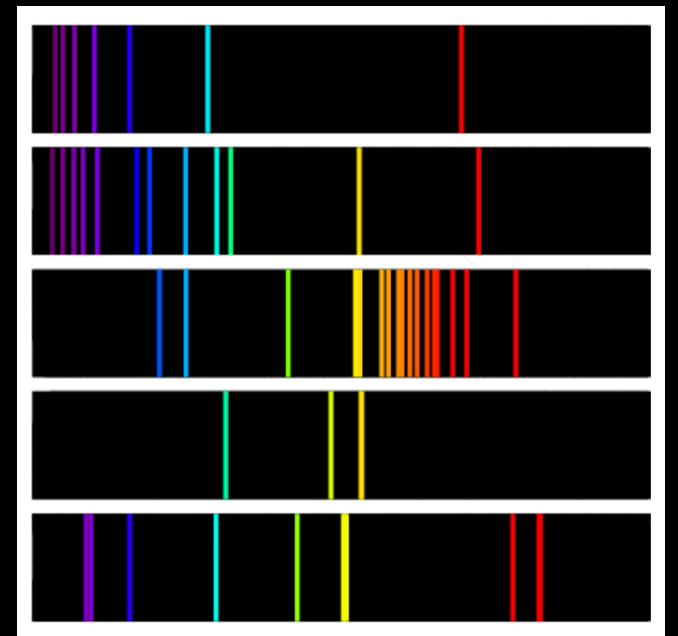
H

He

Ne

Na

Hg



Fisica quantistica

Interpretazione statistica e probabilità

Funzione d'onda

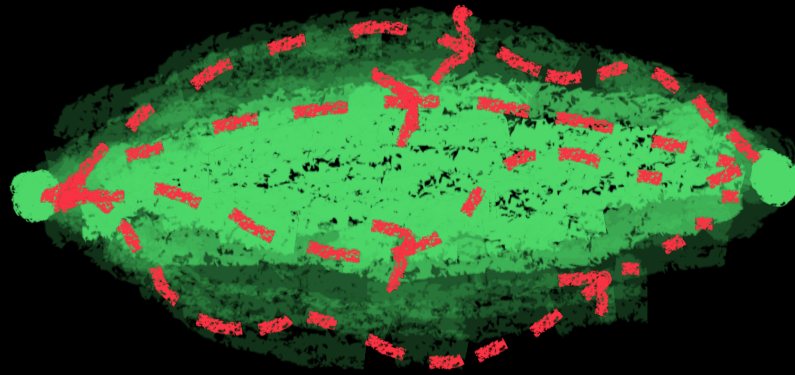
Equazioni di Schroedinger & Dirac

$$i\hbar \frac{\partial \psi}{\partial t} = \mathcal{H} \psi$$

Incertezze strutturali della FQ

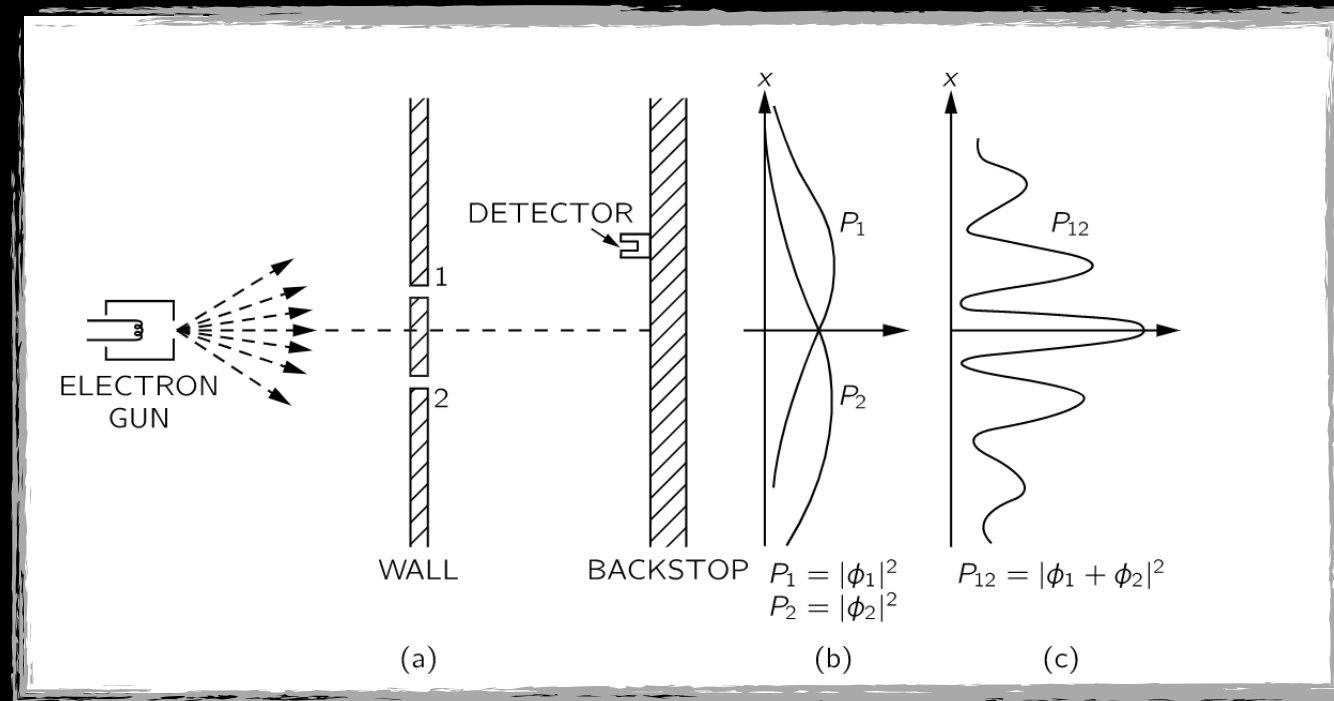


x, v



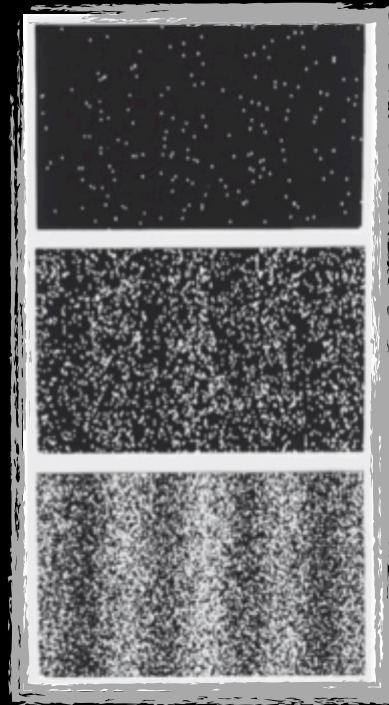
$\Delta x, \Delta v$

Interpretazione Statistica



Pioggia di gocce, fotoni, elettroni, ...

Interpretazione Statistica



Pioggia di gocce, fotoni, elettroni, ...

$$P = |\psi|^2$$

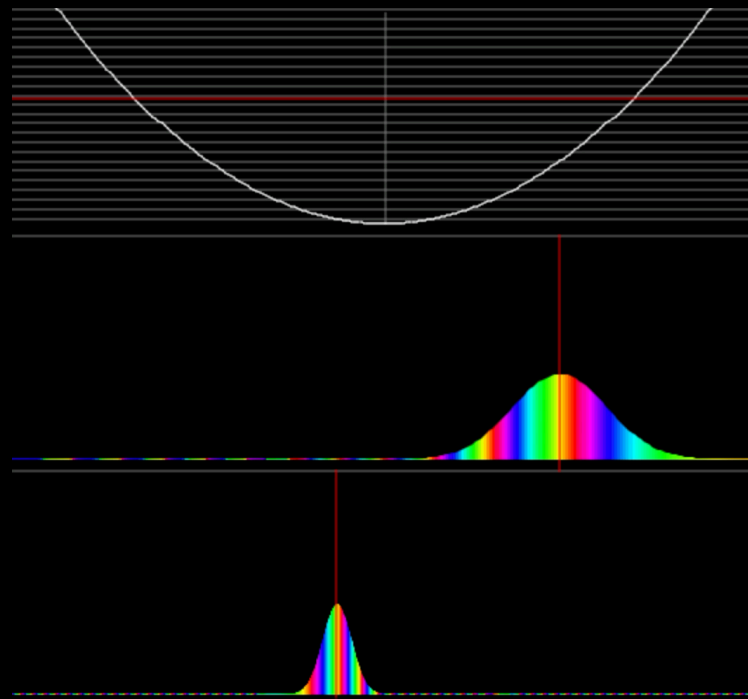
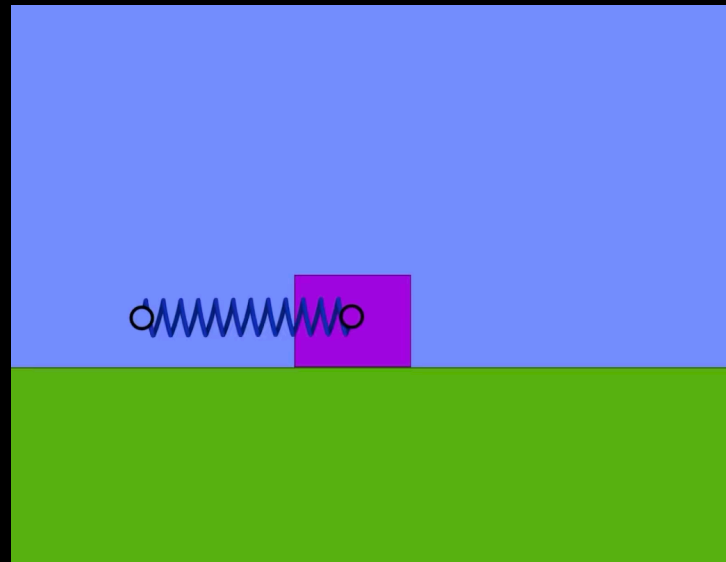
Fisica classica

Forze $\rightarrow$ Traiettorie

Fisica quantistica

Forze
[Energia] $\rightarrow$ Funzione
d'onda

oscillatori classici e quantistici



L'atomo di idrogeno quantistico

