

FUNDAMENTAL FORCES

- ultimate reduction

4 fundamental forces

→ gravity. (Newton)

(modified by
Einstein 1915
"general relativity")

→ Electromagnetism (Faraday + " ")

James Clerk Maxwell

explains optics

Maxwell's Eq $\frac{1}{s} \Rightarrow$ light speed is
a limiting velocity

⇒ Einstein — 1905 "special
relativity"
spacetime — with c as the
max velocity
(Modifies Newton's mechanics)

⇒ around 1900 — quantum
mechanics
parts of atoms
atomic structure. (1926)
Radioactivity.
— electron was discovered by
J.J. Thompson (1901)

Need a way to deduce the structure of atoms.

atom



electron



ion

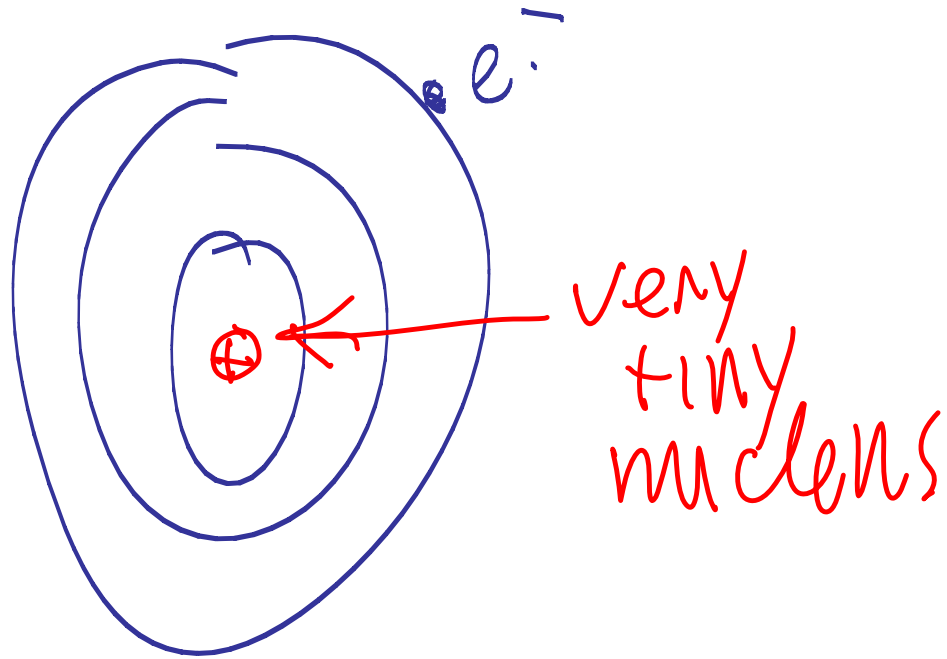
Thompson

"plum pudding atom"

Rutherford Exp



discovered the nucleus.



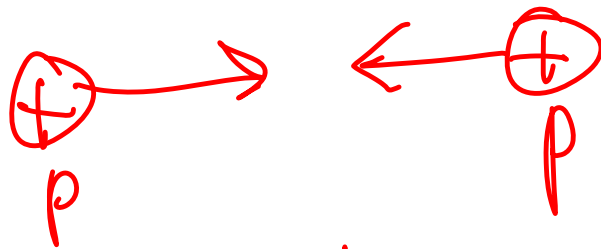
Bohr atom

— leads directly to particle physics

- particles into nuclei
- nuclear physics.
- interior of particles

with powerful artificial radiation
history of particle accelerator
development

Large Hadron Collider
(LHC) proton
synchrotron



$$E = mc^2$$

(1905)

Very fast beam has

Energy $> mc^2$ for new particles.

LHC has $\frac{E_{\text{beam}}}{m_{\text{proton}} c^2} > 700$

14 trillion electron Volts

$\oplus \longrightarrow$
Voltage = 14 trillion volts