

PHY100S - The Magic of Physics - Class 21

"Among all paradigms for probing a puzzle, physics proffers none with more promise than a paradox ... No one took the paradox [of quantum theory] more seriously than Bohr. No one worked around the central mystery with more energy wherever work was possible. No one brought to bear a more judicious combination of daring and conservativeness, nor a deeper feel for the harmony of physics."

-- John Wheeler

Assume nurture position is correct.

Identical twins:

identical DNA

separated at birth

raised in different

environments

Choice of profession,
musical taste determined
by their environment

Local Causality

Correlations:

profession
taste in music

measure profession of one twin
measure musical taste of the
other.

More sophisticated correlation
expt.

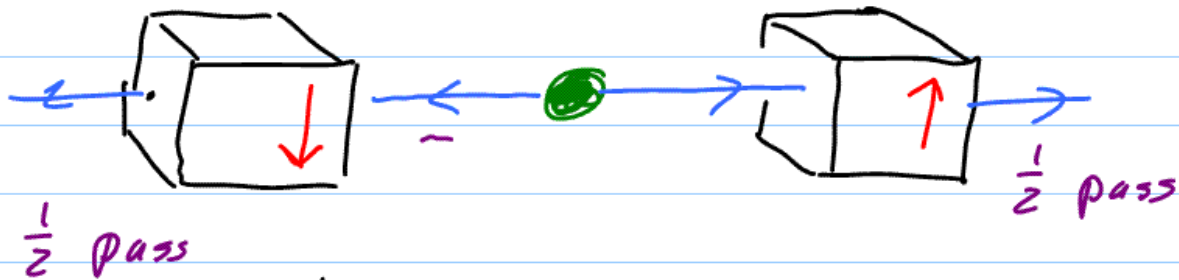
Observe correlations: Local
causality is wrong.

Spin Correlations

Radioactive decay!

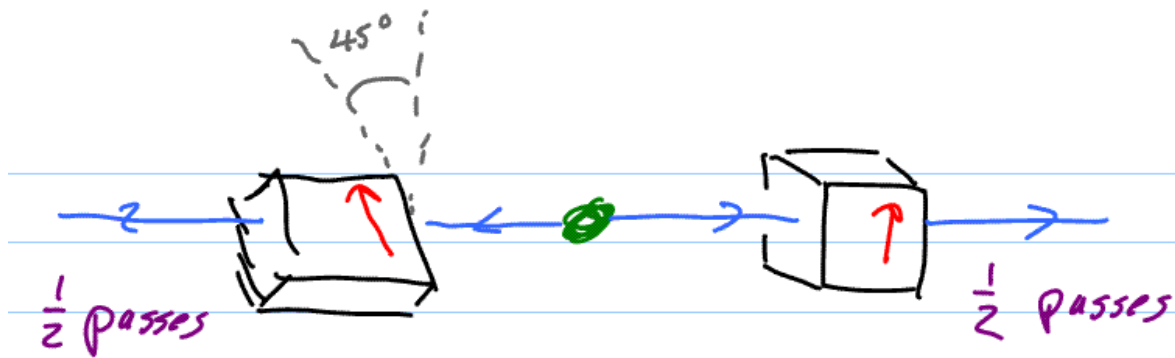
Some

- ① Emit 2 electrons in opposite directions in each decay.
- ① Total spin is zero



If e^- passes, so does
its companion $rh\ e^-$

If e^- does not pass, neither does
its companion $rh\ e^-$

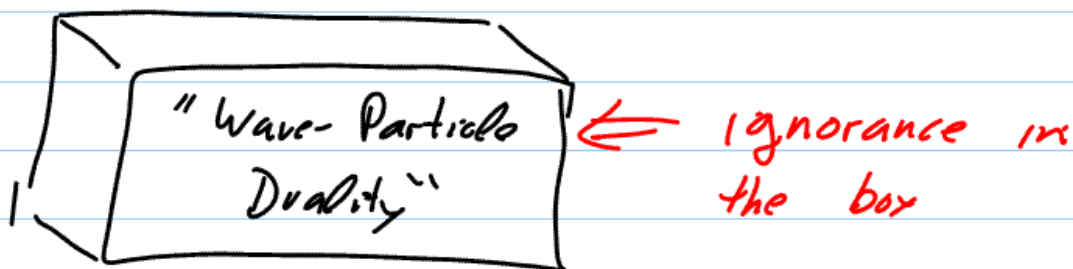


Quantum Theory (Bell 1964)

predicts! correlations that
violate Local Causality

Confirmed by experiment!
Electrons "entangled"

§14.6 Copenhagen Interpretation
of QM



Complementarity Principle

Measurement



minimum interaction:
1 photon.

separation between observer &
observed does not exist.

Bohr: "There is no quantum
world."

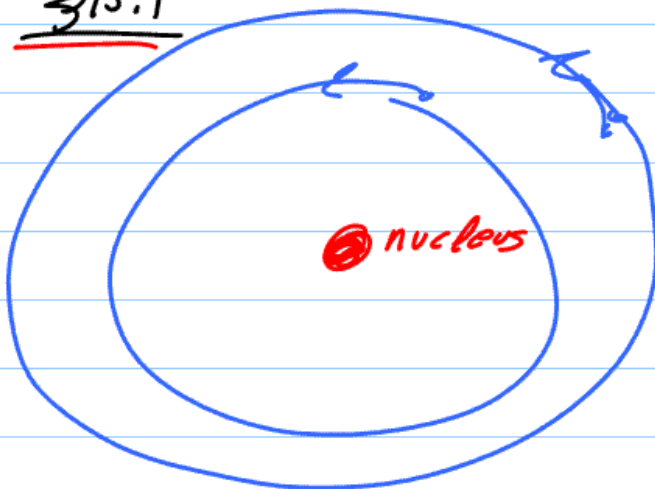
Wheeler: replace word "observer"
with "participator"

CHAPTER 15

Everyday life: 2 interactions

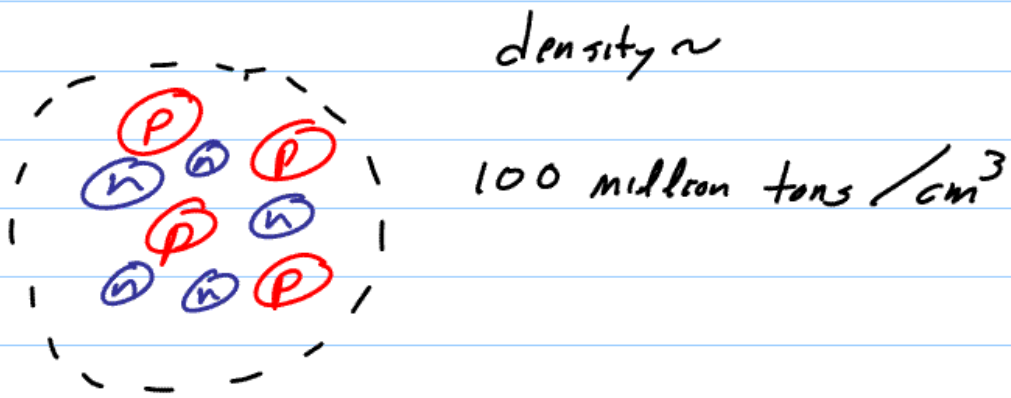
- ✓ ① Gravity: objects with mass.
- ✓ ② Electromagnetic: objects with electric charge

§13.1



nucleus!
protons: (+)ve
charge
neutrons: neutral

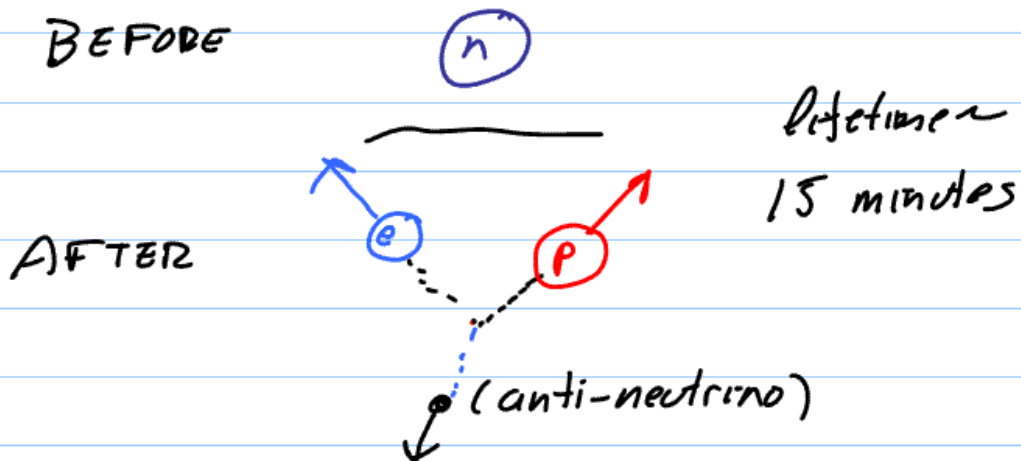
Nucleus



3rd type of interaction:

{ Strong }
{ Nuclear }

Free neutron:



4th interaction: "Weak"