30-07-2020 SCIENCE AND TECHNOLOGY

PARTICLE PHYSICS

Atoms → e, P, n → Quarks, Muons, Leptons, Neutrinos, Boson. → Fundamental Particles.

Atomic Level

Subatomic level = Particle Physics.

Theories of Universe

1. Event horizon
2. Singularity
3. String Theory.
4. Standard Model → highly valid theory

Universe formed by fundamental particles.

etc.

Particles comes under Quantam Mechanics

I. 0 = Zero = in understanding Universe it is important.

(+) + (−) = 0

Matter + Anti-matter = Universe

↳ both have same masses — Less known

$m = m$

have opposite charge.

(+) = (−)

(−) = (+)

eg.

electron (−) — Positron (+)

proton — Anti-proton

Brookhaven National Laboratory

↓

Study of Anti-matter

trying to find out Anti matter in our surroundings.

also trying to create anti-matter.

II. Origin of Universe

Big Bang Theory

In the beginning, universe was a singularity with indefinite mass & volume & density.

The universe started to form 13.6 billion years ago. (3)

(1) Highly dense
Temp millions °C
Dark condition

Unstable condition = Explosion called the big bang.

Construction and Destruction happened for billions of years (2)
(Density reduced)
(Millions °C)
(Dark condition)

Missing Link.

Fundamental Particles came into being (3)
Quarks, Leptons, Muons
Neutrinos, Bosons etc

2 up Quark + 1 down Quark = proton.
1 up quarks + 2 down Quarks = neutrons
Leptons - electrons.

e + p = hydrogen.

Fusion reaction $_1H^2 + {}_1H^2 \rightarrow {}_2He^4$ + Heat & energy

Helium.

Sun

This universe got light due to stars.

Elements H, C, N. came into being

Stanley Miller experiment. (4)
mix to form gases

CH_4, NH_3, H_2, water vapours (5)

Electricity

Carbo

Gave (Protein
Amino acid
fatty acid - acid
Glucose

(6) Gave origin to life

Big Bang — 13.6 billion ya — origin of Universe

↓

~ 4.6 billion ya — origin of Earth

↓

~ 3.2 billion ya — origin of life on Earth

III. Dark Matter and Dark Energy

in the dark region in the universe. These two matter & energy are there

— In dark areas there are forces of attraction which makes sure there is no deformity.

↓

Dark Matter — binds all celestial bodies.

— Energies that make dark matter attractive forces weak are called dark Energy.

↓

makes the binding weak.

IV. Expansion of Universe

(1) Doppler's Effect of Light

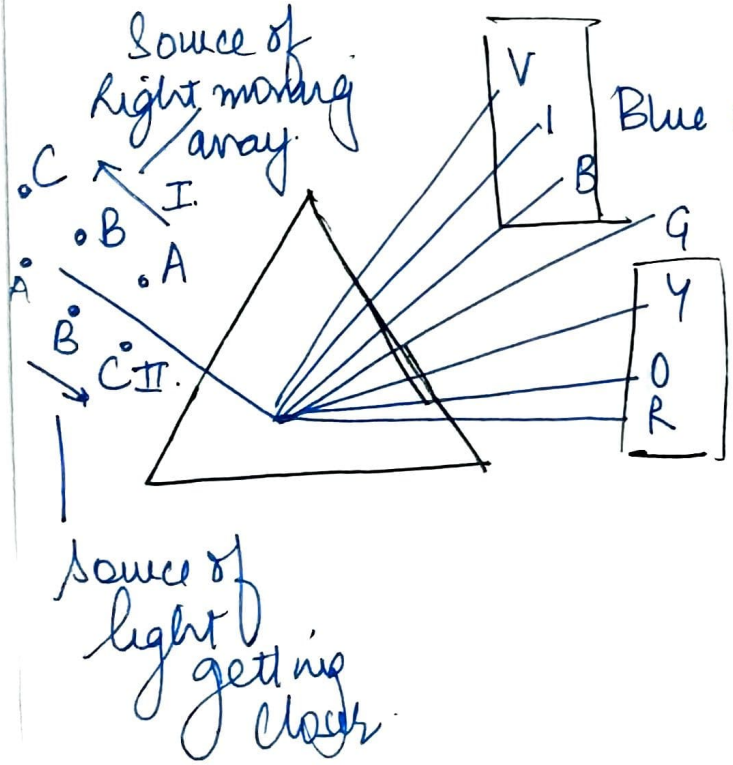
- Red shift effect → Red dominating when source of light is moving away.
- Blue shift effect → When blue dominates when source of light is moving closer

(2) Microwave Expansion Theory

Microwave is directional wave coming from all celestial object.

period of time → frequency is measured over

→ when frequency decreases due to expansion.



When source of light moves away Red dominates

When source of light moving closer Blue dominates.

I.

CERN EXPERIMENT / High particle energy experiment.

1. God Particles – Higgs Boson Particle
2. Accelerator → Linear – LINAC
   → circular – cyclotron
   – Synchrotron
   – Large Hadron collider (LHC)
3. Particle Detector → ALICE, ATLAS
   CMS, LHCB.

I. God Particle / Higgs Boson

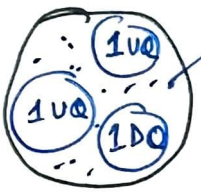
every atom has mass due to god particle
or
every fundamental particle has mass due to

first man to inform about god-particle → Prof. Satyendranath Bose.
- Peter Higgs → further expanded on God particle.

father of god particle.
- padma vibhusan given by India

→ CERN experiment happened at Swiss-France borders near Geneva.

└ accelerator was developed - LHC Large Hadron collidor.



Boson particle gives mass.

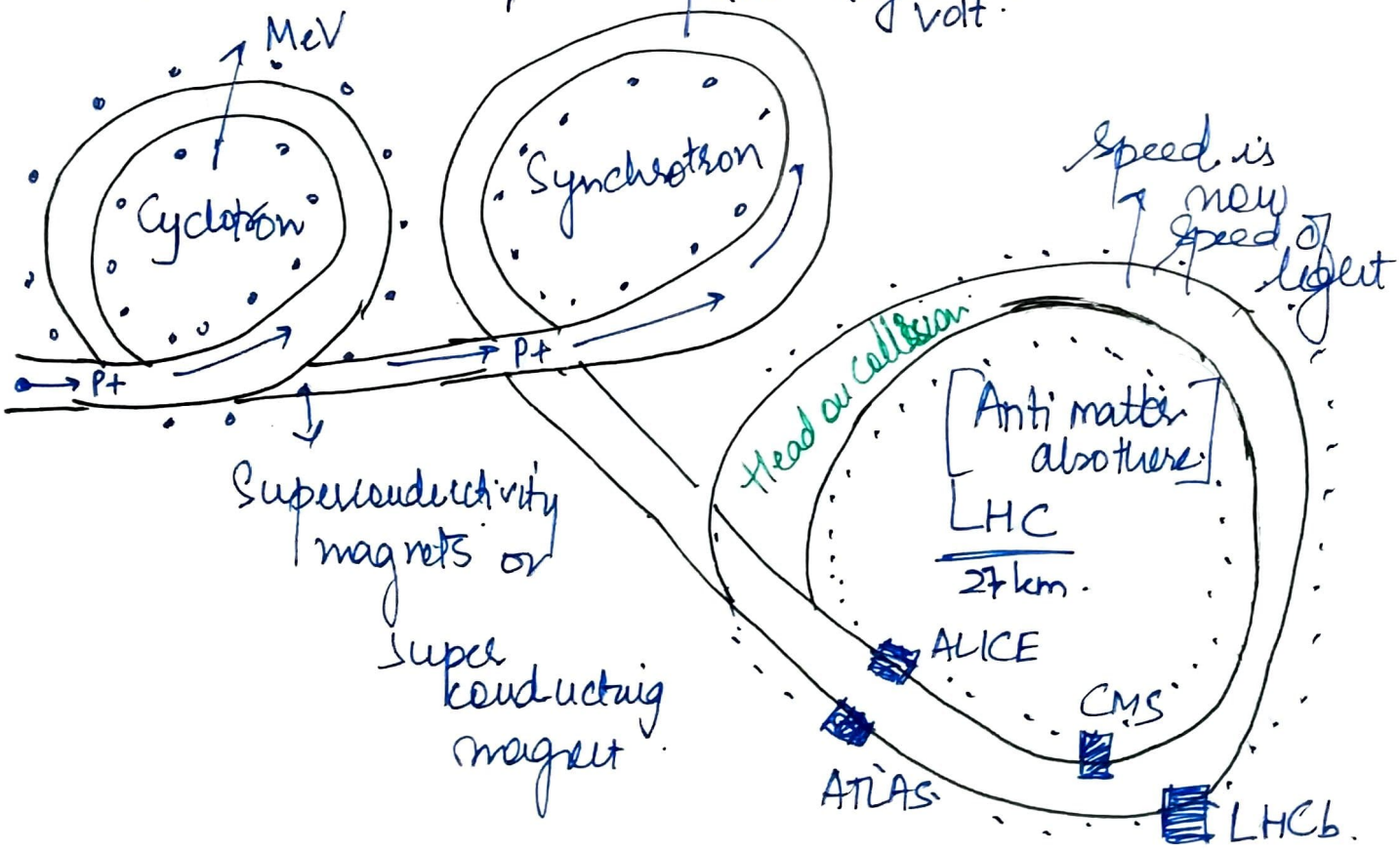
Proton

Higgs Boson field → celestial body acquire god particle or Higgs boson particle they acquire mass & exist

↓ it gives mass to the celestial objects & bodies.

→ Those having 2 or more Quarks they are considered as Hadron (proton & neutron)

GeV - Giga electron volt



VI. Neutrino

massless
Chargeless.

Neutron

mass + Chargeless.

Came just after bigbang – very old particle.

- Natural sources of neutrinos – Supernova phase of Star (death)
  - Gamma ray burst
  - Stars are sources.
- Wolfgang Pauli → Radioactive elements produce neutrinos.

Application of Neutrinos

1) ICT - It will bring a revolution – can reduce loses.
2) Medical – radiation therapy – no radiation effects.
3) Geo-neutrinos – detect fossil underground.
   - Heat convectional current can be checked
   - plate movement – detect earthquakes.
4) Understanding of Universe – Dark matter, Dark energy and black holes

ICE CUBE – largest neutrino observatory in Antartica

1 km^3 has been setup – Ice cube telescope

INO – Indian Neutrino Observatory

Theni dist. (Tamil Nadu).

Neutrino Oscillation → 2015 – Nobel Prize – Physics

ν_e ν_μ ν_τ – types of Neutrinos.

from the space – they were having loses.

which proved tiny mass not totally massless.

– tiny mass + Chargeless.

VII. GRAVITATIONAL WAVES

Electromagnetic waves
strong forces
weak forces.
Gravitational waves

} 4 types of forces exist in Universe.

Two heavenly bodies have attraction waves — Gravitational forces which lead to fusion of the bodies

which in term produce

Gravitational waves

- get to know about past of universe.
- we can understand & find out the distance, reason & time of the collision of heavenly body

- Observatories are used to detect the gravitational waves.
- Einstein
  - Special theory of relativity (1905)
  - General theory of relativity (1915)

Universe follows (Space time fabric)

- constantly expanding.
- presence of gravitational waves.

everything fixed in universe

- The solar system is under the influence of Sun's gravitational force as it has max mass.
  - more gravity more bending of light
  - gravity gives light its bending nature.

For - gravitational waves - observatories have been set up.

- LIGO - Hanford (Washington) } operational
- LIGO - Livingston (Louisiana) } operational
- VIRGO } under construction
- LIGO INDIA } under construction (Hingoli (Maha))
- KAGRA } under construction
- GEO600.

Black holes have maximum mass and have bending of light at its max.

→ LIGO - laser Interferometer Gravitational wave observatory.