Nuclear Reactions Applications

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DEFINITION

- Nuclear physics is the field of physics that studies atomic nuclei and their constituents and interactions.
- It includes the study of,

1. The general properties of nucleus.
2. The particles contained in the nucleus.
3. The interaction between these particles.
4. Radio activity and nuclear reactions.
5. Practical applications of nuclear phenomenon.

NUCLEAR REACTIONS

- A nuclear reaction is a rearrangement of nuclear components induced by particle bombardment.

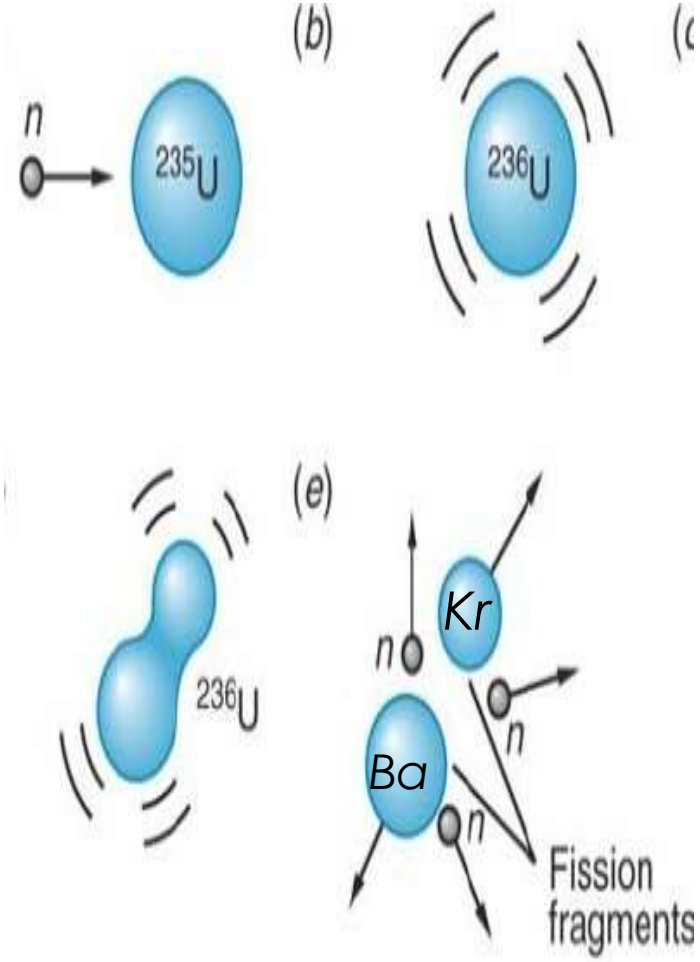
1. Fission
2. Fusion

- Nuclear reactions are subject to the following conservation laws:

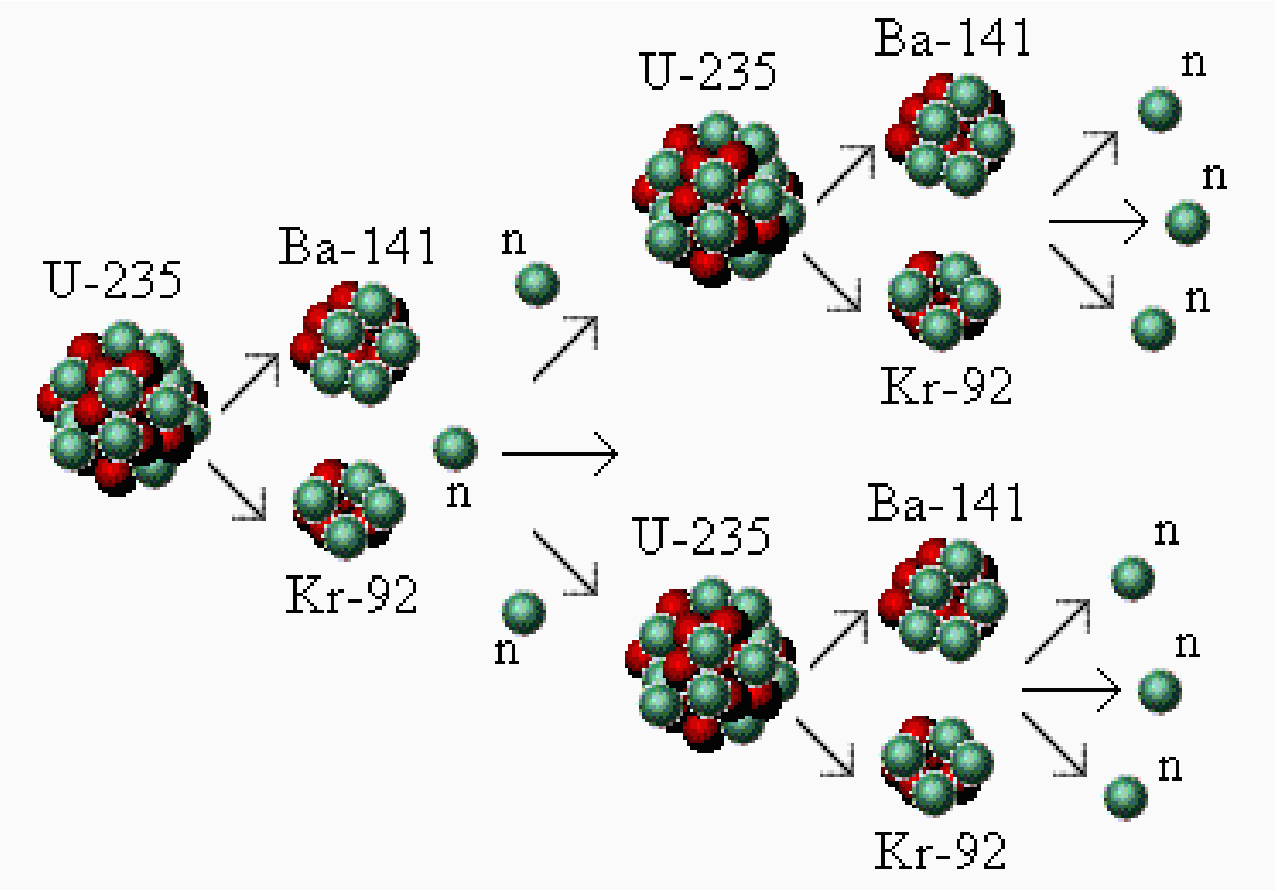
1. Charge.
2. Momentum and angular momentum.
3. Energy.
4. Total number of nucleons.

FISSION

- Splitting of large nucleus to smaller ones results in the liberation of energy.
- *n + 235U →141Ba + 92Kr + 3n*
- In this reaction more than 200MeV energy liberated.
- Chain reaction is controlled and is applied in fission reactors.
- Chain reaction left uncontrolled and is applied in atom bomb.



FISSION CHAIN REACTION



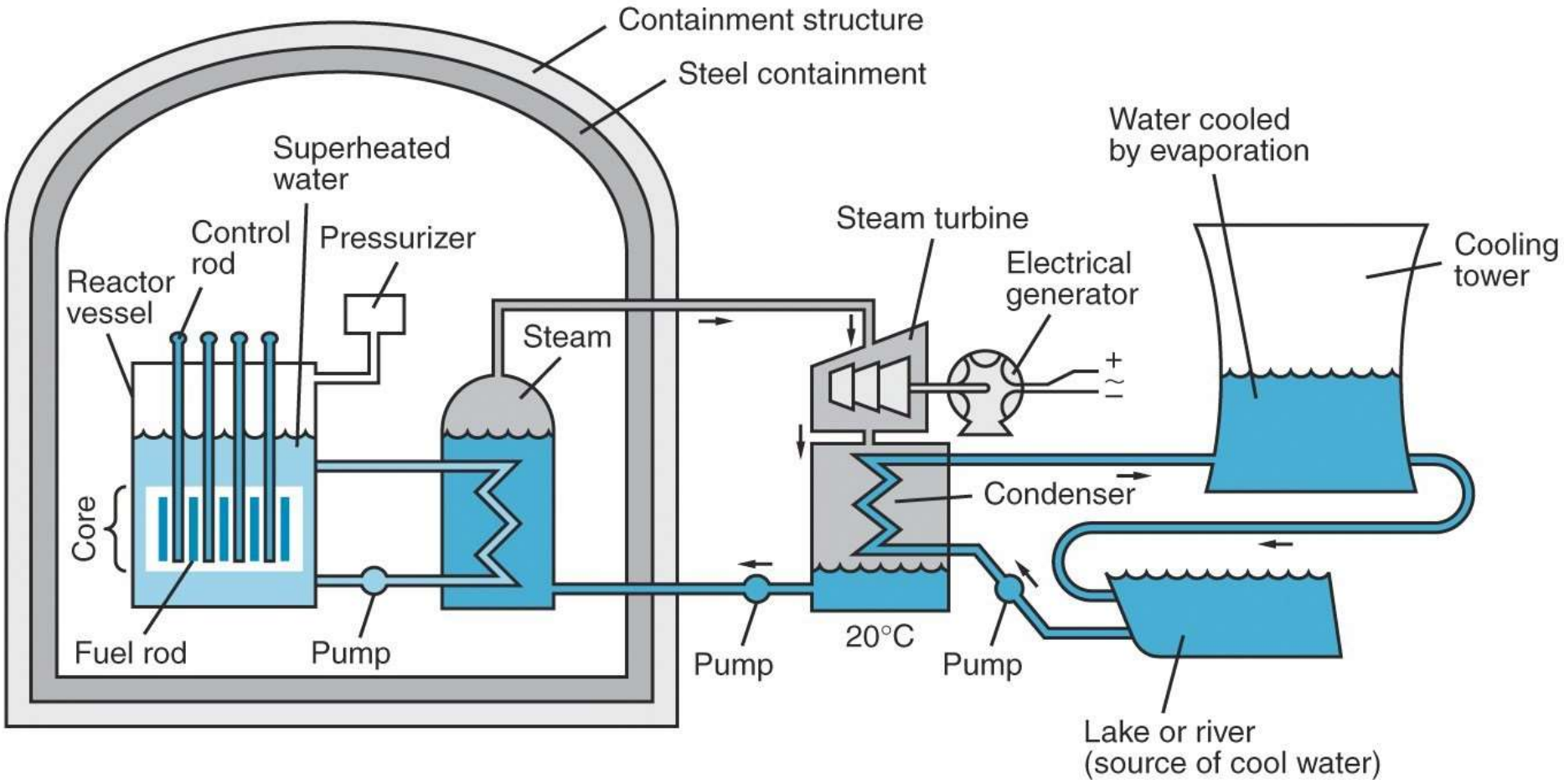
At each step energy is released !

NUCLEAR FISSION REACTOR

- Place where controlled fission chain reaction occurs.
- Liberated energy is used for the production of electricity.
- <u>PARTS OF THE REACTOR;</u>

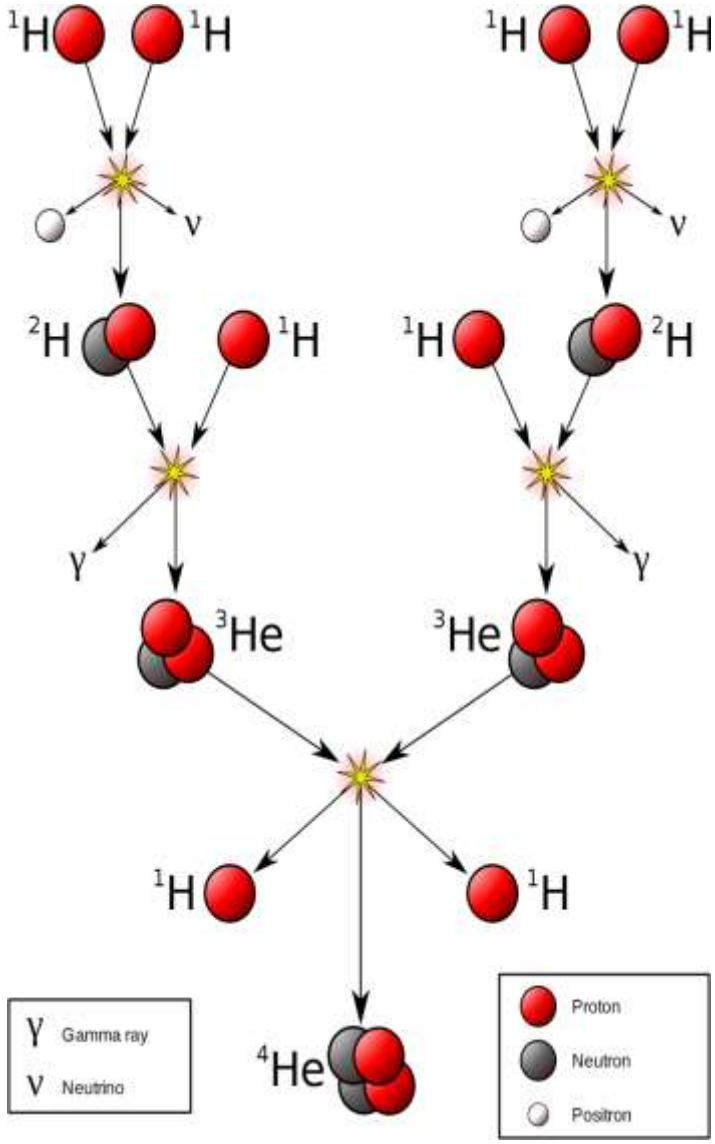
1. Fuel-Uranium,Plutonium,Thorium
2. Moderator-Water,Graphite- slow down neutron.
3. Control rods-Cadmium- absorb neutrons.
4. Concrete wall- block radiations.

NUCLEAR FISSION REACTOR



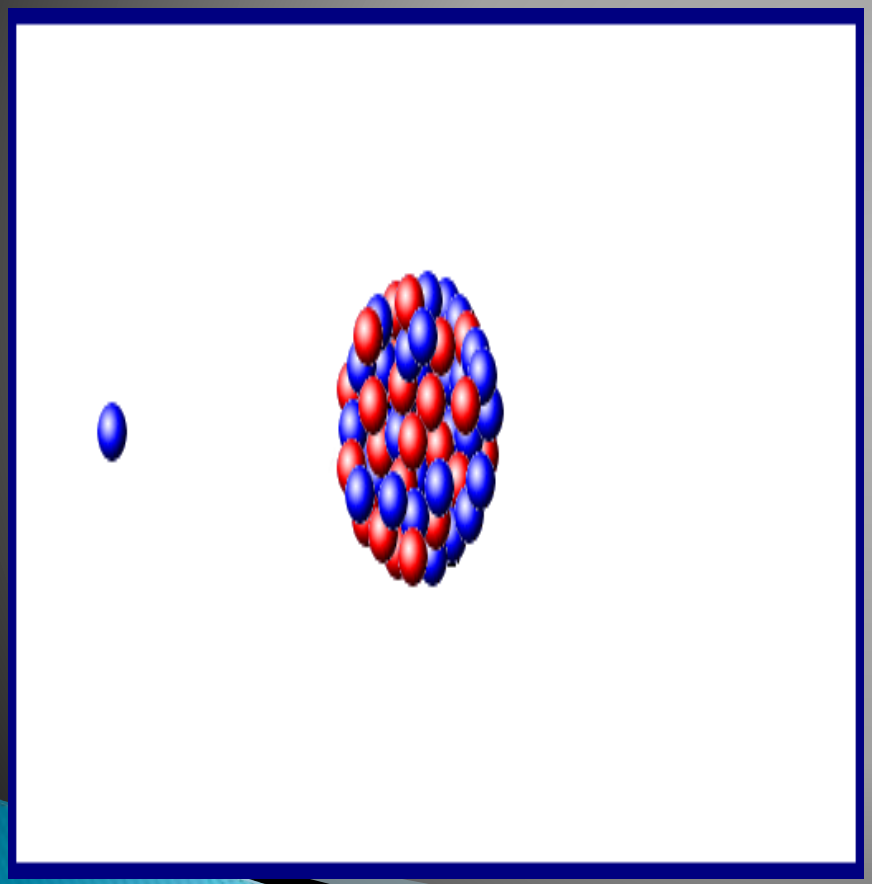
FUSION

- Two light nuclei fuse together to form a heavier nucleus results in the liberation of energy.
- 2H + 3H →4He + n + 17.6 MeV
- It is the primary source of the sun's energy.
- Fusion reaction is applied in hydrogen bomb.

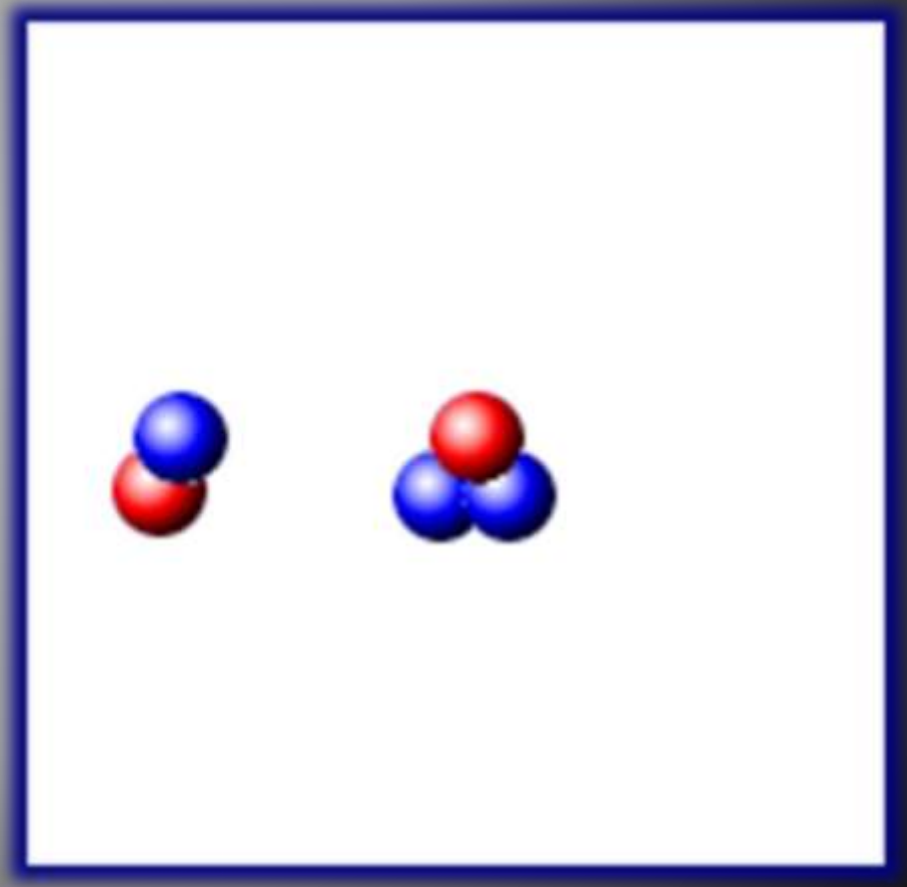


FISSION & FUSION

FISSION

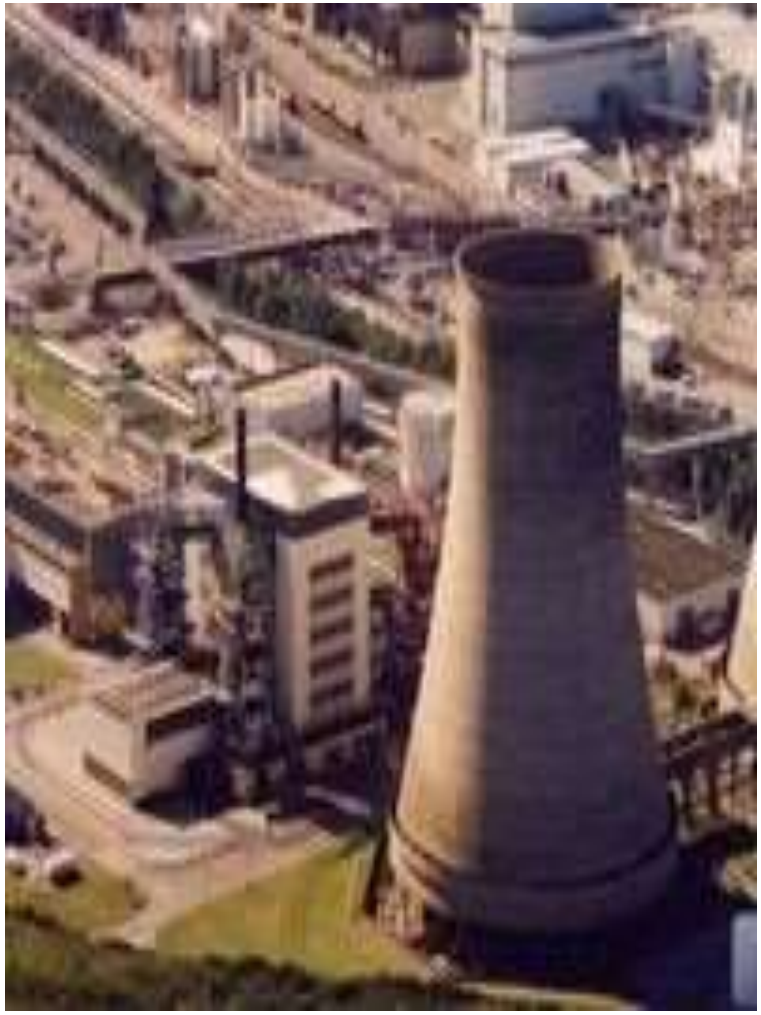


FUSION



FUSION REACTOR

work in progress: ITER International Thermonuclear Experimental Reactor (500MW power in 1000second through fusion reaction)



FISSION & FUSION

FISSION

- *Splitting a large mass nucleus into two medium mass nucleus.*
- *Energy released per nucleon is less.*
- *Can be controlled.*
- *Heat is not needed.*
- *Lot radioactive byproducts.*

FUSION

- *Joining two low mass nuclei into a larger mass nucleus.*
- *Energy produced per nucleon is large.*
- *Can not be controlled.*
- *Extreme heat is needed.*
- *No radioactive byproducts.*

APPLICATIONS ARE

- Medical radio-isotopes (imaging & therapy).
- Magnetic Resonance Imaging (MRI).
- Identification of materials.
- Dating of materials.
- Power generation (fusion and fission).
- Weapons of mass destruction (WMD).

REFERENCE

- NCERT physics text book.
- www.elsevier.com.
- www.sciencedirect.com.
- www.wikipedia.org.