# M.Sc(chem) ,Sem-II, CC-V, Unit I

# Nuclear Reaction and Cross section ,Lect.No- 3

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**General Introduction / Definition:**

The **nuclear cross section** of a nucleus is used to describe the probability that a nuclear reaction will occur. The concept of a nuclear cross section can be quantified physically in terms of "characteristic area" where a larger area means a larger probability of interaction.

Unit-The standard unit for measuring a nuclear cross section ( σ) is equal to 10−28 m² or 10−24 cm².

**Characteristics of Cross section.**

1. Cross sections can be measured for all possible interaction processes together, called total cross sections or for specific processes to distinguish elastic and inelastic scattering.
2. Cross sections can be computed for any sort of process, such as capture scattering, production of neutrons, etc.
3. In many cases, the number of particles emitted or scattered in nuclear processes is not measured directly.
4. . The cross section obtained in this way is called the total cross section and is usually denoted by a σ or σT.
5. Typical nuclear radii are of the order 10−14 m. Assuming spherical shape, we therefore expect the cross sections for nuclear reactions to be of the order of π*r*  or 10−28 m² (i.e. 1 barn). For instance slow neutrons absorbed during the nuclear reaction show a much higher cross section i.e. > 1000 barn .
6. The cross sections for transmutations by gamma-ray absorption are in the region of 0.001 barn.
7. Macroscopic cross section- Nuclear cross sections are used in determining the nuclear reaction rate, and are governed by the reaction rate equation for a particular set of particles (usually viewed as a "beam and target" thought experiment where one particle or nucleus is the "target" [typically at rest] and the other is treated as a "beam" [projectile with a given energy]).

A **barn** (symbol: b) is a unit of area equal to 10−28 m2 (or 100 fm2). A **barn** is approximately the cross-sectional area of a uranium nucleus. The **barn** is also the unit of area used in **nuclear** quadrupole resonance and **nuclear** magnetic resonance to quantify the interaction of a nucleus with an electric field gradient.

1. A neutron can have many types of interactions with a nucleus (Ragheb, 2011).

The most important of them are:

σse = elastic scattering cross-section

σsi = inelastic scattering cross-section

σγ = radiative capture cross-section

σf = fission cross-section

σp = (n, p) reaction cross-section

σT = (n, T) reaction cross-section

σα = (n, α) reaction cross-section

The sum of the cross sections that can lead to the disappearance of the neutron is designated as the absorption cross section:

σ a = σγ + σf + σp + σT + σα

Similarly, the sum of the cross-sections that lead to scattering of the neutron is designated as scattering cross-section:

σs =σsi+σse

The sum of the all reactions is designated as the total neutron cross-section:

σt =σa+σs

σt=σse+σsi+σγ+σf+σp+σT+σα

The standard unit for measuring the total neutron cross-section is the barn, which is equal to 10−28 m2 or 10−24 cm2.

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* {\displaystyle r\_{x}} :
* {\displaystyle \rho \_{A}} :
* {\displaystyle \Sigma \_{x}\equiv \sigma \_{x}\ \rho \_{A}}