The quantity nv is usually called the "neutron flux" since it is the number of neutrons incident per unit area per unit time on the target. Values of σ will obey the approximate inequality

$$10^{-24}\ \mathrm{cm}^2 \lesssim \sigma < \lambda^2 \qquad (2\text{-}5)$$

where the de Broglie wavelength λ of the neutron is defined in equations (2-2) and (2-3).

2.3 MEASUREMENT OF TOTAL CROSS SECTIONS

The "total" cross section of a given material for incident neutrons is determined by measuring the neutron transmission of a known sample of the material. A source emits neutrons so that a beam of intensity I_o (neutrons/sec/cm^2) is incident on the sample, see Figure 4. As a result of scattering and absorption processes in passing through the material the neutron intensity is reduced to I. The detector response with the sample "in" the beam and "out" of the beam are measured so that I and I_o, respectively, can be determined.

The geometrical arrangement must be such that any scattered neutron will not be detected. This means that the solid angle of the absorber at the source and at the detector must be very small. The broken line in Figure 4 shows how a scattered neutron might be detected if the neutron beam were not properly collimated. By defining the beam (i.e., making incident and transmitted beams parallel) with suitable apertures the geometrical conditions mentioned can be met. In addition to these geometrical conditions it is also necessary that any multiple scattering process in which a scattered neutron could be rescattered back into the beam has a negligible probability. This cannot always be satisfied for "thick" samples in which scattering predominates over absorption. (In the discussion of neutron diffusion and slowing-down, in a later chapter, it will be obvious that the exponential law to be derived herewith will not be valid.)

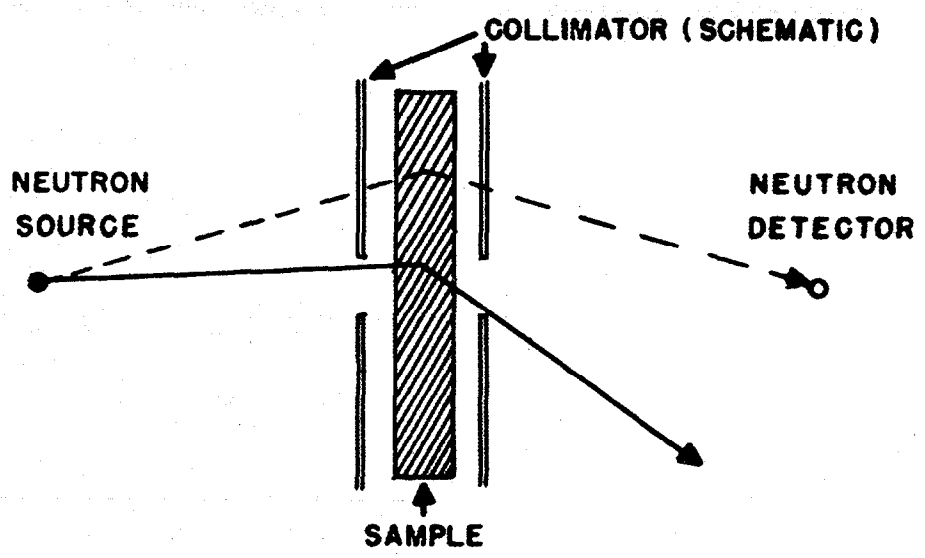

Figure 4. General arrangement for neutron transmission experiment (total cross section measurement).

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