It is well to keep in mind that the 1/v law holds for *relative* velocities. That is, when the neutron velocities become small (comparable to thermal velocities) the thermal agitation of the target nuclei must be considered in the application of the 1/v law. Suppose neutrons are incident upon some material in which σ is proportional to $1/v_{rel}$, where the subscripts have been added to indicate that it is the relative velocity of neutron to target nucleus which counts. Suppose further that a fraction N_u of all the target atoms are moving with an absolute velocity u relative to some fixed laboratory frame of reference. Since σ is proportional to $1/v_{rel}$ and the number of "meetings" per second is proportional to $N_u \cdot v_{rel}$ then the capture probability is $A \cdot N_u$ with A a constant. Summing over all possible target atom velocities $\sum_u A \cdot N_u = A \cdot N$ shows that the total capture probability is a constant.

Thus, *the number of captures per unit time is a constant and independent of the relative velocities between neutron and target atoms whenever the cross section is proportional to 1/v.* This independence of relative velocities can also be seen by inspection of equation (2-4).

One of the early fundamental experiments (*Physical Review* 49:777 (1936)) was based on this principle. In the experiment the transmission of a rotating boron covered disk, on which a beam of neutrons was directed (axis of neutron beam inclined with respect to axis of disk rotation), was measured. The 1/v law was verified by observing no change in transmission with variation of rotational speed. The transmission by substances not obeying the 1/v law, e.g., cadmium, was found to vary as the rotation was changed.

The lighter isotope of lithium reacts with neutrons according to the scheme $Li^6(n,\alpha)H^3$ with a Q of +4.5 Mev. As anticipated in the previous section, neutron absorption is according to the 1/v law, at least up to about 0.1 ev. This is shown in Figure 10. It may be said in general that the 1/v law holds to higher energies for light nuclei, where the energy levels are spaced far apart, than for heavy nuclei where the energy levels are close packed and the factor M′ varies sharply. This will be discussed in some detail in Chapter IV.

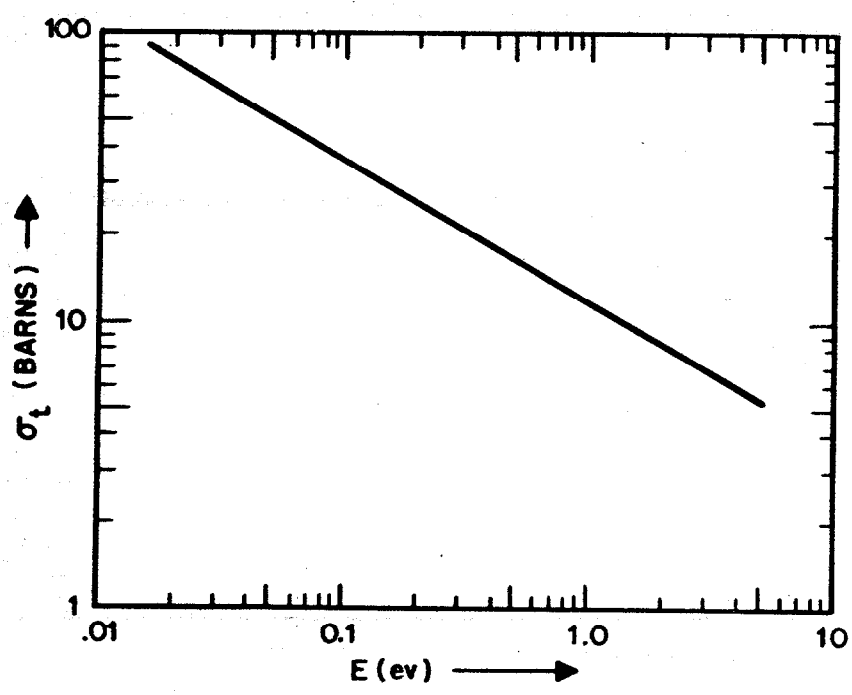

Figure 10. Lithium. Total neutron cross section vs. neutron energy.

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