Note that the denominator is not the total probability but the probability of positive velocities, $0 \le \theta \le \pi/2$. $\rho(V,\theta,\phi)$ symbolizes the velocity distribution. However for the for isotropic distributions it is independent of direction $\rho(V,\theta,\phi) \Rightarrow \rho_{vel}(V)$. (The subscript vel emphasizes the fact that this is an isotropic velocity distribution, not a speed distribution.) As a result the integral ratio simplifies to

$$\widehat{V\cos\theta}\Big|_{pos} = \frac{\int_0^{2\pi} d\phi \int_0^{\pi/2} \cos\theta \sin\theta \, d\theta \int_0^{\infty} V\, V^2 \rho_{vel}(V)dV}{\int_0^{2\pi} d\phi \int_0^{\pi/2} \sin\theta \, d\theta \int_0^{\infty} V^2 \rho_{vel}(V)dV} = \frac{2\pi\left(\frac{1}{2}\right)}{2\pi(1)}\hat{V} = \frac{\hat{V}}{2}$$

The solution of Exmp. 4 showed that the average positive velocity component of *any type of translating particles* in equilibrium moving in a single direction is V/2. Further, since these velocity distributions are isotropic, half of the particles will have positive velocity components and the other half negative. Therefore, the rate at which carrier particles move in a single direction per unit area time in an equilibrium gas is

$$\dot{n}'' = \left(\frac{n_v}{2}\right) \widehat{V\cos\theta}\Big|_{pos} = \frac{n_v \hat{V}}{4} \qquad \text{(IIIE-11)}$$

where n_v is the number of carrier particles per unit volume, or *carrier particle density*. The particle flux directly governs the *maximum* rate of diffusion of any specific type of particle. Since each transported quantity is carried by a flux of carrier gas particles, $\dot{n}''$ also sets an upper limit on each transport process equal to the mean value of the transported quantity per particle times $\dot{n}''$, see below. However, rather than substitute directly to determine the maximum flux limits, we first consider those processes that reduce transport rates below their respective maxima.

Transport can only occur at its maximum rate when the carrier particles are unimpeded in their motions. Insofar as the carrier particles collide with one another or with other particles present within the transport space, transport is reduced below this maximum.

C. Interparticle Collisions

A carrier particle has undergone a collision when its momentum is altered by particles or barriers within the system. Collisions with the boundaries of the system are called particle-wall collisions. Collision between particles within the system are particle-particle collisions. We begin our discussion with the consideration of particle-particle collisions. Obviously, particle-particle collision frequencies will depend upon the densities of the colliding particles, the speed with which they move, and the range and distribution of the forces acting between them. The last of these characteristics of the colliding particles is known collectively as their *collision cross section*. In general collision cross section is dependent on the type of particles that collide, the magnitude and relative directions of their momenta, and their angular orientation at