11.G. Computation of Transport Coefficients

Let

$$\hat{C}^- \Delta_j = p_j \qquad i,\ j = 1, 2, 3 \text{ or } x, y, z \qquad (11.194)$$

$$\hat{C}^+ A_j = \left(-\frac{5}{2} + \frac{\beta}{2m} p^2 \right) p_j$$

(11.195)

$$\hat{C}^+ B_{ij} = p_i p_j$$

(11.196)

With $\hat{\boldsymbol{k}} = \hat{\boldsymbol{x}}$ understood, (11.127 & 186-7) simplify to

$$D = -\frac{1}{m^2} \left(\frac{\beta}{2\pi m} \right)^{3/2} \int d\boldsymbol{p}\ e^{-\beta p^2/2m} p_x \Delta_x$$

(11.191) $$\eta = -\frac{n_0 \beta}{m^2} \left(\frac{\beta}{2\pi m} \right)^{3/2} \int d\boldsymbol{p}\ e^{-\beta p^2/2m}\ p_y p_x B_{xy}$$

(11.193)

$$K = -\frac{n_0 k_B}{m^2} \left(\frac{\beta}{2\pi m} \right)^{3/2} \int d\boldsymbol{p}\ e^{-\beta p^2/2m} \left(-\frac{5}{2} + \frac{\beta}{2m} p^2 \right) p_x A_x \qquad (11.192)$$

where we have also used $c_P = \frac{5}{2} k_B$ to get the last equation.

Incidentally, these results are identical to those obtained by the better known Chapman-Enskog procedure [see S.Chapman & T.G.Cowling, “The mathematical Theory of Nonuniform Gases”, CUP (1970)].

(11.191-3) can be calculated by expanding Δ_j, A_j & B_{ij} in terms of the orthogonal Sonine polynomials.