Transport Issues

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Transport

Isotropic diffusion

$$f(r,t) = \frac{N}{(4\pi K t)^{3/2}} e^{-\frac{r^2}{4Kt}}$$

$$\int_0^\infty 4\pi r^2 dr\, f = N$$

Fluence:

$$\int_0^\infty dt\, f(r,t) = \frac{N}{4\pi K r}$$

How many particles does a detector see?

$$f = n \frac{\delta(v - v_0)}{4\pi v_0^2}$$

$$\int v_x f\, d^3\underline{v} = \int_0^1 \int_0^\infty v\mu\, f\, 2\pi\, d\mu\, v^2 dv$$

$$= \frac{n v_0}{4}$$

Fluence: $\frac{N}{4\pi K r} \frac{v_0}{4}$

Radial outflow: $\frac{N}{4\pi r^2}$

$\frac{\text{Diffusion}}{\text{Outflow}}$: $\frac{r v_0}{4K} = \frac{3}{4}\frac{r}{\lambda}$

Fluence of a Shock Event

$$F_i(v) = \xi_i n_i (v/V)^{-\beta} \left[\frac{1}{\lambda V_s} + \frac{K_i(v)}{V V_s} \right]$$

A Fluence Calculation

$$Vr^{-2}\partial/\partial r(r^2U) - K_0 p^\alpha r^{-2}\partial/\partial r(r^2\partial U/\partial r) - (2/3)Vr^{-1}\partial/\partial p(pU) = 0$$

$$\lim_{r\to 0} rU = N(p)/(4\pi K_0 p^\alpha)$$

$$\int dpU(r,p) = n(r)/(4\pi)$$

$$U(r,p) = \int_p^\infty dqN(q)G(r,p,q)$$

$$G(r,p,q) = \lambda(\alpha + 3/2)p^2(4\pi K_0)^{-1}(q^{\alpha+3/2} - p^{\alpha+3/2})^{-2}$$

$$\bullet\exp\left[-\lambda rp^{3/2}(q^{\alpha+3/2} - p^{\alpha+3/2})^{-1}\right]$$

$$\lambda = (1+2\alpha/3)V/K_0$$

Gross et al., 1977

Fluence Continued

$$N(q) = q^{-\gamma}$$

$$\lambda r p^{-\alpha} << 1: \quad U \propto r^{-1} p^{-(\gamma+\alpha)}$$

$$\lambda r p^{-\alpha} >> 1: \quad U \propto r^{-1} p^{-(\gamma+\alpha)} (p^{\alpha}/r)^{(\gamma+\alpha+1/2)/(\alpha+3/2)}$$

$$Note: \quad I(r,k) \propto r^{-3} k^{-5/3}$$

$$K_{par} \propto r^{-1/3} v^{4/3}$$