Notes
[a] $I(E)$ in keV cm^{-2} s^{-1} sr^{-1} keV^{-1}; $4\pi J_\lambda$ in erg cm^{-2} s^{-1} μm^{-1}.
[b] For $E > 3.3$ keV, $I(E) = 11.0E$ (keV)$^{-0.4}$ keV cm^{-2} s^{-1} sr^{-1} keV^{-1}.

Reference
1. McCammon, D., & Sanders, W.T. 1990, *ARA&A*, **28**, 657

Sources of the observed gas and dust in the Galaxy are given in Table 21.5.

Table 21.5. *Sources of gas and dust in the Galaxy* [1, 2].

Stellar type	No. in Galaxy	$dM(\text{gas})/dt$ ($\mathcal{M}_\odot$ yr^{-1})	$dM(\text{dust})/dt$ ($\mathcal{M}_\odot$ yr^{-1})
M stars (Miras)	1.3×10^5	0.01–0.03	$(1–3) \times 10^{-4}$
OH/IR stars	10^4	0.1–0.5	$(1–5) \times 10^{-3}$
C stars	$(3–6) \times 10^4$	0.1–0.5	$(1–5) \times 10^{-3}$
Supernovae	0.02–0.03 yr^{-1}	0.1–0.3	0.001–0.006
M supergiants	5211	0.05–0.5	$(2–50) \times 10^{-4}$
Wolf–Rayets: WN, WC7	2744	0.05	0
WC8, WC9	484	0.01	10^{-4}
Planetary Nebulae	1.5×10^4	0.02–0.2	$(0.7–7) \times 10^{-5}$
Novae	30–50 yr^{-1}	$(0.5–1) \times 10^{-4}$	10^{-5}–10^{-4}
RV Tauri stars	600–1200	0.006–0.01	$(3–5) \times 10^{-6}$
O, B stars	$(2.5–5) \times 10^4$	0.03–0.3	0
Total in Galaxy	...	0.3–1.5	0.003–0.015
Star formation rate	...	−(3–10)	−(0.03–0.1)

References
1. Gehrz, R.D. 1989, in *Interstellar Dust*, edited by L.J. Allamandola and A.G.G.M. Tielens (Kluwer Academic, Dordrecht), IAU Symp. 135, p. 445
2. Jura, M., & Kleinmann, S.G. 1992, *ApJS*, **79**, 123

21.2 GALACTIC INTERSTELLAR EXTINCTION

21.2.1 Extinction

If $E(B-V) = A(B) - A(V)$, then $N(\text{H})/E(B-V) = 5.8 \times 10^{21}$ atoms cm^{-2} mag^{-1} [13]. Here $A(\lambda)$ is the extinction, in magnitudes, or $1.086\tau(\lambda)$, where τ is the optical depth in dust. The mean extinction law for interstellar dust can be described [14] as depending upon the optical parameter $R_V = A(V)/[A(B) - A(V)]$. The diffuse ISM has a typical value $R_V = 3.1$; in dense clouds, a typically $R_V = 4$–5. Table 21.6 gives mean values for 3.1 and 5. There is considerable uncertainty in the infrared extinction for ($\lambda > 5$ μm), perhaps a factor of 2 or more for $\lambda \geq 20$ μm.

$A(V)/N(\text{H}) \approx 5.3 \times 10^{-22}$ cm^2 mag, where $N(\text{H})$ = column density of ($\text{H}+\text{H}^+ + 2\text{H}_2$). Johnson filters are indicated in parentheses in Table 21.6.

Table 21.6. *$A(\lambda)/A(V)$ at various wavelengths for $R_V = 3.1$ and 5.*[a]

λ (μm)	$R_V = 3.1$	5	λ (μm)	$R_V = 3.1$	5	λ (μm)	$R_V = 3.1$	5
250[b]	4.2(−4)	4.9(−4)	5	0.027	0.031	0.24	2.54	1.68
100	1.2(−3)	1.3(−3)	3.4 (L)	0.051	0.059	0.218	3.18	1.97
60	2.0(−3)	2.3(−3)	2.2 (K)	0.108	0.125	0.20	2.84	1.74