THE EXTINCTION EFFICIENCY OF DUST GRAINS AT 1 MM

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We have determined the extinction efficiency factor Q for the objects in the Table by means of maps, scans, or photometry at 1 mm using a composite bolometer at the prime focus of the ESO 3.6m telescope (Arnold et al., 1978; Arnold, 1979). The beam is 2' in diameter.

The flux density F in Janskies (column 2 in Table) is related to the dust temperature T_D and optical depth τ_ν by $F_\nu = B_\nu(T_D)\Omega(1-e^{-\tau\nu})$, where Ω is the beam solid angle. Using the empirical relation found for Sgr B2 by Erickson et al. (1977) between optical depth and frequency, $\tau_\nu = \tau_{\nu_0} (\nu/\nu_0)^m$ with m = 1.5, we have been able to determine dust temperatures (column 3) and optical depths (column 5) by combining 100 μm data from the literature with our 1 mm data appropriately smoothed in resolution.

From the literature we find estimates for the visual extinction (usually converted from infrared values). In the case of Sgr B2 we combined the value from Erickson et al. (1977), $\tau_{100\mu m} = 1.6$, with the observation by Harvey et al. (1979a,b) that $\tau_{.55\mu m}/\tau_{100\mu m} = 100$. In most cases the visual extinction applies to an object at the centre of the dusty region whereas at 1 mm the region is optically thin and we "see" the entire region. Therefore we have increased the value of A_V by a factor of 2 in order to compare relative optical depths with the extinction efficiency factor at 1 mm, Q (column 9). For ρ Oph we adopt a "slab" model that has all the dust in front of the source of heating (Harvey et al., 1979b). $\tau_{1mm} = Q\pi a^2 N_D$ and $A_V = 1.086\, Q_V \pi a^2 N_D$, where N_D is the dust column density (cm^{-2}), a is the grain radius 0.15×10^{-4} cm, and $Q_V = 1.5$ is the extinction efficiency in the visual. Q is determined from the above relations; the mean value is $3.1 \pm 0.9 (m.e.) \times 10^{-4}$. However, errors in T_D, τ_{1mm}, and A_V are large and the true error in Q must be larger than the one derived here. Nevertheless, the mean value of Q agrees well with that predicted by Werner and Salpeter (1969) for a 0.15 μm core-mantle grain.

We note that $\langle Q \rangle / a = 21 \pm 6\ cm^{-1}$. Using the gas-to-dust mass ratio implied by Bohlin et al. (1978) we find $(1.0 \pm 0.3) \times 10^{-25} cm^2$ per

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SOURCE	F_{1mm} Jy	T_{DUST} K	REF. T_D	τ_{1mm} $x10^{-3}$	A_V mag	REF. A_V	A_V/τ_{1mm} $x10^3$	Q_{1mm} $x10^{-4}$
Sgr A	⩾30	50	9	0.9	7	9	7.8	2.1
Sgr B2	463±36	32±4	5	24.6	160	5,13	6.5	2.5
M17/SW	185±27	42±10	11	7.2	20	3	2.8	5.9
267.9-1.1	⩽101±3	69±13	8	⩽2.2	21	14	9.5	1.7
287.6-0.6	⩾52	55	12	⩾1.5	3.0	6	2	8.1
327.3-0.6	94±13	73±15	8	1.9	40	14	21	0.8
333.6-0.2	113±4	84±18	8	2.0	35	14	17.5	0.9
337.9-0.5	52±6	75±15	8	1.0	24	7	24	0.7
ρ Oph	28±4	16.5±1	13	3.7	12.5	10	3.4	4.8

hydrogen atom; i.e. 16 gm cm^{-2}. These values become 2.6 x 10^{-25} cm^2 and 6 gm cm^{-2} for a gas-to-dust mass ratio of 100:1.

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