Effects on the Optical Spectrum

The main contribution to the observed reddening of the visible spectrum, which implies a total visual absorption $A_V \sim 3$ magnitudes in some cases, probably comes from dust occupying a more extended volume than that in which the observed infrared radiation and the line emission originate. The inclusion of grains therefore need not alter significantly the conclusions reached in earlier studies[12,13] of the excitation of the emission regions by a nonthermal ultraviolet source. One might, however, expect the dust selectively to attenuate resonance line radiation, which is subjected to repeated scatterings by the gas.

The nature of our proposed model is such that it does not allow any strong predictions concerning the energy output and spectrum of the central source, much of which may lie in the far ultraviolet. Some such information may be inferred from studies of the optical line emission. The central source will be reddened by the grains which surround it, and radiation scattered from these grains may contribute to the observed continuum. This effect would tend to increase the apparent angular size of the central source and the line emitting region.

Comparison with our Galaxy

It is extremely interesting that the total amount and spatial density of dust required to produce the observed infrared emission of Seyfert galaxies are not unreasonably large. Within the uncertainties of the model, in fact, the required 6 magnitudes kpc^{-1} of extinction is comparable with the 2·5 magnitudes kpc^{-1} observed towards the centre of our galaxy[16]. This supports the view[17,18] that a Seyfert galaxy may be a normal spiral in which an explosive event has produced a strong central source of radiation. Strong far infrared radiation from the direction of the galactic centre has recently been detected by Hoffmann and Frederick[19]. It is likely that this radiation can be explained by a grain model of the type we suggest. It would then follow that the galactic radiation is concentrated at 100 µm, and not at 10 µm (as for Seyferts), because there is no compact ultraluminous body at the centre of our galaxy. In fact, Hoffmann and Frederick were unable to resolve the galactic centre emission in galactic longitude, and deduced a minimum extent for the 100 µm radiation of 6°·5 in the galactic plane. This corresponds to a distance of ~ 500 pc from the galactic centre, and the diffuse nature of this radiation is itself indicative of a dust model.

Conclusions

We have examined some of the consequences of attributing the infrared radiation from Seyfert galaxies to thermal emission from grains. The present observations are well satisfied by a relatively simple model in which a bright central object is embedded in a large cloud of grains at a density comparable with the density of grains in the central regions of our galaxy.

We hope that our conclusions and predictions may soon be tested. A crucial observation would be to measure the infrared output and spectrum of Seyfert galaxies with variable apertures which are sufficiently small to exclude radiation from the stellar component. Such measurements may be possible only for the nearer objects, and only at the longer infrared wavelengths. Measurements of the total flux as a function of aperture may yield useful information about the nature of the grains and/or the luminosity of the central object. Spectra taken with the smaller apertures must be flatter if our picture is correct. If this prediction is not verified, or if the infrared radiation shows rapid variations in the far infrared ($\lambda \gtrsim 10$ µm), it may be necessary to invoke other mechanisms to explain the infrared fluxes. The discovery of polarization would not necessarily indicate a non-thermal model, for the emission from magnetically aligned grains could be highly polarized[20].

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Windblown Dust on Mars

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The wave of darkening in the Martian springtime, which some say may have a biological explanation, can be explained in terms of windblown dust.

IN the Martian springtime there is a sequential enhancement of contrast between bright and dark areas, called the wave of darkening, which statistically occurs first at higher latitudes although there are marked variations in behaviour for individual areas[1–3]. The biological explanation of the darkening is that organisms inhabiting the dark areas grow and reproduce during the Martian spring[4]. An alternative hypothesis is that the seasonal darkening of the dark areas is due to the movement of dust particles to the bright areas[2,5,6]. Here we shall develop the windblown dust model, starting from the assumptions of major elevation differences on Mars, the presence of fine dust, and of winds adequate to move the dust. All three assumptions have some measure of observational support.

We begin by estimating the dependence on particle size and atmospheric density, ρ, of the minimum or