*Probing the Optical Depth of Spiral Galaxies using Multi-Waveband Observations**

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Abstract

The questions of the optical depth and extinction of galaxies obviously have far-reaching implications; from determining the true stellar content and baryonic mass of galaxies to the origin of the major component of their far infrared radiation. We have investigated whether the reddening of stars can be used to determine the amount and extent of obscuring dust. We find that the amount of reddening is very sensitive to the assumed geometry. The usually assumed case of a screen of dust between the observer and the star produces, for a given optical depth, the maximum amount of reddening. However, for external galaxies such a geometry is clearly wrong. More realistic geometries where the dust and stars are uniformly mixed (a 'slab') or where the dust is sandwiched by unobscured stars (a 'sandwich') produce significantly less reddening. For the slab geometry the reddening rises to a maximum value as the optical depth is increased, and for a sandwich geometry the reddening will actually decrease as the optical depth becomes larger (see Figure 1). The reddening vectors produced by these realistic geometries are compared to multi-waveband observations of individual regions of a sample of eight galaxies. We find evidence for significant optical depths in the central regions of some

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of these galaxies, but optical depths of less than unity at ~ 2 scale lengths from the centres. The optical depths derived are in good agreement with other tests such as the measured hydrogen column densities and the far infrared to blue light ratios. However, whereas these two latter approaches are insensitive to the relative distributions of the stars and the dust, the amount of reddening seen in these eight galaxies strongly suggests that the dust to stellar scale height ratio ξ is ≥ 0.5. We find typical blue band extinctions of $A_B = 0.75$-1.0, a factor of 3-4 higher than the RC2 value.

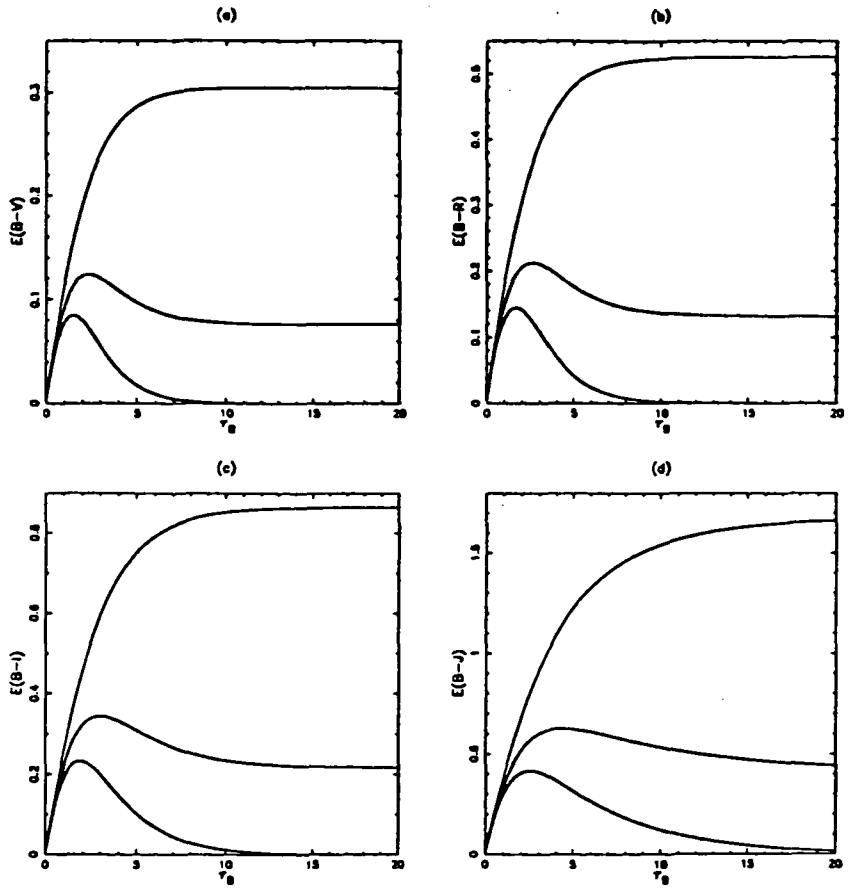

Fig. 1: The colour excess for realistic geometries as a function of B-band optical depth τ_B. In each plot the upper curve is the 'slab', the middle curve is a 'sandwich' with $\xi = 0.25$ and the lower curve is wtih $\xi = 0$.