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MODELS OF DUSTY DISCS IN ACTIVE GALACTIC NUCLEI

A. EFSTATHIOU AND J.H. HOUGH
Division of Physical Sciences, University of Hertfordshire, Hatfield, Herts AL10 9AB, UK

M. ROWAN-ROBINSON
School of Mathematical Sciences, Queen Mary & Westfield College, Mile End Road, London E1 4NS, UK

INTRODUCTION

One of the challenges faced by unified theories for Active Galactic Nuclei (AGN) is to match the observed infrared emission to that predicted for the optically and geometrically thick dusty discs believed to obscure the central source of radiation. We have used the method of Efstathiou & Rowan-Robinson (1990), generalised to take into account a distribution of grain species and sizes (Efstathiou & Rowan-Robinson 1993), to compute models that assume different density distributions. The method treats multiple scattering from grains.

RESULTS AND DISCUSSION

The assumed disc geometry is illustrated in Figure I. The dust density is assumed to follow a power-law in radius ($n \propto r^{-\beta}$) and the energy distribution of the central source a power-law in frequency ($F_\nu \propto \nu^{-\alpha}$). The total equatorial ultraviolet (1000Å) optical depth τ_{uv} is another model parameter. The grain mixture of Rowan-Robinson (1992) is used for the calculations. We have computed models with $\beta = 0, 1$ and 2 and τ_{uv} in the range $100 - 2000$. The main conclusions from this study are as follows:

(1) All of the models predict significant anisotropy in the infrared emission. The anisotropy is minimised with decreasing τ_{uv} and increasing H/r_2.

(2) The predicted spectra of models with $\beta = 1, 2$ are narrower, peak at shorter wavelengths and also show 'shallower' $10\mu m$ absorption features compared with uniform density models.

(3) Models with $\beta = 1, 2$ show 'featureless' mid-infrared spectra over a wider range of parameter space than the uniform density models.

We have also compared predicted spectra with the observed spectrum of NGC1068. There is no direct estimate of the value of the extinction to its centre. It is usually assumed that the absence of hard X-rays implies an A_V of the order of 1000 (e.g. Pier & Krolik 1993.) There is equally good evidence, however, for an A_V in the range 20-30 (Bailey et al. 1988, Bridger et al. 1993.) In Figure II we present a very good fit to the spectrum of NGC1068 which assumes a line of sight A_V of 28. Clearly the extinction can not be constrained by the infrared

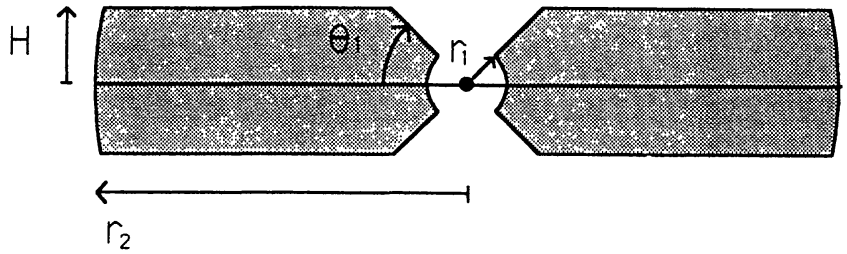

FIGURE I Schematic of the assumed disc geometry.

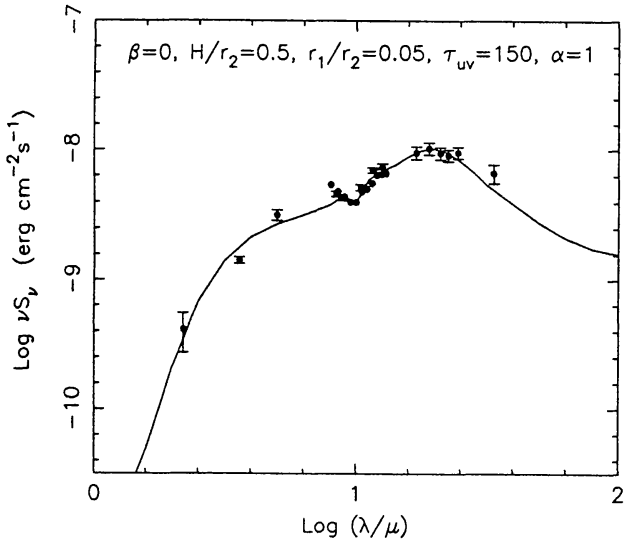

FIGURE II Fit to the spectrum of NGC1068 with a model assuming $\Theta_1 = 60^o$. The A_V along the line of sight is 28 mag. and the predicted viewing angle is 34° from the equator. Data from Rieke & Low (1975) and Roche et al. (1991).

spectrum alone. An independent approach such as spectropolarimetry is needed in order to make further progress.

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