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MEASURING THE INHOMOGENEOUS OBSCURATION OF AGN WITH MID-INFRARED OBSERVATIONS

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We apply inhomogeneous models of the obscuring torus of AGNs, emphasizing the mid-IR observational consequences.

1. IR EMISSION FROM AGNS

The intrinsic emission of the central engines of active galactic nuclei (AGNs) must be blocked from some lines of sight, and it is reprocessed to emerge at infrared (IR) wavelengths. Current data reveal several problems with "unified AGN models" that include a homogeneous obscuring torus. First, X-ray data indicate a wide range of column densities along the line of sight, while the IR spectral energy distributions show little variation. Second, uniform models predict silicate emission around 10μm in all directly-viewed (type 1) sources, and absorption in all obscured (type 2) sources. The emission is in fact detected from only a small number of type 1 sources, and the depth of the feature is not strongly correlated with the total obscuration of type 2 sources.

We apply recent models (Nenkova et al. 2002) of inhomogeneous obscuration by large optical depth clouds to solve these problems. Mid-IR spectroscopy and imaging then constrain the physical parameters in modelling individual AGNs, including the optical depth per cloud, the number of clouds along the line of sight, the radial variation and height of the distribution, and the viewing angle. We can also recover the intrinsic AGN luminosity in the type 2 sources, where it cannot be measured directly. We have applied these diagnostics to observations of NGC 1068 (Mason et al. 2006).

In general the mid-IR emission is anisotropic on small scales (Figure 1), which may be discerned in nearby, luminous examples. In all cases, however, the dominant emission is confined to very small physical scales, even though the total extent of the cloud distribution may be large.

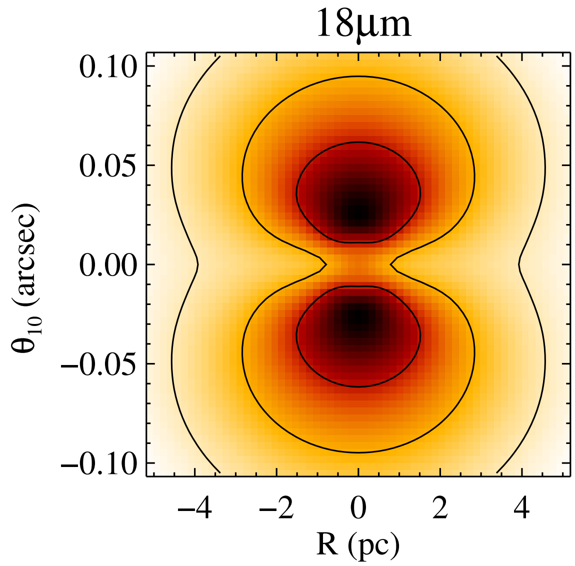

Fig. 1. Simulated image of torus emission at 18μm. Both axes are scaled to $L_{AGN} = 10^{12} L_{\odot}$. The angular size, θ_{10}, is also scaled to a distance of 10 Mpc.

High spatial resolution is essential to isolate the immediate circumnuclear region from larger-scale emission. The Gran Telescopio CANARIAS with CanariCam will be ideally suited to obtain these sensitive data. In the future, we will measure true samples of many galaxies rather than rely on isolated examples of exceptional sources.

REFERENCES

Mason, R. E., Geballe, T. R., Packham, C., Levenson, N. A., Elitzur, M., Fisher, R. S., & Perlman, E. 2006, ApJ, 640, 612

Nenkova, M., Ivezić, Ž., & Elitzur, M. 2002, ApJ, 570, L9

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