S02a A New Mid-Infrared Test of the Dusty Torus Model for Seyfert Nuclei

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We propose a new test of the "dusty torus" model for Seyfert nuclei using mid-infrared emission. Since dusty tori are optically thick significantly, the infrared spectra of dusty tori show the strong dependence on the viewing angle. If the torus is observed from a nearly face-on view, the hot inner torus is observed and thus mid-infrared emission of $\lambda < 10$ μm is more enhanced than far-infrared emission. Therefore, effect of the anisotropic property appears most significantly at $\lambda < 10$ μm while less significant at $\lambda > 20$ μm.

In order to investigate the difference in torus emission between type 1 and type 2 Seyferts, we therefore utilize the intensity ratio between 3.5 μm and 25 μm; $R = \log[\nu S_\nu(3.5\ \mu\mathrm{m})/\nu S_\nu(25\ \mu\mathrm{m})]$. We have found that the critical value between type 1 and type 2 Seyferts is $R \simeq -0.6$; almost all the type 1 Seyferts have $R > -0.6$ while the majority of the type 2s tend to have $R < -0.6$. We therefore consider that the viewing angle that gives $R = -0.6$ is the critical viewing angle separating between type 1 Seyfert galaxies and type 2s provided that the properties of dusty tori are nearly the same among the Seyferts.

Comparing this observational test with the theoretical model by Pier & Krolik (1992, ApJ, 401, 99; 1993, ApJ, 418, 673), the critical viewing angle is estimated to be 45° – 50°. This value is consistent with the critical viewing angle derived statistically by the relative number of type 1s and type 2s. The results support that the idea of dusty torus is plausible for currently popular unified model of active galactic nuclei.