Silicate Dust Extinction of Active Galactic Nuclei

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AGNs are thought to be surrounded by an optically thick dust torus. Correction for the torus extinction is crucial to recovering the AGN intrinsic spectral energy distribution and to revealing nature of the central engine. In the diffuse interstellar medium of the Milky Way, $A_V/\Delta\tau_{9.7}$, the ratio of the visual extinction (A_V) to the optical depth of the silicate absorption at 9.7μm ($\Delta\tau_{9.7}$) is about 18, and to the Galactic center direction, this ratio is smaller by a factor of two, $A_V/\Delta\tau_{9.7} \approx 9$. In AGNs, this ratio is substantially reduced to approximately 6.4, only a third of the Galactic value, probably due to the preferential destruction of small grains by X-ray/UV photons from the central engine and/or the coagulational growth of dust in the dense circumnuclear regions of AGNs. In this work, we investigate how the ratio $A_V/\Delta\tau_{9.7}$ changes over a wide range of silicate dust sizes. It is found that $A_V/\Delta\tau_{9.7}$ peaks at $a \approx 0.2\mu m$, with a peak value of ~5.6, confirming that the observed small ratio $A_V/\Delta\tau_{9.7}$ in AGNs could be explained in terms of larger grains. In view of the presence of carbonaceous dust and its contribution to the visual extinction, we argue that the observed low $Av/\Delta\tau_{9.7}$ ratio of AGNs could be explained by dust with $a > 0.2\mu m$. The effects of the silicate dust shape and composition on $Av/\Delta\tau_{9.7}$ are also discussed and found to be negligible.