NuSTAR Reveals Extreme Absorption in z <0.5 Type 2 Quasars

The intrinsic column density (N-H) distribution of quasars is poorly known. At the high obscuration end of the quasar population and for redshifts z <1, the X-ray spectra can only be reliably characterized using broad-band measurements that extend to energies above 10 keV. Using the hard X-ray observatory NuSTAR, along with archival Chandra and XMM-Newton data, we study the broad-band X-ray spectra of nine optically selected (from the SDSS), candidate Compton-thick (N-H > 1.5 x 10^{24} cm^{-2}) type 2 quasars (CTQSO2s); five new NuSTAR observations are reported herein, and four have been previously published. The candidate CTQSO2s lie at z <0.5, have observed [O III] luminosities in the range 8.4<log(L-[O III]/L_{\text{circle dot}})<9.6, and show evidence for extreme, Compton-thick absorption when indirect absorption diagnostics are considered. Among the nine candidate CTQSO2s, five are detected by NuSTAR in the high-energy (8-24 keV) band: two are weakly detected at the approximate to 3 sigma confidence level and three are strongly detected with sufficient counts for spectral modeling (greater than or similar to 90 net source counts at 8-24 keV). For these NuSTAR-detected sources direct (i.e., X-ray spectral) constraints on the intrinsic active galactic nucleus properties are feasible, and we measure column densities approximate to 2.5-1600 times higher and intrinsic (unabsorbed) X-ray luminosities approximate to 10-70 times higher than pre-NuSTAR constraints from Chandra and XMM-Newton. Assuming the NuSTAR-detected type 2 quasars are representative of other Compton-thick candidates, we make a correction to the N-H distribution for optically selected type 2 quasars as measured by Chandra and XMM-Newton for 39 objects. With this approach, we predict a Compton-thick fraction of f(CT) = 36(-12)(+14)%, although higher fractions (up to 76%) are possible if indirect absorption diagnostics are assumed to be reliable.

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