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The Spatial Clustering of ROSAT All-Sky Survey AGNs II. Halo Occupation Distribution Modeling of the Cross Correlation Function

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This is the second paper of a series that reports on our investigation of the clustering properties of AGNs in the ROSAT All-Sky Survey (RASS) through cross-correlation functions (CCFs) with Sloan Digital Sky Survey (SDSS) galaxies. In this paper, we apply the Halo Occupation Distribution (HOD) model to the CCFs between the RASS Broad-line AGNs with SDSS Luminous Red Galaxies (LRGs) in the redshift range 0.16<z<0.36 that was calculated in paper I. In our HOD modeling approach, we use the known HOD of LRGs and constrain the HOD of the AGNs by a model fit to the CCF. For the first time, we are able to go beyond quoting merely a `typical' AGN host halo mass, M_h, and model the full distribution function of AGN host dark matter halos. In addition, we are able to determine the large-scale bias and the mean M_h more accurately. We explore the behavior of three simple HOD models. Our first model (Model A) is a truncated power-law HOD model in which all AGNs are satellites. With this model, we find an upper limit to the slope (\alpha) of the AGN HOD that is far below unity. The other two models have a central component, which has a step function form, where the HOD is constant above a minimum mass, without (Model B) or with (Model C) an upper mass cutoff, in addition to the truncated power-law satellite component, similar to the HOD that is found for galaxies. In these two models we find the upper limits of \alpha < 0.95 and \alpha < 0.84 for Model B and C respectively. Our analysis suggests that the satellite AGN occupation increases slower than, or may even decrease with, M_h, in contrast to the satellite's HODs of luminosity-threshold samples of galaxies, which, in contrast, grow approximately as \propto M_h^\alpha with \alpha\approx 1. These results are consistent with observations that the AGN fraction in groups and clusters decreases with richness.

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