Accretion History of AGN: Constructing a Supermassive Black Hole Population Synthesis Model Using a Neural Network

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Introduction

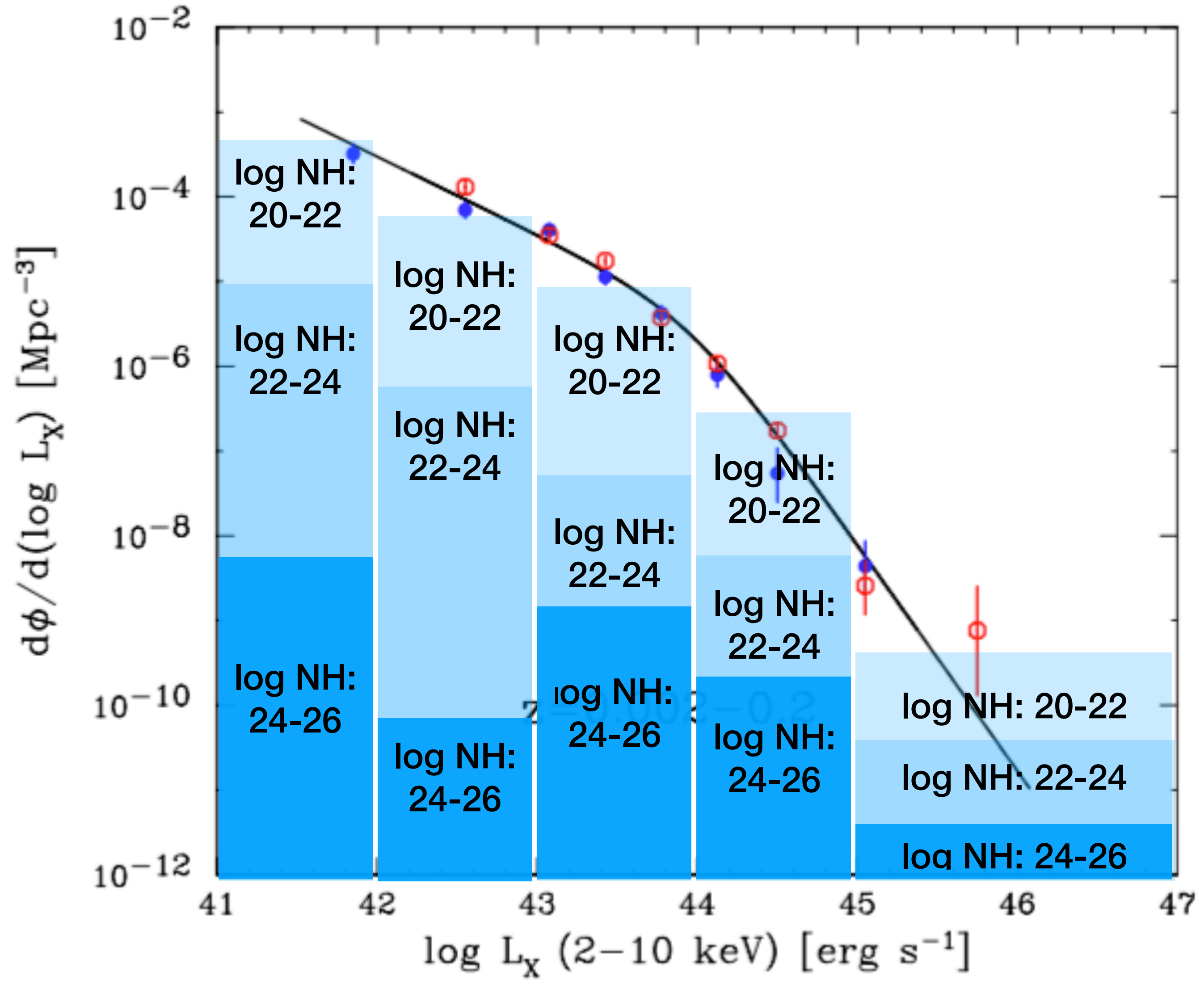
At the center of nearly every galaxy resides a Supermassive Black Hole (SMBH). These black holes grow in bursts of accretion, when they appear brightly in most wavelengths of the electromagnetic spectrum.

X-rays are one of the most unbiased tracers of the growth of these black holes, as they are produced very close to these objects (in the region surrounding the accretion disk) and penetrate the most obscured column densities, especially at high energies.

Population synthesis model describes the evolution of these AGNs in the form of a set of X-ray spectra and an X-ray luminosity function (XLF). In this work, we present a new population synthesis model which fits all of the latest observed constraints, such as the Cosmic X-ray Background (CXB), and number counts observed in different surveys.

Method

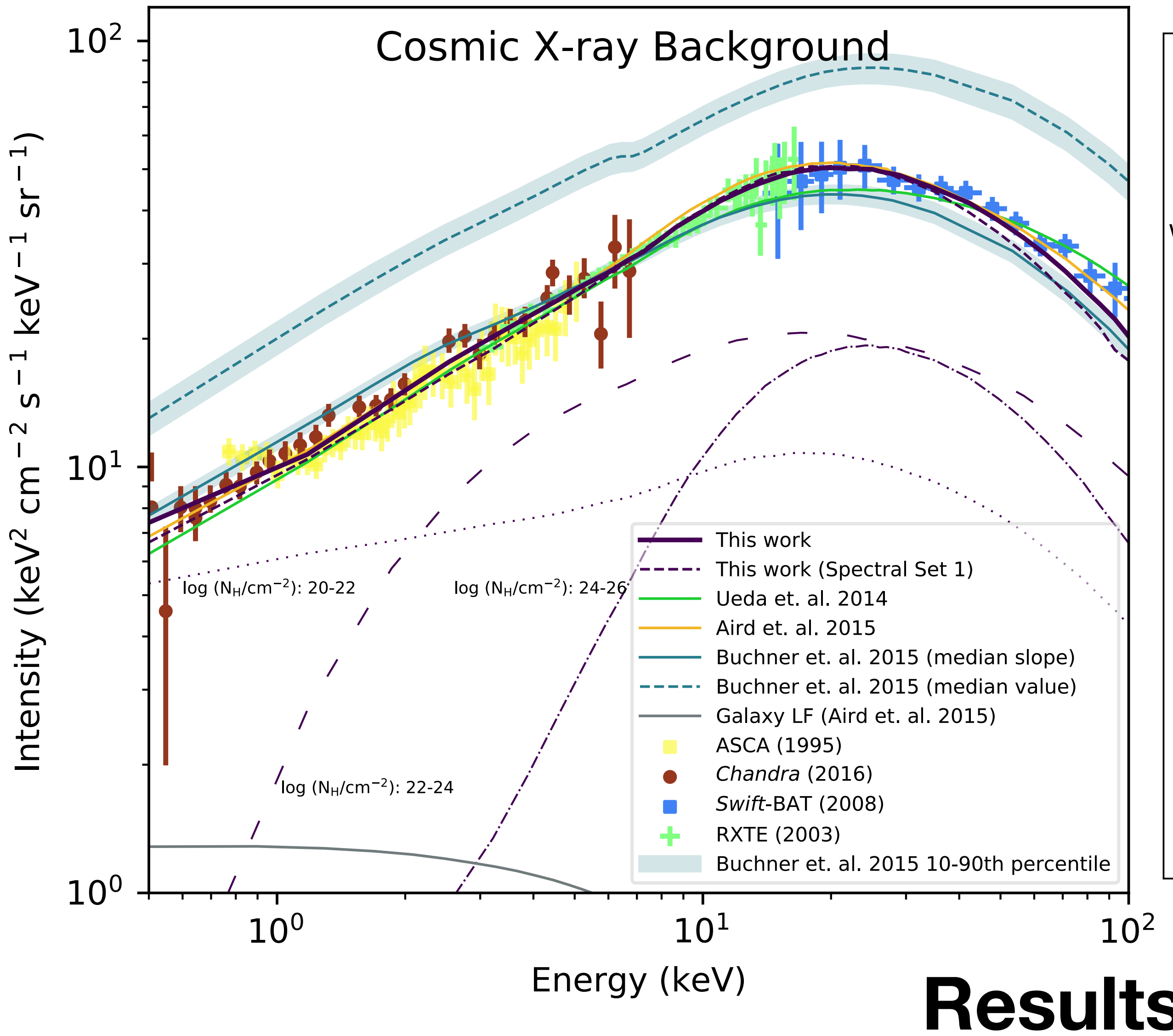
Shape of a typical XLF:

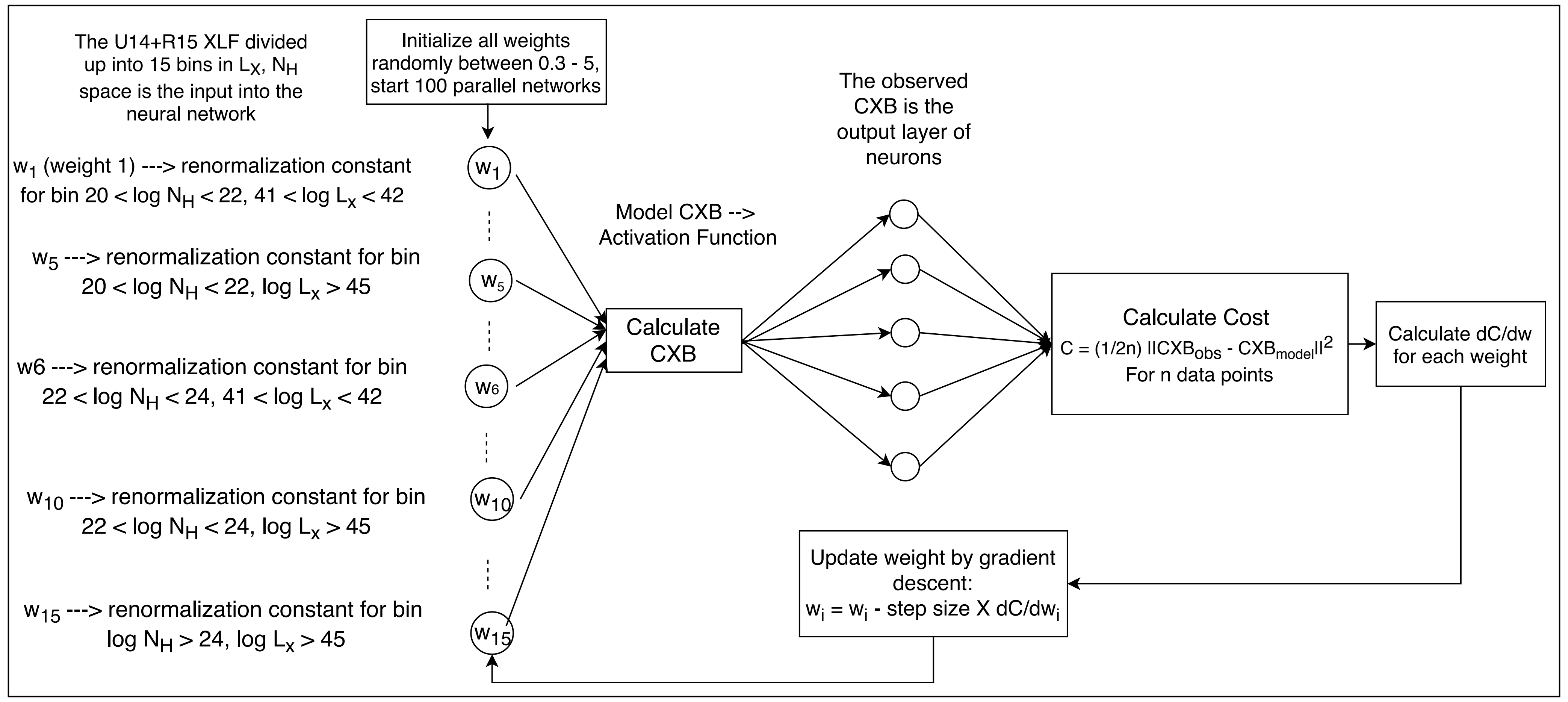


The XLF typically follows a bending power-law shape with respect to luminosity, and objects with the same intrinsic luminosity can be distributed differently in absorption bins.

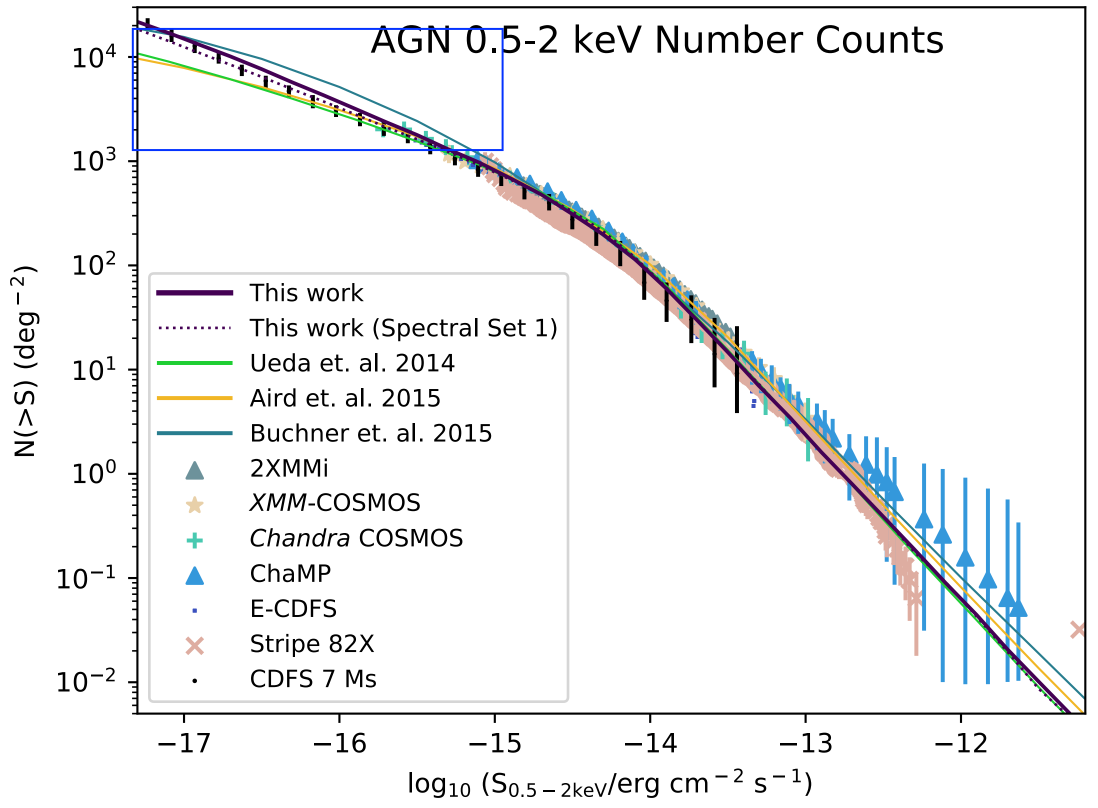
Method

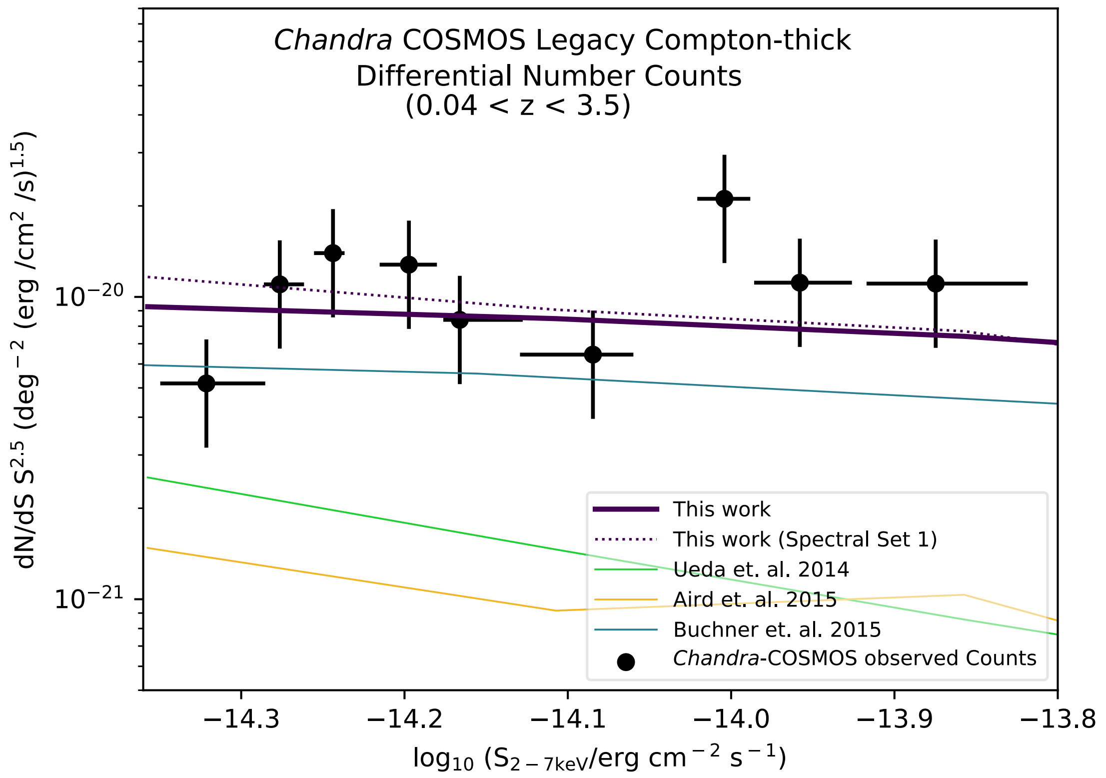
Renormalize each block, and use a neural network to update the renormalization factor to try to fit all the observed constraints.





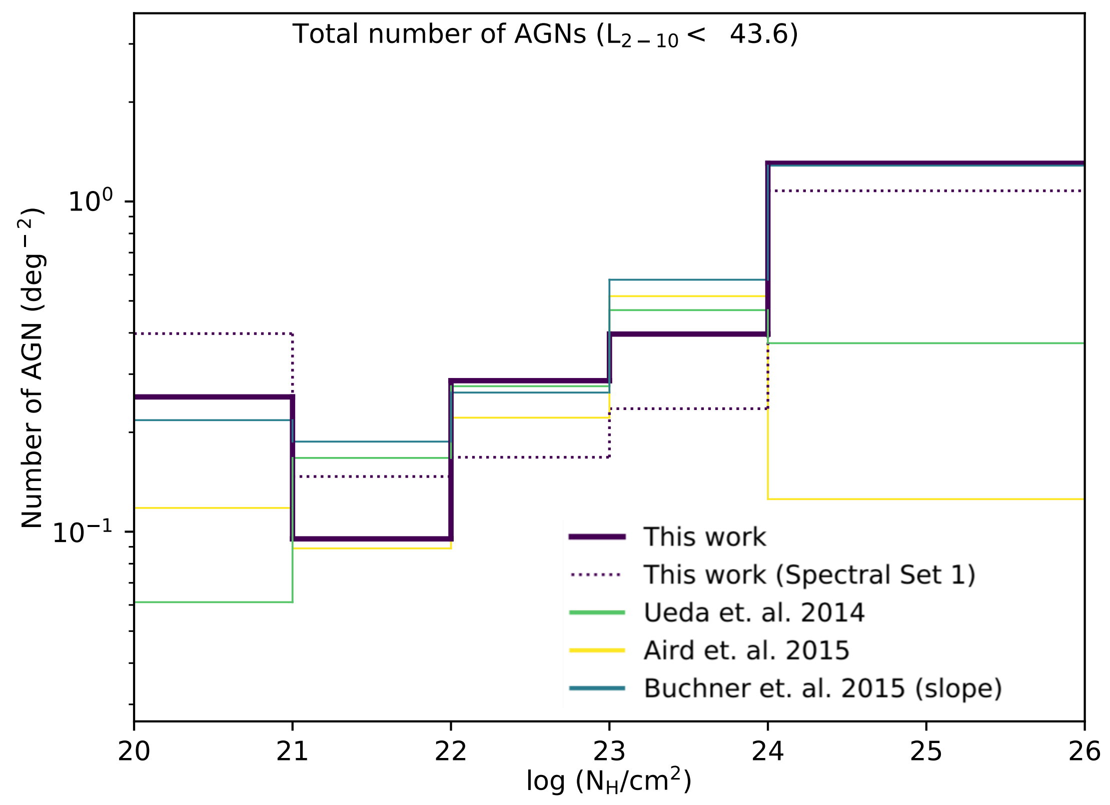
Results





Number counts of AGN is an important observational constraint from X-ray surveys, which tells us the number of AGNs observed per square degree when a certain flux limit is imposed. We find that previous models don't fit the deepest flux limits (shown within the blue rectangle in the left panel) in 0.5-2 and 2-10 keV bands. This is also true for the most obscured objects (Compton-thick AGN). However, the constraints are well fitted by our new model. The left panel shows number counts in 0.5-2 keV for all objects and the right panel shows number counts in 2-7 keV for Compton-thick objects.

Conclusions



Our new model, which satisfies all the current observed constraints, suggests that intrinsically, 50±9% (56±7%) of all AGN within z ~ 0.1 (1.0) are Compton-thick.

Based on: Ananna et. al. 2019a

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