Probing Cosmology with the X-ray Forest

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abstract

There is a growing consensus that in the present universe most baryons reside in galaxy clusters and groups in the form of highly ionized gas at temperatures of $10^6 \sim 10^8$ K. The H-like and He-like ions of the heavy elements can produce absorption features - the so-called “X-ray Forest” - in the X-ray spectrum of a background quasar. We investigate the distribution of the X-ray absorption lines produced by this gas under three different cosmological models: the standard CDM with $\Omega_0 = 1$, a flat model with $\Omega_0 = 0.3$ and an open model with $\Omega_0 = 0.3$. We give a semi-analytic calculation of the X-ray forest distribution based on the Press-Schechter formalism, following PL98. We choose three ions (O8, Si14 and Fe25) and calculate the distribution functions, the number of absorbers along the line-of-sight (LOS) to a distant quasar vs. redshift and column density in a given ion. We find that significant differences in the evolution of the distribution functions among the three cosmological models. Using Monte Carlo simulations, we simulate the distribution of X-ray absorption lines for 10,000 random LOS. We find there are at least several O8 lines with column density higher than $10^{16}$ cm$^{-2}$. Finally we explore the possibility of detecting the X-ray forest with current and upcoming X-ray missions and we present an XMM RGS simulation of a representative quasar X-ray spectrum.