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Theoretical Predictions of Large Scale Clustering in the Lyman-alpha Forest

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With the recent progress of Lyman-alpha forest power spectrum measurements, understanding of the bias between the measured flux and the underlying matter power spectrum is becoming crucial to the percent level cosmological interpretation of these measurements. Previous theoretical studies of this bias have used N-body and hydro-PM simulations and inferred large-scale bias parameters that are in reasonable agreement with observations. In this work we attempt to develop a deeper understanding of the physical origin of the large-scale biasing of the forest. We have run a series of hydrodynamic N-body simulations in order to compare numerically measured bias factors with analytical predictions from formulae derived by Seljak (2012) using second-order perturbation theory. We demonstrate the success of this theory in a fluctuating Gunn-Peterson approximation (FGPA) framework for certain regimes, and characterise its limitations due to hydrodynamic effects, such as thermal broadening, with the hope of improving future theoretical models. Deeper understanding of the large-scale Lyman-alpha biasing will help us in using the large-scale clustering of the forest as a cosmological probe beyond baryon acoustic oscillations.

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