QSO Absorption Lines and the 3D Matter Distribution

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Over the past half decade considerable progress has been made in the theoretical understanding of the nature of the Lymanα forest. In all recent models a direct relation between the Lymanα forest and the cosmological structure formation is presumed. Since observational data are available now at almost all redshifts up to $z = 5$ one would wish to model the complete lines of sight in order to link the Lymanα forest evolution at high and low redshifts. The hydro-simulations are already able to give a very detailed description of the Lymanα forest. The amount of computing time is such however that most of the descriptions are limited to $z > 2$. Using assumptions that have been shown to be valid in the low density regime we have been able to study the evolution of the Lymanα forest over the whole redshift range $5 > z > 0$ (Petitjean et al. 1995, Mücket et al. 1996, Riediger et al. 1998). The results are encouraging enough to consider furter properties of the obtained Lyα cloud distribution.
The increasing observational material for QSO pairs and groups yields information about the probability for line coincidence in the spectra of different QSOs separated by some angle θ (see e.g. Petitjean et al. 1998). Using our simulations we have computed the probabilities for line conincidences as function of the separation between two lines of sight for different redshifts. Those functions show a clear impact of the filamentary structures of the gas distribution. Since the evolution of the filamentary structures are more sensitive with respect to the underlying cosmological models the increasing basis of related observational material could provide further criteria for discreminating between the most probable cosmological models.
The probabilities of line coincidences in two l.o.s. as function of the sight line separation is shown in Fig. 1. Each plot gives the probabilities for the four column density thresholds ($\log(N_{\rm HI}) > 13, 14, 15, 16$). The dependence on redshift can be noticed by comparing the probability plots at two different redshifts ($z = 3.0$ (top) and $z = 1.5$ (bottom)). It can be clearly seen that the probability as function of the separation between two lines of sight is almost flat for low column densities while having a steep decrease for high column densities. This indicates the large contribution of filamentary and sheetlike distributed gas. The gas at high column densities which is more concentrated in haloes shows a much steeper decrease with increasing separation.

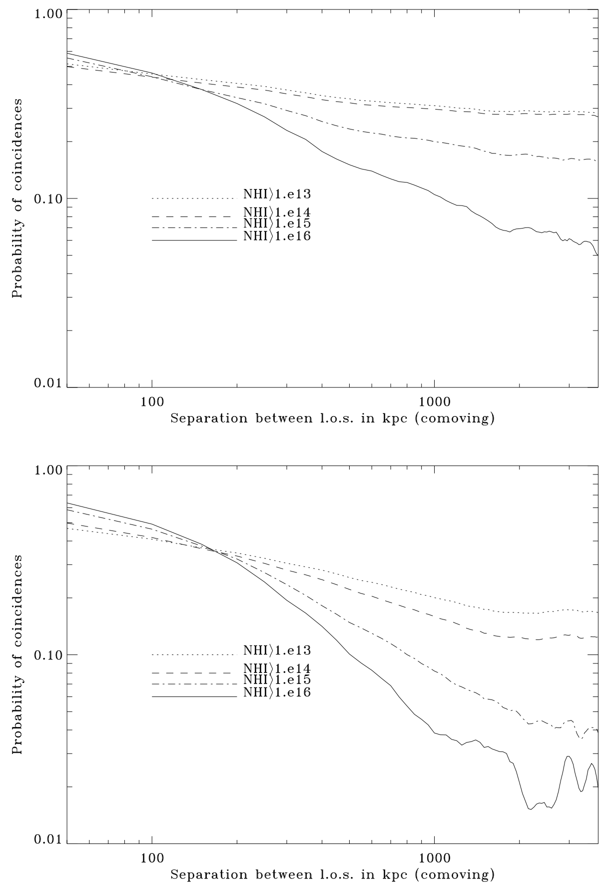

Figure 1: Probabilities of line coincidences in the spectra of two l.o.s. as function of the sight line separation at $z = 3$ (top) and $z = 1.5$ (bottom) for different N_{HI} column density thresholds as indicated in the figures.

References

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