Extent of Lyman-α Complexes from HST Observations of Four Pairs of Quasars

Bastien Aracil[1], Patrick Petitjean[1], Alain Smette[2,3], Jean Surdej[3,4], Jan Peter Mücket[5], Stefano Cristiani[6]

[1] *Institut d'Astrophysique de Paris , 98bis Boulevard Arago, F-75014 Paris, France*
[2] *NASA Goddard Space Flight Center, Code 681, Greenbelt, MD 20771, USA*
[3] *Fonds National de la Recherche Scientifique, Belgium*
[4] *Institut d'Astrophysique et de Géophysique, Liège, Belgium*
[5] *Astrophysikalisches Institut Potsdam, An der Sternwarte, Potsdam, Germany*
[6] *Space Telescope European Coodinating Facility, Karl-Schwarzschild Str. 2, D-85748 Garching, Germany*

Abstract. We present HST observations of four pairs of quasars with ~2–3 arcmin angular separation and redshift $z \sim 0.9$. By using the Nearest-Neighbor method we determine the number of coincidences in a sample of observed Lyman-α lines with rest equivalent width greater than 0.3 Å we detect a 3.1σ excess of coincidences with velocity difference smaller than 500 km s^{-1} when compared to samples drawn from Monte-Carlo simulations.

1 Introduction

The transverse extent of intergalactic clouds or structures giving rise to the Lyman-α forest can be constrained by the level of correlation between absorptions observed toward quasars closely separated on the sky. Previous studies have shown that the absorption complexes could have transverse extent as large as $500h_{50}^{-1}$ kpc (Smette et al. 1992, Dinshaw et al. 1995, Crotts & Fang 1998, Petitjean et al. 1998, D'Odorico et al. 1998, Monier et al. 1999, Young et al. 2001). Using new HST observations of QSO pairs with separations of 2 to 3 arcmin, we probe the 1 Mpc scale at redshift $< z > \sim 0.9$.

2 Methodology

We used a home-made software to fit theorical Voigt profiles to the absorption lines detected above 4σ of the error in each spectrum. We have carefully identified all metal lines and applied the Nearest-Neighbor method to the lines that stand at velocity larger than 3000 km s^{-1} from the Lyman-α emission line and with rest equivalent width larger than 0.3 Å. In this method, two absorption lines of two different lines of sight are considered coincident if each one is the nearest neighbor of the other. The distribution of the found coincidences is plotted on Fig. 1 versus the velocity difference $|\Delta v|$ between the two coincident lines.

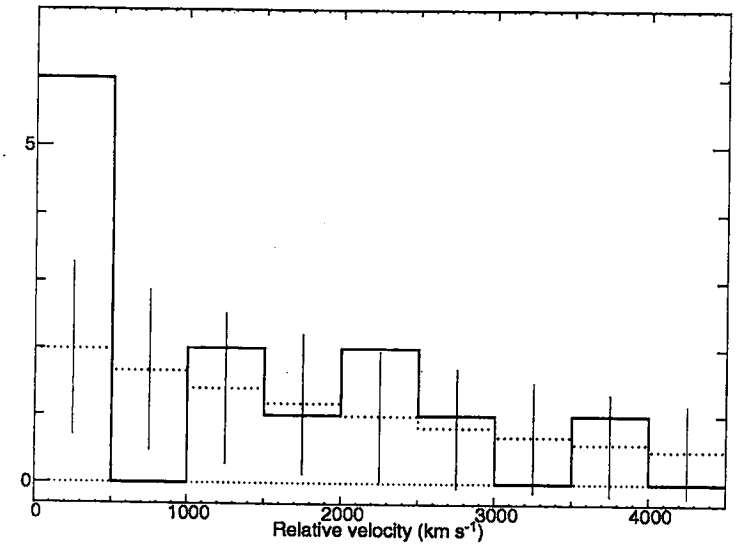

Figure 1: Number of coincidences versus $|\Delta v|$ in 500 km s^{-1} bins. The dotted line and the error bars are respevtively the expected number of coincidences and the 1σ error from 10,000 Monte-Carlo simulations .

3 Conclusion

We find 6 coincidences with $|\Delta v|$ <500 km s^{-1}. According to Monte Carlo simulations which give the expected number of coincidences if lines are placed randomly, this corresponds to a 3.1 σ excess. A 4.2 σ excess is present when adding the data by Young et al. (2001). These excess cleary show that the Lyman-α forest is correlated on scales larger then $1.h_{50}^{-1}$Mpc at z$\sim$1.

Acknowledgements. Based on observations with the NASA/ESA *Hubble Space Telescope*, obtained at the Space Telescope Science Institute, which is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS5-26555.

References

[1] Crotts A.P.S., Fang Y., 1998, ApJ 502, 16
[2] Dinshaw N., Foltz C.B., Impey C.D., Weymann R.J., Morris S.L., 1995, Nature 373, 223
[3] D'Odorico V., Cristiani S., D'Odorico S., Fontana A., Giallongo E., Shaver P., 1998, A&A 339, 678
[4] Monier E. M., Turnshek D. A., 1999 ApJ, 522, 627
[5] Petitjean P., Surdej J., Smette A., Shaver P., Mücket J., Remy M., 1998, A&A 334, L45
[6] Smette A., Surdej J., Shaver P.A., Foltz, C. B., Chaffee F. H., Weymann R. J., et al, 1992, A&A 389, 39
[7] Young P. A., Impey C. D., Foltz C. B., 2001 ApJ 549, 76