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THE ABSORPTION LINE SPECTRUM OF QSO 1225+317

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ABSTRACT

In this paper, we present observations of absorption line spectrum of QSO 1225+317 with resolution of 18 $km\ sec^{-1}$. Four possible new heavy element line systems are identified. The properties of Lyman α forest lines are discussed.

Key Words : QSO, absorption line

I. INTRODUCTION

Numerous narrow absorption lines in spectra of QSOs are usually classifies as two types, i.e. heavy element line systems and so-called Lyman α forest lines. The former is believed to be produced in clouds connected with galactic disks or haloes. And the later is generally thought to be produced in intervening primeval clouds (Sargent et al 1980), though there is some evidence that they may be associated with galaxies (Lanzetta et al 1995; Le Brun et al 1996). The study on these lines is very important, helpful to understand the physical conditions at early universe, the formation and evolution of galaxies as well as the large scale structure of the Universe.

Previous studies based on intermediate resolution (FWHM $\sim 1.0 - 2.0$ Å) show that the statistical properties of Lyman α forest lines are quite differrent from those of heavy element line systems. For example, Lyman α forest lines have lower column density, strong cosmic evolution and weak clustering. On the contrary, heavy element line systems have higher column density, weak cosmic evolution and strong clustering.

But, because Lyman α forest lines are numerous, the line blending is very serious in intermediate resolution spectra. On the other hand, some multi-component heavy element lines can not be resolved in intermediate resolution spectra. Therefore, in order to understand the properties of these lines well, it is necessary to have higher resolution spectrum observations. Although there have been observations of over 10 quasars with high resolution spectra (e.g. Pettini et al 1990; Rauch et al 1992), more data are always welcome. In this paper, we report the study on absorption line spectrum of QSO 1225+317 at resolution of 18 $km\ sec^{-1}$.

II. OBSERVATIONS

The spectrum of QSO 1225+317 was obtained at Kitt Peak National Observatory, using the Mayall 4 m telescope plus echelle spectrogragh. The spectrum covers 3100 Åto 4500 Å. The total exposure time is about 12 hours. The Th-Argon arc lamp images are used to calibrate the wavelength. All the data reduction are completed by IRAF. We estimate the S/N of the spectrum is greater than 15 and the resolution is about 18 $km\ sec^{-1}$.

III. HEAVY ELEMENT LINE SYSTEMS

Many authors studied heavy element line systems in spectra of QSO 1225+317 (e.g. Wilkerson et al 1978; Young, Sargent and Boksenberg 1982; York et al 1984; Steidel and Sargent 1992). 10 heavy element line systems were identified in these studies above. They are: System A, z=1.7944; System B, z=1.6251; System C, z=1.8865; System D, z=1.8963; System E, z=2.1103; System F, z=1.3582; System G, z=2.1197; System H, z=0.363; System I, z=1.2255; System J, z=1.4290. We checked these systems by use of our data. We found some of the systems above are, maybe, not real.

We searched for new heavy element line systems in the spectrum of QSO 1225+ 317. Four possible systems were identified. They are:

System K: z=1.7726. The lines belong to this system include NI λ 1134, NI λ 1199, HI λ 1215, NiII λ 1317, NiII λ 1370, CI λ 1560.

System L: z=1.9429. The lines belong to this system include NII λ 1083, SiII λ 1190, SiII λ 1193, NV λ 1242, SiII λ 1260, CI λ 1277, TiIII λ 1298, SiII λ 1526.

System M: z=2.1440. The lines belong to this system include HI λ 1025, NII λ 1083, FeII λ 1144, NI λ 1199, SiIII λ 1206, HI λ 1215, NV λ 1238, NV λ 1242.

System N: z=1.4586. The lines belong to this system include SiIV λ 1393, SiIV λ 1402, CI λ 1656.

Our data covered only 3100 Å- 4500 Å. More data are necessary to check these systems above.

IV. LYMAN α FOREST LINES

A large number of Lyman α forest lines exist in the spectrum. In order to study the statistical properties of Lyman α forest lines, it is necessary to do profile fitting and deblending. The method is similar to that described by Kulkarni et al (1996). Only system A (Bechtold et al 1987) is considered for profile fitting and deblending. In this case, we got a Lyman α forest line list which can be used to study the properties of Ly α forest lines.

A simple analysis found that most Lyman α forest lines have lower column density, the average of column density is about $10^{14} cm^{-2}$. A single power law is hard to represent the distribution of column density over all Lyman α forest lines. The Doppler parameter b vary in a wide range, its average is about 30 $km\ sec^{-1}$. Besides, b may be correlated with column density.

Pair correlation analysis shown that Lyman α forest lines towards QSO 1225+317 are clustered on the scale of 100 $km\ sec^{-1}$. By use of the method for analysing the clustering suggested by Liu and Liu (1992), it is found Lyman α forest lines are clustered on the scale of 10 h^{-1} Mpc, combining our data with the data of high resolution spectra towards other QSOs.

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