1. CHEMICAL UNIFORMITY AT HIGH Z?

In stark contrast to many interstellar lines-of-sight in the Milky Way or the Magellanic Clouds, high-redshift DLA systems usually appear to be chemically uniform [1]. But despite their chemical uniformity, for any redshift the observed metallicities are different by up to two orders of magnitude [2].

The known DLA systems make a heterogeneous population involving very different physical environments—a very unfavorable precondition for tracing nucleosynthesis and the chemical evolution of galaxies. But the physical environments of molecular clouds are less diverse. In fact, for the known H$_2$-bearing DLA systems the metallicity-redshift distribution may exhibit less variation than for the regular DLA systems [3].

Molecular hydrogen is detected in DLA components exhibiting high particle densities and low kinetic temperatures [4, 5]. The metallicity of DLA systems is usually calculated by averaging ad hoc radial velocity intervals, i.e., by averaging several absorption components. But the depletion of chemical elements in H$_2$-bearing components may surpass the average by up to one order of magnitude [4, 5]. Moreover, narrow components arising from cold gas are blurred in the usually complex absorption profiles.

In fact, high-resolution (55 000) and exceptionally high signal-to-noise (90-140) spectra of the H$_2$-bearing DLA system toward the QSO HE 0515–4414 indicate the hitherto unperceived chemical nonuniformity of individual metal absorption profile components, similar to the interstellar lines-of-sight intersecting Galactic warm disk and halo clouds (Figs. 1, 2). In addition, for the H$_2$-bearing components the calculated [6] fraction of iron in dust of 98 percent is close to that of Galactic cold disk gas. Is the DLA system toward HE 0515–4414 just a rare case, or are compact high-metallicity dust clouds systematically missed in present spectroscopic observations due to insufficient resolution or low signal-to-noise ratio?

2. FAINT QSOS OBSCURED BY DUST?

The possibility that present surveys of DLA systems are affected by dust is an ongoing concern: If the extinction of DLA absorbers is high enough, optical surveys will miss the QSOs behind them. However, present samples of DLA absorbers toward radio-selected and SDSS QSOs do not indicate any distinct selection bias due to dust [8, 9].

In contrast, the new H/ESO survey of DLA systems toward a complete subsample of 182 HE QSOs produces convincing evidence for the effect of dust attenuation: Four new DLA systems were discovered toward the bright half of the QSO subsample, but 14 were detected toward the faint. The probability for both numbers being drawn from the same Poissonian is less than 2.5 percent (Fig. 3). Do the DLA systems toward the fainter QSOs exhibit more dust than those toward the bright?

3. FUTURE AIMS

In order to study the possible biases and selection effects involved with dusts, we aim at starting a sound abundance database established on high-resolution and high signal-to-noise spectroscopy of the complete sample of DLA systems discovered by the H/ESO survey. The database will
be extremely useful for studying the physical conditions in DLA systems, and may shed some light on the star formation history of the universe and the problem of missing metals [10, 11].

As spin-off product, newly detected C\textsc{i} and C\textsc{ii} fine-structure absorption lines may be used to test the temperature-redshift relation predicted by the standard big-bang cosmology. A further potential spin-off will be a homogenous sample of Fe\textsc{ii} lines suitable for probing the hypothetical variation of the fine-structure constant $\alpha$ by means of the regression many multiplet method [12, 13].

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Figure 2: Evidence for chemical nonuniformity at high redshift. Gas-phase abundance ratios (relative to solar ratios) for the absorption components shown in Fig. 1 compared with typical values found for Galactic cold (C) and warm (W) disk and halo (H) clouds [7]. Since the volatile element Zn is only mildly depleted, the abundance ratios reflect the differential depletion of chemical elements into dust. Note that Cr, Mn, Fe, and Ni are strongly depleted in the H$_2$-bearing components 23/24 but appear essentially undepleted in component 28.

Figure 3: Evidence for attenuation of fainter QSOs by dust. The number of DLA systems detected toward the bright (faint) half of 182 HE QSOs is 4 (14). The absorption paths of both subsamples exhibit almost the same length. Two Poissonians with means 4 and 14 are marked by, respectively, the red and gray vertical bars. The probability for both numbers being drawn from the same Poisson with mean N is indicated by green dots.