# HIGH-REDSHIFT MOLECULAR CLOUDS AND ABSORPTION-LINE SPECTRA OF QUASARS

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The optical spectra of distant quasars (OQ 172, PHL 957, PKS 0237-233 and 11 others) were reanalysed with the purpose of searching molecular lines /2, 4/.

Several systems of absorption lines redshifted by $Z_a = 2\text{-}3$ which include lines of the $H_2$ and/or CO molecules together with atoms and ions were found among the preliminary unidentified absorption features. The probability of accidental line coincidences was estimated for each of the systems; in some cases the reliability of the identification of molecules is high enough.

For example, a system at $Z_a = 2.651$ in the OQ 172 spectrum contains about a dozen of the $H_2$ lines of the Lyman and Werner bands: L4-0, L5-0, L6-0, L7-0, L8-0, W1-0, W2-0, W3-0 and others (Fig.1). In addition to molecular lines a series of atomic and ionic lines can be identified at the same $Z_a$: H I ($L_\alpha$, $L_\beta$, $L_\gamma$); C I (1328.8, 1277.2, 945.5); C II (1334.5, 1036.3); N I (1199.6); O I (1302.2); S I (1295.7); S II (1259.5); Ca II (1649.9, 1341.9, 1342.5); Fe II (1096.9). It gives a strong argument for the $H_2$ identification. The column density of $H_2$ is approximately $10^{20}$ cm$^{-2}$ and the absorbing material is essentially molecular. Hence it is a high-redshift molecular cloud.

Consequently, molecular clouds existed at the early cosmological epoch $Z_a = 2\text{-}3$, when the age of the Universe was only 10-30 percent of the present one. The basic properties of these clouds - the column density of the material, its composition, its ionization and excitation - are similar to those of the Galactic interstellar clouds with $N_H \geq 3 \cdot 10^{19}$ cm$^{-2}$ ($A_V \geq 0^m.5$). It is most likely they belong to some distant, unseen intervening galaxies.

Investigation of high-redshift molecular clouds may give an important information on the physical conditions and the chemical and isotopic composition of the matter at the early stages in the evolution of galaxies.



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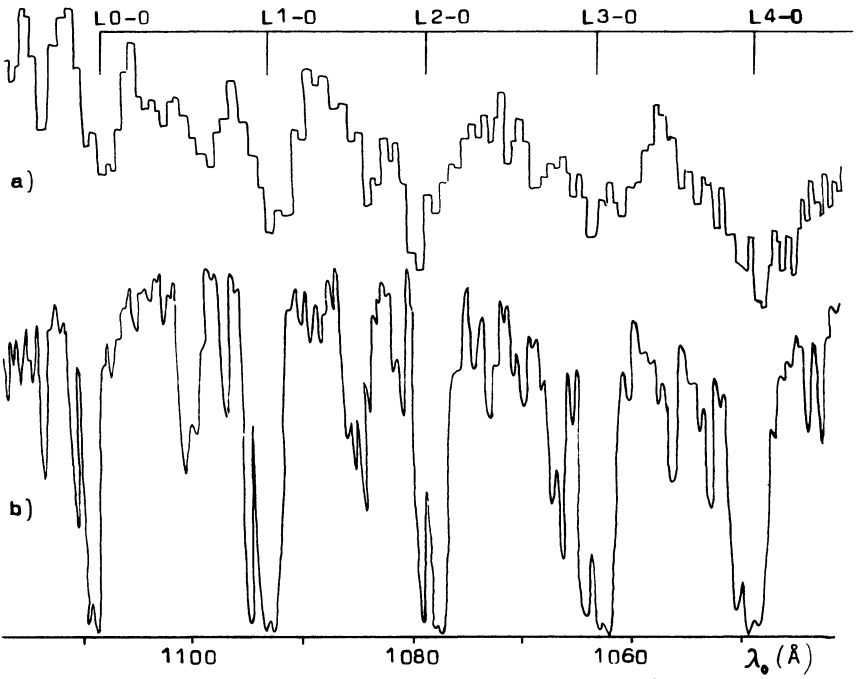


Fig.1 a) A fragment of the 00172 spectrum (Baldwin et al. 1974); the absorption features marked by Lv-0 can be identified with the $H_2$ Lyman band red-shifted $\lambda = \lambda_0(1+z_a)$ at $z_a = 2.651$.
b) The UV absorption spectrum of the interstellar $H_2$ in the direction to $\zeta$ Per (Savage et al. 1977).

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Dr. Varshalovich had intended to present this paper at the Symposium. At the last minute, he was unable to attend. The paper was summarized at the Patras General Assembly. Eds.

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