position. Basic residues and glycines are present in both subunits where predicted. A critical tryptophan is located 14 residues from the initial cysteine of the immunoglobulin-like motif in β1 and 12 residues from it in β2, in agreement with the consensus. Therefore, the neural cell-adhesion molecules and the sodium channel β1 and β2 subunits all contain structurally related V-like immunoglobulin motifs. These new structural comparisons strengthen the implication that the immunoglobulin-like motifs of the β1 and β2 subunits act like neural cell-adhesion molecules in interacting with extracellular protein ligands. Identification of the extracellular ligands for these subunits may shed light on the mechanisms of localization and immobilization of sodium channels in neurons.

Lori L. Isom
Department of Pharmacology,
University of Michigan Medical School,
Ann Arbor, Michigan 48109-0632, USA
William A. Catterall
Department of Pharmacology,
University of Washington,
Seattle, Washington 98195, USA

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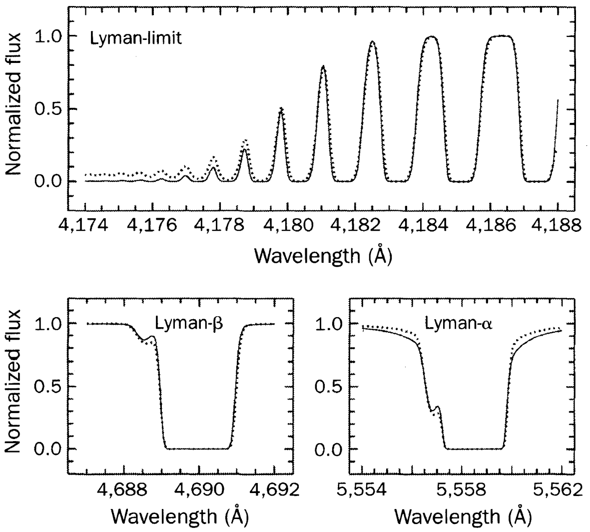
Alternative hydrogen cloud models

SIR — The ratio of deuterium (D) to hydrogen (H) in the early Universe is one of the fundamental checks of our understanding of the Big Bang. First observations gave an unexpectedly high D/H ratio for primeval, high-redshift hydrogen clouds[1–5] and suggest a very low baryon content for the Universe. A recent paper by Tytler *et al.*[6], which finds a D/H ratio in a new high-redshift cloud less than one-fifth that of earlier estimates, has provoked considerable controversy over the deuterium abundances at high redshift. Here I show that it is possible to construct alternative cloud models that are both consistent with the published data of Tytler *et al.*[6] and give D/H ratios that are 3–4 times higher than their value. A final choice between the high D/H values and the low value favoured by Tytler *et al.*[6] will require an accurate determination of the residual continuum level near the hydrogen series limit. The very high precision quoted by Tytler *et al.*[6] for their D/H estimate results from the neglect of alternative models.

Only a small fraction of the high-redshift hydrogen clouds have enough column density and a simple enough velocity structure to produce observable deuterium lines, and also have sufficiently low column density that there is only moderate optical depth in the hydrogen continuum. For such systems it is possible to determine the hydrogen column densities in ways that are insensitive to modelling parameters. But as the cosmic abundance of deuterium is low[7], the deuterium lines are faint and their strength can be confused by blending with one of the many unrelated hydrogen lines that densely populate high-redshift spectra. Because any contamination would increase the apparent deuterium abundance, it is safest to quote these D/H ratios only as upper limits. The new Tytler *et al.*[6] cloud has several times the hydrogen column density previously found in systems used for D/H estimates[1–5]. As the accompanying deuterium line is also relatively strong, the probability that the deuterium line is significantly contaminated by unrelated hydrogen absorption is low. But the hydrogen spectrum is saturated and this greatly increases the sensitivity of the derived hydrogen column density determination to modelling assumptions. At issue is whether one can find a model that simultaneously satisfies the constraints of the new spectrum while giving a D/H ratio consistent with earlier estimates[1–5].



Comparison of the two-cloud fit of Tytler *et al.*[6] (solid line) and the alternative three-component model discussed here (dotted line). The cloud parameters for the new model are: N_H = 1, 1.2, 2.6 ($\times 10^{17}$ cm^{-2}); b = 16, 18, 23 (km s^{-1}) and redshift z = 3.5721101, 3.5722401, 3.5724301. The D/H ratio for the new model is 6.3×10^{-5}, compared to 2.3 (±0.3 ±0.3) $\times 10^{-5}$ for the Tytler *et al.*[6] fit.

When absorption lines are blended and saturated, great freedom is available in the choice of fitting parameters. As all these choices should be treated as free parameters, the set of possible solutions that are consistent with the data is large. By increasing the number of velocity components, the absorption can be more evenly distributed over the line profile and less column density is required to produce deep, broad lines. The remaining free parameters can then be suitably adjusted to match the line wings. The figure shows the Tytler *et al.*[6] fit (solid line) together with one of the numerous alternative models (dotted line). This alternative model reduces the hydrogen column density by using three instead of two discrete cloud velocities and results in a D/H ratio that is three times that quoted by Tytler *et al.*[6].

There are two important differences between the old fit and the new model: at a wavelength of 4,176.6 Å (Ly22) the residual intensity has increased from $\sim$0% to $\sim$2.5%, and at Lyα the damping wings are much weaker than before. These two differences are a consequence of the reduced hydrogen column density and are unavoidable in all low-hydrogen models. For any model to be acceptable, such differences must not be so great as to be inconsistent with the data. In the published data the Lyα damping wings are blended with deuterium and other unrelated lines. Consequently, their weakness in the new model is less of a potential problem than is the increased residual intensity at wavelengths below Ly22. Further decreasing the hydrogen column density by an additional factor of 1.5 increases the residual intensity at Ly22 to $\sim$8.6% of the local continuum. Although the spectrum may not permit this large a departure from the Tytler *et al.*[6] fit, a close inspection of their Fig. 2 does suggests that for Ly14 to Ly20 the zero level of the fit has been systematically set above data by a few per cent of the local continuum. If further observations/analyses do show that the residual continuum below 4,177 Å is as high as 10%, models that are both consistent with the data and have D/H $> \sim 10^{-4}$ can be constructed.

E. J. Wampler
National Astronomical Observatory
of Japan,
2-21-1 Osawa, Mitaka,
Tokyo 181, Japan

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