

COSMIC EVOLUTION

**on the occasion of the 60th birthdays of
Jean Audouze and James W. Truran**

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DEUTERIUM NEAR AND FAR IN THE GALAXY

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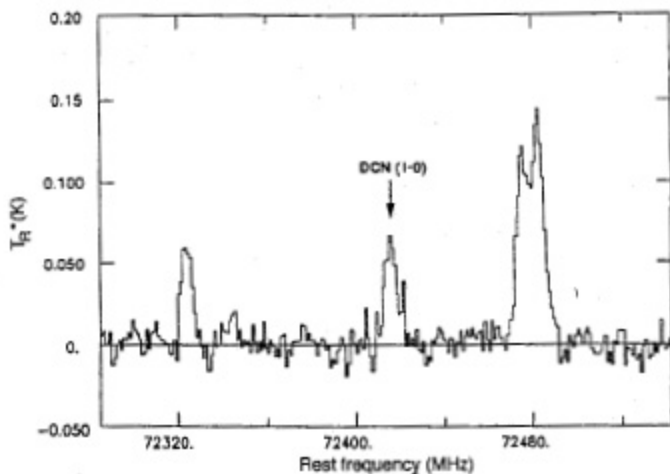
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We report on our program to determine the deuterium abundance distribution in the Milky Way. We have reported $D/H = 1.7 \times 10^{-6}$ in a molecular cloud 10 pc from the Galactic Center, from which we infer recent continuous infall of pregalactic primordial gas. We have searched for the Balmer $D\alpha$ lines with high S/N = 300 - 1000 observations of a halo star (HD 140283), slowly rotating B stars (ι Her and γ Peg), H II regions (Orion Nebula and M17), and the planetary nebula NGC 7027.

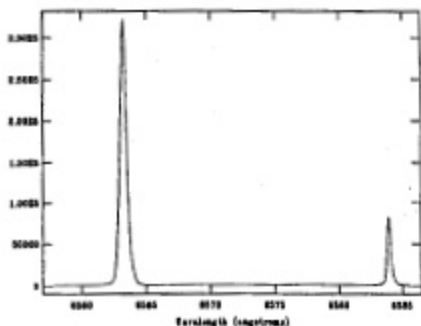
From observations of the $J = 1-0$ and $2-1$ microwave spectral lines of DCN (Fig. 1a) we recently determined that D exists in the 50 km/s molecular cloud 10 pc from the Galactic Center (GC) with $D/H = 1.7 \times 10^{-6}$ (Lubowich, Pasachoff, Balonek, Millar, Tremonti, Roberts, and Galloway. *Nature*, 405, 102, 2000). We concluded that significant amounts of D are not produced via any Galactic process, the D observed in the GC is the result of infall from low-metallicity gas representing primordial or pre-Galactic matter, and the GC has not had a recent quasar or AGN phase within the past 5 Gyr. Our results are consistent with a cosmological $D/H = 5 \times 10^{-5}$, which implies that most of the baryons are in the form of dark matter and that most of this dark matter is non-baryonic. We will use this technique in 2001 to determine D/H in molecular clouds in the GC and edge of the Galaxy (2 pc and 28 kpc from the GC).

We are continuing our search for the Balmer $D\alpha$ lines in stars and nebulae. We have not $D\alpha$ in stars or nebulae. We have taken high S/N echelle spectra of the Orion Nebula at three positions (one position is shown in Figs. 1b and 1c), the slowly rotating sharp-lined B4 IV stars ι Her and γ Peg, the low-metallicity halo star HD 140283, and the planetary nebula NGC 7027. The spectra were taken with the NSO McMath 1.5-m and KPNO coude feed 0.9-m telescopes. Our future work includes searching for D/H in stars and H II regions 14 - 18 kpc from the Galactic Center.

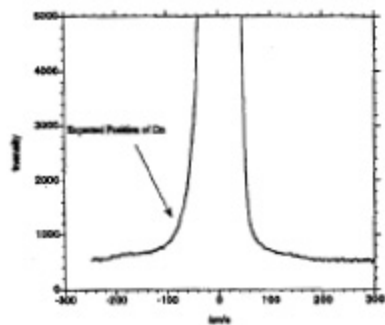
¹ DAL is supported by an NSF international travel grant administered by the AAS.



1a. DCN spectrum of the Galactic Center 50 km/s molecular cloud. (NRAO 12 m radio telescope)



1b. Echelle spectrum of Orion Nebula 15 arcsec west of the brightest Trapezium star HD 37022. 1800 s exposure taken on 21 Dec. 1999 (NSO McMath-Pierce 1.5 m telescope, resolution = 84,000)



1c. Expanded echelle spectrum of Orion Nebula 15 arcsec west of the brightest Trapezium star HD 37022. Combined nine 1800 s exposure taken on 21 Dec. 1999.