MOUNT WILSON AND PALOMAR OBSERVATORIES
CARNEGIE INSTITUTION OF WASHINGTON
CALIFORNIA INSTITUTE OF TECHNOLOGY

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PASADENA 4, CALIFORNIA

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Mr. Grote Reber
P.O. Box 4868
Cleveland Park Station
Washington, D.C.

Dear Grote:

A lot of thinking and computation on the hyperfine structure of hydrogen has been done by van de Hulst, at Leiden. He has built a device, I believe, to find the 1420 megacycle radiation. I do not know whether he has succeeded as yet. The presence of lots of neutral hydrogen in space means that the population of the upper hyperfine level is comparable to that of the lower. I believe that there will be enough atoms in both states so that the optical depth is appreciable, or large. In that case the observed emission will depend on the electron temperature in neutral hydrogen regions, and will in fact be the thermal emission $B_\nu(T)$. Now T is very low in H I regions, i.e. 100°K; it may be 10,000° in H II regions, but these do not contribute very much. If the absorption in the 1420 mc radiation is complete, near the sun, one might get a nearly isotropic 100°K emission. If incomplete, one should see the flattened Milky Way system, with a maximum apparent temperature near 100°K.

The population of the upper level is due to collision with neighboring atoms, which have average energies of 0.01 volt, enough to excite the upper level. Your hypothesis of ionized matter recombining and dropping down to the upper level is unnecessary.

One of your questions which I have not answered is what is the opacity at 1420 mc. This will depend on the transition probability; unfortunately I do not know the value, and it is certainly known to van de Hulst. I hesitate to compute it unless you cannot find it from him, from some of your colleagues in physics, or from the literature. Rabi, at Columbia, would certainly know the transition probability. From the latter you compute the absorption coefficient per atom. There would be about 10^{22} atoms/cm^2 column capable of performing this transition.

(D) I would doubt the wisdom of searching for the deuterium line. It is probably extremely rare; it must be less than one part in a thousand in stars. It is known to be less than one part in five, in space, compared to H.

Best regards,

Jesse L. Greenstein

JLG/e