LETTERS TO THE EDITOR

RADIOPHYSICS

OH Absorption Profile in the Direction of Sagittarius *A*

WE would like to confirm Weinreb, Barrett, Meeks and Henry's[1] discovery of the hydroxyl (OH) radical in the interstellar medium at frequency 1667·36 Mc/s. Fig. 1 shows observations of the Sagittarius *A* source in the frequency range 1,667·672–1,667·210 Mc/s. These observations were made between December 2 and December 9, 1963, with the 33-ft. antenna at the Hat Creek Radio Astronomy Observatory of the University of California, Berkeley. We used a switched-frequency receiver in which the comparison channel was fixed at 1,669 Mc/s and the signal channel, of bandwidth 50 kc/s, was scanned over the spectrum at the rate of 0·93 Mc/s per hour. The output of the receiver was digitized. 'Print-out' occurred every 23·3 kc/s during the scan; this corresponds to an integration time of 90 sec per point. For the receiver used we found an excess system noise of 750° K. We may thus expect (and we find) a root mean square uncertainty of 0·7° K for a single readout. The mean error of a plotted point on the OH curve in Fig. 1 is ± 0·13° K. The plotted frequency profile represents the mean of 29 scans.

We did not succeed in detecting the OH line in absorption in Cygnus *X* (α = 20h 30m, δ = + 40·0°) or in emission in the galactic anticentre region (α = 5h 30m, δ = + 30°) on the basis of observing series similar to that shown for Sagittarius *A* in Fig. 1. If the OH line does exist in the Cygnus *X* and anticentre regions, it must be substantially weaker than the principal OH absorption line in Sagittarius *A*, and may have a brightness temperature not exceeding 0·1° K. The failure to detect OH in emission in the anticentre region with a level of uncertainty of 0·1° K in our observations is consistent with the negative results obtained by Penzias[2].

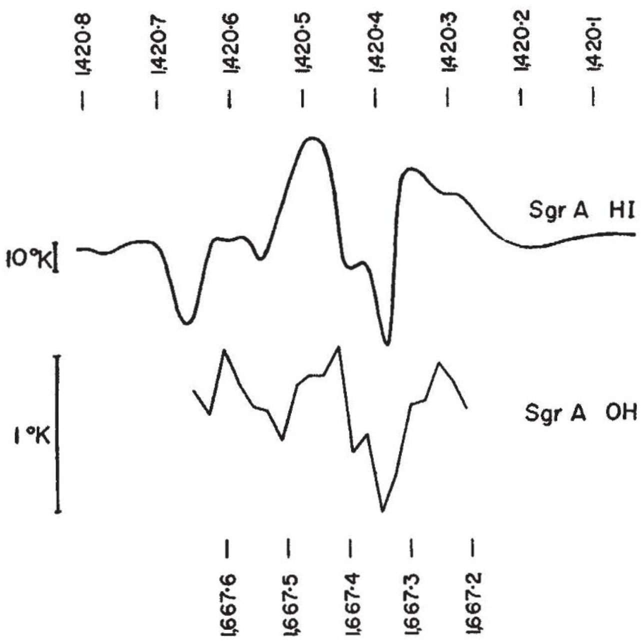

Fig. 1. The upper diagram shows the neutral hydrogen profile observed for Sagittarius *A* (Sgr *A*), the lower one the OH profile observed for Sgr *A*. The scale of brightness temperature for the two profiles is shown on the left. The frequency scale for HI (in Mc/s) is shown at the top of the diagram; the frequency scale for OH (in Mc/s) is at the bottom. The two profiles are drawn so that corresponding points of the lines are one over the other

For comparison purposes, we have plotted in Fig. 1 the profile of Sagittarius *A* as observed in neutral hydrogen. In the drawing the frequency scale of the HI line has been adjusted to that of the OH line in accord with the expression $\Delta\nu_{OH} = [\nu_0(OH)/\nu_0(HI)]\,\Delta\nu_{HI}$, where ν_0 represents the rest frequency of a line. From our observations we find the rest frequency of the $F = 2 \rightarrow 2$ transition of OH to be 1,667·360 ± 0·015 Mc/s, in excellent agreement with the result obtained by Weinreb, Barrett, Meeks and Henry[1].

The general similarity of form exhibited by the HI and OH lines in the Sagittarius *A* source is striking. The strongest HI absorption lines at approximately the rest frequency are clearly present in OH, as is the weak HI absorption feature at 1,420·55 Mc/s (1,667·53 Mc/s in OH). It is to be regretted that our observations stop short of the OH frequency characteristic of the 3 kiloparsec arm absorption at 1,420·66 in HI. There is a slight indication in our observations that the 3 kiloparsec arm absorption may be expected in OH.

The most notable difference between the HI and OH profiles is the lack of emission (compared with absorption) in the OH profile. This is not unexpected. From the deepest OH absorption shown in Fig. 1 we compute an optical depth of 0·022 ± 0·004. We anticipate that the excitation temperature of the OH will be of the order of 10° K because of the probably dominant role of radiative excitation. There may thus be OH emission of the order of 0·2° K at the rest frequency in areas adjacent to the Sagittarius *A* source. The emission in the spectral range upward from the rest frequency will be less than this. Our observations do not permit us to confirm or to deny emission of this low value, but they do indicate that OH emission is comparatively less important than that of HI because of the lower excitation temperature of OH.

Weinreb, Barrett, Meeks and Henry[1] find the abundance ratio of OH/HI to be of the order 10^{-7} in the direction of Cassiopeia *A*. Our observations show a similar abundance ratio in the direction of the galactic centre.

We thank Mr. Donald S. Sproul for his help with the receiver, and the observers at the Hat Creek Radio Astronomy Observatory, Robert Conrad, Kenneth Evans, David Lesh and Werner Scharlach, for their help.

The Radio Astronomy Laboratory is supported by contract *Nonr* 222(66) with the Office of Naval Research.

H. F. WEAVER
D. R. W. WILLIAMS

Radio Astronomy Laboratory,
University of California,
Berkeley.

[1] Weinreb, S., Barrett, A. H., Meeks, M. L., and Henry, J. C., *Nature*, **200**, 829 1963).
[2] Penzias, A. A., Meeting of Amer. Astron. Soc., Washington, D.C., December 26–28, 1963. [See also, *Nature*, **201**, 279 (1964).]

A Radio Spectrograph with High Sensitivity and High Time Resolution

WORK has recently been done on the fine structure in time of solar radio emission. This fine structure is characterized by short-lived variations of the intensity; they may have either small or large intensities[1].

For these investigations a conventional swept-frequency radio spectrograph[2] lacks sensitivity when a large frequency band is combined with high time resolution. To overcome this difficulty the Utrecht Observatory makes