LETTERS TO THE EDITOR

RADIOPHYSICS

Observation of OH Absorption Lines in the Radio Spectrum of the Galactic Centre

THE first detection of the 18-cm lines of the OH radical was recently reported by Weinreb, Barrett, Meeks and Henry[1]. The lines were observed in absorption in the spectrum of Cassiopeia *A* at frequencies agreeing closely with laboratory values. Optical depths of 0·016 and 0·010 were measured corresponding to values of ~ 3 for hydrogen lines with the same radial velocities. As the optical depth of the zero-velocity hydrogen line in the galactic centre source (Sagittarius *A*) is also of the order of 3 and its line width is greater than those in Cassiopeia *A*, it appeared that we might be able to confirm the results given in ref. 1 with easily improvised equipment.

The observations were made with the 210-ft. telescope at Parkes. The receiver was a switched-frequency type with a bandwidth of 50 kc/s; the overall system noise temperature, including the source contribution of 220° K, was 700° K (double channel). The receiver output was integrated for 100 sec at frequencies 20 kc/s apart in a range of ± 160 kc/s about the expected line frequency. A single such run gave clear evidence for the absorption line. The data obtained from three runs on each line on November 20 are given in Table 1.

Table 1. CHARACTERISTICS OF OH ABSORPTION LINES IN SAGITTARIUS *A*

Transition	Frequency (kc/s)	Optical depth	Observed line width (kc/s)
$F = 2 \rightarrow 2$	1,667,377 ± 10	0·025 ± 0·004	66 ± 5
$F = 1 \rightarrow 1$	1,665,419 ± 10	0·015 ± 0·003	63 ± 3

The frequency difference of 1,958 kc/s between the two lines is within 3 kc/s of that reported by Weinreb *et al.* and the ratio of the optical depths of 1·7 is in good agreement with their observed values of 1·6 and the theoretical prediction of 1·8. The observed line widths are somewhat narrower than those of the equivalent hydrogen line observed by Clark, Radhakrishnan and Wilson[2] with a 6-kc/s bandwidth or by Kerr (private communication) with a 35-kc/s bandwidth on this telescope. The radial velocities of the OH and hydrogen lines also differ by about 4 km/sec, assuming the rest frequencies of Weinreb *et al.*[1]. These differences can be accounted for in terms of a variation in the abundance of OH to H in different regions contributing to the absorption. Similar effects have been noted in some of the Cassiopeia *A* results.

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[1] Weinreb, S., Barrett, A. H., Meeks, M. L., and Henry, J. C., *Nature*, **200**, 829 (1963).
[2] Clark, B. G., Radhakrishnan, V., and Wilson, R. W., *Astrophys. J.*, **135**, 151 (1962).

Radio Observations of the Interstellar OH Line at 1,667 Mc/s

THE first experimental evidence for the presence of 18-cm absorption lines of the hydroxyl (OH) radical in the radio absorption spectrum of Cassiopeia *A*, as suggested by Lilley[1], was obtained by Weinreb *et al.*[2] based on observations made during the period October 15–29, 1963. The Radio Physics Laboratory, Commonwealth Scientific and Industrial Research Organization, in Sydney, Australia, has reported the successful measurement of OH absorption in the spectrum of Sagittarius (see preceding communication).

In this communication we wish to report the successful detection of OH in the radio absorption spectrum of Cassiopeia *A* and Sagittarius *A* as supporting confirmation of the discovery by the Lincoln Laboratory, Massachusetts Institute of Technology. Our observations were conducted during December 7–December 10, using the equatorially mounted 84-ft. parabolic antenna at the Sagamore Hill Radio Observatory of the Air Force Cambridge Research Laboratories, located in Hamilton, Massachusetts. The spectral line radiometric receiving system was a model *EK/HI* receiver designed by the Ewen Knight Laboratory approximately one year ago for use with the 84-ft. parabolic antenna.

The receiver is a triple conversion superheterodyne in which all three local oscillators are crystal controlled. Frequency scanning is achieved by introducing a variable side tone on an appropriately selected frequency rail, generated at the output of a master oscillator multiplier chain. The frequency of operation while scanning is read directly on an external counter to an accuracy of ± 100 c/s.

The receiving system in its original form included a low noise beam-type parametric RF preamplifier which provides a 2-db. system noise figure over a bandwidth of 100 Mc/s centred at 1,420 Mc/s. For these observations, a similar RF preamplifier tuned to 1,667 Mc/s was loaned by the Aerospace Instrumentation Laboratory of the Air Force Cambridge Research Laboratories. The measured overall receiving system noise figure, including cable and RF switch losses, was a maximum of 3 db.

The receiving system was operated in a mode which compares the antenna temperature to that of a thermally insulated resistive load, by alternately connecting the receiver input to the antenna terminals and to the resistive load, through action of an RF switch operating at a switching rate of 100 c/s. In this mode of operation the difference between the antenna temperature and load temperature, at the receiver input, may be effectively balanced to zero, by adjustment of a 'gain modulator' introduced in the second IF amplifier chain. This unit varies the receiver gain in synchronism with the RF switch in a manner such that the noise power-levels contributed by the antenna and by the comparison load can be adjusted to the same value, prior to IF detection. By this technique, fluctuations at the receiver output, due to gain variations, are made negligible. A unique feature of this approach is the ability to achieve effective RF input noise balance without introducing additional system noise. The more conventional 'switched frequency' mode of operation for the detection of line structure[3] was not used because of the unknown temperature-dependent frequency characteristics of the low noise input RF amplifier. The efficacy of this technique is determined to a significant degree by the ability of the antenna to track the radio source precisely during the observing period. Variations in antenna pointing error while tracking are observed as a 'baseline drift' in the output record. Relatively large receiver output fluctuations are observed as a consequence of angular fluctuations of the radio boresight axis of the antenna under gusty wind conditions. This condition was observed for a few hours on only one occasion during our experimental observations, when the wind velocity reached 35 m.p.h. On all other occasions, the antenna sidereal tracking capability was within 1 min of arc over periods of several hours.