A NARROW EMISSION LINE NEAR 1720 MHz IN THE DIRECTION OF SGR A*

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SUMMARY

A narrow emission feature (of half-width 4.5 km s\(^{-1}\) in velocity) has been detected in the 1720 MHz OH-line spectrum of Sgr A at a frequency that would correspond to an OH velocity of +132 km s\(^{-1}\) (l.s.r.). However, the identification as an OH transition is questioned because there are no features of similar velocity in the line profiles of either the other OH ground-state transitions or transitions for other molecules.

The line profiles for the four groundstate transitions of OH in the direction of Sgr A are shown in Fig. 1. The observations were obtained in 1974 June and November with the Parkes 64-m radio telescope—the equipment and method of observation have been described elsewhere (Whiteoak & Gardner 1975). In the 1720 MHz profile there is a hitherto undetected feature at a frequency corresponding to an OH velocity of +132±2 ± 0.5 km s\(^{-1}\), a value higher than previously associated with the OH spectrum.

This new emission line is shown in greater detail in Fig. 2, where the results for the two periods of observation are superimposed. The June observations are noisier because the integration time of 15 min is only half that used for the November observations. The effective resolution is 12 kHz. The agreement between the two sets of results is excellent. There is little doubt that an emission line is present with a peak antenna temperature of 10 K and a half-intensity width of 26 kHz (equivalent to 4.5 km s\(^{-1}\) in velocity). Subsequent observations at Parkes have shown that the emission has an angular extent less than 5 arcmin and is centred on Sgr A to within ±2 arcmin.

The identification of the line as an OH feature is questionable. There is no evidence of a line (either in absorption or emission) with a similar velocity and width in the profiles of any of the other three groundstate transitions of OH, even at antenna temperatures lower by an order of magnitude. This is contrary to the situation for the other features in the profiles.

Of all the known OH emission sources with 1720 MHz emission there are only two cases where this emission exceeds by more than an order of magnitude the absorption or emission at the other groundstate frequencies. One example is the peculiar star V1057 (I.0 & Bechis 1974). Here the line is narrow (a width less than 1 km s\(^{-1}\)), highly variable in intensity, and circularly polarized. However, the line shown in Fig. 2 is not circularly polarized, has a greater width of 4.5 km s\(^{-1}\), and does not appear to vary in intensity.

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Fig. 1. Line profiles of the OH groundstate transitions in the direction of Sgr A.
A narrow emission line near 1720 MHz

The other example is the supernova remnant W28 (Robinson, Goss & Manchester 1970); it may be an extreme case in a class, containing W44 and other non-thermal sources, which is characterized by emission at 1720 MHz and absorption at the other groundstate frequencies. The emission velocities are similar to the velocities of spiral arm features located along the lines of sight to the sources. There are objections to an interpretation as such a source. An emission line at +132 km s\(^{-1}\) would originate behind the galactic centre. It is generally accepted that a +135 km s\(^{-1}\) spiral arm feature exists behind the centre, as first pointed out by Rougoor (1964). However, at the longitude of Sgr A the feature is most pronounced at \(b = \circ \cdot 2\), about 15 arcmin north of the source (see e.g. the H\(\text{I}\) observations of Kerr & Vallak 1967). There is little evidence of the arm when observing Sgr A with high angular resolution—along the galactic equator neither the distribution of CO emission (Sanders & Wrixon 1974) nor H\(_2\)CO absorption (unpublished observations obtained at Parkes) show the presence of molecular clouds at +135 km s\(^{-1}\), although an extended feature at +170 km s\(^{-1}\) behind the galactic centre is well defined. Thus it seems improbable that the emission shown in Fig. 2 could be associated with the +135 km s\(^{-1}\) arm and yet be located along a line-of-sight which (1) is almost coincident with the direction of Sgr A (there is no corresponding emission in unpublished Parkes observations obtained in the directions of nearby continuum sources such as G359·4−0·1 and Sgr B2); (2) contains no other evidence of the spiral arm complex; and (3) passes more than 40 pc below the axis of the +135 km s\(^{-1}\) arm.

If the line is not an OH transition it is probably associated with some unidentified molecule of similar simple structure—a more complicated molecule might be expected to yield a broad emission line composed of several components. The width of the line is similar to that of the CH emission with zero velocity in front of Sgr A (Gardner & Robinson 1974). If the line originates in the molecular cloud associated with this emission its rest frequency is 1719·77 MHz. The other possibility is that the line originates in the +40 km s\(^{-1}\) clouds near Sgr A. In this case the rest frequency would be 1720·00 MHz. However, this interpretation is
not consistent with the narrow width of the line—for other molecules the +40 km s\(^{-1}\) lines typically have half-intensity widths exceeding 20 km s\(^{-1}\).

A study of the angular distribution may assist in the choice of possibilities. As for CH, emission at zero velocity would be expected to maximize north of Sgr A while emission at velocities near +40 km s\(^{-1}\) would maximize 1–2 arcmin south or east of the continuum peak (see e.g. Whiteoak, Rogstad & Lockhart 1974). The possibility that the line is merely an OH transition would be eliminated by the detection of a line with one of the above rest frequencies in other continuum sources.

REFERENCES