Some of the smaller structural features of the neutral hydrogen appear to coincide in position with components of the continuum distribution near the centre. This agreement suggests that the continuum sources are at least partly thermal.

Absorption

Very striking absorption effects are observed in the vicinity of the continuum source at the centre, Sagittarius A. The intensity levels in Figure 3 are unreliable in this region, because the receiver overloads in the presence of the strong continuum radiation, and the necessary corrections have not yet been applied.

The high resolution enables the central absorption to be seen unaccompanied by emission from surrounding areas. Several components of absorption at different velocities can be seen in Figure 3, corresponding to absorption in bodies of gas in different positions along the path from the centre to the observer. There is a general asymmetry in the longitude distribution, but the various portions of the absorption spectrum show different variations with longitude, leading to a very complex overall pattern, which has not been fully interpreted at this stage of the analysis.

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Discussion

Westerhout: Many of the features on your map seem to have typically the width of the band (of the receiver) and of the beam. Are they not noise fluctuations? If not, then this is very interesting, because it means that you are about to resolve really small features and with a narrower velocity and space resolution the whole pattern might break up completely.

Kerr: The smallest details of the diagrams are certainly influenced by noise, but all others are clearly real. Some of the features are very sharp in angle and velocity, and I agree that these could be further resolved.

45. HIGH-RESOLUTION OBSERVATIONS OF THE GALACTIC CENTRE AT 1420 MC/S IN THE CONTINUUM AND IN THE NEUTRAL HYDROGEN LINE

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The large Pulkovo radio telescope has a beamwidth of 7 min of arc in R.A. at a frequency of 1420 Mc/s. The continuum emission from the source Sagittarius A was measured with a bandwidth of 5 Mc/s. The mean drift curve is shown in Figure 1. It can be separated into components according to Drake (1959) as indicated in the figure. The galactic ridge is also shown. The right ascension, the antenna temperature, the observed angular diameter, and the flux density of each component are given in Table 1. The errors given in the table can be somewhat higher in the case of components 2 and 3 because of the difficulties of separating them. The calibration of the antenna and receiver was made using the flux densities of the sources IAU 19N4A,

* Presented by Y. N. Parijsky.

05N2A, 05S0A, and 18S1A according to Westerhout (1958) with the corrections given by Altenhoff *et al.* (1960). The atmospheric extinction at $\lambda = 21$ cm was taken from these works as well.

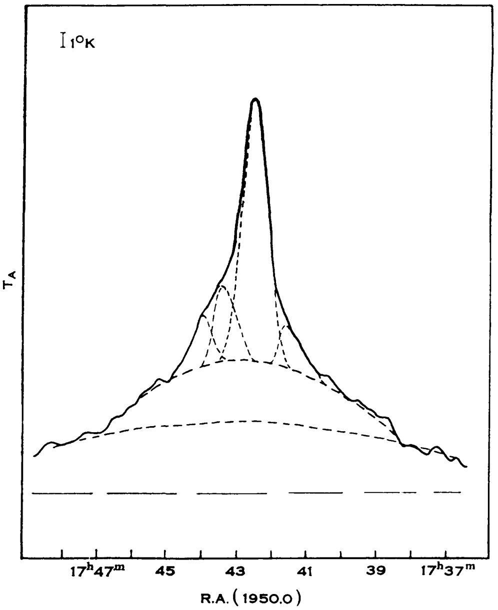

Fig. 1.—The continuum drift curve at the declination of the source Sgr A resolved into components according to Drake (1959). The galactic ridge is also shown.

TABLE 1

COMPONENTS OF THE RADIO SOURCE SAGITTARIUS A

No.	Name of the Component	R.A. (1950) $\pm 1^s$	Antenna Temperature (°K) $\pm 0{^\circ}5$	Angular Diameter (min of arc) $\pm 1'5$	Flux Density $\times 10^{-26}$ (Wm^{-2} $(c/s)^{-1}$) $\pm 30\%$
1	Central bright source	$17^h42^m27^s$	16·0	6	540
2	Asymmetrical bright region	17 43 09	5·3	8	190
3	Northern part of Drake's ring	17 43 51	3·5	6	110
4	Southern part of Drake's ring	17 41 24	2·3	6	80
5	Broad source	17 42 27	4·5	65	920
6	Galactic ridge	—	5·0	180	—

The total flux of the source Sgr A is 1840×10^{-26} Wm^{-2} $(c/s)^{-1}$ $\pm 30\%$; subtracting the flux of the broad source (N5) we get 920×10^{-26} Wm^{-2} $(c/s)^{-1}$. This value is in agreement with the total flux of the source given by Lequeux (1962): 960×10^{-26}. The broad source was excluded in his measurements. Taking into account the flux densities of the source components in the 3-cm region given by Parijsky (1959), Howard, Rood, and Boyce (1962), and Lequeux (1962, planimetry of Drake's isophotes) and at $\lambda = 10$ cm by Cooper and Price (this volume, paper 40)

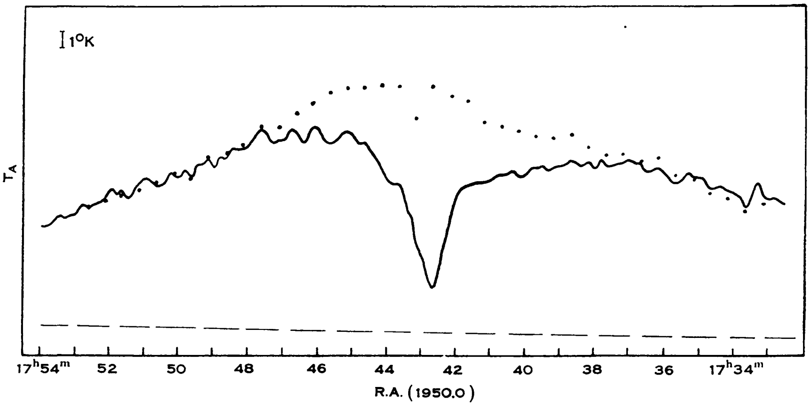

Fig. 2.—Neutral hydrogen drift curve at a radial velocity $V = 0$ relative to the LSR. The dots indicate the calculated "expected" curve.

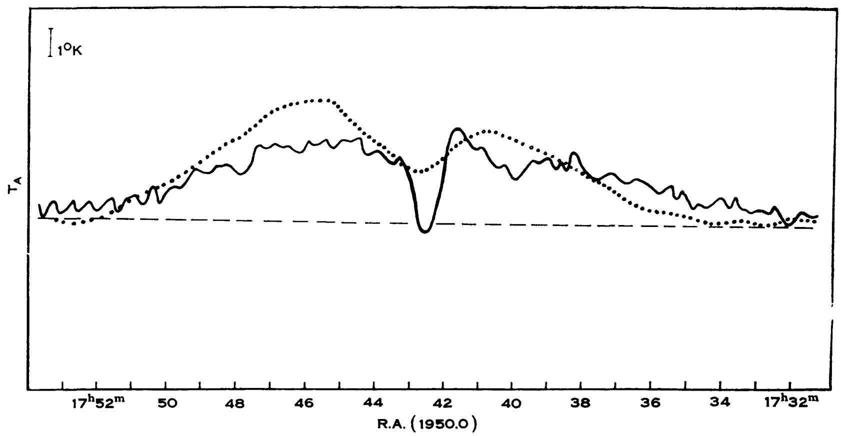

Fig. 3.—Neutral hydrogen drift curve at a radial velocity $V = -53$ km/sec relative to the LSR. The open circles represent the drift curve obtained at Dwingeloo (van Woerden, Rougoor, and Oort 1957).

it is possible to make some preliminary conclusions on the spectra of the components. The central bright source is not purely thermal. The components 2 and 3 may have a flat spectrum, and the southern part of Drake's "ring" is rather nonthermal as well as the broad source.

We have investigated the absorption of the Sgr A radiation by neutral hydrogen at a radial velocity close to zero relative to the LSR, with 90 kc/s bandwidth. The mean drift curve is shown in Figure 2. Assuming a constant optical depth of the hydrogen in the solid angle of the source and taking the value of this depth from the Cal Tech measurements, we added the absorbed quantities to the mean drift curve. The result of this addition — the calculated "expected" curve — is marked by dots in Figure 2. The "expected" curve coincides well with the strip across the galactic plane 3° to the north of Sgr A. Therefore the radiation from all the components is absorbed almost equally, and the components of the source Sgr A are not closer to the Sun than 3–4 kpc.

The mean drift curve taken at a velocity $V = -53$ km/sec is shown in Figure 3. Analysing this curve in a similar manner we conclude that the neutral hydrogen in the 3-kpc expanding arm absorbs the radiation from the central bright source, asymmetrical bright region, and the northern part of Drake's "ring". The south-western part of the "ring" is not absorbed in the 3-kpc arm, unless it is the effect of fine structure of the arm (Kerr, this volume, paper 44). If the southern part of the "ring" is really not absorbed in the 3-kpc arm, the two components of the source situated symmetrically about the centre and lying in the galactic plane cannot represent the projection of a ring of emission surrounding the galactic centre. The minimum in the 3-kpc arm emission at $\alpha_{1950} = 17^{h}40^{m}$ which is mentioned in our work (Ryzhkov *et al.* 1963*a*) can be an example of striking absorption features in the central region found by Kerr (this volume, paper 44). The details of our observations and reductions are in print (Ryzhkov *et al.* 1963*b*).

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Discussion

Cooper: The flux for the central feature is given as 540 flux units. How does this relate to the values obtained earlier at 3 and 9 cm?

Parijsky: The measurement of the absolute flux at such a low elevation angle is difficult and the errors involved might be high. Earlier investigations showed fluxes of 150 flux units (MKS) at 3·0 (and 9) cm. In any case, I think the flux must certainly be less than 200 flux units at 3 cm. I should like to ask Mr. Cooper how he can account for the value of 130 flux units derived by Howard *et al.* in their pencil-beam measurements of the area.

Cooper: In the paper by Howard, Rood, and Boyce, no flux densities of comparison sources were quoted. We should perhaps endeavour to find out from them how their equipment was calibrated.

Price: I feel that this points out the definite need for closer cooperation and communication between groups working on this problem. Considering the wide differences noted from different investigators, it is obvious that we need to adopt standard flux values, sizes, and brightness distributions for calibration sources in order to put all measurements on a relative scale. These data are often omitted in final publication of results dealing with the galactic centre region and this slows the reliable comparison of results between groups.

Bolton: The apparent lack of absorption of the southern part of Drake's ring by the 3-kpc arm need not mean that there is necessarily no absorption. The emission background often has considerable fine structure and if such coincides with the direction of the source its effect may be included in the apparent absorption deduced from the subtraction of the composite and "expected" profile. This effect shows quite clearly in absorption profiles deduced from observations with telescopes of different resolving power. Fine structure in the emission background can appear as false absorption, or add to or subtract from true absorption effects.

46. INTERPRETATION OF VELOCITY DISTRIBUTION OF THE INNER REGIONS OF THE GALAXY

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I. The large positive and negative velocities in the 21-cm line profiles near the galactic centre have indicated the presence of substantial departures from circular motions in the central parts of the Galaxy. The Leiden astronomers (Oort and Rougoor 1958; Rougoor and Oort 1960) have interpreted these observations in terms of an "expanding arm" at a mean distance of about 3 kpc from the centre. It is not clear how these arms or arcs are related to the regular spiral structure, if the Galaxy is an ordinary spiral similar to M31 as commonly assumed. If, on the other hand, the Galaxy is similar to the SAB(r) or SAB(rs) systems, as suggested by the multiplicity of the spiral pattern discussed in another communication, a different interpretation of the velocity distribution is possible.

II. The average diameter of the rings in SB(r) spirals of the Virgo cluster is $1'.6 = 5\cdot0$ to $6\cdot3$ kpc, if the distance is 10 to $12\cdot6$ Mpc ($m_0-M = 30\cdot0$ to $30\cdot5$; de Vaucouleurs 1957); it ranges from 2 to 4 kpc for the other ringed types. This value agrees well with the 3-kpc radius of the "expanding arm" derived from the tangential point, and it confirms the presence of a ring structure in the central region. Since the ring seems to be incomplete an open ring structure as in the SB(rs) and SAB(rs) types is suggested; the length of the bar is tilted about 30 to 45° to the Sun-centre line with the breaks of the ring roughly at right angles to the bar (cf. Fig. 1).

In this model the negative velocities in the direction of the centre are interpreted not as an expanding arm or ring, but as indicating that the gas is streaming along the bar from the nucleus outward at velocities of the order of 60 to 70 km/sec, the line-of-sight component being 53 km/sec in the direction of the nucleus (Oort, Kerr, and Westerhout 1958). Such a flow pattern, which is strongly suggested by the narrow dust lanes commonly observed along the bars of barred spirals, was directly detected by recent spectroscopic observations of several systems described in another communication.

III. A frequent characteristic of barred spirals is the small, elliptical, and often exceedingly bright and sharp nucleus, e.g. as in NGC 1365, 1433, 4303, and 5236.