particle model. The main feature displayed here is the marked difference between the colour difference results for multiple (A) and single (B) scattering. The more positive $(B-V)$ colour differences between star and nebula for the multiple scattering model indicate that this model leads to a nebula which is consistently bluer than is the case for single scattering. This is as expected, since light scattered from particles with radii of the order of a wavelength is bluer than the original incident light. The increased number of scatterings implied in the multiple scattering theory thus leads to increased bluing of the light reflected from the nebula.

As can be seen from Figure 2, the multiple scattering theory gives results which are in closer agreement with experiment than are the results of single-scattering calculations. This indicates the necessity of using radiative transfer in quantitative studies of reflection nebulae, at least in the cases where the optical radii are appreciable.

Finally, it is interesting to note the consistent difference between theoretical and experimental colour differences at small angular displacements from the central illuminating star. It seems likely that this discrepancy is due to the assumption, made in Sobolev's original theory, that the space density and optical properties of the nebular grains are independent of the radial distance from the radiating source. One would expect that, in regions close to the star, such effects as radiation pressure on the grains, and the Poynting-Robertson effect, will lead to the formation of a central cavity in the nebula. A more complete study of light scattering in reflection nebulae thus requires the adoption of model nebulae in which the space density and scattering properties of the nebular dust grains are dependent on the radial distance from the star.

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The Use of HI Absorption to Determine Distance for 10 Galactic Radio Sources

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An extensive survey of HI absorption in the spectra of discrete radio sources has been in progress for the past three years at the Parkes radio observatory. One part of the survey comprising sources along the galactic plane north of declination $-50°$ has recently been completed.[1] In this communication we discuss some conclusions concerning the distances of 10 sources drawn from a preliminary analysis of the data.

The problem of distances is a major consideration in the investigation of galactic radio sources. Reliable distances can only be obtained for nearby radio sources which are optically identified. In most cases this restricts us to distances $\lesssim 3$ kpc. For many optical HII regions the nebulae are heavily obscured and it is not possible to pick out the exciting stars to determine photometric distances. Most galactic radio sources have no optical counterpart and for these indirect methods must be employed to obtain a distance. For supernova remnants Kesteven[2] and Milne[3] have developed a method of relating surface brightness to linear diameter. For thermal sources a great advance in the determination of kinematic distances has resulted from the extensive observations of radio recombination lines carried out in the past few years. At present about 200 sources have been observed. For $90° < l^{II} < 270°$ an unambiguous kinematic distance can be determined from the measured radial velocity by using the Schmidt rotation curve. Even here considerable caution is needed for it has been shown[4, 5] that in the Perseus arm there are large deviations from circular motion (20-30 km/s) and it is possible to overestimate distances by about 1 kpc. In the longitude range $\pm 90°$ from the galactic centre a distance ambiguity exists if the velocities are positive in the 0-90° range and negative in the 270-360° range—i.e. there are two points along the line of sight which can possess the same radial velocity.

There are four methods to resolve this ambiguity: (1) If the source is optically identified (even if no exciting stars can be seen) then the distance is *probably* less than ~3 kpc. (2) If a source is well off the galactic plane the choice of the far point may imply an excessive distance from the galactic plane which would probably place it outside the HI layer. Then the observed absorption would imply that the source is at the near point. This criterion must, however, be used with caution, since some well-known HII regions are well off the galactic plane—e.g. Orion A is 150 kpc from the plane. (3) If the velocity of the source is near the tangential velocity, where the line of sight passes closest to the galactic centre, no significant ambiguity exists. (4) If the source is on the solar side of the tangential point HI absorption can occur only at velocities less than the tangential velocity. On the other hand, if the source is at or beyond the tangential point, HI absorption could, but need not, extend up to the velocity of this point. We are assuming here that the absorbing HI clouds do not generally have large peculiar motions.

We have used the above criteria to estimate the distances of 8 sources having galactic longitudes within 90° of the galactic centre. For the two outside this longitude range we have been able to set lower limits. The distance determinations are summarized in Table I. The source name and 'G number' are listed in columns 1 and 2. The recombination line (H109α) data, shown in columns 3, 4 and 5 are taken from Reifenstein *et al.*[6] and Wilson *et al.*[7] The distance estimates from the HI absorption measurements are given in column 6. The final column contains notes on each source.

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