The idea of choosing this subject for a Joint Discussion arose about a year and a half ago, during the Australian IAU Symposium on the Galaxy and the Magellanic Clouds. That symposium dealt mainly with the large-scale properties of the galactic system, and a few days ago we heard about those aspects again in Prof. Oort's admirable discourse.

Today we shall focus attention on the properties of the small portion of the system surrounding the Sun. There were various inducements to do so. At these short distances we are naturally able to investigate structure and motions in much greater detail than in the more remote parts of the Galaxy. It is generally believed that our local region is in many respects a representative sample of the outer parts of the Galaxy in general. Thus, much of the information obtained here is of much more than local significance. This applies especially to studies of the stellar composition with reference to subdivision into age groups, with their different chemical and kinematical properties, and to the inferences with regard to the history of the Galaxy as a whole.

However, there is also the field of investigations which deal with the local region in its own right. I am thinking here particularly of the components which are typical for the most recent phase of the evolution in the Galaxy: the interstellar medium and the young stars. Although the structural features here certainly must be seen as part of the *general pattern* that we usually indicate by the term spiral structure, this detailed structure varies from place to place, and it is of great importance that we try to assemble all the information on the structure and state of motion of *this particular region*. Such studies may throw light on the detailed behaviour of the gas and dust within a local stretch of a spiral arm; on the rate of change of the local spiral structure, on the rate of star formation out of the gas and the kinematics with which the stars are formed, on the degree to which these local affairs are submitted to influences from outside, etc.

The Organizing Committee has decided to stress in this Joint Discussion *these* special aspects of the *young component* of the population, rather than the ones I mentioned first. We encounter here a large variety of fields of research which are intimately connected, and for which it seemed useful to bring out their mutual relation in a somewhat systematic survey. The logical order seemed to be, to start with a review of the properties of the interstellar medium. This, we will do this morning, in the afternoon we will proceed, first, to the stars of most recent formation, and next to some related problems.

A number of speakers have been invited to present review papers on the different aspects of the subject. Naturally, there will be opportunity for brief remarks and discussion following these reviews. The speakers have been informed about the time they have available, and we hope they will stay within these limits. In view of the large number of contributions, may I urge those who wish to present additional remarks to be brief, and strictly limit them to items dealing with the *local properties* of the Galaxy.

I. LOCAL PROPERTIES OF THE INTERSTELLAR MATTER

2. OVERALL PROPERTIES OF THE INTERSTELLAR GAS

F. J. Kerr

General Remarks

This paper is a review of some of the overall properties of the interstellar gas, as an introduction to the more detailed papers. The most extensive information on the gas comes from radio observations, particularly of the 21-cm hydrogen line. There are some difficulties, however, in fitting together radio and optical results.

The radio investigations are least precise in the solar neighbourhood, where small deviations

from circular motion can lead to large errors in distance estimates. Also the very transparency which makes the whole Galaxy accessible to radio investigations can prove an embarrassment in the study of near-by individual objects, which are difficult to isolate from their background.

A great deal of work remains to be done in tying together the detailed optical information on stars, clusters, etc., in the first few kiloparsecs, and the more smoothed out radio picture of the hydrogen over a much larger area.

Distribution and Motions

The overall distribution and motions of the hydrogen were then discussed, but this account will not be reproduced here, as the subject has recently been extensively reviewed by Kerr and Westerhout (1965). Some current problems will be mentioned briefly.

Current Problems

The present diagram of hydrogen spiral structure is still based on old low-resolution observations from Leiden and Sydney. The production of a new version will be difficult, because much more detail is present in recent observations, and also there is more realization of the complexity of the kinematical pattern.

There is evidence from various sources that spiral arms are broken up into 'patches', 500–1000 pc in length. Further, these individual patches seem to have small deviations from circular motion, some inwards and some outwards.

The rotation curves derived from 21-cm observations show a substantial difference between the northern and southern galactic hemispheres, and also considerable irregularity (Kerr 1963, Shane 1965). These effects are presumably related to asymmetries and irregularities in the hydrogen distribution, and also the local deviations from circular motion must have their effect on the apparent rotation curve. In his discussion, Shane has drawn attention to the gravitational distortion of the rotational pattern which would be produced by the mass in spiral arms.

It is clear that a smoothly-varying circular-orbit model of galactic rotation can no longer be used, and the overall picture of gas distribution and motions will be a quite complex one.

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3. CLOUD STRUCTURE AND LOCAL KINEMATICAL PROPERTIES OF THE INTERSTELLAR MATTER

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The structure of the interstellar medium has been the subject of considerable controversy. Most workers in the field favour the discrete-cloud model, but others prefer to think of a relatively smooth medium with only minor density fluctuations. Obviously, in any model density and velocity are functions of position; the character of these functions determines whether the word 'cloudiness' is a suitable description.