GIANT CLOUDS AND STAR-FORMING REGIONS AS SPIRAL-ARM TRACERS

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ABSTRACT

A variety of observations suggest that clouds of 10^6-10^7 $M_\odot$ and extended regions of star formation are the best tracers of spiral structure in the Milky Way.

OB associations such as Ori OB1, Per OB2, M16, and M17 have been used as spiral-arm tracers in the Milky Way since Morgan, Sharpless and Osterbrock (1952) and Morgan, Whitford and Code (1953) first delineated the nearby structure. The main spiral arms of our Galaxy are traced best, however, by larger regions of star formation (Mezger 1970). W42, W44, W47, and W51, for example, are among the giant HII regions that delineate the Sgr Arm. These giant regions are nearly invisible at optical wavelengths.

Studies of other galaxies indicate that the largest scales for cloud and star formation in the Milky Way should be between 1 and 4 kpc (Elmegreen and Elmegreen 1983, hereafter "EE"). Regions of this size should be the best spiral tracers. McGee and Milton (1964), for example, mapped 29 giant HI clouds (10^7 $M_\odot$) along 4 spiral arms in the outer part of the Milky Way. Such large HI-emission clumps were also observed by Burke, Turner and Tuve (1964), Kerr (1964), and others after the first 21-cm line surveys were available. Equally large structures are present in molecular emission. Wouterloot (1981) found 2 large (1-kpc) OH complexes in the Perseus Arm, and Dame et al. (1983) found 19 CO clouds with masses greater than 5×10^6 $M_\odot$ in the Sagittarius Arm. Other evidence for extremely large clouds comes from extinction surveys by Neckel (1967), Fitzgerald (1968) and Lucke (1978).

Clouds with masses in excess of 10^6 $M_\odot$ produce giant star complexes (300-pc scales) and conglomerates of clusters and OB associations. Such regions have been discussed by Efremov (1978), Shevchenko (1979) and others (see EE). A star complex typically contains one or more active sites of star formation, a few older clusters, and a large envelope of Cepheid variables and red supergiant stars. Such coherent large-scale

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star formation is probably responsible for the origin of comoving stellar groups (Eggen 1964). The most active conglomerate of star formation found locally is Gould's Belt. Similar regions elsewhere in the Galaxy have been discussed by Schmidt-Kaler and Schlosser (1973). Other examples are the giant clumps of A-type stars in the Carina Arm (Bok 1964; Maurice 1983).

A galaxy like ours produces new stars by forming enormous HI clouds, which then fragment and collapse into molecular clouds and clusters of star clusters (a family of 5 nearby clusters has been identified by Lyngå and Wramdemark 1983). The origin of the largest clouds is uncertain, but the cloud masses and internal motions suggest that they are weakly self-gravitating. They may be the result of Jeans-type instabilities in either the ambient interstellar medium (Elmegreen 1979; Cowie 1981; EE; Jog and Solomon 1983) or in large swept-up gas shells (Elmegreen 1982).

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