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DOES THE FAR-INFRARED/RADIO CORRELATION IN SPIRAL GALAXIES EXTEND TO THE SPATIAL DOMAIN?

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A comparison is made between the spatial distribution of the thermal far-infrared and non-thermal radio emission of nearby spiral galaxies. This is done in an attempt to improve our understanding of the well known correlation between the integrated IRAS far-infrared and radio emission of spiral galaxies, *e.g.* de Jong *et al.*, 1985, Helou *et al.*, 1986.

A physical explanation for this correlation is not straight forward due to the ambiguous nature of the origin of the far-infrared and radio, and the dependence of the non-thermal radio on each galaxies' magnetic field. It is now widely believed that the infrared emission detected in the longer wavelength IRAS wavebands (> 50μm) arises from at least two distinct sources, *e.g.* Cox *et al.*, 1986, Persson and Helou, 1987:

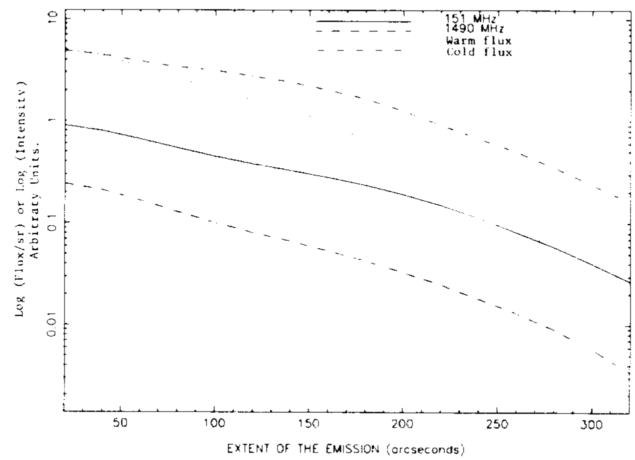
i) a warm (T~40K) component associated with dense dust clouds heated by embedded O and B type stars.

ii) a cooler (T~20K) component associated with diffuse dust distributed throughout the ISM heated by the interstellar radiation field.

A link between the warm component and the radio via electrons originating in Type II supernovae (the ultimate fate of many of the O and B type stars responsible for the warm component) has been suggested by numerous authors. The supporting evidence is scarce and inconclusive. The dominant source of the radio is not yet known, discrete supernova remnants contributing only a few per cent of the total. Indeed diffusive shock acceleration theory diverts the question away from the class of objects responsible for the radio radiating cosmic-ray electrons. Instead the origin of a much less energetic reservoir of electrons and the means by which some of these electrons are accelerated to relativistic energies becomes the central issue, *e.g.* Bloemen, 1987. When account is taken of our sketchy knowledge regarding extragalactic magnetic fields, (but see Hummel, 1986) it can be seen why the far-infrared/radio correlation is so puzzling.

We have attempted to provide some insight into the problem by looking at the spatial distribution of the different components in some nearby spiral galaxies, starting with the face-on spiral M51. The source of the far-infrared data is the IRAS CPC instrument. This has a resolution of ~1.5 arcmin at 50 and 100μm, compared to that of the Survey detectors, 4.3 by 6.9 arcmin at 100μm. Warm and cold far-infrared fluxes integrated over all wavelengths and the radio intensity at two frequencies are plotted against radius in Figure 1 below. All plots are to a common resolution of 100 arcsec, the radio data originating from the Cambridge Low Frequency Synthesis Telescope (151 MHz) and the VLA (1490 MHz, from Condon, 1987). The warm and cold regions are assumed to be represented

Figure 1: The Radial Distribution of the Far-Infrared and Radio Emission in the Face-on Spiral Galaxy M51.



by a single galactic wide temperatures of 50 K and 20 K respectively. A dust emissivity of 1 has been assumed. The form of the plots is little effected by varying these assumptions. As can be seen the radio and cold component curves appear to follow each other most closely, in contradiction to the simple OB star/type II supernovae hypothesis mentioned above. The significance of this result awaits analysis of more galaxies and an interpretation of the dominant influences on the distribution of each of the components.

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