THERMAL RADIO STARS AND HIGH-RESOLUTION RADIO OBSERVATIONS +

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1. INTRODUCTION

The main purpose of this talk is to outline a few of the problems in our understanding of thermal radio stars that may be resolved by the large arrays. Several radio telescopes in operation (such as the VLA and MERLIN arrays) or under construction (such as the Australia Telescope) have both the required resolution and sensitivity.

The basic model explaining the thermal radio stars was first described by Seaquist and Gregory (1973) and developed by Olnon (1975), Panagia and Felli (1975) and Wright and Barlow (1975). More recently (Wright 1981), I have reviewed the model and discussed the various classes into which the stars can be grouped.

2. THE CLASSICAL MASS-LOSS STARS

The classical mass-loss stars, such as γ Vel, P Cyg and ζ Pup, are well described by the simple model. Mass loss rates determined from the total radio fluxes also agree well with those determined by other methods (see e.g. Morton and Wright, 1978; Abbott et al., 1980; Bieging et al., 1982). The suggested flux variability of P Cyg and 9 Sgr (Abbott et al., 1981) has been shown to be caused by incorrect VLA reduction procedures (see White and Becker (1982) for a discussion). Measurement of the angular diameter and total flux density gives a value for the wind temperature directly. Furthermore, measurements of the angular diameter at different frequencies give information about the temperature structure throughout the wind.

3. THE SYMBIOTIC-SLOW NOVA STARS

Observations of objects in the other main group of thermal radio star, the symbiotic-slow nova class, do not in general agree as well with the predictions of the simple model. They have radio spectra which are moderately - but significantly - steeper than the expected $\alpha = 0.60$. And many objects show a flattening of the spectrum at frequencies $\gtrsim$10 GHz, indicative of an optically thin region. The star H1-36 (see Fig. 1) shows both effects.

A steeper spectrum indicates either (i) that the wind density decreases faster than r^{-2} or (ii) that the wind temperature decreases outwards. A cooling wind could be produced by expansion cooling becoming important in its outer regions. But this cannot produce spectral indices steeper than $\alpha \approx 0.65$ (White and Becker, 1982). On the other hand,

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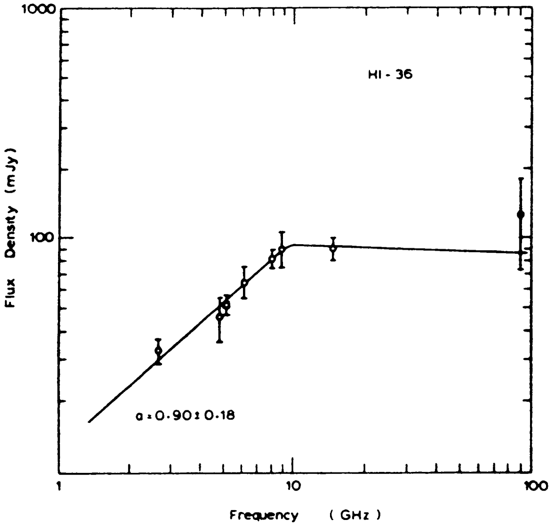

Figure 1. The radio spectrum of H1-36. The line represents a best fit to the data at the lower frequencies but has been forced to have a slope of $\alpha = -0.1$ at high frequencies.

a steep density profile may be caused by (i) variable stellar mass loss rates, (ii) acceleration of the wind or (iii) non-spherical symmetry of the outflowing gas. There is not space here to discuss these possibilities in detail.

Turning to the question of the optically thin spectrum at high frequencies: the straightforward interpretation would be that mass loss has recently stopped in these stars. However, observations have found no evidence that either the turnover frequency or the flux is decreasing with time, as predicted. On the contrary, the fluxes of H1-36 and V1016 Cyg appear to be *increasing*. A more plausible explanation for the flat spectrum is that the stellar wind is neutral (and thus transparent) close to the star. Obviously then this same star cannot cause ionization of the outer regions of the wind. There must be another hot star in the stellar system. Just such a model has been proposed by Allen (1983) for H1-36. Briefly, a compact star accretes mass from a wind flowing outwards from a companion M giant. The resulting ultra-violet radiation ionizes most of the wind, except for the dense regions close to the M giant and a "shadow zone". An angular size estimate would severely test this model.

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