# THE RELATIONSHIP OF OH AND $H_2O$ MASERS TO THE HII REGIONS IN CEP A

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There is evidence to show that OH and $H_2O$ maser emission is associated with the early stages of star formation. But the complexity of both the HII regions and the distribution of maser sites, makes it difficult determine how they are associated. Recent high resolution radio observations of Cep A, obtained using the VLA (Hughes 1985), together with accurate positioning of OH and $H_2O$ masers using MERLIN (Cohen et al. 1985), may help in this matter.

The Cep A condensation, as mapped in CO by Sargent (1977), shows all the evidence for star formation (e.g. see Hughes and Wouterloot 1984). High resolution radio observations, using the VLA at $\lambda$6cm and $\lambda$20cm show that it contains about 14 individual HII regions, arranged in two strings, each region appearing to have been formed by a B3 star. The regions towards the middle of the area are very compact, with radii at least as small as 100 au, while the outer regions are more extended with radii $\sim$ 1,000 au. The more compact regions have spectral indices, $\alpha > -0.1$, which indicates that part of the region must be optically thick, while region 2 has $\alpha \sim 1.6$ at high frequencies, which approximates the value of 2.0 expected from an optically thick black-body (Hughes 1985). These facts give additional support to the assumption that the HII regions are excited by stars.

A radio map of the central area at $\lambda$6cm, with resolution of $0\overset{''}{.}3$, is shown in the Figure. Also plotted are the positions of $H_2O$ masers (filled circles) and OH masers (open circles). It is seen that the $H_2O$ masers are situated at the edge of the HII regions, while the OH masers are situated well outside at radii of $\sim$ 1,000 au.

The interpretation of this data is that we are seeing the final stages of accretion for B3 stars, prior to their arrival on the Main Sequence. The stage ends when a stellar core forms, and its luminosity increases to the point where radiation pressure, acting chiefly on the grains, reverses the infall and causes the infalling matter to be expelled. Close to the core, a high molecular count is expected, as the result of evaporation off grains. The latter are expelled to a radius $\sim$ 1,000 au, where radiation pressure is balanced by gravitational attractive force of the core, where they form a cocoon, as indicated by the presence of the OH masers. Subsequently, the HII region expands and the



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$H_2O$ masers appear at its edge, pumped in the shock front. The OH is probably pumped by infrared, which is the result of absorption of stellar radiation in the cocoon. The lack of observed infrared sources from the regions is likely due to the exceedingly high obscuration, estimated to reach $75^m$ at visual wavelengths (Lenzen et al. 1984).

Applying this scenario to star forming regions in general, the position of masers and the length of time that they exist, will depend on the luminosity of the exciting star. An earlier type star will exert a greater radiation pressure and produce a cocoon at a larger radius; the rate of expansion of the HII region, and thus the duration of the $H_2O$ masers will also depend on the details of the final accretion stage. Not many details exist for other HII regions, but in the case of W3(OH) it would appear that the HII region has expanded as far as the cocoon, and only the OH masers are now seen.

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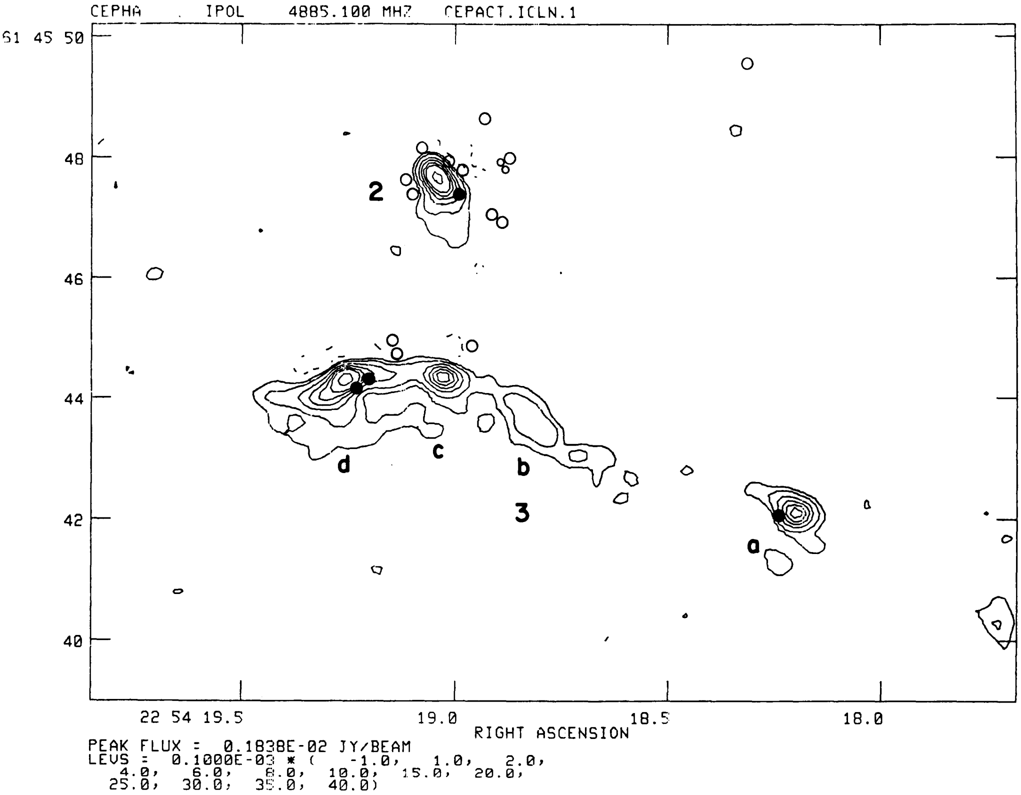


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