# OH/IR Sources as an Example of a Successful Simultaneous Radio and Infrared Programme

*Drs. E. Kreysa, G.V. Schultz, W.A. Sherwood and A. Winnberg from the Max-Planck-Institut für Radioastronomie (MPIfR) in Bonn have during the last two years simultaneously observed OH/IR sources at the 100 m Effelsberg and the 1 m ESO telescopes. G.V. Schultz reports about the results which open the door to further exciting investigations:*

In the *Messenger* No. 6, September 1976, W.A. Sherwood reported on the successful discovery of infrared counterparts of type II OH/IR sources previously found in the Onsala OH survey by A. Winnberg et al. The frequency of discovering the IR counterparts was about 50 % at that time. In the meantime our detector has been improved in sensitivity by E. Kreysa and our frequency of detection with the new photometer has risen to 80 % of a sample of 40 OH sources without having to use a larger telescope.

However, we are now limited at 3.7 μm (by background radiation) to $9^{m}$ with a signal-to-noise ratio of one in one-second integration time and only a larger telescope can increase the discovery rate. On the other hand at 2.2 μm we improved the sensitivity in August 1977 to $11^{m}.7$ and still we are not at the background limit, i. e. we can improve the sensitivity between 1.2 μm and 2.2 μm without using a larger telescope. This value of $11^{m}.7$ allows us to estimate the limiting magnitude for a 15-min integration time to be $15^{m}.4$ or with the 3.6 m telescope to be $18^{m}.2$ between 1.2 and 2.2 μm in the absence of source confusion.

Having discovered an infrared source near the position of an OH source, one cannot be certain that it is really the IR counterpart of the OH source due to the positional errors of the radio and optical telescopes. Hence, we began to observe 15 out of these type II OH/IR sources two years ago simultaneously or quasi-simultaneously at the 100 m telescope in Effelsberg and the 1 m ESO telescope, approximately every 6 months. What we found is not only interesting but, in one point, extremely exciting. First, there is a general correlation between flux changes in the OH lines and in the IR band. This confirms our identifications of the IR sources as the counterparts of the OH sources. Second, we can determine different phase lags between the 1612 MHz line, the 1667 MHz lines and the IR radiation and third, we have found that there is also a phase lag between the high and the low velocity components of the 1612 MHz line of about twenty days.

The simplest model is a long period variable M star which is surrounded by expanding dust and molecule shells. All changes in flux of the star caused, for example, by variations of the surface temperature arrive at the same time at the shell, if the shell has spherical symmetry (not required in a more detailed study) with the M star at the centre. The excited OH radiation, however, has different travel times to reach the observer depending on whether it comes from the front or the back sides of the shell. A phase lag of 20 days means that the radiation from the backside requires 20 days to cross to the near side and that the diameter of the OH-molecule shell has a value of $6 \cdot 10^{16}$ cm which is the first direct observational support for the value used in the calculations of Goldreich and Scoville (*Ap.J.* **205,** 144 and 384, 1976).

To determine the radius (or radii) of the shell, one has to measure the relative intensities of the two components carefully and many times during one cycle. This method also opens up the possibility of determining the distances of the sources if one combines the determination of the shell radii with interferometric determinations of the exact positions of maser points around the star. On the other hand, measurements of the energy distribution in the infrared wavelength region allow the temperature of the dust to be determined as well as the radius of the dust shell if the distance is known. By comparison of the radii of OH and dust shell, one may be able to see how the molecules and dust are distributed with respect to the star.

This example should show how valuable the combination of radio and IR measurements is.

# Photometry of OB Stars in Carina

*The spiral structure of our Galaxy has for many years been mapped by radio observations of the hydrogen 21-cm line. Similar optical observations are severely influenced by the absorbing interstellar matter in the plane of the Milky Way and we know comparatively little about the distribution of stars beyond some kiloparsecs. However, investigations of faint (and therefore mainly distant) hot OB stars in the direction of the Carina spiral arm now give a more accurate picture of this feature. Dr. Stig Wramdemark of the Lund Observatory in Sweden last year published the results of earlier observations at La Silla. He here gives an up-to-date summary of his latest observations:*

The study of the spiral structure in our own galaxy is a very difficult task, primarily because of our position near its plane. From studies of other spiral galaxies it is found that good spiral tracers (i. e. objects that outline the spiral arms) are OB stars, H II regions, long-period Cepheids, late-type supergiants and Wolf-Rayet stars. A study of these young stars in our own galaxy shows that we are situated on the inner side of a spiral arm, the Local arm. The most conspicuous arm in the northern hemisphere is the Perseus arm, situated 2–3 kpc outside the Local arm. In the southern hemisphere the Sagittarius arm is probably connected with the Carina arm. A thorough study of more than 400 OB stars brighter than $V \approx 11.5$ in Carina was made by Dr. John Graham (*Astron. J.* **75,** 703). The stars have distances between