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INFRARED EMISSION FROM OH 284.2−0.8

JAY A. FROGEL* AND S. ERIC PERSSON*
Center for Astrophysics, Harvard College Observatory and
Smithsonian Astrophysical Observatory
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ABSTRACT

OH 284.2−0.8, a strong, peculiar OH emitter, has been found to be a bright infrared source less than 4″ in diameter, and to be associated with a knot of optical nebulosity. The general appearance of the infrared energy distribution resembles that of a compact H II region, although the emission shortward of 3.5 μ is relatively blue, and may contain a contribution from reddened starlight. There is an absorption feature at 3.1 μ, but no apparent emission or absorption features near 10 or 20 μ.

Subject headings: infrared sources — interstellar matter — molecules — nebulae, individual

I. OBSERVATIONS

As part of a program of studying infrared emission from southern thermal radio continuum and molecular sources (Frogel and Persson 1974 and unpublished data), we observed the peculiar OH emitter OH 284.2−0.8. The distinctive radio properties of this source (Manchester, Goss, and Robinson 1969; Manchester, Robinson, and Goss 1970) include very wide (50 km s^{-1}), structureless 1612- and 1665-MHz line profiles of low polarization, no 1667- or 1720-MHz emission or absorption, and an upper limit to the 6-cm continuum flux density of 0.4 Jy. The purpose of this paper is to describe the unusual infrared emission which we have found to be associated with this source.

The infrared observations were carried out with the 1-m telescope at Las Campanas Observatory, Chile, in 1974 May. The observations from 1.25 to 3.5 μ were made with a PbS photoconductor, and those from 4.8 to 22.9 μ with a Ge:Ga bolometer; both systems utilized cooled focal-plane apertures and broad-band filters. We first scanned a region 5′ square centered on the OH position (Manchester *et al.* 1969) with a 1′ diameter aperture at 2.2 μ, and found only one source brighter than 0.3 Jy. Scans of a more limited region at 10 μ with a 14″.5 diameter aperture also yielded only one source brighter than 5 Jy. The positions of the infrared and molecular sources agree to within the experimental errors. The (1950.0) positions are:

$$2.2\,\mu\colon\ \alpha = 10^{h}19^{m}44^{s}.7 \pm 0^{s}.5\,,$$
$$\delta = -57°50'42'' \pm 4''\,;$$
$$10\,\mu\colon\ \alpha = 10^{h}19^{m}44^{s}.4 \pm 0^{s}.5\,,$$
$$\delta = -57°50'40'' \pm 4''\,;$$
$$\text{OH:}\ \alpha = 10^{h}19^{m}42^{s} \pm 8^{s}\,,$$
$$\delta = -57°50'.1 \pm 1'\,.$$

* Guest Investigator, Las Campanas Observatory, Carnegie Institution of Washington.

A small, diffuse knot of optical emission, visible with difficulty at the telescope, is located with a few arcsec of the infrared position. Unfortunately, no adequate photograph of the field exists.

Scans through the source in declination and right ascension at 2.2 and 10 μ were indistinguishable from those of comparison stars. We thus place an upper limit of 4″ to the diameter of OH 284.2−0.8 at these wavelengths. Additionally, since flux measurements made at 2.2 and 3.5 μ were independent of aperture for diameters from 14″.5 to 60″, we conclude that there is no obvious low-surface-brightness halo around OH 284.2−0.8.

The photometric results are displayed in figure 1, where the open circles represent the broad-band

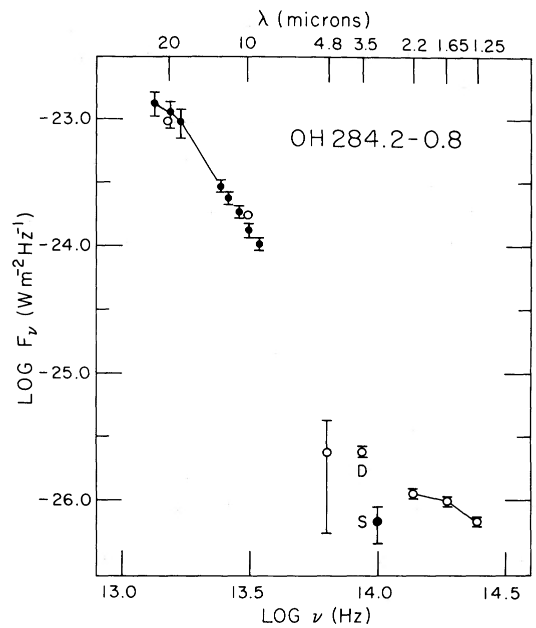

FIG. 1.—The spectral energy distribution of OH 284.2 − 0.8. The open and filled circles are broad-band and intermediate-band measurements, respectively. The letters *S* and *D* are explained in the text.

measurements. In addition, a number of intermediate band-width filters (*filled circles*) were employed to isolate various spectral features. The central wavelengths and half-power bandwidths of these latter filters are: 3.1 μ, 0.084 μ; 8.8 μ, 1.0 μ; 9.8 μ, 0.9 μ; 10.6 μ, 1.75 μ; 11.7 μ, 2.6 μ; 12.6 μ, 1.2 μ; 18.1 μ, 1.6 μ; 19.8 μ, 1.7 μ; 22.9 μ, 2.25 μ. With the exception of the 3.1-μ filter, these filters were placed immediately outside the Dewar and hence were at the ambient temperature. The 3.1-μ filter was specifically selected to study the H_2O ice band, and measurements with this filter were calibrated by smoothly interpolating between the 2.2- and 3.5-μ magnitudes of standard stars. The large errors attached to the three intermediate bandwidth points in the 20-μ region are due primarily to calibration uncertainties. For the purposes of this paper, we have assumed that η Car can be represented by a 250 K blackbody in the 18–23-μ region (Sutton, Becklin, and Neugebauer 1974), and have compared OH 284.2−0.8 directly to it.

II. DISCUSSION

The steeply rising energy distribution of OH 284.2−0.8 longward of 5 μ, a high infrared surface brightness, and a close association between an infrared and an OH source, are properties usually associated with compact infrared/H II regions (see review by Wynn-Williams and Becklin 1974). The presence of an optical emission knot and a discrete size to the infrared source are reminiscent of K3-50 (see summary of observations in Persson and Frogel 1974). The lack of any radio continuum emission would not present a problem to this interpretation, since even if all of the 2.2-μ flux arises from thermal bremsstrahlung, the upper limit to the infrared size implies that the source would be optically thick at 6 cm with $S_\nu < 0.4$ Jy, the upper limit quoted by Manchester *et al.* (1969). The distinguishing infrared characteristics of OH 284.2−0.8 are its relatively blue energy distribution shortward of 5 μ and, in particular, the combination of a deep absorption feature at 3.1 μ with the absence of such a feature at 10 or 20 μ (cf. Gillett and Forrest 1973). A convolution of the 3.1-μ filter response curve with the shape of the ice band observed in the Becklin-Neugebauer (BN) object (Gillett and Forrest 1973) shows that $\tau(3.1\ \mu)$ in OH 284.2−0.8 is nearly 3 times as large as in the BN object.

Let us suppose that the infrared source is associated with a compact H II region. For $\lambda \leq 3.5\ \mu$, the emission from such regions can be satisfactorily explained by a combination of reddened emission from ionized gas and hot dust, with perhaps a small contribution from starlight. The broad-band observations of OH 284.2−0.8 from 1.2 to 3.5 μ, however, require a large contribution from reddened starlight in order to be fitted by a combination of these mechanisms. Any such combination put forward to explain the short-wavelength data preserves the strong absorption dip indicated by the 3.1-μ observation. The presence of this absorption feature, probably due to H_2O ice, and the absence of absorption at 10 μ, is conspicuously at variance with observations of other sources in which both features are present (Gillett and Forrest 1973; Merrill and Soifer 1974). The distinct possibility exists that the lack of absorption at 10 μ is only apparent and arises from a cancellation between an absorption and an underlying emission feature (Aitken and Jones 1973; Gillett and Forrest 1973).

An ad hoc explanation of the short-wavelength data, consistent with a compact H II region model, is that all of the radiation shortward of 3.5 μ arises from a reddened, early-type star. (Note that the observed short-wavelength colors are not consistent with those of a reddened late-type star.) A comparison of the colors of O stars given by Johnson (1966) with the data of figure 1, shows that the observed [1.25 μ] − [2.2 μ] and [1.65 μ] − [2.2 μ] colors are consistent with 1.1 mag of extinction at 2.2 μ, or 12 mag in the visual, according to the Whitford law. We can then predict what the observed stellar flux at 3.5 μ should be. This quantity is indicated by the letter *S* in figure 1. The letter *D* represents the observed 3.5-μ flux minus the predicted stellar flux, i.e., the flux which presumably arises from heated dust within the H II region. The 3.5- to 20-μ energy distribution is then typical of those observed in H II regions that have no 10-μ absorption feature, while the 3.1-μ observation does not differ significantly from that which would be expected from the star. The radio continuum upper limit is again consistent with this interpretation. However, if the 1.65- and 2.2-μ radiation arises from starlight, then M_v lies between −8 and −9 for a distance between 4 and 6 kpc.

In conclusion, we have shown that a bright infrared source with distinctive properties is associated with the peculiar OH source OH 294.2−0.8. Although the infrared properties resemble those of compact H II regions, the evidence for such an interpretation is by no means compelling. Perhaps the source is another peculiar example of an infrared/OH source not associated with thermal continuum emission (Wynn-Williams, Becklin, and Neugebauer 1974; Wynn-Williams and Becklin 1974). Radio data are needed to resolve these questions.

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JAY A. FROGEL and S. ERIC PERSSON: Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138