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A NEW INFRARED SOURCE IN M17

D. E. KLEINMANN AND E. L. WRIGHT
Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory
Cambridge, Massachusetts 02138
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ABSTRACT

We have discovered a small (<10″), bright (20 f.u. at 10μ) source in the dusty, southwest part of M17. Its 10–20 μ color temperature is 200° ± 15° K and its 10-μ surface brightness is at least 10^{-8} W cm^{-2} μ^{-1} sterad^{-1}; these values are comparable to those found at the peaks of the two extended 10-μ sources previously discovered in M17.

Subject headings: infrared sources — nebulae, individual

Existing infrared maps of M17 (Kleinmann 1970, 1973; Lemke and Low 1972) show extended (~100″ diameter) sources whose position and structure agree with those found in high-frequency radio continuum maps (Schraml and Mezger 1969; Montgomery *et al.* 1971; Webster, Altenhoff, and Wink 1971). The source that we have discovered is not evident in any of these radio continuum maps; its absence from the maps of Webster *et al.* (1971) establishes an upper limit of 1 f.u. (10^{-26} W m^{-2} Hz^{-1}) for the 11-cm flux from it. It is located just outside the error box given by Johnston, Sloanaker, and Bologna (1973) for an H_2O maser.

The physical parameters and broad-band infrared fluxes of this object are given in tables 1 and 2. We have used the effective wavelengths and absolute calibrations given by Low and Rieke (1973). The 15 percent errors assigned to the fluxes in table 1 reflect the fact that the principal uncertainties are in the standardization and absolute calibration, and not in the statistics of the measurements themselves. We have presumed that the source is physically associated with M17, whose distance has been determined to be 2.1 kpc (Reifenstein *et al.* 1970). Figure 1 serves as a finding chart.

This source is outside the region previously mapped at 10 μ. It was discovered in a series of 22 right-ascension scans made on the Boyden Observatory 152-cm reflector, with a beam size of 17″ and a beam separation of 22″ in the right ascension. The scans were spaced one beamwidth apart in declination over the area between −16°09′ and −16°15′.4 and from $18^h17^m13^s$ to $18^h18^m28^s$. To a flux limit of 10 f.u. at 10 μ, this object was the only new source found in these scans, apart from the detailed structure evident in the previously discovered sources.

The present data do not allow an unambiguous determination of the nature of this new (presumably thermal) source. Such a determination will require sensitive infrared continuum, radio continuum, or radio line measurements made with high spatial resolution, good positional accuracy, and discrimination against the high background from M17. One possibility is that it is simply a 10″ diameter concentration of dust and ionized gas. In this case, it would be optically thin at 10 μ; if the dust grains are taken to have a radius $a = 0.1$ μ and an absorptive efficiency $Q = 0.005$, then the observed 10-μ brightness implies a mass in dust of 10^{-5} $M_\odot$. With this mass of dust held constant, the object could conceivably be as small as 0″.2 in diameter, where it would become optically thick at 10 μ, and unable to radiate the observed flux at the observed temperature.

It is also possible that the source is an optically thick ball of dust and neutral gas, with the outer layer of dust being heated by ultraviolet radiation from M17. The

TABLE 1

PHYSICAL PARAMETERS

α (1950.0)	$18^h17^m26.5^s \pm 0.6^s$
δ (1950.0)	$-16°14'54'' \pm 9''$
Angular size	$<10''$
10-μ surface brightness	$>10^{-8}$ W cm^{-2} μ^{-1} sterad^{-1}
10–20 μ color temperature	$200 \pm 15°$ K
Distance	2.1 kpc
Physical size	$<2 \times 10^4$ a.u.
Luminosity	1500 $L_\odot$

TABLE 2

INFRARED FLUXES

Wavelength (μ)	Magnitude	Flux (10^{-26} W m^{-2} Hz^{-1})
2.2	+6.8	1.3 ± 0.2
3.6	+4.4	5 ± 1
5.0	+3.1	9 ± 2
10.6	+0.7	20 ± 3
21	−2.4	90 ± 14

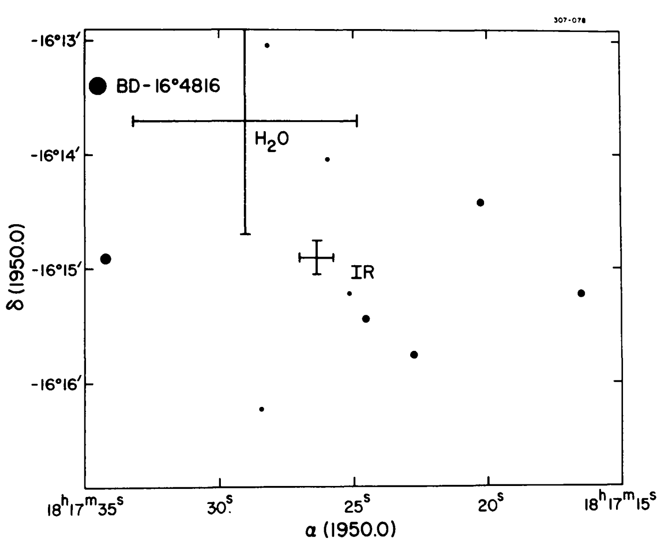

FIG. 1.—Finding chart for the new infrared source in M17. The source location is given by the cross marked IR; the cross marked H_2O denotes the position of the H_2O maser (Johnston *et al.* 1973). The filled circles represent stars whose positions are taken from plate A24224 of the Harvard plate collection and referenced to nearby stars (including BD—16°4816) in the *Smithsonian Astrophysical Observatory Star Catalog* (Staff, SAO 1966); the size of the circle reflects the brightness of the star.

infrared surface brightness and temperature of this layer are determined by the ultraviolet energy density and the relative absorption efficiency of the grains between the infrared and the ultraviolet. By using the observed 10–20 μ color temperature, and assuming that the absorptive efficiency of the grains is inversely proportional to wavelength, we obtain from this model a diameter of 2″ for the source and determine the ultraviolet energy density around it to be 10^4 eV cm^{-3}.

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