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MULTICOLOR PHOTOMETRY OF THE M DWARF PROXIMA CENTAURI

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Photometric observations of Proxima Centauri between 0.3 μ and 5 μ show that this star has an effective temperature of 2700° K, a bolometric luminosity of 6.7×10^{30} ergs sec^{-1}, and a radius of 1.3×10^{10} cm, agreeing with the calibration of the faint end of the main sequence made by Greenstein, Neugebauer, and Becklin (1970).

Key words: photometry — M dwarf star — lower main sequence

Introduction

The sun's nearest neighbor is the M5e dwarf flare star Centauri C, "Proxima," with a measured distance of 1.31 pc (van de Kamp 1971). Its proximity and flare activity make the physical parameters of this star especially interesting. Because of its late spectral type and optical line blanketing, the total power radiated by Proxima can be observationally determined only through infrared observations longward of 1 μ.

Observations

Infrared and optical observations of Proxima in its quiescent state are given in Table I and illustrated in Figure 1. All of the data were obtained on telescopes at Cerro Tololo Inter-American Observatory (CTIO). The *UBVRI* observations are averages of several observations taken over an extended period of time but none of them were made during a period of flare activity. The Smithsonian Astrophysical Observatory/Harvard College Observatory (SAO/HCO) entries are averages of two sets of observations separated in time by about ten minutes and differing by less than 5%.

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TABLE I

PHOTOMETRY OF PROXIMA CENTAURI

Band Designation	λ_{eff} (μ)	Magnitude	Flux (x $10^{15} W\ cm^{-2}\ \mu^{-1}$)
CTIO Data (16-inch telescope)			
U	0.36	14.56 ± 0.05	0.007
B	0.43	13.02 ± 0.01	0.045
V	0.54	11.05 ± 0.03	0.15
R	0.70	8.68 ± 0.03	0.6
I	0.90	6.42 ± 0.03	2.2
SAO/HCO Data (36-inch telescope)			
H	1.6	4.73 ± 0.05	1.5
K	2.2	4.40 ± 0.05	0.7
L	3.5	4.17 ± 0.10	0.15
Minnesota Data (60-inch telescope)			
K	2.3	4.6 ± 0.1	0.6
L	3.4	4.1 ± 0.1	0.17
M	4.8	4.0 ± 0.2	0.05

Discussion

Mean relations between spectral type, bolometric magnitude, effective temperature, and radius were observationally determined by Johnson (1965) for a sequence of K and M dwarfs. Greenstein, Neugebauer, and Becklin (1970) (hereinafter referred to as GNB) observed the two faintest known M dwarfs, Wolf 359 and

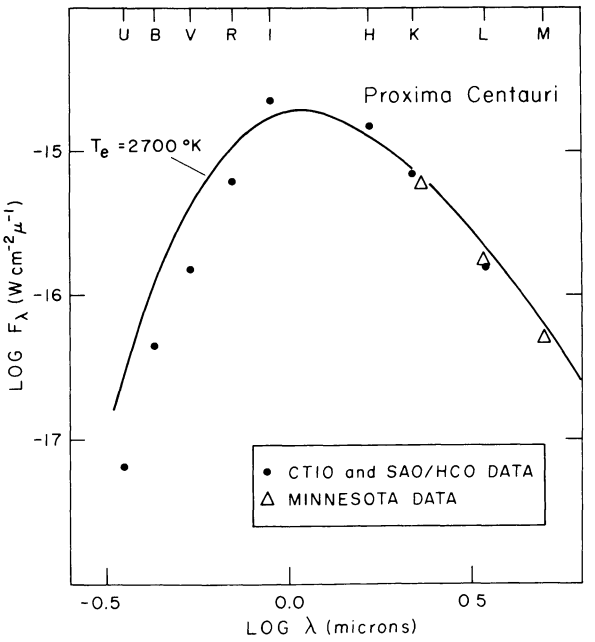

FIG. 1 — The photometric observations of Proxima Centauri together with the best-fit blackbody. The standard deviations are smaller than the symbols.

VB 10 and reanalyzed all of the extant data on M dwarfs (including Johnson's) in an attempt to recalibrate the faint end of the main sequence.

Following the method of GNB, we drew a best-fit blackbody through the points of Figure 1, subject to two constraints: (1) The areas under the blackbody and spectral energy curves must be equal, and (2) A reasonable amount of blanketing shortward of 1μ must be allowed for. The temperature so determined was used with the distance given by van de Kamp (1971) to calculate the parameters listed in Table II. For a blackbody at 2700° K, the present photometric observations span the interval in which 97% of the power is radiated.

Locating the parameters given in Table II on Figure 6 of GNB indicates that they are in good agreement with the mean relations established by GNB and that Proxima is slightly more luminous than Wolf 359. Thus, the data presented in this note are interpreted as supporting the recalibration undertaken by GNB.

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TABLE II

CALCULATED PHYSICAL PARAMETERS FOR PROXIMA CENTAURI

Effective temperature	2700^{+200}_{-150} ° K
Bolometric luminosity	$(6.7 \pm 0.7) \times 10^{30}$ ergs sec^{-1} ($\log L/L_\odot = -2.75$)
Radius	$(1.3 \pm 0.2) \times 10^{10}$ cm ($\log R/R_\odot = -0.72$)
Bolometric magnitude	+11.66
Bolometric correction	+3.80