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Bruce A. Peterson, John Middleditch
and Jerry Nelson

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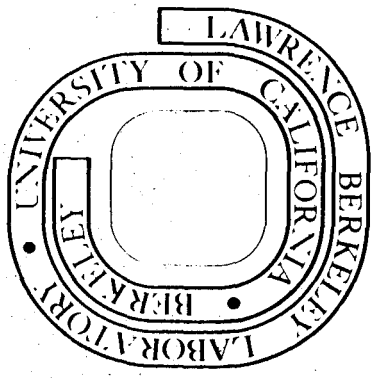

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A SEARCH FOR OPTICAL PULSATIONS FROM CENTAURUS X-3

BRUCE A. PETERSON
Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University
AND
JOHN MIDDLEDITCH AND JERRY NELSON
Lawrence Berkeley Laboratory, University of California
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ABSTRACT

No optical pulses were detected from Cen X-3 at the 0.2 percent level. The observations were made during the binary phase expected to produce optical pulses of the greatest amplitude.

Subject headings: eclipsing binaries — photometry — pulsars — X-ray sources

I. INTRODUCTION

Observations of Cen X-3 from *Uhuru* by Schreier *et al.* (1972) show that the X-ray source emits pulsed X-rays with a period of 4.842 s, and that it is eclipsed every 2.08 days. An optical identification has been made by Krzemiński (1973) with a star ($m = 13.4$) that shows small-amplitude light variations with the same period as the X-ray eclipses. From spectroscopic studies, Vidal *et al.* (1974) have found that the optical counterpart is an OB star with He II λ4686 and Hβ in emission.

Avni and Bahcall (1974) have suggested that the optical pulsations from Cen X-3 might be comparable with those from Her X-1 because the reflection effect responsible for the optical pulsations increases as the square of the pulsation period. Alternatively, the background light, from the intrinsically more luminous optical primary in the Cen X-3 system, will be relatively greater, while the effects of X-ray heating in the Cen X-3 system, because of the greater distance of the X-ray source from the optical primary, will be relatively lower. Thus if the optical pulsations were related directly to X-ray heating, the detection of optical pulsations from Cen X-3 may be expected to be more difficult.

In an attempt to maximize the probability of detecting optical pulses, we have taken most of our observations during the phases 90° ± 30° and 270° ± 30°, which have been found by Middleditch and Nelson (1973) to be the phases of the Her X-1 system when the largest-amplitude optical pulses are seen.

II. THE OBSERVATIONS

The ¾ m reflector on Mount Stromlo with a 1P21 and pulse-counting equipment was used to obtain the observations. The prescaled counts were recorded on one track while a timing signal was recorded on the other track of an analog tape recorder. This tape was then converted to a digital tape, and following Middleditch and Nelson (1973), a single Fourier transform of the entire record was computed. In this way, the maximum frequency resolution and signal recovery were obtained.

Our results are summarized in table 1. The sensitivity limits of these observations allow us to detect a pulsed

TABLE 1

CENTAURUS X-3 OBSERVATIONS

Run No.	Date (modified Julian day)	Time (UTC)	Binary Phase Cen X-3	Counts s^{-1} from Cen X-3	Duration of Run (seconds)	Upper Limits (90% confidence level) Pulsed Rate (counts s^{-1})	Pulsed Fraction	Pulsed Mag
1.....	42075 (1974 Jan 28/29)	1425–1555	110°–121°	1100	5243	2.58	2.4×10^{-3}	19.9
2.....	42076 (1974 Jan 29/30)	1406–1706	271°–293°	1100	10486	1.85	1.7×10^{-3}	20.3
3.....	42105 (1974 Feb 27/28)	1409–1709	244°–266°	900	10486	1.25	1.4×10^{-3}	20.5
4.....	42175 (1974 May 12/13)	1143–1443	30°–52°	1100	10486	1.16	1.1×10^{-3}	20.8

fraction of 0.2 percent (90% confidence). At this level, optical pulses were detected from Her X-1. However, the power within the Doppler range of Cen X-3 does not exceed the expected fluctuations in power from a noise source and thus no optical pulses were detected from Cen X-3. A similar result has been reported by Lasker (1974) from observations made during other phases.

The level of detection could be improved by a factor of $\sim$10 with a more efficient detector, a larger telescope, and longer integration time.

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JOHN MIDDLEDITCH and JERRY NELSON: Bldg. 50A 6117, L.B.L.–U.C., Berkeley, CA 94720

BRUCE A. PETERSON: Mount Stromlo and Siding Spring Observatory, Private Bag, Woden P.O., A.C.T., Australia, 2606

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