Bull. Astr. Soc. India (2002) 30, 811–813

A remote-controlled fast infrared photometer for simultaneous lunar occultation observations in K and L bands – successful observations of two M3 giants

Soumen Mondal*, T. Chandrasekhar and P.K. Kikani

Physical Research Laboratory, Ahmedabad 380 009, India

Abstract. Details of successful use of a new high speed infrared photometer for recording lunar occultation light curves simultaneously in K (2.2 μm) and L (3.6 μm) bands are presented. The photometer has also a provision to incorporate a CCD in its light path for quick monitoring and positioning of the optical/IR sources. A motorized flip mirror arrangement for 45° angular movement using stepper motor controlled drive has been put into operation. The change from optical to IR channels can also be triggered by remote control using a radio frequency transmitter-receiver system. Lunar occultation observations of two M3 giants η Gem and μ Gem in K and L bands have been successfully observed.

Keywords : lunar occultation, angular diameter, IR photometer, L-band

1. Introduction

Many of the late-type red giants, supergiants and carbon stars (T_{eff} ~ 3000 K) have circumstellar material at temperatures less than ~ 1000 K. A lunar occultation of such a star observed simultaneously in K (2.2 μm) and L (3.6 μm) bands can provide high angular resolution information on both the star and the circumstellar shell. It is important to measure multi-wavelength angular sizes of Mira variables or dusty M/C-type giants as many of these objects have complex atmospheres with wavelength-dependent opacity. Occultation observations in the IR (L-band) are still a major challenge due to the large thermal background from the telescope and sky adjacent to the Moon. In this paper we report successful simultaneous observations in K and L bands of two M3 giants, η Gem and μ Gem.

2. Instrument

The two channel fast infrared photometer essentially consists of a photometer box, a specially designed Cassegrain plate for accommodating two liquid nitrogen cooled dewars and an IR

*E-mail : soumen@prl.ernet.in

beam-splitter. The detectors are made of InSb and the filters and aperture are cooled. The beam splitter configuration permits the transmission channel in J, H and K bands and the reflection channel in L and M bands. Details of an earlier version of the instrument can be found in Mondal et al. 1999. For remote operations, using mechanical gears and a radio frequency switch a 45° flip mirror can be introduced into the light-path when necessary to divert the beam to an optical CCD. Remote operation is possible up to a distance of 15 -m from the Cassegrain end.

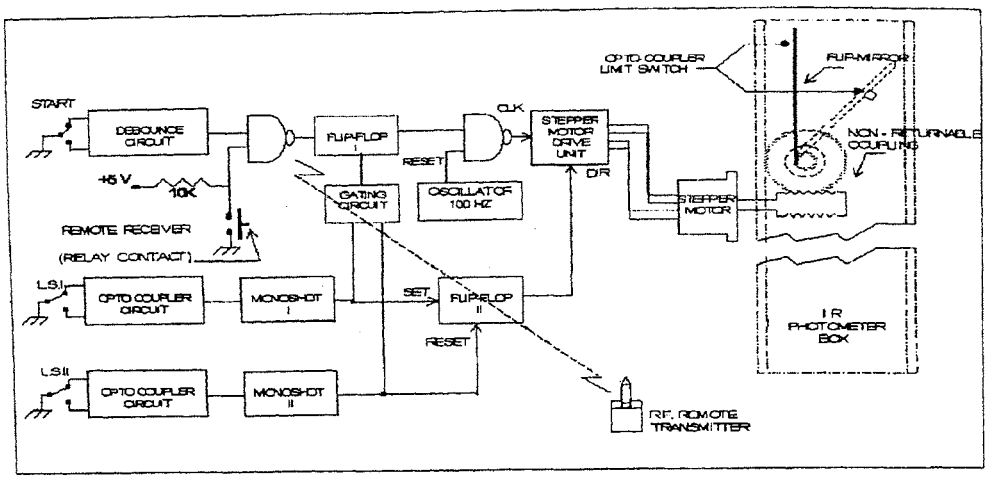

Figure 1. Block diagram of remote operation of flip-mirror using a stepper motor control drive unit and a radio frequency based transmitter and receiver.

Table 1. Circumstances of the occultation events.

Star	η Gem	μ Gem
IRC No.	20139	20144
Date	08 January 2001	04 March 2001
Event Type	Disappearance	Disappearance
Event time (UT)	$18^h\ 15^m\ 45^s$	$18^h\ 14^m\ 13^s$
Position angle (NESW)	26°	77°.35
Contact angle	60°.5	17°.6
Altitude	81°.6	41°.5
Predicted vel. comp. of Moon in the dir. of occult. (km s^{-1})	0.33	0.76
Data sampling rate	2 ms	2 ms
Filter (Bandwidth) in μm	2.2 (0.4) & 3.6 (0.6)	2.2 (0.4) & 3.6 (0.6)
Spectral class	M3 III	M3 III
$m_V : m_K : m_L$	3.32 : −1.49 : −1.60	2.91 : −1.89 : −2.03

3. Observations and analysis

The lunar occultation of two M3 giants η Gem and μ Gem were observed in K and L bands at the 1.2 m infrared telescope of Gurushikhar Observatory, Mt. Abu, India (latitude : 24° 39′ 8.8″ N, longitude : 72° 46′ 47.47″ E, altitude: 1680 m). The occultation light curves are shown in Fig. 2. The observational details are shown in Table 1.

The L band occultations could be successfully recorded only by adjusting the bias control

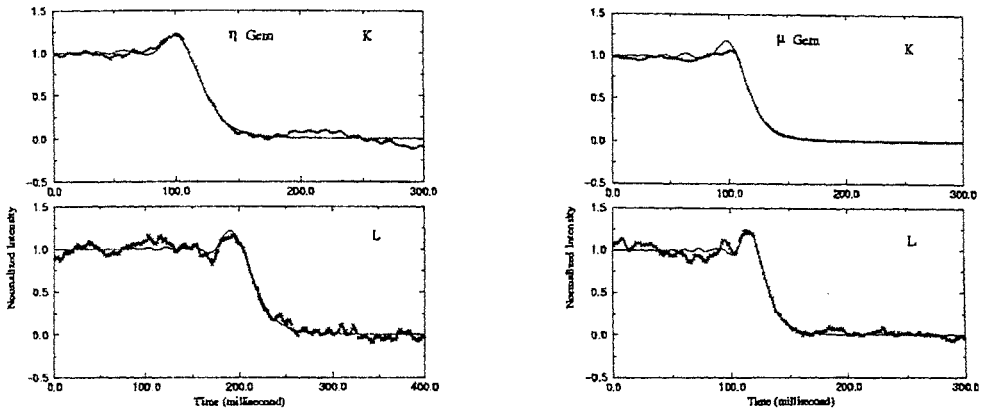

Figure 2. Lunar occultation light curves of η Gem and μ Gem in K and L filter-band.

of dewar to keep the system under saturation until a few seconds before data acquisition. It can be seen that, in contrast to K-band, L-band exhibits a large scintillation noise. Preliminary fits to the data have been made and are shown in Fig. 2. The derived uniform disk angular diameters are :

η Gem : 12.1 ± 2.0 mas (L-band)
12.8 ± 1.0 mas (K-band)

μ Gem : 13.5 ± 2.0 mas (L-band)
16.2 ± 2.0 mas (K-band)

References

Mondal S., Chandrasekhar T., Ashok N.M., Kikani P.K., 1999, BASI, 27, 335.