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A NEAR-INFRARED PHOTOMETER FOR THE LABORATORIO NACIONAL DE ASTROFISICA

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RESUMO. Foi construído um fotômetro para o infravermelho próximo, com detetor fotovoltaico de InSb. No momento dispõe-se de 2 filtros, para a banda H (1.6 μm) e K (2.2 μm). A aquisição de dados é realizada com um microcomputador tipo IBM-XT.

ABSTRACT. A near-infrared photometer has been constructed with an InSb photovoltaic detector. At present, we dispose of two filters for bands H (1.6 μm) and K (2.2 μm). The acquisition of data is made using a IBM-XT microcomputer.

Key words: INSTRUMENTS — PHOTOMETRY

I. INTRODUCTION

A near-infrared photometer has been designed to be used at the Cassegrain focus of the 1.6 m telescope of the Laboratório Nacional de Astrofísica (LNA), Brasópolis, and is now available to the community. Its construction was first motivated by the availability of a cryostat equiped with an InSb photovoltaic detector, which was purchased for the 2-micron survey of the galactic plane made with the Valinhos 60 cm telescope (Epchtein et al., 1985). In order to transform it in general purpose photometer, a beam modulation system for sky background compensation, and a convenient data acquisition system have been developped.

II. DESCRIPTION OF THE PHOTOMETER

A sketch of the photometer is shown in figure 1, and the main characteristics are displayed in table 1. The beam modulation system consists of a rotational vibrating mirror, with a position sensor behind it which provides a reference signal for synchronous detection.

The supporting box of the photometer contains a set of three mirrors adjustable in position, used to bring the image onto the detector, one of these being the vibrating mirror. A retractable mirror allows viewing the field. The cryostat is mounted on an electrically insulated base, adjustable for alignement.

The dewar is a model HD-3 from Infrared Laboratories, Inc., which has two reservoirs, both filled with liquid nitrogen in our case. The infrared radiation penetrates in it through a CAF_2 window. Two interference filters, for H (1.6 micron) and K (2.2 micron) bands, are installed on a sliding rule and can be manually exchanged. The filters, a diaphragm (usually 20 arcseconds) and a meniscus lens are cooled to liquid nitrogen temperature. The InSb detector, from Santa Barbara Research Labs., has a diameter of 2 mm and an impedance of about 2.10^2 ohms.

The unit of control of modulation allows adjustment of frequency and amplitude. When the system is properly regulated, the signal from the position sensor is a square wave. The system is also able to change the side of the comparison field after a fixed number of cycles, and to work in the "nodding" mode, in which the side of the comparison field is changed every cycle. The modulation frequency is usually adjusted to 20 Hz, and the amplitude to about 30 arcseconds in the sky.

A preamplifier fixed on the body of the dewar and provides adjustable bias to the detector. The detector output siganl is fed to an ORTEC lock-in amplifier, which also receives

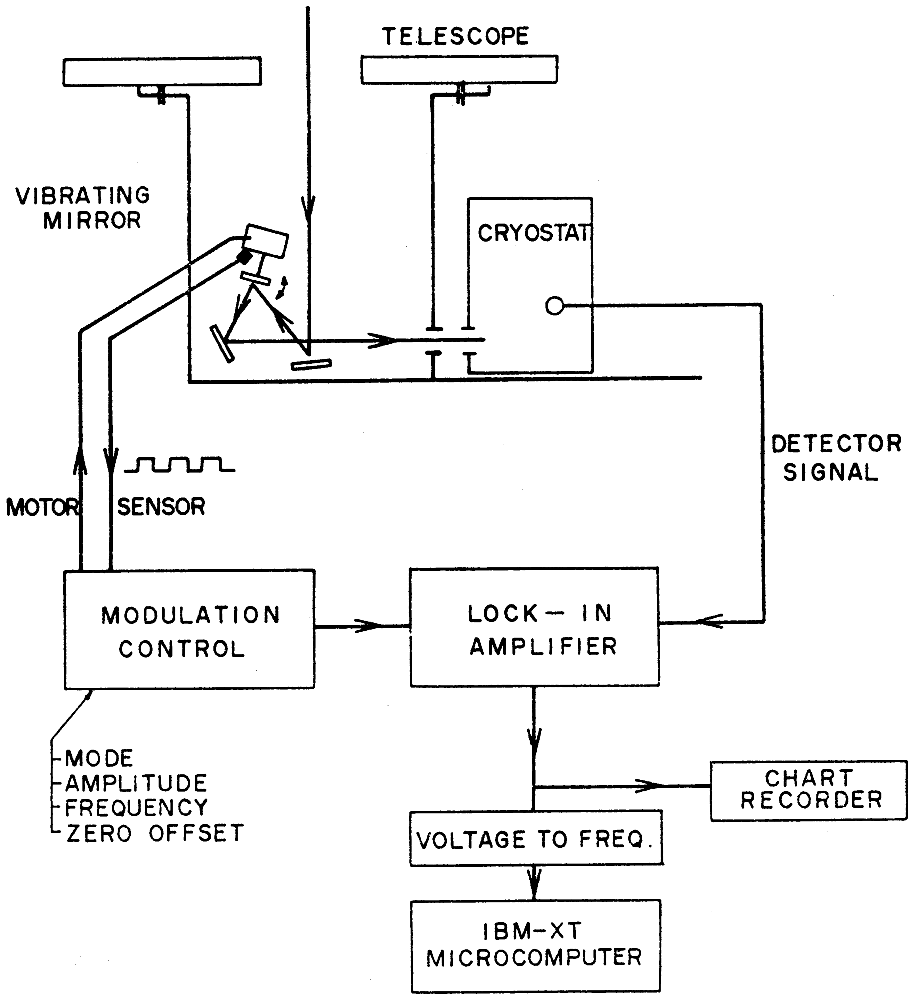

TABLE 1 - CHARACTERISTICS OF THE NEAR-INFRARED PHOTOMETER

Detector	InSb photovoltaic
Size	2 mm
Impedance	2.10^8 ohms
Dewar	Model HD-3 from Infrared Lab., Inc.
Operating Temperature	77-50 K
Filters	H (1.6 μm), K (2.2 μm)
Beam modulation	Vibrating mirror frequency and amplitude adjustable
Synchronous detection	Lock-in amplifier ORTEC
Data acquisition	IBM-AT-like microcomputer

the reference signal from the control unit. A large range of sensitivity scales can be chosed.

The output of the lock-in amplifier can be monitored with a strip chart recorder, and is also red by the data acquisition microcomputer. The analog to digital conversion is made by a voltage to frequency converter and a counter. A flexible data acquisition program has been written in Quick Basic. The results of the measurements are displayed graphically on the screen during the observations as a series of positive and negative values, related to the observing mode in which the comparison side is changed after each individual measurement (the signal from the lock-in amplifier corresponds to star minus sky, and next to sky minus star).

III. RESULTS

Standard stars for infrared photometry have been measured up to magnitude 5 in K, and stars with estimated magnitudes larger than 9 have been detected with a few minutes of integration. The sensitivity in the H band is less, by about 1-2 magnitudes. The best results have been obtained by pumping the liquid nitrogen so as to produce solid nitrogen, cooling the system down to about 50 K.

The photometer was successfully used to observe the occultation of the bright infrared star ^{28}Sgr by the rings of Saturn, on July 3, 1989. The occultation curve revealed many interesting features, which correspond to sub-structures of the rings. The results of this observation, made by Dr. J. Barroso from Observatório Nacional (Rio de Janeiro), will be reported elsewhere.

IV. CONCLUSIONS AND PROSPECTIVE DEVELOPMENTS

The infrared photometer described here is not yet the ideal instrument for general photometry of individual objects for several reasons: 1) only two filters are presently available; 2) the diaphragm cannot be changed during observation; 3) the sensivity does not correspond to the state-of-the-art. Another InSb detector with smaller diameter (0.5 mm), and consequently with larger impedance, is being purchased. A new set of filters (H, K and L) with samller diameters, will be installed on a new sliding rule. These changes will be introducec during the first semester of 1990.

For the moment, several types of observing programs can already be performed, such as surveys of areas of the sly, monitoration of variability of late-type stars, and occultations.

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