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LARGE FORMAT CCD CAMERA FOR THE KISO 105 cm SCHMIDT TELESCOPE

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ABSTRACT

A new CCD camera equipped with a large format chip is now under construction for the Kiso 105-cm Schmidt telescope. We use SITe TK2048E, of which pixel size is 24 μm and chip size is 48 mm square. TK2048E is thinned back-illuminated so that it has high sensitivity in U-band. The chip is cooled by a refrigerator instead of liquid nitrogen. MESSIA III is used as CCD control system.

Key Words : CCD camera

I. INTRODUCTION

In 1993 April, a CCD camera equipped with a TI-Japan 1024 × 1024 chip (1-k CCD camera) was made available for the Kiso 105 cm Schmidt telescope as a common use facility to outside users, including those from abroad. Since then, about 90% of the telescope time has been allocated to observations with this CCD camera. The advantage brought by equipping a large Schmidt telescope with a CCD is that a short exposure time (~several minutes) is enough to obtain deep sky-limited images due to the bright focal ratio of the Schmidt telescope. This allows us a much more effective use of the telescope time. Actually, 1-k CCD camera has produced about 48,000 frames until now. These data are archived and opened for any researcher who hope to use them after one year of privilege duration for the original observer. As for the detail of the 1-k CCD camera, see the reports appeared elsewhere (Yoshida et al., 1995, Yoshida et al., 1996).

One clear shortcoming of the CCD camera is the narrowness of its field of view (12 arc minutes square) compared with the original field of the Schmidt telescope (6 degree square). To overcome this weak point, mosaicking technique was developed by group from Department of Astronomy, University of Tokyo and National Astronomical Observatory of Japan (Sekiguchi et al. 1992). 16-elements (the chips used are also TC-215) mosaic camera was constructed and actually attached to the Schmidt telescope with satisfactory success in observation.

However, the field of view is still less than 2% of the full field of the telescope. We must arrange hundreds of TC-215 chips to obtain full field image. One may feel it impossible technically and conclude that the usage of larger CCD chip is essential.

To overcome this, we decided to construct a new CCD camera equipped with a large format chip.

II. 2-K CCD CAMERA

(a) SITe TK2048E 2048 × 2048 chip

The new CCD camera for the Kiso Schmidt telescope is equipped with a large format chip having 2,048 × 2,048 pixels, SITE TK2048E (2-k CCD chip), of which pixel size is 24 μm and chip size is 48 mm square. This size corresponds to 48 arc minutes sqare at the focal plane of the Kiso Schmidt. With this size, 30-40 chips are enough to cover the full field of the Schmidt telescope. This number of chips are well in the technical limitation for controll.

Another advantage of TK2048E is its high sensitivity in U-band wavelength region. Since 1-k CCD chip is a front-illuminated type and does not have enough quantum efficiency in wavelength shorter than 4000 Å. On the other hand, TK2048E is thinned back-illuminated and has 50% of quantum efficiency even at 3500 Å. It will make the observation in U-band quite easy and many astronomical objects will come into new targets of the Kiso Schmidt.

(b) Cryogenic

Fig. 1 shows the cryogenic for 2-k chip. The size is about 20 cm × 20 cm × 10 cm. HOYA-N50 strengthened glass of ~100 mmϕ is used as window. As camera shutter, COPAL iris type 80 mmϕ one is used. The chip is cooled by IWATANI S007 oscillation surpressed refrigerator instead of liquid nitrogen. The chip temperature goes down to -100 °C by this method.

(c) Camera Control System

We use MESSIA III, developed by Sekiguchi for general CCD control system, as a fundamental part of electronics. Also we developed additional special part (ADC/Clock driver) for TK2048E. Fig. 2 shows the control system. MESSIA III is composed of three parts: Sbus-Interface, VME-Interface, and CCD/Instruments controller. Sbus-Interface is directly attached to controlling computer (SUN Sparc workstations) and connected with VME-Interface, which is placed near de-

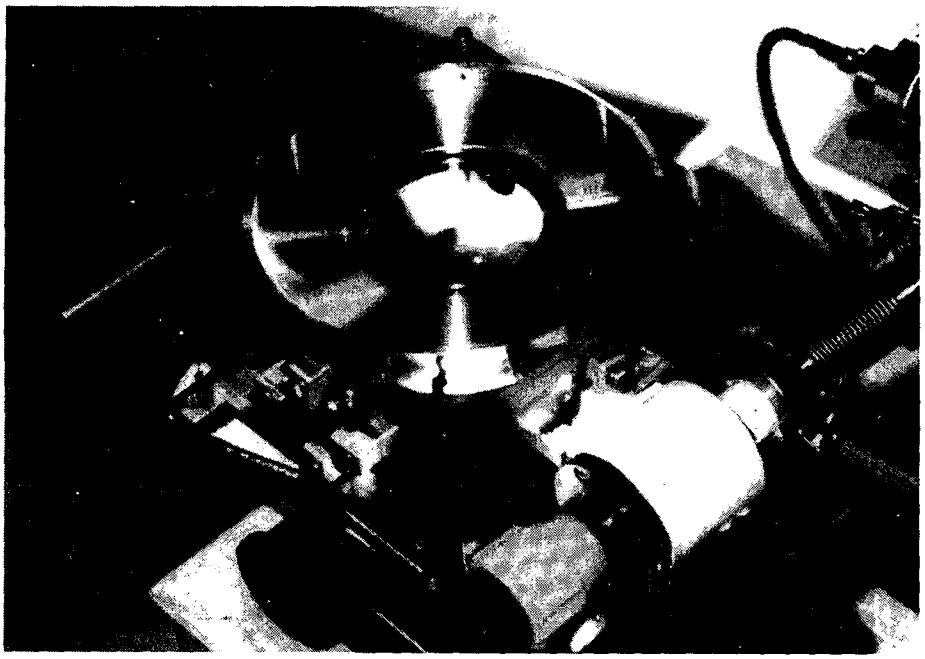

Fig. 1.— Dewar for 2048×2048 chip

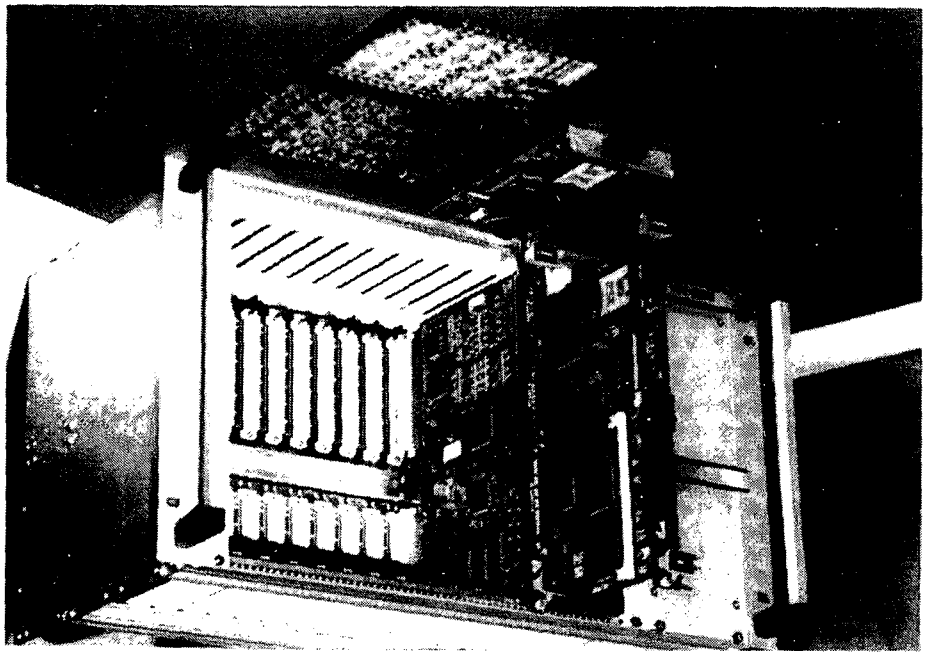

Fig. 2.— CCD control system - MESSIA III

tectors, through optical glass fiber. Usage of optical glass fiber enable high rate data transfer up to 80 Mbyte/s. CCD/Instruments controller has 32 channel clock-pattern outputs for CCD control and several I/O ports for instrument control. ADC/Clock driver has 4 ADC channels and 24 control I/O ports. Although TK2048E has only 1 read out channel, we prepared 4 ADC channels considering replace of the chip to higher grade one or mosaicing.

(d) Filter System

We have prepared standard *UBVRI* filters (10 cm square), but the mechanism to change filters are still under consideration. At first, we will use filter change system for photographic plates (for 3 filters).

Final adjustments are now going on and we will get first light image soon and make experimental observations in this autumn.

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