

INFORMATION-MEASURING AND REGISTERING SYSTEM OF AN ASTRONOMICAL POLARIMETER

A. Vid'machenko

*Main Astronomical Observatory, National Academy of Sciences of Ukraine,
Holosiwo, Kyiv-127, 03680, Ukraine*

Received September 15, 2000.

Key words: instrumentation: spectrometers, polarimeters

A cooled photometer head (PH) was built for the InGaAs photomultiplier (PM) for the astronomical two-channel spectropolarimeter (ASP) of the Main Astronomical Observatory, National Academy of Sciences of Ukraine. The “Quantakon” type PMs are sensitive in a wide wavelength range (340–1070 nm). They have narrow output pulses, and their photoreponse is high. The PH operates in the single-electron mode. It incorporates a thermal battery unit, an electronic unit and temperature isolation elements. The thermal stabilization unit is assembled out of thermal batteries which operate by the Peltier effect. The electronic unit includes a low-noise wide-band amplifier with an amplification of about 40 dB, and a pulse discriminator/former with a sensitivity of no less than 5 mV. Optical elements allow the observer to conduct measurements in four modes: photometry, spectrometry, photopolarimetry and spectropolarimetry.

The desired signal from the PM passes through the pulse discriminator and comes via an interface to a standard Advantech PCL-830 card mounted inside a personal computer. PCL-830 is a multi-function counter-timer and digital “Input/Output” add-on card for IBM PC/AT. It provides ten 16 bit up/down counters, a 1 MHz crystal oscillator timebase with divider and a general purpose 16 bit TTL input and output ports.

Two timing controller chips with micro devices AMD 9513 are used for all counting and timing functions. This card has some keyfeatures: (1) 10 independent 16 bit up/down counters; (2) 6.8 MHz maximum input frequency; (3) 1 MHz on-board timebase; (4) binary or BCD counting; (5) programmable frequency output; (6) time of day option; (7) alarm

comparators on counters of each chip; (8) complex duty cycle outputs; (9) one-shot or continuous outputs; (10) programmable count gate/source selection; (11) programmable gate function; (12) 16 bits of TTL/DTL digital input with latch; (13) 16 bits of TTL/DTL digital output; (14) jumper-selectable interrupt level. We used this card for event counting, coincidence alarms, frequency measurements, period and pulse duration measurement, time delay generation and for periodic interrupt generation.

There are 14 PCL-830 CALL functions. Each function covers a specified routine of using the PCL-830. We used some of them: F00 – initializes the PCL-830 driver routines, F01 – sets the counter mode register, F02 – multiple counter control command such as arm, load, latch and so on, F03 – loads a selected counter load register, F04 – reads a selected counter hold register, F05 – reads digital input port “DI 0-15”, F06 – writes digital output port “DO 0-15”, F07 – latches counters and store data on interrupt, F08 – returns status of interrupt, F09 – unload data from memory and transfer to array, F10 – measures frequency of up to 9 inputs, F12 – selects the number of AMD 9513 (Chip 1 or Chip 2), F13 – reads the chip number of the AMD 9513 being selected.

We developed a software in the Turbo Pascal language for controlling the operation of the ASP from the keyboard and processing the observational material in real-time mode. Laboratory investigations and trial observations of some celestial objects made with the ASP allowed us to draw the following inferences: (1) astronomical investigations in a wide wavelength range (340–1070 nm) can be conducted with a single PM, (2) the cooled PH we designed for the ASP reaches its operating conditions in a time of about 60 min; the temperature stabilized to within 0.5 deg is held over an observation period of 16 hours at least, (3) trial observations demonstrated that the electronic tract of the PH maintains the output signal linearity up to counting rates of 1500000 pulse/s.

The instrumental polarization of the “telescope + ASP” system is characterized by the Stokes parameters $Q = 0.012 \pm 0.016$ percent and $U = 0.031 \pm 0.016$ percent (obtained from the observations of α Lyr).