ON THE IMPORTANCE OF ASTRONOMICAL PHOTOMETRY OF VARIABLE STARS IN ASIAN DISTRICT

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At the Tokyo Astronomical Observatory, University of Tokyo, I am in charge of the Photometric Section, but frankly speaking, I am not the best person who can speak on this wide field of optical astronomy, because I do not know every nook and cranny of the astronomical photometry in general.

As for the photographic photometry, Prof. Takase will probably mention on his nice work with the Schmidt Camera at the Kiso Station of Tokyo Astronomical Observatory tomorrow. Prof. Ishida has already spoken on the photometric activity at the Okayama Astrophysical Station from his wide experience. Therefore, my today's talk will be concentrated on the photoelectric photometry of variable stars, mainly of eclipsing binary stars and close binary stars.

Before doing so, I would like to mention a few words about how important this kind of observations are in Asian district. Needless to say, an international cooperation is inevitable in any field of research sciences. In the astronomical photometry and spectroscopy of variable stars, however, this kind of cooperation among various countries is particularly important.

The variable star research is one of the most important branches in astronomy and astrophysics. These stars change their radiative

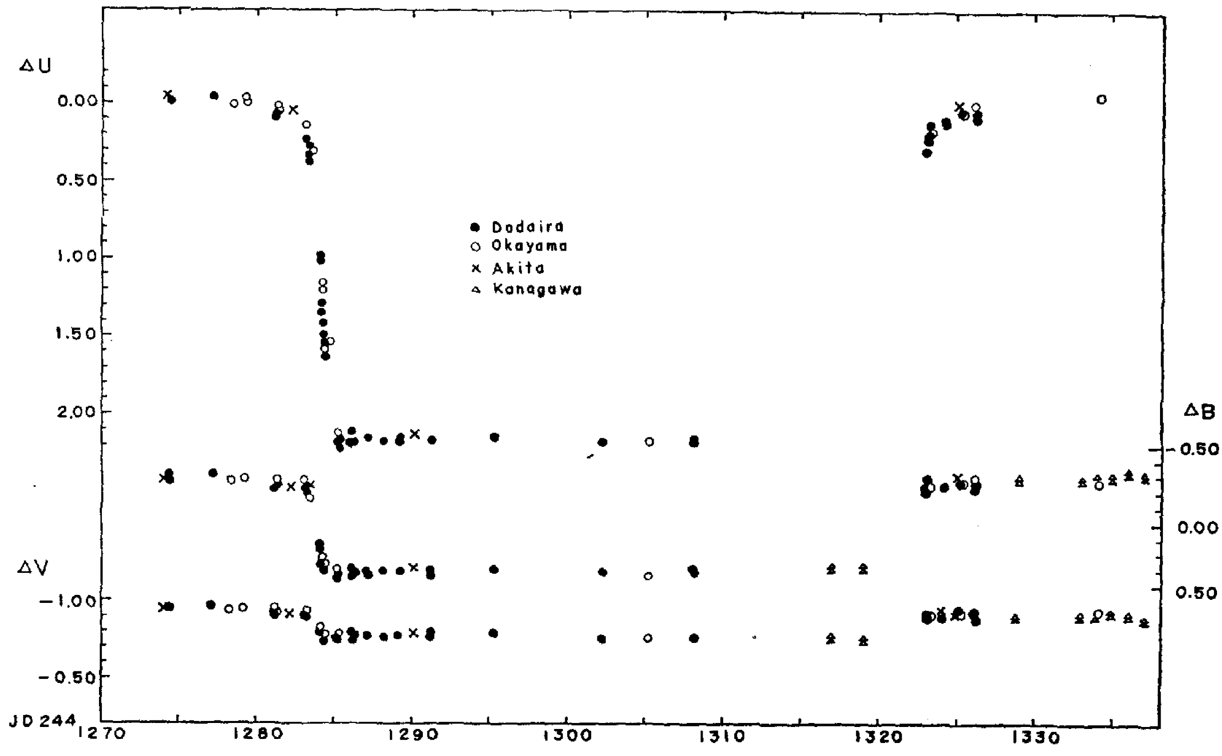

Fig. 1. Light Variations of Zeta Aurigae between JD 2441274 (November 18, 1971) and 2441337 (January 20, 1972).

intensities with time. In order to catch such variable phenomena precisely, they should be observed continuously from the earth. As our earth is rotating, various observatories in different countries must collaborate by taking over the successive observations from one observatory to another. From the geographycal point of view, Korea and Japan take important positions for successive observations of such astronomical objects. Observations in the United States must be taken over immediately by Korea or Japan because no observations could be done on the wide Pacific Ocean. If it happens that no observation was not done in the Far East at the end of such a big gap, the significance of the International Campaign of cooperative observations results in nothing or only partial.

Secondly, I would like to mention on the weather conditions in Asian district for photoelectric photometry. In the Winter season, Europe and Eastern America have not many clear nights. On the other hand, in Korea and

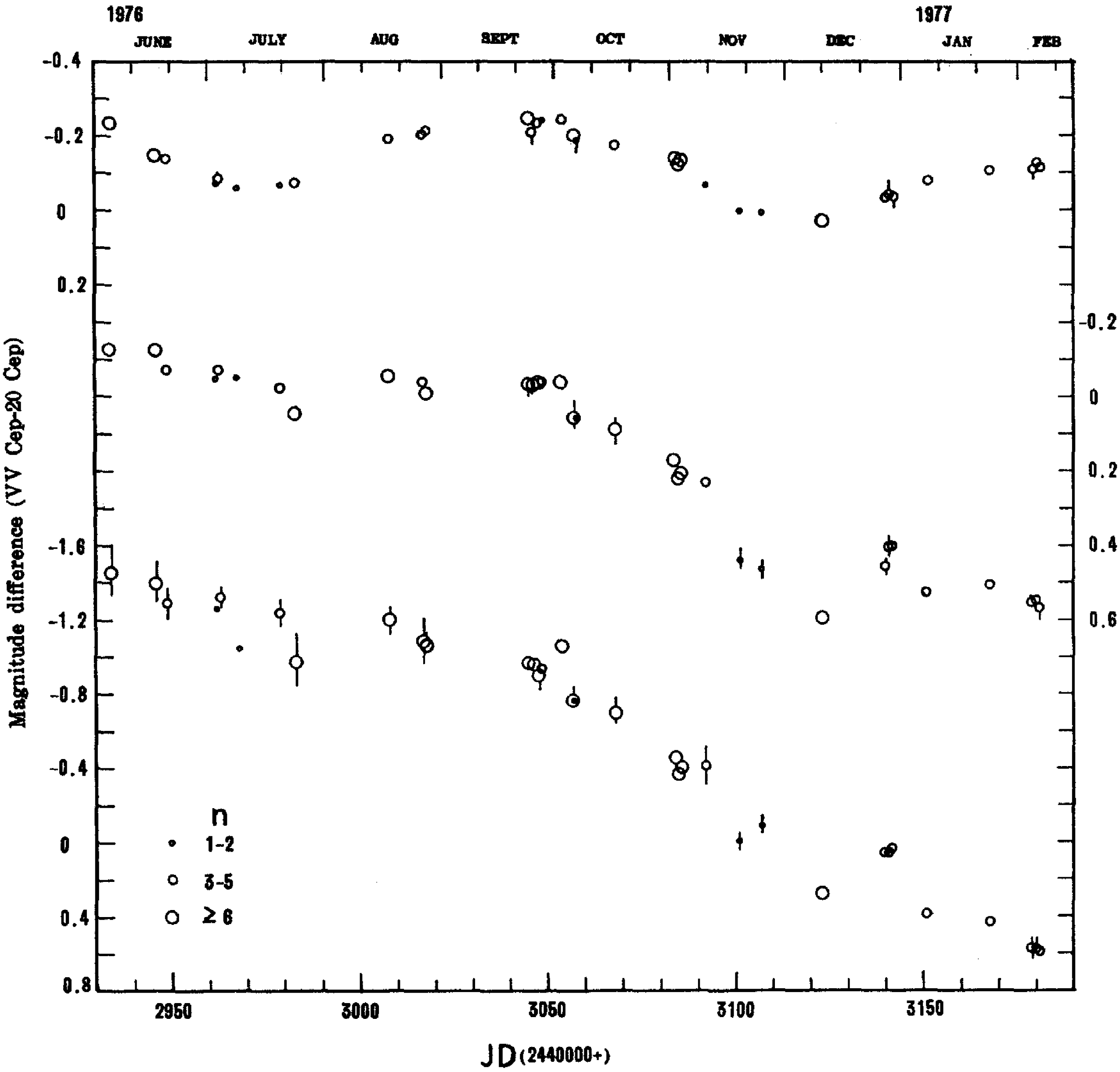

Fig. 2 Light curve of VV Cephei between June, 1976 and February, 1977. The top is for 5080 A, the middle for 4170 A and the bottom for 3500 A. The scale of ordinate for 3500 A is half the scales for 4170 A and 5080 A. The circles denote the mean values on each observation night and the bars attached represent the range of scattering of the values. The size of a circle corresponds to the number, n, of observations, as shown on the lower left of the figure.

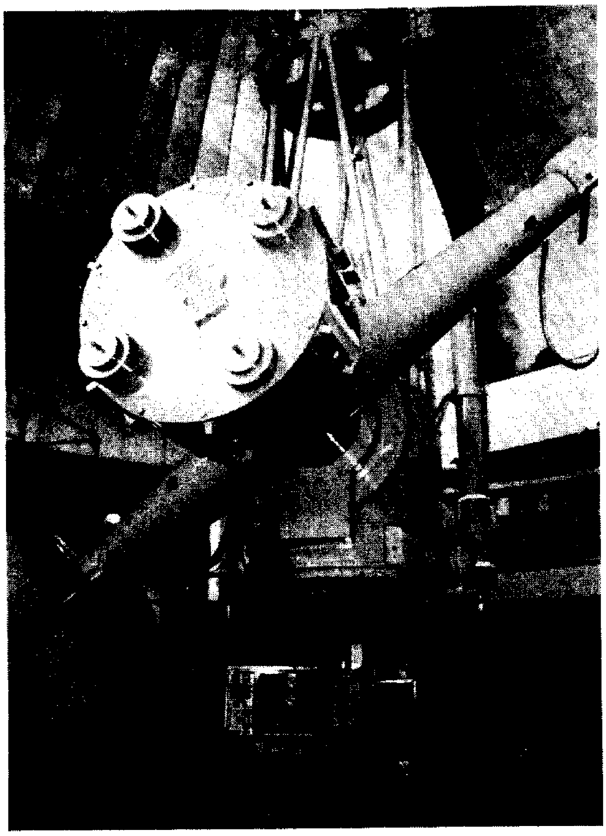

Fig. 3 Dodaira 91cm reflector

Japan, the weather in this season is much better for astronomical observations. So far as the photoelectric observations of winter objects are concerned, the role of Korean and Japanese observatories in quite large. Several years ago, the variable star Zeta Aurigae (Period = about 2.7 years) at its eclipse was elected as an object of the international campaign by the IAU. In this campaign, Japan could obtain the most necessary data but Europe and America got very few owing to the bad weather conditions there in winter.

In Japan, the observations were carried out with the 91cm reflector at the Dodaira Station of Tokyo Astronomical Observatory, the 30cm reflector at the Okayama Astrophysical Station, the 25cm reflector at Akita University (in the northern part of Honshu island) and the 20 cm refractor at the Education Centre of Kanagawa Prefecture (near Tokyo). These cooperative observations were undertaken with the purpose of covering as many phases as possible during the eclipse.

Fig. 1 shows the result of cooperative photoelectric observations of the eclipsing variable star Zeta Aurigae during its eclipse (Kitamura 1973; Kiyokawa et al 1972).

Fig. 2 shows our recent result of another cooperative photoelectric observations of the variable star VV Cephei which was selected as the object for the international campaign at the 1976 IAU General Assembly. For the observations of VV Cephei whose primary component is a supergiant M-type star, three observatories in Japan, Okayama, Dodaira and Akita, participated with three interference filters (Hayasaka et al 1977). Fig. 3 shows the main body of the Dodaira 91cm reflector equipped with the photoelectric photometer.

As the last example, I would like to introduce work of the variable star IW Persei which one of my research students, Mr. Tu-hwan Kim, is now doing. The visual magnitude of this star is about V = 5.8 and the period is 0.917 days. This was known as a close binary system, though not eclipsing, with a light variation of a small amplitude. In catalogues this variable was classified as an ellipsoidal variable which means a rotating ellipsoidal star. No UBV photoelectric observation has been done before Mr. Kim.

Mr. Kim obtained the first UBV light curve from his observations with the 91cm reflectors at Dodaira and Okayama. The amplitude of the light variation is only 0.04 magnitude. Such a small variation can be detected only by precise photoelectric observations. From this light curve, Kim deduced the distortion degree of the ellipsoidal primary component. The fainter secondary is invisible on spectrogram. Spectra of this close binary was taken by the 188cm coude reflector at Okayama and about fifty spectrograms with dispersion of 10 A/mm were secured. From the measurements of displacements of spectral lines on these spectrograms, he deduced a radial velocity curve of the visible primary component. The acutual reduction was made with the electronic computer at Tokyo Observatory. Fig. 4 shows the light curve in UBV and Fig. 5 the velocity curve.

IW Per has been also known as one of the metallic-line stars, so-called Am star. The Am star is known to be of abnormal chemical compositions. Mr. Kim measured the intensities of some characteristic absorption lines on his spectrograms and obtained the variation of line intensities with phase. The intensity of any metal line of a star should depend upon its surface

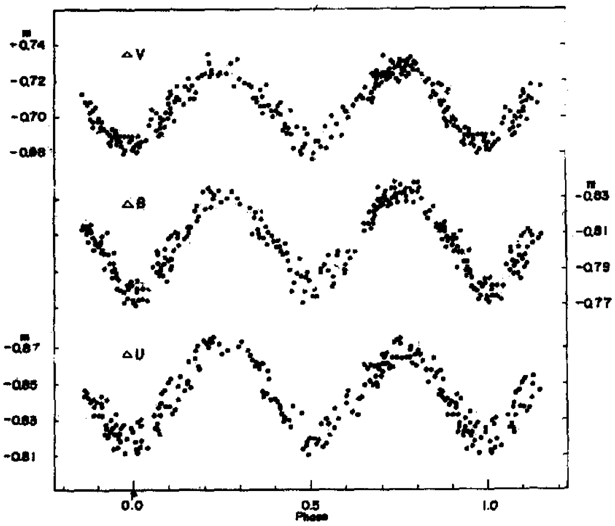

Fig. 4 UBV light curve of IW Per.

gravity. Combining this intensity variation with the already deduced distribution of surface gravity, he is doing a critical test for models for metallic-line Am stars which have been proposed by various theoreticians.

This is all of my talk today, but finally I would like to again emphasize the importance of photoelectric photometry in this country. This kind of observation can provide important information of astronomy and it can be done with any moderate-size telescope. We have a lot of variable stars, close binary stars and elipsing binary stars for which precise photoelectric data are urgently desirable. I do hope that your 24-inch new reflector at the Sobaek-San Observing Station will contribute to this field of astronomy and astrophysics. Thank You.

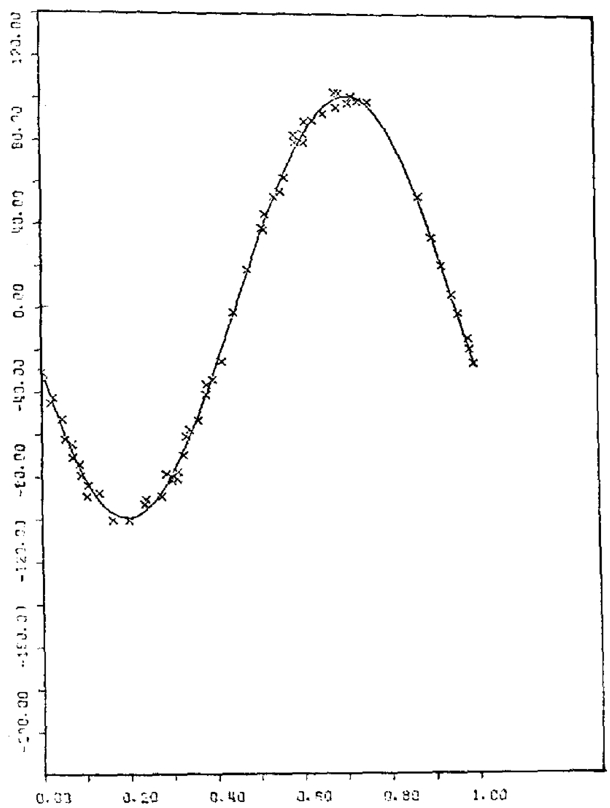

Fig. 5 Radial velocity curve of IW Per.

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