

Visual Observations of Recent Novae

by

Keiichi SAIJO

Department of Science and Engineering, National Science
Museum, Ueno Park, Tokyo 110, Japan

Abstract

Visual observations of ten well observed novae discovered since 1986 are reported from the database of VSOLJ, which contains nearly all visual observations of variable stars acquired in Japan (Saijo and Kiyota 1991). Characteristics of individual light curve of each nove are also disuccussed.

1. Introduction

Light curves of novae are classified into three types, i.e., fast nova (Na), slow nova (Nb), very slow nova (Nc), according to the decline speed of nova outburst (see *e.g.*, Payne-Gaposchkin 1957, Warner 1989). However, physical differences among these types are not fully understood yet although nova events are well understood as thermonuclear runaway processes in the surface of white dwarfs in close binary systems.

Recent studies of theoretical light curves of novae (*e.g.*, Kato 1993, Kato and Hachisu 1993) show possibility to get white dwarf mass only by nova light curves. Therefore, intensive photometric observations are need for individual nova to determine physical characteristics.

In this paper, from the database of VSOLJ (Saijo and Kiyota 1991), I report visual light curves of ten novae intensively observed since 1986, bacause van den Bergh and Younger (1987) collected UBV photometric data for 32 novae and its cutoff date is 1986 November 1.

2. Visual Observations

Accomplishment of the database managed by VSOLJ (Variable Star Observers League in Japan) for visual observation in Japan from 1910's to the end of 1990 is reported by Saijo and Kiyota (1991). After that new observations to the present time are added into this database. I use only visual observations in this database to get light curves of recent novae.

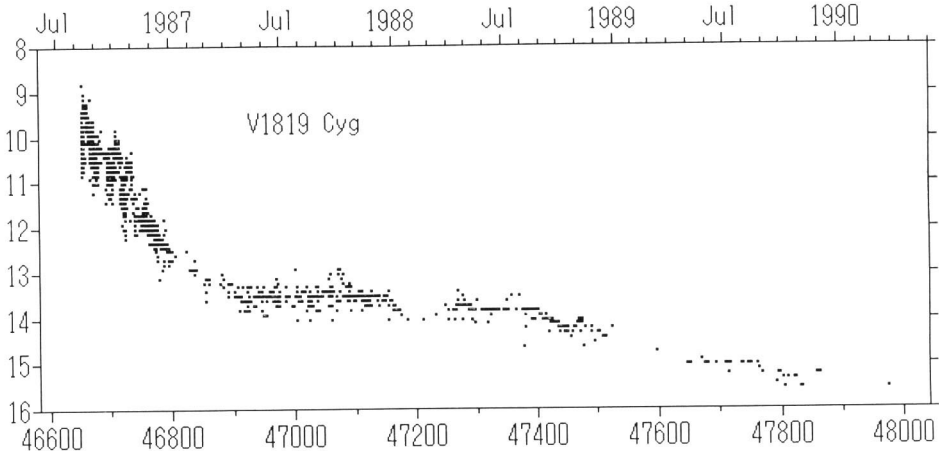


Fig. 1. Total light curve of V1819 Cyg. Ordinate shows visual magnitude, upper abscissa shows date and lower abscissa shows Julian Day minus 2400000, which are common in all figures.

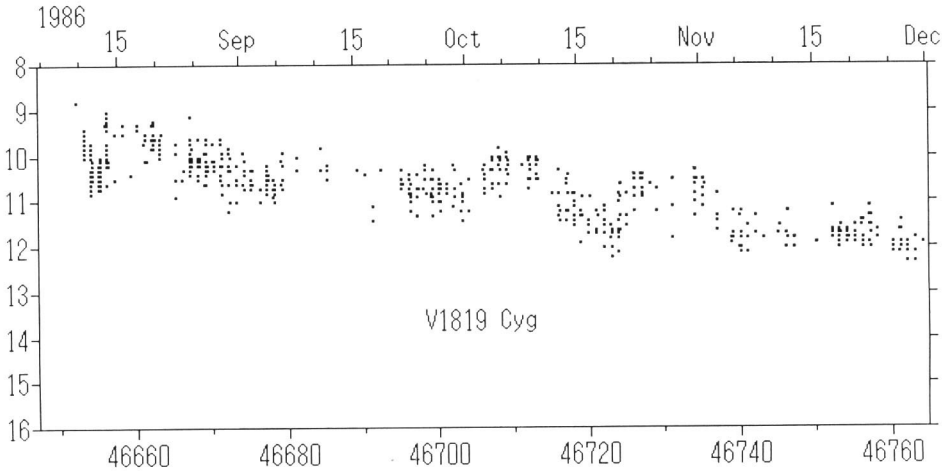


Fig. 2. Light curve of V1819 Cyg in early declining stage

3. Visual Light Curves of Novae

Van den Bergh and Younger (1987) studied empirical relations among photometric quantities of novae based on a literature search for UBV photometry. On the basis of their study, I report individual light curve and derive some quantities for each nova.

3.1. V1819 Cyg=Nova Cyg 1986

V1819 Cyg was discovered on August 4, 1986 of $m_{pg}=9.4$ (IAUC4242). Figure

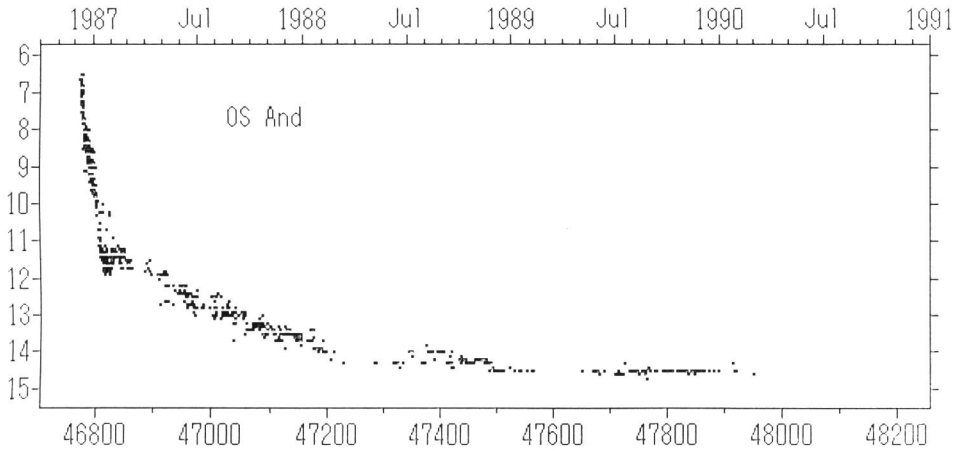


Fig. 3. Total light curve of OS And

1 shows all observations and figure 2 shows rapid light declining phase, which last for about 100d. First data of this nova in the database acquired on August 9, 1986, of magnitude 8.8. Light maximum of this nova seems around August, 8, and of visual magnitude 8.8.

Van den Bergh and Younger (1987) indicate that average of absolute visual magnitude at 15d after the light maximum of novae is $M_v(15) = -5.23 \pm 0.16$ mag. Observed visual magnitude at 15d after maximum of this nova is estimated about 10.0. Therefore, absolute visual magnitude at light maximum is estimated about -6.4 for this nova. The value of t_3 , defined as the time between the light maximum and the 3 magnitude decline below light maximum, is used to classify nova types. In this nova t_3 is estimated about 100d and indicates slow nova.

In rapid declining phase (figure 2), light fluctuation of period about 20d and of magnitude about 1 clearly shown from JD2446700 to JD 2446740 seems to be superimposed on linear light decline of about 0.017 mag/d. After JD2446850 nova magnitude shows nearly constant for 300d.

3.2. OS And=Nova And 1986

OS And was discovered on December 5, 1986 of $m_{pg} = 8.0$ (IAUC4281). Kikuchi *et al.* (1989) derived photometric properties for this nova from their own photometry and visual observation to August, 1987, using empirical relations of van den Bergh and Younger (1987). Figure 3 shows all visual data including after August, 1987. From Kikuchi *et al.* (1987), date of light maximum is December 7.5, V magnitude of that is 6.2 ± 0.1 , $t_3 = 20 \pm 1$ d, i.e. fast nova, and M_v , absolute visual magnitude at light maximum, is -7.8 ± 0.2 mag.

Light curve of OS And shows a small dip at the end of first decline phase around JD2446810 and after this it shows linear light decline of about 0.010 mag/d for 300d.

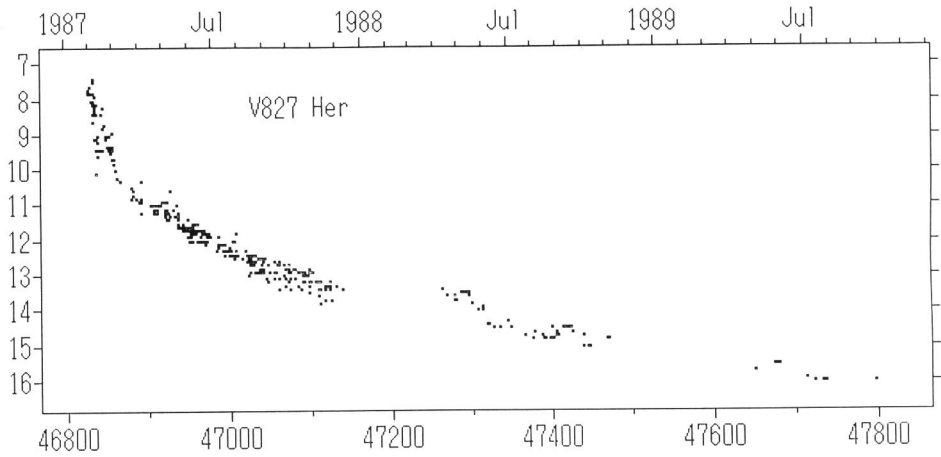


Fig. 4. Total light curve of V827 Her

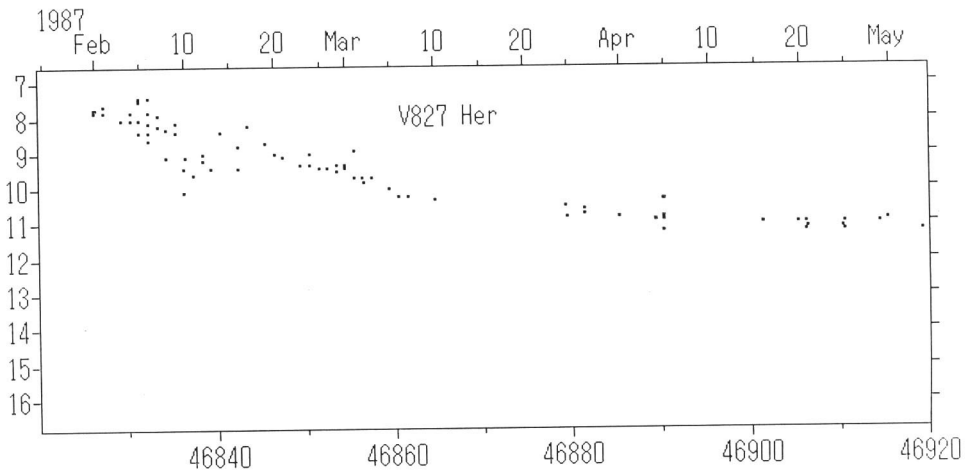


Fig. 5. Light curve of V827 Her in early declining stage

3.3 V827 Her=Nova Her 1987

V827 Her was discovered on January 25, 1987 of $m_{pg}=8.5$ (IAUC4307). Figure 4 shows all observations and figure 5 shows early declining phase of about 100d. Date of light maximum is around February 2 at visual magnitude of 7.8. After van den Bergh and Younger (1987), absolute visual magnitude at light maximum is about -6.4 and t_3 is about 80d, i.e., fast nova. Small dip of about 1 magnitude around JD2446838 is shown in the early declining phase. Linear light decline of about 0.012 mag/d is shown from JD2446860 to JD2447120.

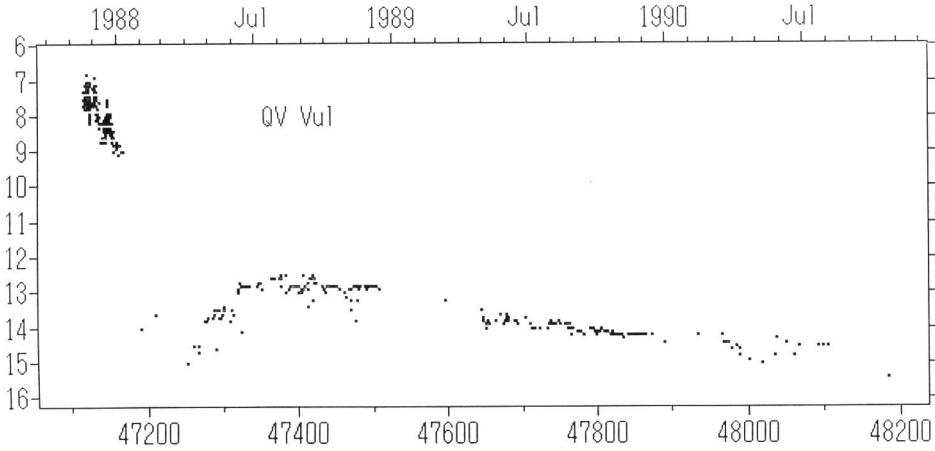


Fig. 6. Total light curve of QV Vul

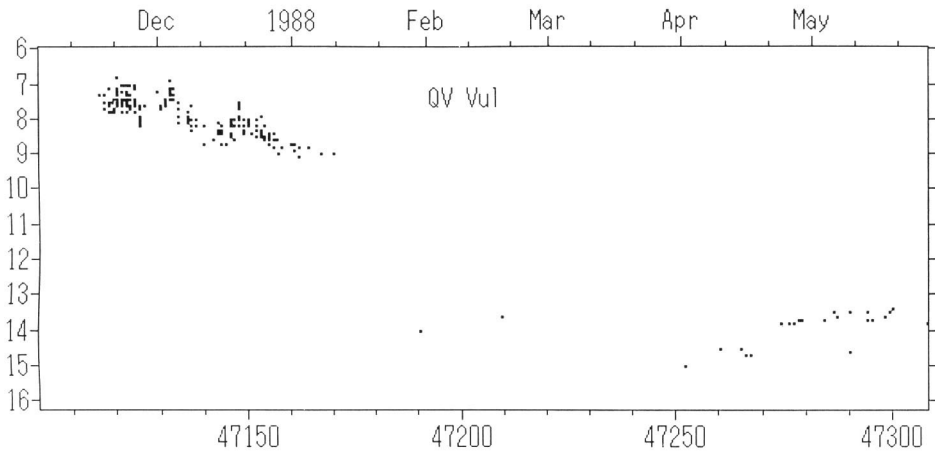
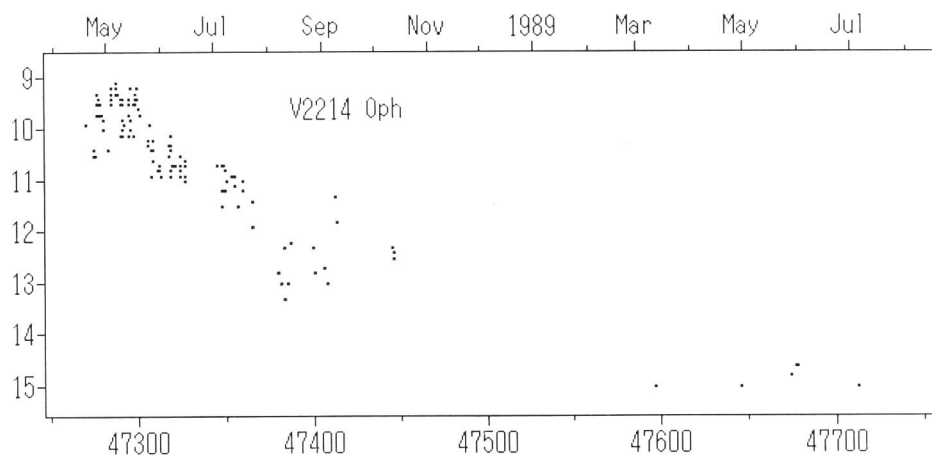


Fig. 7. Light curve of QV Vul in early declining stage

3.4 QV Vul=Nova Vul 1987

QV Vul was discovered on November 15, 1987 of $m_v=7.0$ (IAUC4488). Figure 6 shows all observations and figure 7 shows early declining phase. Date of light maximum seems to be a few days before discovery. A deep, wide light minimum disturbed an ordinary decline from January to April, 1988, but was not definitely seen by the lack of observations because of the same direction to the sun. Such a deep, wide minimum is seen light curves of many slow nova. But the value of t_3 of this nova may be less than 100d appropriate for fast nova although it shows light fluctuation of about 1 magnitude in the very early phase (to JD2447160).



[Fig. 8. Total light curve of V2214 Oph]

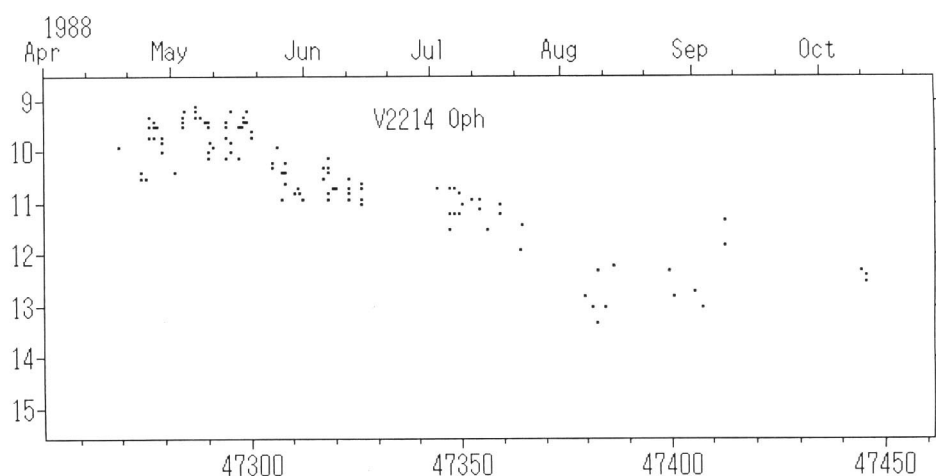


Fig. 9. Light curve of V2214 Oph in early declining stage

3.5. V2214 Oph=Nova Oph 1988

V2214 Oph was discovered on April 10, 1988 of $m_{pg}=8.5$ (IAUC4581). Figures 8 and 9 show total and early phase of light curve, respectively. Date of light maximum is around May, 2 and maximum visual magnitude is about 9.4, same as the magnitude of 15 days after light maximum. So absolute visual magnitude at light maximum is about -5.2 . The value of t_3 seems about 110d and this nova is a slow nova.

3.6. V838 Her=Nova Her 1991

V838 Her was discovered on March 24, 1991 of $m_{pg}=5.4$ (IAUC5222). According

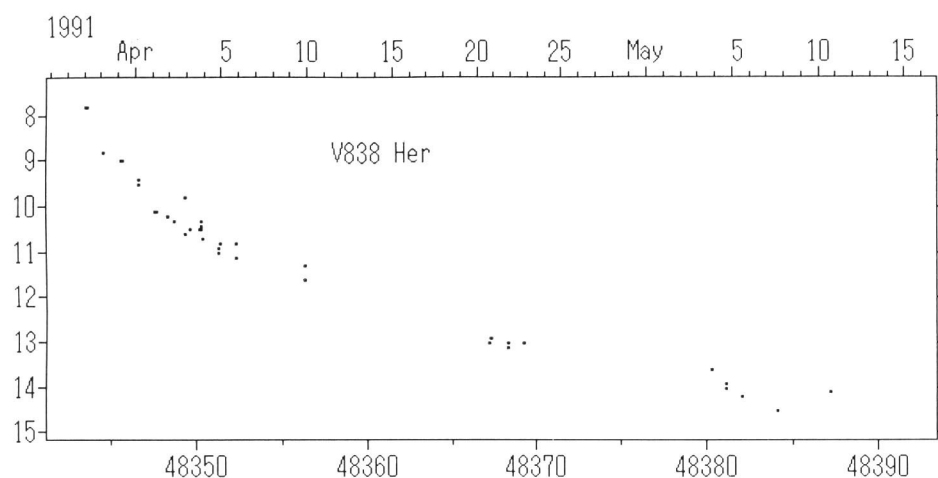


Fig. 10. Total light curve of V838 Her

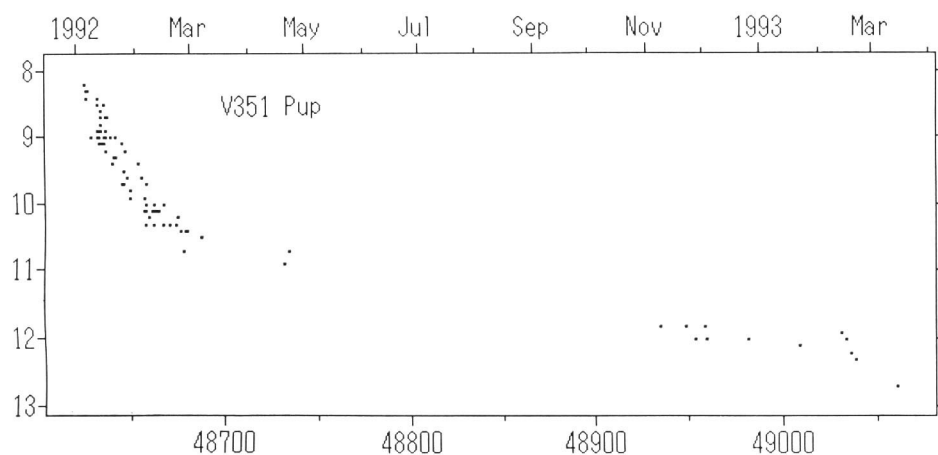


Fig. 11. Total light curve of V351 Pup

to McNaught (1991), the date of light maximum is between March 17 and March 20 and of magnitude 5.0. Visual data in figure 10 started on March 29 during rapid decline. Quick decline of brightness, $t_3 \sim 10$ d, indicate that the nova is a fast nova.

3.7. V351 Pup=Nova Pup 1992

V351 Pup was discovered on January 1, 1992 of $m=6.4$ (IAUC5422). Light curve of figure 11 indicate that this nova is a fast nova. After rapid decline, the nova showed linear light decline of very small rate, 0.005 mag/d between JD2448700 and DJ2449000.

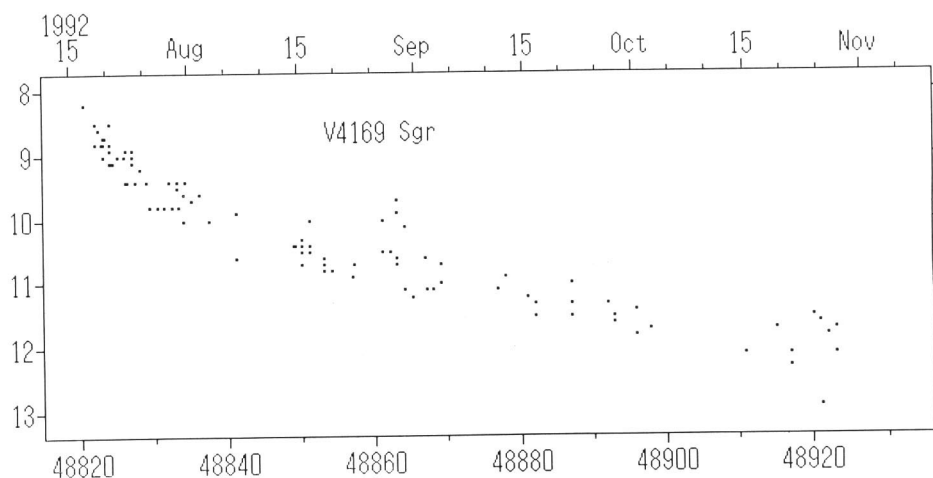


Fig. 12. Total light curve of V4169 Sgr

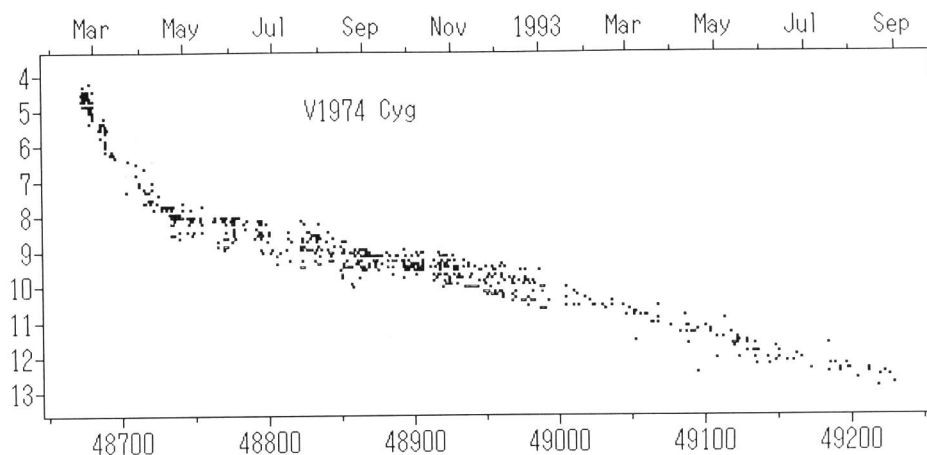


Fig. 13. Total light curve of V1974 Cyg

3.8. V4169 Sgr=Nova Sgr 1992 No. 2

V4169 Sgr was discovered on July 9, 1992 of $m_{pg}=8.5$ (IAUC5561). From the light curve of figure 12, t_3 is about 37d, which indicates that this nova is a fast nova.

3.9. V1974 Cyg=Nova Cyg 1992

V1974 Cyg was discovered on February 19, 1992 of magnitude 6.8 (IAUC5454) under the course of light increase. Figure 13 and 14 show total and early stage of light curve, respectively. It reached magnitude 4.3 on around February 22 and then it started to decline. The rate of light decline changed from about 0.1 mag/d

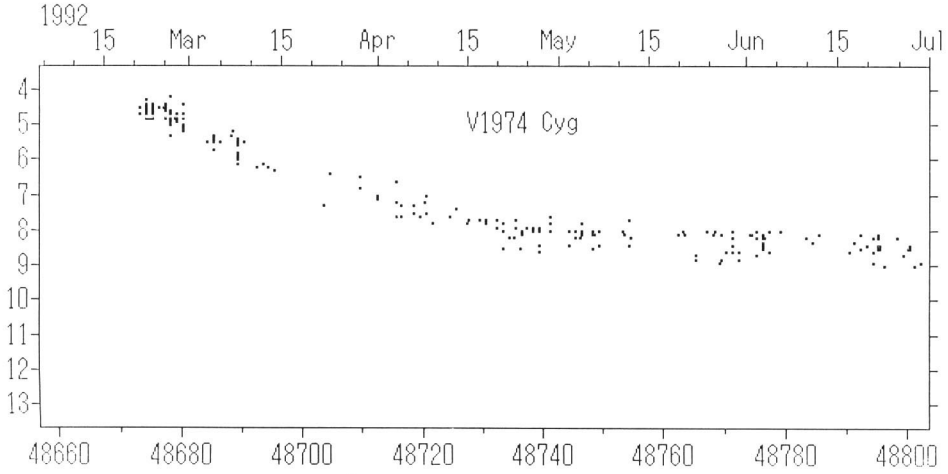


Fig. 14. Light curve of V1974 Cyg in early declining stage

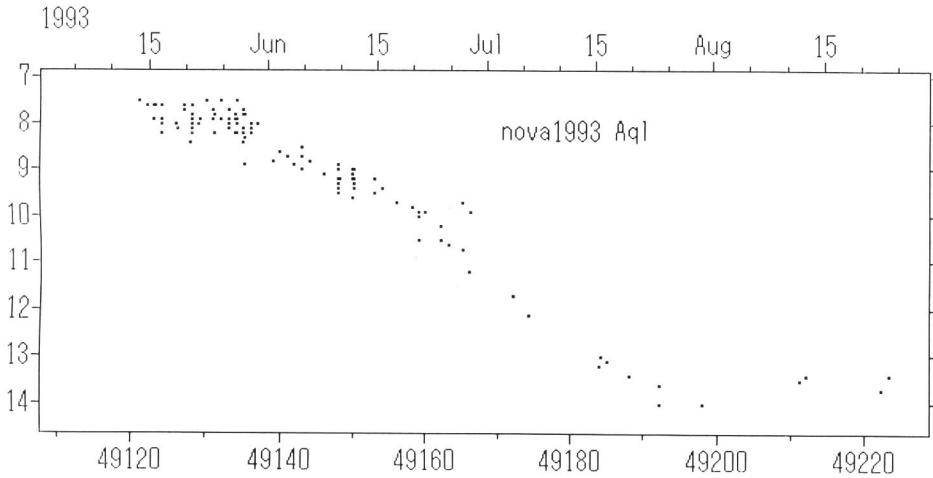


Fig. 15. Light curve of nova Aql

to about 0.01 mag/d on around JD2448720.

This nova is a fast nova, because t_3 is about 45d. Visual magnitude observed at 15 days after maximum is 5.75 ± 0.05 . Then, absolute visual magnitude at the light maximum is about -6.6 (van den Bergh and Younger 1987). The distance of this nova seem to be 1 Kpc from multicolor photometric and polarimetric observations by Saijo *et al.* (1993), whose detailes will be published elsewhere.

3.10. Nova Aql 1993

Nova Aql 1993 was discovered on May 14, 1993 at $m_{pg}=7.6$ (IAUC5791). From

figure 15, before the beginning of the early decline, the nova appeared to be a constant magnitude for a while. Although the nova seemed to be a fast nova, t_3 is about 40d, a small (1 mag), but rather wide dip was seen.

4. Summary

The characteristics of light curves of ten novae discovered in recent times are discussed. Two novae, V1819 Cyg and V2214 Oph, are slow novae, and the others are fast novae.

Acknowledgement

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Reference

- KATO, M., 1993. Private communication.
 KATO, M. and HACHISU, I., 1993. Private communication.
 KIKUCHI, S., KONDO, M., and MIKAMI, Y., 1988. Photometry and Polarimetry of Nova Aquadromeda 1986. *Publ. Astron. Soc. Japan.*, **40**, 491.
 MCNAUGHT, R. H., 1991. in *International Astronomical Union Circular (IAUC)*, No. 5222.
 PAYNE-GAPOSCHKIN, C., 1957. in *The Galactic Novae*, North-Holland, Amsterdam.
 SAIJO, K. and KIYOTA, S., 1991. Database for visual observations of variable stars in Japan. *Bull. Natn. Science Museum. Ser. E*, Vol 14. pp. 11–13.
 SAIJO, K., SATOH, H., KATO, T., HIRATA, R., SEKINE, Y., KIKUCHI, S., and OKAZAKI, A., 1993. Private communication.
 VAN DEN BERGH, S. and YOUNGER, P. F., 1987. *UBV Photometry of novae. Astron. Astrophys. Suppl.* **70**, 125.
 WARNER, B., 1989. *Properties of Novae: an overview*, in *Classical novae*. eds. Bode, M. F. and Evans, A., pp. 1–16., Willey, Chichester.