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OUTBURST OF A WZ Sge-TYPE DWARF NOVA, AL Com IN 2007

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AL Com is a WZ Sge-type dwarf nova, which is a subclass of dwarf novae characterized by very long recurrence times of outbursts. In the case of AL Com, outbursts were observed in 1892, 1941, 1961, 1965, 1974, 1975 (Bertola, 1964; Richter, 1992), 1976, 1995 (Howell et al., 1996; Kato et al., 1996; Patterson et al., 1996; Nogami et al., 1997), and 2001 (Ishioka et al., 2002). Superhumps were detected for the first time in 1995, and again in 2001. The 1961, 1965, and 1975 outbursts also lasted more than 30 days, which were probably superoutbursts (Richter, 1992). The light curve of its superoutbursts is characterized by a “dip” which suddenly interrupts a plateau phase of the superoutbursts (Bertola, 1964; Richter, 1992; Howell et al., 1996; Ishioka et al., 2002). After the dip, AL Com experienced a rebrightening. Several types of rebrightening phenomena have been observed in WZ Sge stars just after main superoutbursts (Richter, 1992; Kato et al., 2004; Uemura et al. 2007). The mechanism of them and the origin of their diversity are poorly understood. The rebrightening light curve of AL Com is characterized by a long plateau lasting more than 10 days.

Here, we report a new outburst of AL Com in October—November 2007. We performed optical and near-infrared photometry at 3 observatories. Details of our observational equipments are shown in Table 1. Using the standard procedure of image reduction and aperture photometry, we obtained magnitudes of AL Com and comparison stars from our images. As the optical comparison star we used a neighbor star located at $12^{\text{h}}32^{\text{m}}10^{\text{s}}.04$, $+14^{\circ}20'15''.3$ with the AAVSO *V*-band magnitude ($V = 13.509$, a star labeled as “AUID 000-BBS-916”¹) for the images obtained at Higashi-Hiroshima and Ilston. For the infrared data obtained at Higashi-Hiroshima we used the same comparison star with *J*-band magnitude from the 2MASS catalog ($J = 12.032$, 2MASS 12321003+1420153²). For the optical data obtained at Iowa, we used a comparison star located at $12^{\text{h}}32^{\text{m}}05^{\text{s}}.30$ $+14^{\circ}23'34''.0$ with the R_c -band magnitude presented in Skiff (2007) ($R_c = 13.09$, labeled as “NGC 4501 11”).

¹<http://www.aavso.org/>

²<http://www.ipac.caltech.edu/2mass/>

Figure 1 shows the optical light curve of the outburst. While our observations are rather sparse due to a bad seasonal condition, the feature of the light curve is reminiscent of the past superoutbursts in 1995 and 2001; a main superoutburst until JD 2454405 and a subsequent rebrightening phase until about JD 2454425. We, hence, propose that this outburst is a superoutburst. On the basis of the latest 3 superoutbursts, the supercycle of AL Com is calculated to be ~ 6 yr. This is the shortest among WZ Sge stars (Kato et al., 2004), while the stability of the cycle should be checked by a long monitoring in the future.

A noteworthy feature of the 2007 superoutburst is the behavior during the rebrightening phase. As can be seen in Figure 1, the magnitude apparently oscillates in a range of $V = 16.2$ – 15.2 mag between JD 2454410 and 2454421. A clear short flare was, furthermore, observed on JD 2454425, just before the final fading stage. These large amplitude variations were not seen during the past rebrightenings of AL Com, in which the object exhibited only low amplitude (~ 0.1 mag) superhumps (Nogami et al., 1997). The lower panel of Figure 1 presents the $V - J$ color variation. The color became bluer when the object was brighter. This is a typical behavior of dwarf nova outbursts, suggesting an appearance and disappearance of a hot, optically-thick accretion disk. We note that the $V - J$ color is atypically red during the rebrightening phase, compared with typical colors at the maximum of dwarf nova outbursts ($V - J \sim 0$).

In order to find possible superhumps, we performed time-series observations during the rebrightening phase. The light curves are shown in Figure 2. The figure contains 4 sets of light curves, in each the left panel includes all observations and the right panel is a phase-averaged light curve using the superhump period of 0.05722 d (Kato et al., 1995). As can be seen in these figures, we cannot find significant periodic variation having amplitudes larger than ~ 0.1 mag. The observed large oscillation is, hence, not attributed to superhumps. In conjunction with the color behavior, we conclude that the apparent oscillation is a sign of repetitive short rebrightenings with a cycle of 1–2 days, as observed in WZ Sge (Patterson et al., 2002).

As mentioned above, it is unclear what determines the rebrightening types in WZ Sge stars. In this paper, we revealed that AL Com exhibits not only long plateau type rebrightenings, but also short repetitive ones. This is the second case that different rebrightening behaviors were unambiguously observed in a WZ Sge star; WZ Sge itself exhibited no major rebrightening in the 1946 superoutburst, while short repetitive rebrightenings were observed in the 1978 and 2001 superoutbursts (Patterson et al., 1981). EG Cnc also experienced a hint of different types of rebrightenings (Kato et al., 2004). These facts indicate that the type of rebrightenings depends not directly on the physical parameters of the binaries and their components, for example, mass ratios or the strength of magnetic fields, but on the mass-accretion process of the outburst.

Table 1. Details of instruments used for our observations.

Site	Telescope	Camera	Filter	Exposure time (sec)
Higashi-Hiroshima	1.5-m (KANATA)	TRISPEC	V, J	63(V), 60(J)
Ilston	35-cm	SXVF-H16	no filter	30
Iowa	37-cm (Rigel)	FLI SITE-003	no filter	25

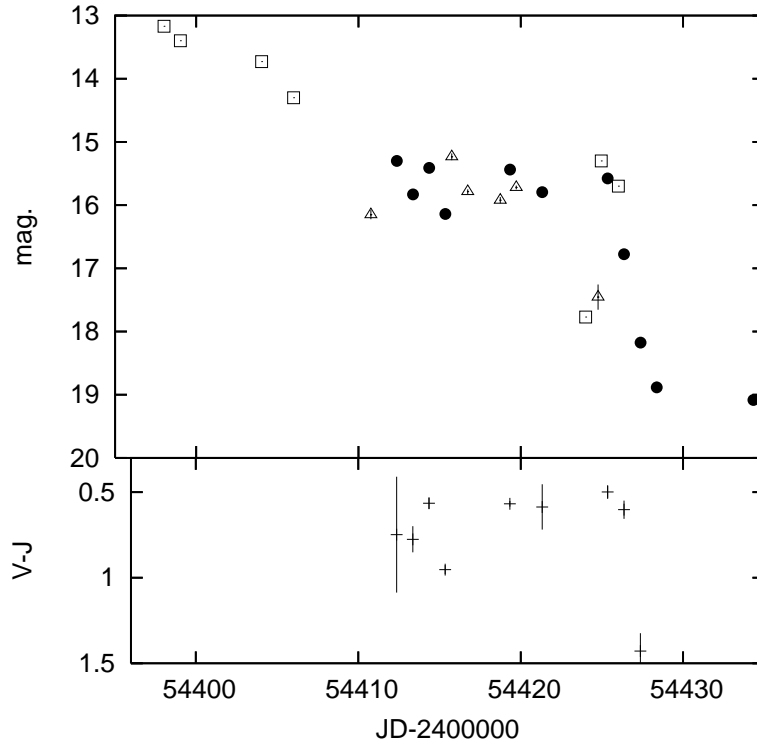


Figure 1. Upper panel: Light curve of the 2007 superoutburst of AL Com. The abscissa and ordinate denote the time in JD and the magnitude, respectively. The filled circles are V -magnitudes obtained at Higashi-Hiroshima. The open triangles and squares indicate unfiltered CCD observation at Ilston and Iowa. The magnitudes of Ilston’s data were calculated by adding the V -magnitude of the comparison star ($V = 13.509$) to its differential magnitudes. Those of Iowa’s data were calculated by adding the R_c -magnitude of the comparison ($R_c = 13.09$) to its differential magnitudes. Errors of the magnitudes are indicated as vertical bars, while most of errors are smaller than the symbol size. Lower panel: Color variations. The ordinate denotes $V - J$.

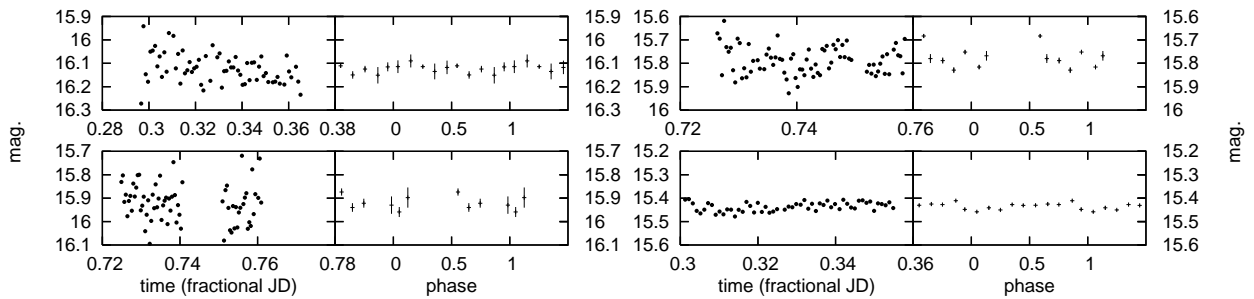


Figure 2. Time-series light curves during the rebrightening phase. Observations were performed on JD 2454415 (upper left), 2454416 (upper right), 2454418 (lower left), and 2454419 (lower right). Each panel contains two light curves; the left ones show all data points and the right ones are phase-averaged light curves folded by the superhump period of 0.05722 d (Kato, et al., 1995).

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