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HD 194378 – A NEW ECLIPSING BINARY IN THE OPEN CLUSTER M 29(= NGC 6913)

We carried out time-series CCD photometry of M 29 for five nights from August 12 to September 13, 1994. The observations were made with a Photometrics PM512 CCD camera and Johnson V filter, which were attached to the 61cm Ritchey–Chrétien telescope at Seoul National University Observatory (SNUO). The size of the field in the CCD image is $8\farcm1 \times 8\farcm1$ (0.945 arcsec pixel^{-1}) at the f/7 Cassegrain focus of the telescope. The exposure time and the duty cycle were 30 sec and 75 sec, respectively. The photometric seeing was typically $4\farcs5$ during the observation period. The finding chart is shown in Figure 1. We monitored 178 stars of M 29, dividing into four fields.

The preprocessing of CCD images was made with the IRAF/CCDRED package. Defective pixels of our CCD chip (Sung 1995) were corrected and the trimming of unreliable subsection was applied. Then, we proceeded with the bias, dark and flat field corrections. We adopted simple aperture photometry to obtain instrumental magnitudes, using the IRAF/APPHOT package (Massey & Davis, 1992). Total probable errors are estimated to be about 7.6 mmag for $9\fm0 \sim 10\fm0$ stars.

We applied the classical two-star differential photometry to get standard magnitudes. Instrumental magnitudes were scaled comparing with the comparison star (HD 229239, No.4 in Figure 1) as follows;

$$V_i = v_i + (V_4 - v_4)$$

where v_i is the instrumental magnitude of the i-th star and the magnitude of the comparison star, V_4=8.927, was calculated from previously known values (Mermilliod 1986). It corresponds to the standard magnitude if the difference of the color correction term between the comparison star and the others, $\alpha_V \times \Delta(B-V)$, is negligible; the color coefficient, α_V, of our filter system is nearly zero (Sung 1995) and the color difference between the stars is mostly smaller than $0\fm5$.

Table 1. Photometric properties of observed stars

ID_{OURS}	$ID^{\dagger}_{S73}$	Star Name	V‡	B−V‡	U−B‡	Remark
1	135	HD 194378	8.58	0.41	0.06	Variable star
2	157	HD 229238	8.88	0.88	−0.11	Check star
3	149	HD 229234	8.91	0.75	−0.24	Check star
4	159	HD 229239	8.99	0.82	−0.18	Comparison star

† : Sanders, 1973 ‡ : Massey *et al.* (1995)

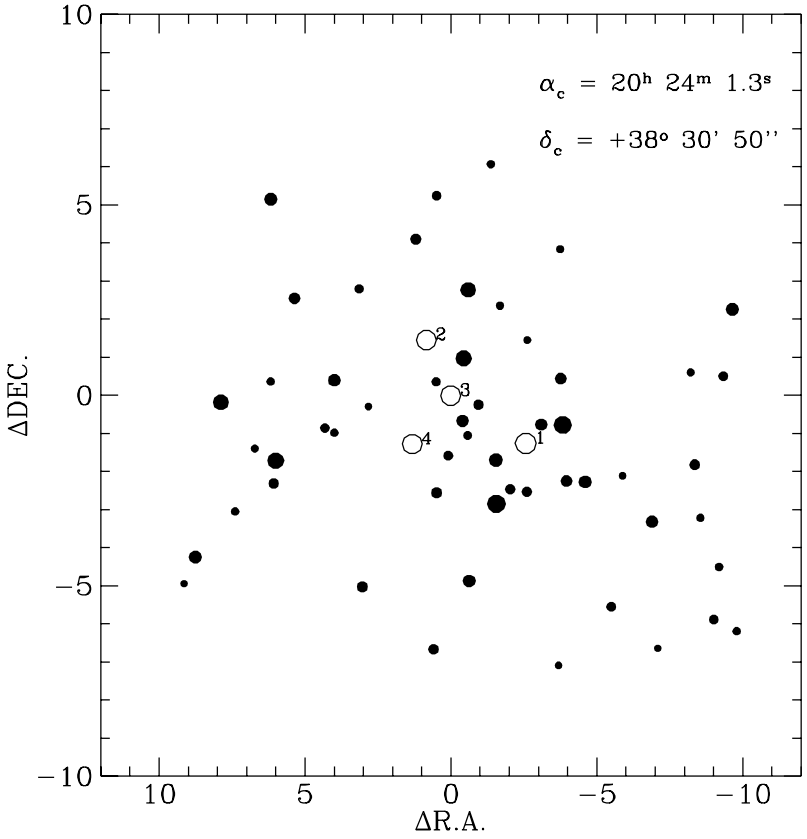

Figure 1. Finding chart of M 29. The new eclipsing binary (1) and three comparison stars (2,3,4) are denoted as open circles.

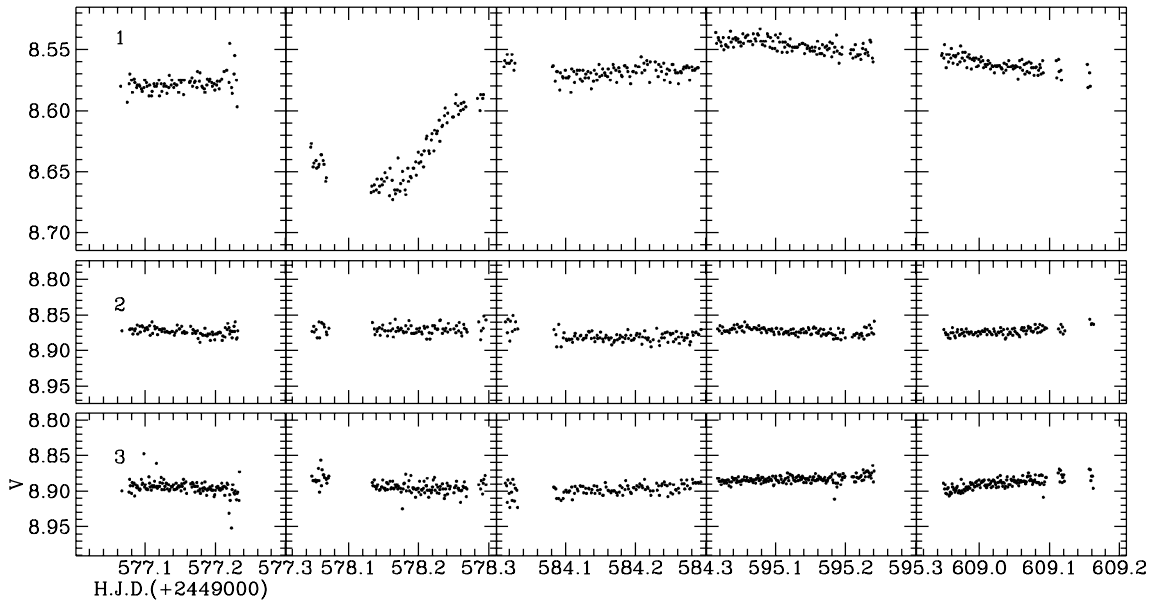

Figure 2. Light variations of HD 194378 and two check stars.

HD 194378 has a high value (79%) of membership probability, which was deduced from the proper motion (Sanders 1973). But it does not locate in the normal evolution sequence at the C-M diagram, indicating that it is a evolutionary peculiar star (Joshi *et al.* 1983) or a non-member star (Crawford & Barnes 1977). From the radial velocity measurements, it was known as a spectroscopic binary (Liu *et al.* 1989). We detected clearly its light variation for one night (J.D. 2449578.0). Its light curves (Figure 2) are similar to that of an Algol-type eclipsing binary (Hoffmeister *et al.*, 1985). Though it is the brightest star in M 29, its light variation has not been reported so far (Kholopov *et al.*, 1985–1988). Our observations suggest that it is an eclipsing binary with a minimum brightness near HJD 2449578.13, and an amplitude of at least $0^{m}.12$.

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