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DISCOVERY OF FOUR CLOSE BINARY STARS IN SAGITTARIUS

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This Note is the second in a series of Notes where we report new variable stars discovered during our extensive CCD monitoring program of the black hole binary V4641 Sgr (SAX J1819.3-2525) (Orosz et al., 2001). In this Note we report on the discovery of four close binary stars (i.e. binaries where the radius of one or both stars is a substantial fraction of the orbital separation).

The reader is referred to our first Note (Gieles et al., 2002) for a complete discussion of the telescopes and data reduction techniques used. Briefly, CCD observations in the U, B, V, R, and I filters were collected between July 2000 and October 2001 using 4 different 1m class telescopes. We have the light curves of about 15 000 stars in a $9' \times 9'$ field. We searched for variables by comparing the standard deviation σ of the light curves and by computing the maximum power in a Lomb-Scargle periodogram (Lomb 1976, Scargle 1982) for each star. These two techniques are well suited for finding either large amplitude variables (these have large values of σ) or smaller amplitude periodic variables (these have large L-S power). Although it is difficult to be quantitative about our completeness for finding variables, we believe our completeness is reasonably high.

Table 1. Photometric data.

Coordinates (J2000)	V	average $V-I$	period (days)	Type of variable
18:19:24.8 −25:24:56.6	$17.5-18.1$	0.82	0.3668	ellipsoidal
18:19:00.9 −25:24:12.1	$14.6-14.8$	1.22	77.0	ellipsoidal
18:19:07.8 −25:27:15.0	$15.8-15.2$	0.85	0.464	W UMa
18:19:24.4 −25:25:53.5	$16.4-18.1$	0.75	0.8273	Algol

We found four stars which are close binary stars. Table 1 gives an overview of the photometric information of the four sources identified. Figs. 1 to 4 show the light curves for each source in different bands. Figs. 5 to 8 show the finding charts for each source. As in our previous Note, the names of the stars are based on their coordinates in equinox

2000 and are given the prefix YALO since most of the variables were discovered with the data of the YALO telescope (Bailyn et al. 1999). None of these sources appear in SIMBAD.

The light curves of YALO J181924.8-252457 and YALO J181900.9-252412 give a strong suggestion that these sources are close binaries where at least one star (nearly) fills its Roche lobe. Since YALO J181900.9-252412 has a relatively long period of 77 days, the star which dominates the light is probably a K giant as it is in the well-known binary 5 Ceti (Eaton and Barden 1988).

YALO J181907.8-252715 is most probably a W UMa type binary (Moss and Whelan, 1970) in which both star overfill their Roche lobes. The two stars probably have nearly the same temperature since the minima are of nearly equal depth.

YALO J181924.4-252554 is most probably an Algol variable.

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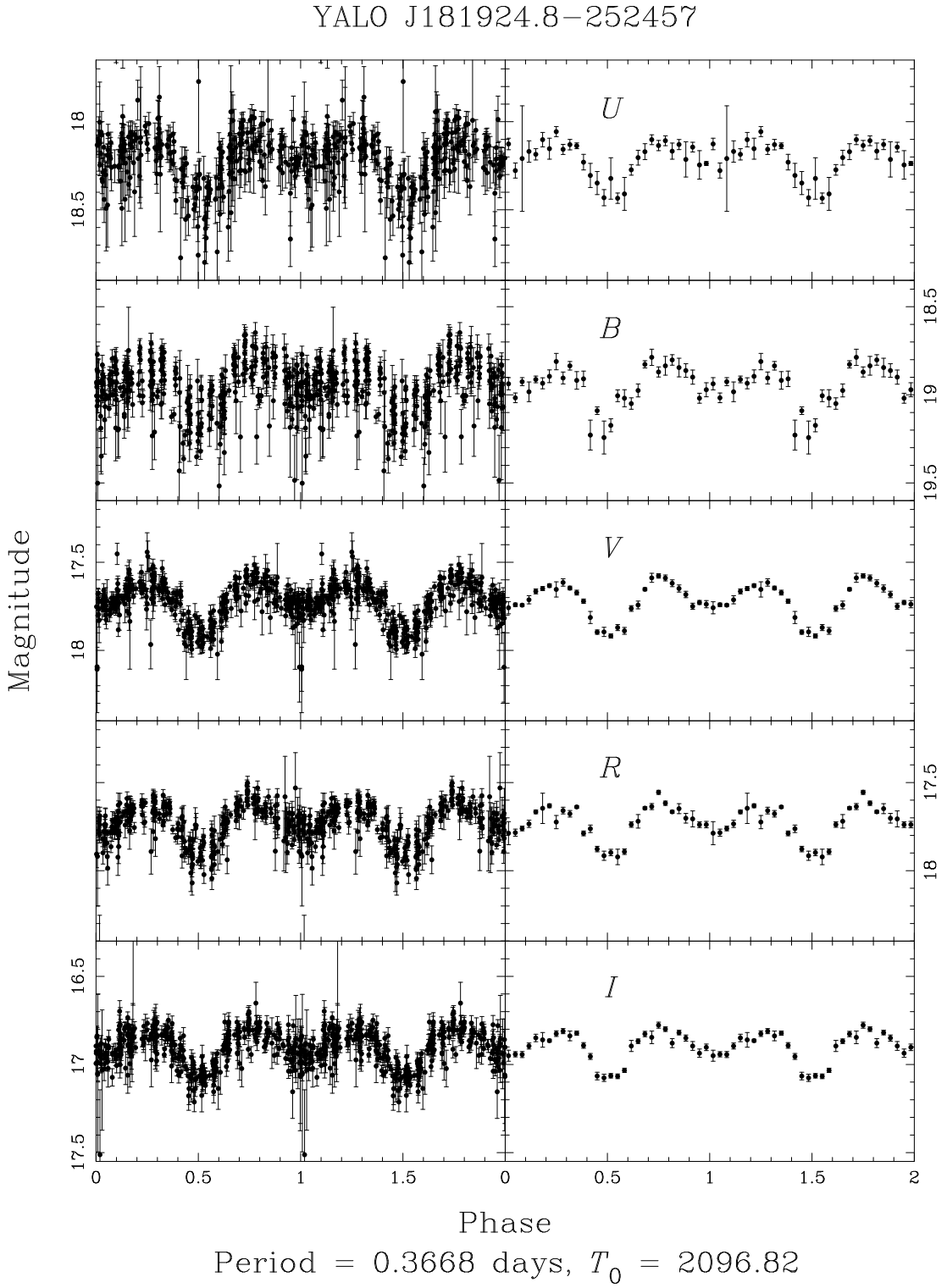

Figure 1. Folded light curves of YALO J181924.8-252457. Left: unbinned data. Right: data binned to 40 phase bins. T_0 is HJD 2 450 000+. Note: the U-band values are instrumental magnitudes.

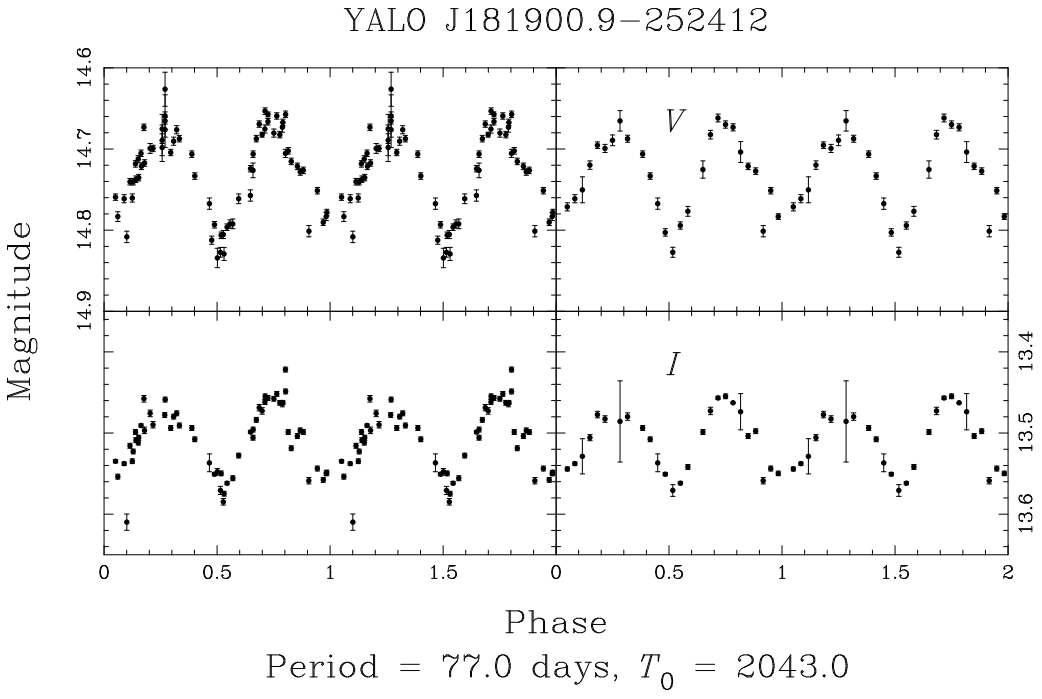

Figure 2. Folded light curves of YALO J181900.9-252412. Left: unbinned data. Right: data binned to 30 phase bins. T_0 is HJD 2 450 000+

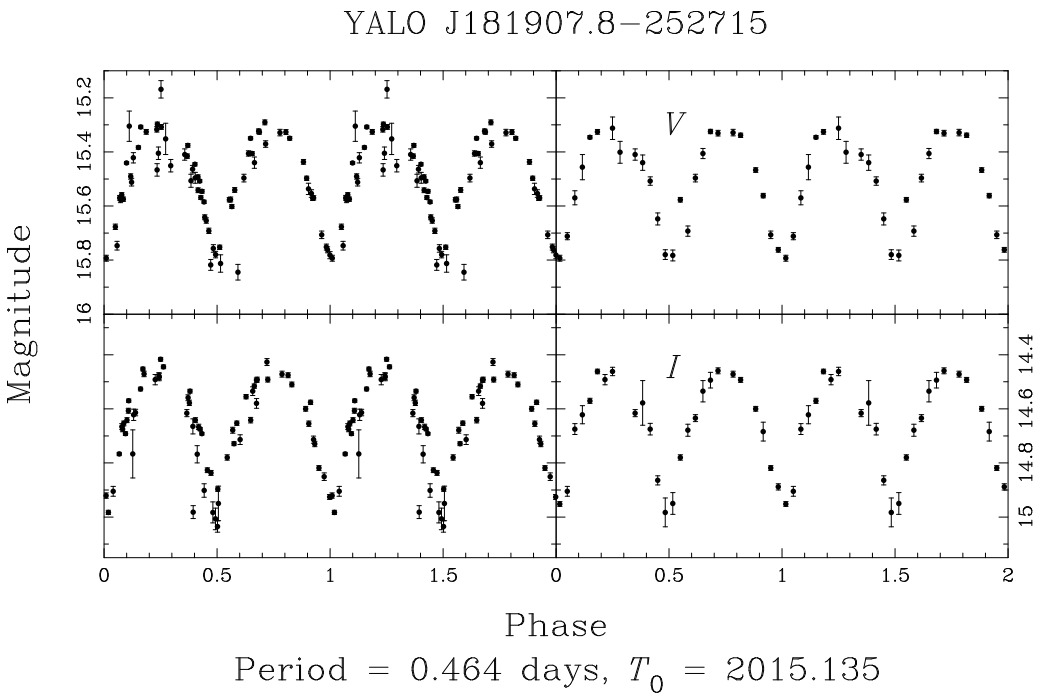

Figure 3. Folded light curves of YALO J181907.8-252715. Left: unbinned data. Right: data binned to 30 phase bins. T_0 is HJD 2 450 000+

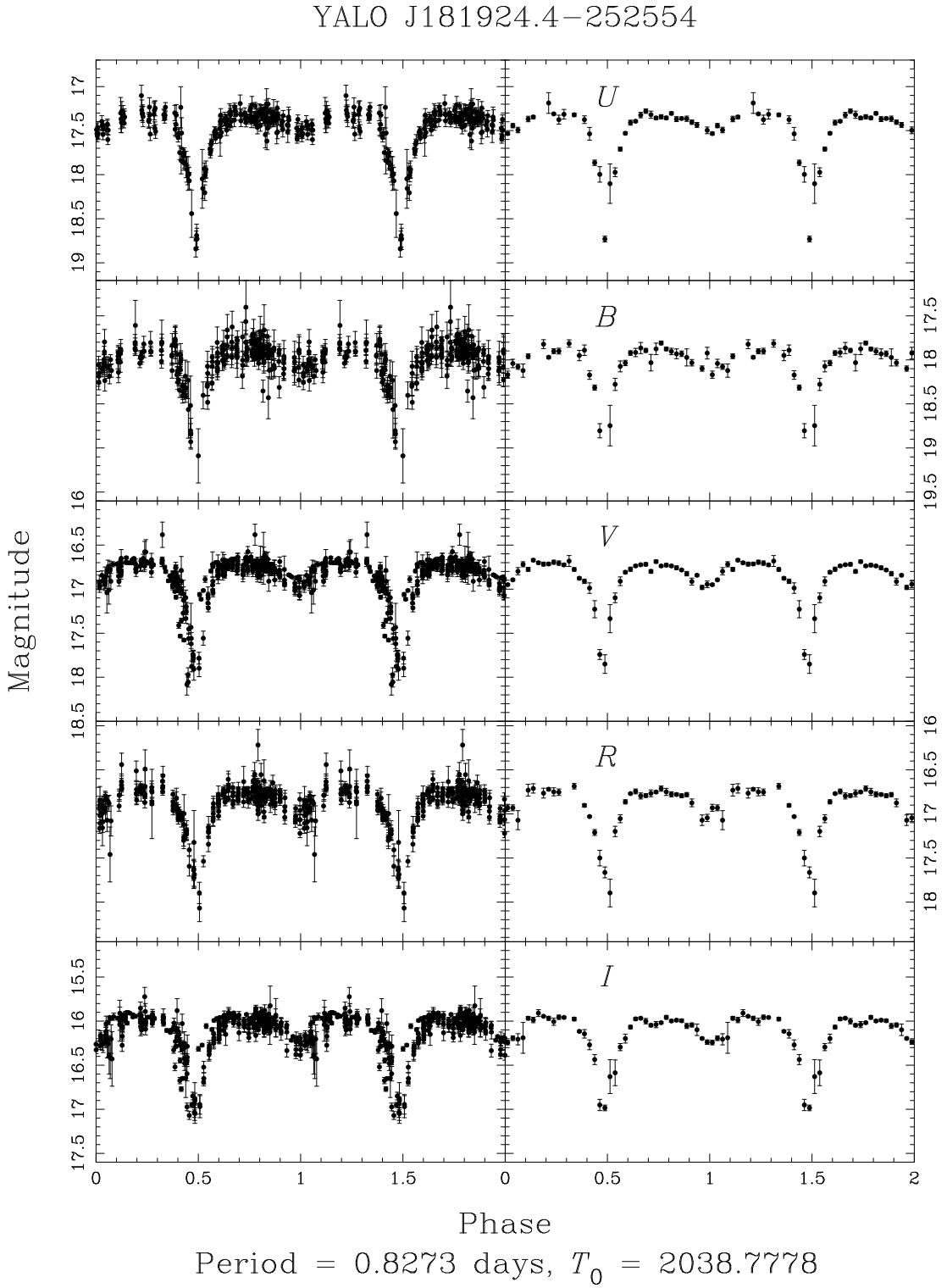

Figure 4. Folded light curves of YALO J181924.4-252554. Left: unbinned data. Right: data binned to 40 phase bins. Note: the U-band values are instrumental magnitudes. T_0 is HJD 2 450 000+

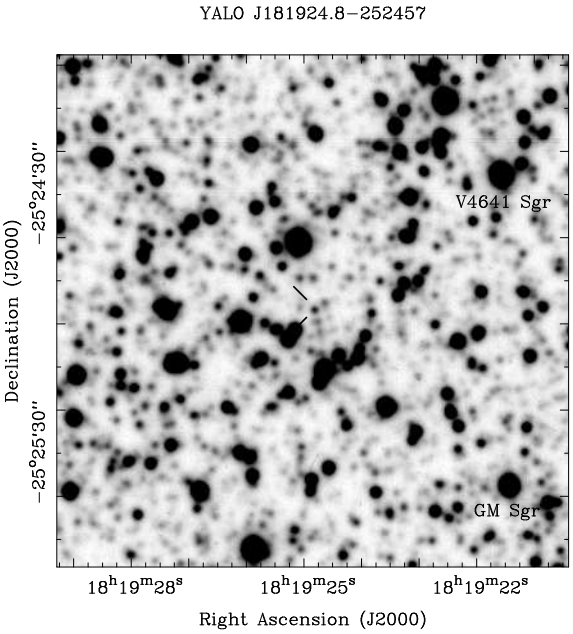

Figure 5. V-band finding chart of YALO J181924.8-252457. Source is in centre. Note: $\sim 3''$ to the west two known variable stars are indicated: V4641 Sgr which is a black hole binary and GM Sgr which is a Mira variable.

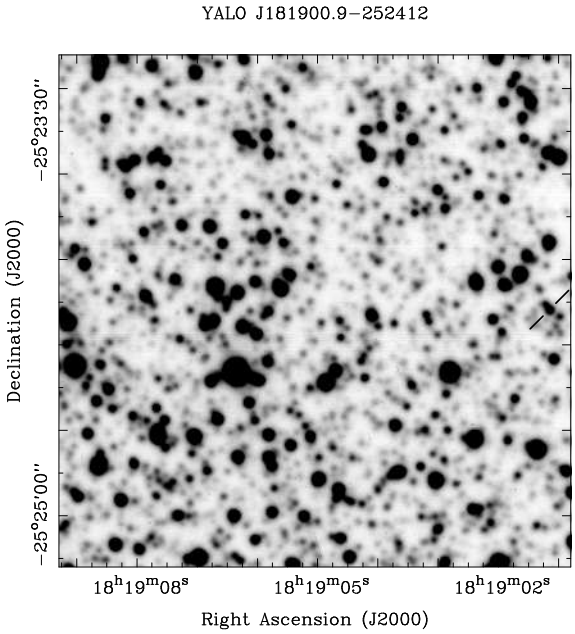

Figure 6. V-band finding chart of YALO J181900.9-252412. Source is right of centre.

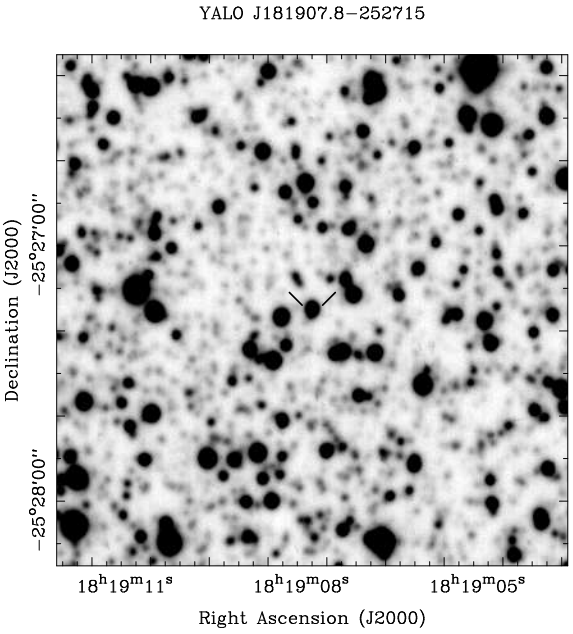

Figure 7. V-band finding chart of YALO J181907.8-252715. Source is in centre.

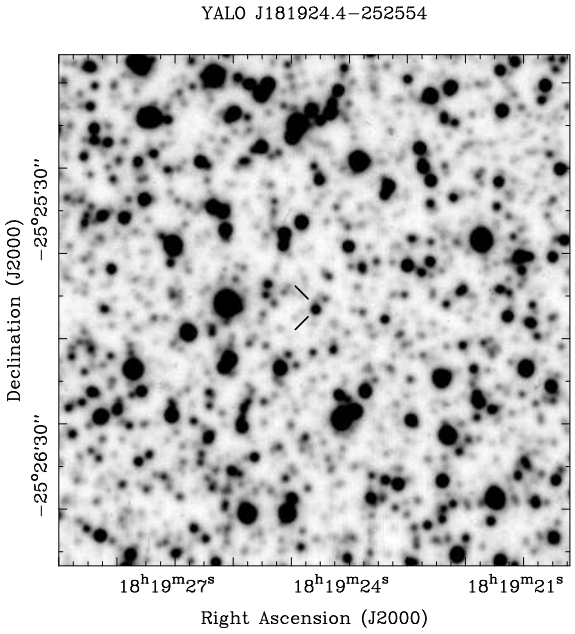

Figure 8. V-band finding chart of YALO J181924.4-252554. Source is in centre.