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NEW AND SUSPECTED MIRA VARIABLES ON STARDIAL IMAGES

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The Stardial system consists of an autonomous drift-scan CCD camera, run by the University of Illinois at Urbana-Champaign (McCullough and Thakkar, 1997). One image per day is taken of each 8×5 degree area of sky centered at a declination of -4°, when the region is near the meridian. The system is therefore ideally suited to follow long period variables (see e.g. Bedient, 2001). Images are publicly available at `http://www.astro.uiuc.edu/stardial/`.

This paper reports on observations of 9 Mira stars, six of which were suspected variables already before, four of them catalogued in the NSV and NSVS. The three other Mira variables are new.

The available images, spanning the years 1999 to the end of 2002 or early 2003, of a particular region were treated as follows. First, photometry was done using the XVista programs written by Michael Richmond[1]. His match programs were then used to transform image coordinates to sky coordinates by comparing star positions from the Tycho catalogue. The programs have at this time essentially produced lists of sky coordinates with raw magnitudes. Then the technique of ensemble photometry (Honeycutt, 1992) was applied to produce homogeneous magnitudes for all the images of the region. Since a non-standard red broadband filter is used by Stardial, the magnitudes obtained cannot really be compared to magnitudes obtained with standard filters. Therefore no attempt was made to transform the magnitudes to a standard system. Only a simple translation was applied to fix the zero point of the magnitude scale, in such a way that for Tycho stars with $-0.1 < B - V < 0.1$, Tycho V magnitudes and Stardial magnitudes are aligned as much as possible. Error bars on the magnitudes are a combination of the photon statistics errors and the errors on the ensemble solution for a particular night.

In the data set, long period variables were then searched for by using the Mean Square Successive Difference technique (von Neumann et al., 1941). This method assumes that the deviation between subsequent data points is small compared to the total variation for a time series showing a trend. In this way a number of long period variables could be discovered and known and suspected variables recovered. This paper reports on nine Mira variable stars, presented in Table 1. The first column gives the USNO-B1.0 identification of the objects, except for two cases where exact identification proved impossible (note that the Stardial pixel size is $36''$, which is not accurate enough for correct identification

[1] `http://spiff.rit.edu/tass/pipeline/pipeline.html`

in crowded fields). The following columns contain the IRAS identification when available, the Julian Date of an observed maximum, the period in days, the amplitude in Stardial magnitudes, and remarks and other identifications. The periods of these stars have been determined using the PDM technique (Stellingwerf, 1978). Light curves are presented in Figures 1 and 2.

Table 1. Data on nine Mira variables

USNO-B1.0	IRAS	JD Max	Period [d]	Amplitude [m]	Remark
0874-0221669	07454-0228	2451491	293	2.0	1
0867-0188840	08239-0307	2451538	323	2.0	2
0824-0264160	–	2451950	364	2.0	3
0834-0296187	16112-0624	2451350	232?	> 3	4
0858-0334726	17440-0407	2451310	349	> 2.0	5
?	18108-0503	2452491	340	1.5	
?	18413-0641	2452516	260:	> 3	6
0847-0554572	19456-0522	2452470	290:	2.5	7
0839-0602533	19582-0613	2452540	115?	> 1.5	

1 GSC 04836-01821 = CSS 401 (Stephenson 1984)
Magnitude in maximum varies by at least 0.5 mag
2 NSV 4082 = GSC 04853-01862
3 NSV 18400 = MSX5C G252.1851+40.6061 = StM 138 (Stephenson 1986)
4 NSV 7549 = BV 1112, amplitude from USNO-B1.0 B1 and R1
5 TASS J174643.5-040811 (Richmond et al. 2000)
6 NSV 11266 = BV 1635
7 GSC 05154-01249, close companion 5″E

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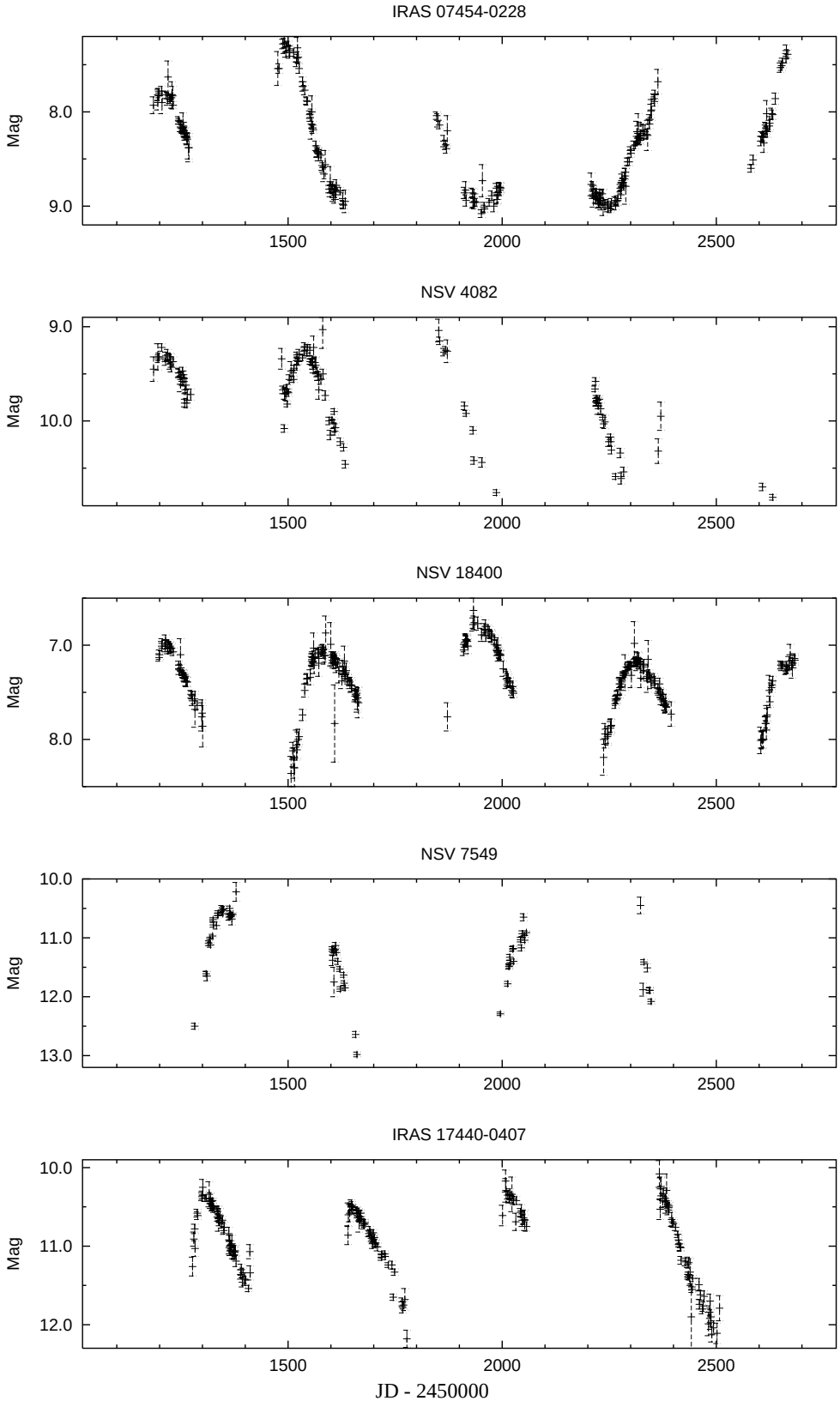

Figure 1. Light curves of five Mira stars.

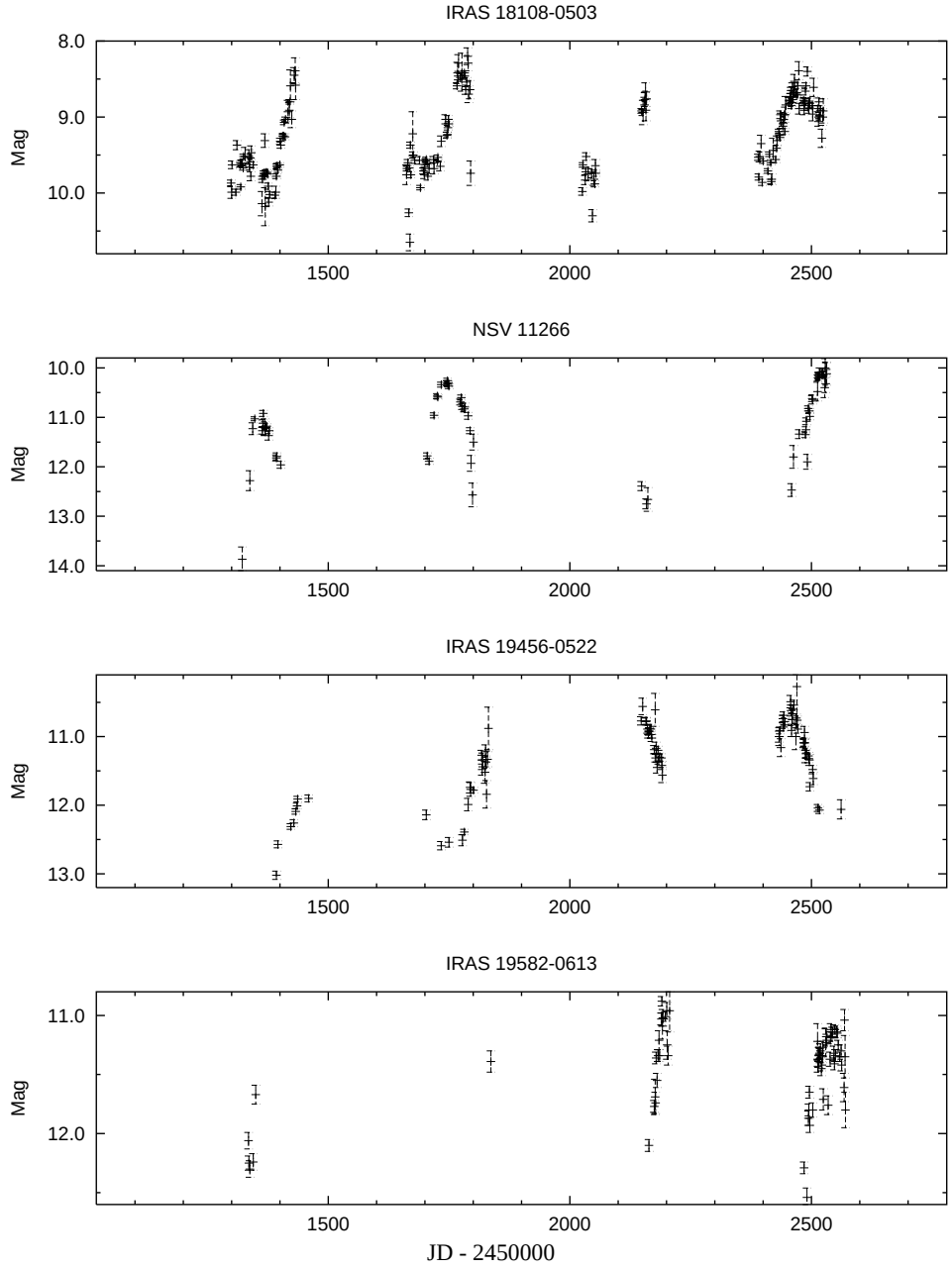

Figure 2. Light curves of the remaining four Mira stars.