Mem. S.A.It. Vol. 84, 540

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Cataclysmic variables discovered in the Chandra Multi-wavelength Plane Survey

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Abstract. We present 25 cataclysmic variables discovered in the Chandra Multi-wavelength Plane Survey (ChaMPlane: Grindlay et al. (2005); Hong et al. (2005); Zhao et al. (2005)), which is designed to investigate the nature of the serendipitous X-ray point sources discovered by the Chandra X-ray Observatory in the galactic plane ($|b| \leq 12°$), in order to constrain the populations of faint ($L_x \leq 10^{33} erg/s$) accretion-powered sources in the Galaxy.

Key words. Chandra, Survey, Galactic plane, Accretion, X-ray binaries, CVs

1. Introduction

ChaMPlane fields are selected from the Chandra archive. Optical V, R, I, Hα images covering the same fields are obtained using the CTIO-4m and KPNO-4m. 74 ChaMPane fields (Mosaic FoV: $36' \times 36'$) are observed, which cover 325 ACIS observations (AO1-13). Chandra optical counterparts and Hα emission sources (Hα−R<−0.3) are identified. Optical spectra are taken. CVs are identified by their hydrogen Balmer and helium emission lines, often broadened and double peaked due to the accretion disk rotation around the primary. Here we present 25 new CV candidates, confirmed by their spectra (to be published elsewhere due to the page limit) taken from the Magellan, CTIO-4m and WIYN telescopes.

Table 1 lists the optical properties of the 25 CVs. Columns 9 lists 11 sources detected by Chandra. Columns 10 marks 17 sources covered by Chandra ACIS (6 of them have no X-ray detection). 8 CVs were not in the Chandra FoV but covered by the Mosaic due to its 5× larger FoV. Columns 11 shows that 9 CVs were previously published by us. 16 of the 25 CVs have never been published before. Table 2 lists the X-ray properties of the 11 Chandra detected CVs and their F_X/F_R ratio. Coincident test shows most these CVs are in the foreground of the Galactic bulge, upto distance of ~2 kpc. Therefore the unabsorbed flux ratio are estimated with the Drimmel model at 1 kpc.

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Table 1. Cataclysmic Variable Candidates Discovered in the ChaMPlane Survey

No	ChOPS[1]	nH^2_{d1}	nH^2_{d8}	V	R	I	Hα−R	X[3]	A[4]	P[5]
1	J012602.18+625506.7	0.10	0.32	20.9	20.3	19.7	−1.35	n	Y	n
2	J012928.15+630702.3	0.10	0.32	21.7	20.5	18.9	−0.58	n	Y	n
3	J013017.55+625348.3	0.10	0.30	20.9	19.2	17.6	−0.34	n	n	n
4	J013022.96+624952.7	0.10	0.30	20.7	19.3	18.0	−0.33	n	n	n
5	J042130.28+330729.2	0.07	0.10	21.1	20.3	19.8	−0.77	n	n	R
6	J043534.32+292038.0	0.08	0.12	–	21.8	–	−0.84	n	n	R
7	J073810.09−092341.2	0.08	0.12	21.9	21.6	–	−0.70	n	n	R
8	J073827.46−093518.3	0.08	0.12	21.2	20.1	18.9	−0.14	n	n	n
9	J112029.35−612524.9	0.12	1.19	20.7	19.0	17.4	−0.40	n	Y	n
10	J134840.05−621754.1	0.12	2.39	20.8	20.0	19.2	−1.02	Y	Y	n
11	J152300.08−571322.4	0.05	1.17	20.5	16.8	14.6	−2.13	Y	Y	n
12	J154305.51−522709.6	0.17	1.26	21.5	20.9	20.3	−0.52	Y	Y	S
13	J161658.37−630318.6	0.07	0.11	17.9	17.5	16.9	−0.48	n	Y	n
14	J170953.03−442510.0	0.13	0.92	20.2	18.8	17.8	−0.33	Y	Y	n
15	J174411.55−284922.1	0.62	10.16	22.8	21.4	20.4	−0.76	Y	Y	n
16	J174421.55−294709.9	0.46	8.08	20.3	19.6	18.4	−0.51	Y	Y	n
17	J174504.67−291905.5	0.54	9.58	–	21.1	19.9	−0.36	n	Y	n
18	J174537.70−292351.9	0.54	9.58	–	23.0	21.3	–	n	n	n
19	J174607.52−285951.3	0.63	11.04	23.1	21.8	20.6	−0.61	Y	Y	K
20	J174638.02−285326.2	0.69	12.11	21.9	20.2	19.2	−0.19	Y	Y	K
21	J174656.89−285233.9	0.68	11.96	22.7	21.3	20.0	−0.19	Y	Y	K
22	J174720.36−290550.2	0.60	10.30	–	22.0	20.6	−0.01	Y	Y	n
23	J175413.58−295301.9	0.06	0.57	20.1	20.1	18.8	−0.68	Y	Y	n
24	J182723.92−040715.9	0.31	1.20	21.8	19.4	16.7	−0.03	n	n	R
25	J235902.61+621325.1	0.10	0.29	20.5	19.7	19.0	−0.56	n	Y	R

[1] Source name prefix ChOPS (Chandra Optical Plane Survey) is registered IAU-style optical source ID. [2] $nH/10^{22}$ based on the model of Drimmel & Spergel (2001) at 1 kpc & 8 kpc.
[3] X-ray detection by Chandra. [4] In the FoV of ACIS. [5] Previously published: R – Rogel et al. (2006), K – Koenig et al. (2008), S – Servillat et al. (2012), n – unpublished before.

Table 2. Cataclysmic Variable Candidates with X-ray Emissions

No	ChOPS	$F_X(Bx) \times 10^{15}$ (0.3–8.0 keV)	$F_X(Bx)/F_R$ (observed)	$F_X(Bx)/F_R$ (unabsorbed)
10	J134840.05−621754.1	142.80	7.99	8.54
11	J152300.08−571322.4	15.22	0.04	0.05
12	J154305.51−522709.6	439.30	56.88	37.10
14	J170953.03−442510.0	1.42	0.03	0.88
15	J174411.55−284922.1	110.80	23.74	3.70
16	J174421.55−294709.9	61.86	2.41	0.55
19	J174607.52−285951.3	40.52	11.85	1.78
20	J174638.02−285326.2	138.90	10.00	1.36
21	J174656.89−285233.9	13.42	2.57	21.05
22	J174720.36−290550.2	95.41	35.20	24.29
23	J175413.58−295301.9	58.97	2.08	2.91

$F_X(Bx)$: Bx band (0.3–8.0 keV) flux, in $[ergs\,cm^{-2}sec^{-1}]$.
$F_X(Bx)/F_R$: flux ratio of Bx band vs. optical R band flux in $[ergs\,cm^{-2}sec^{-1}(1000\text{Å})^{-1}]$.
unabsorbed ratio calculated with nH based on the Drimmel model at 1 kpc.

Acknowledgements. This work is supported in part by the Chandra X-ray Center.

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