Dynamical Evolution of Dense Stellar Systems
Proceedings IAU Symposium No. 246, 2007
E. Vesperini, M. Giersz & A. Sills, eds.

doi:10.1017/S1743921308015998

Paucity of Dwarf Novae in Globular Clusters

P. Pietrukowicz and J. Kaluzny

Nicolaus Copernicus Astronomical Center, Bartycka 18, 00-716 Warsaw
email: pietruk@camk.edu.pl

Abstract. We have conducted an extensive photometric search for dwarf nova (DN) outbursts in 16 Galactic globular clusters (GCs). The survey was based on the rich photometric data collected by the Cluster AgeS Experiment (CASE) team. We have identified two new DNe. Together with previously known systems this gives the total number of 12 known DNe in 7 Galactic GCs. Inserting artificial light curves of "DNe" into frames of investigated clusters allowed us to assess completeness of the search. Our results clearly show that outbursting cataclysmic variables (CVs) are very rare in GCs in comparison to field CVs where half of the systems belongs to DNe. Recent X-ray observations of GCs lead to identification of hundreds of compact binaries. Many of them are promising candidates for CVs. The theory also predicts that dozens of white/red dwarf binaries should form in the cores of GCs via dynamical processes or internal evolution of the binaries. Our results rises the question about possible causes of paucity of outbursts in GCs.

Keywords. stars: dwarf novae, novae, cataclysmic variables, globular clusters: general

1. Observations and reductions

The observations (see Table 1) are made with the 1.0-m Swope telescope at Las Campanas Observatory, Chile. In our search we have used about 20,000 long exposures (80-600 sec) taken in Johnson V filter. The reductions were made using difference image analysis package DIAPL (http://www.camk.edu.pl/∼pych/DIAPL) and DAOPHOT package (Stetson 1987) for profile photometry.

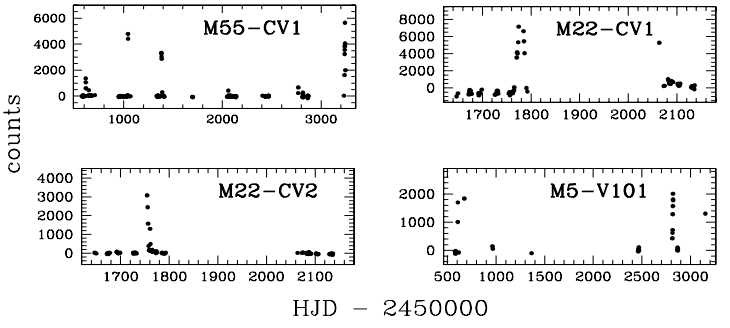

Figure 1. Two new (on the left) and two previously known (on the right) cluster DNe detected in our data

2. Results of the search for DNe

Our search for DNe in 16 GCs yielded two new objects, namely cataclysmic variable CV1 in the globular cluster M55 (Kaluzny *et al.* 2005) and CV2 in M22 (Pietrukowicz *et al.* 2005). In the remaining 14 GCs we found no new certain DNe. We easily recovered two well-known cluster DNe: M5-V101 and M22-CV1. Fig. 1 presents light curves in units of differential counts for all four objects. We note that we detected no light variations near positions of 27 CV candidates located in the fields of analysed clusters.

3. Simulations

We performed simulations to assess completeness of our search. We inserted into frames of three clusters, M22, M30, and NGC 2808, artificial images of erupting DNe and checked whether they would be detected in our search. The simulations were modelled using light curves of two prototype DNe, SS Cygni and U Geminorum, taken from the American Association of Variable Star Observers (AAVSO) International Database. We found that most of such stars would be detected in our data.

Table 1. Data on analyzed globular clusters

Cluster	Seasons	Total number of long exposures in V band	Total number of analyzed nights	Expected number of CVs in the core
M 4	1998-2000, 2002-2005	1981	61	4.8
M 5	1997-1999, 2002-2004	1043	34	36
M 10	1998, 2002	847	28	13
M 12	1999-2001	1236	41	4.6
M 22	2000-2001	2006	71	30
M 30	2000	340	23	39
M 55	1997-2004	3795	151	1.7
NGC 288	2004-2005	297	9	0.3
NGC 362	1997-1998, 2000-2005	1424	90	101
NGC 2808	1998-1999	312	33	208
NGC 3201	2001-2005	751	22	2.6
NGC 4372	2004-2005	601	19	0.7
NGC 6362	1999-2005	2585	104	0.9
NGC 6752	1996-1997	395	7	51
ω Cen	1999-2002	1571	76	30
47 Tuc	1993	551	34	200

4. Conclusions

Our search for DNe in 16 GCs resulted in identification of two new objects. Together with previously known systems this yields the total number of 12 known DNe in 7 Galactic GCs. We have confirmed that ordinary DNe are indeed very rare in GCs. Such a small number of DNe among expected cluster CVs is extremely low in comparison to field CVs of which half are DNe.

Possible explanations of rare outbursts in cluster CVs:

- absence of accretion discs due to strong magnetic fields of the white dwarfs (Ivanova *et al.* 2006)
- a combination of a low mass transfer rates and moderately strong white dwarf magnetic fields (Dobrotka *et al.* 2006)
- frequent stellar encounters affect stability of binary orbits thus affecting their ability to sustain accretion rate suitable for formation of an accretion disc (Shara & Hurley 2006)

References

Dobrotka, A. *et al.* 2006, *ApJ* 640, 288
Ivanova, N. *et al.* 2006, *MNRAS* 372, 1043
Kaluzny, J. *et al.* 2005, *MNRAS* 359, 677
Pietrukowicz, P. *et al.* 2005, *AcA* 55, 261
Shara, M. M. & Hurley, J. R. 2006, *ApJ* 646, 464
Stetson, M. M. 1987, *PASP* 99, 191

https://doi.org/10.1017/S1743921308015998 Published online by Cambridge University Press