

Dr hab. Paweł Pietrukowicz  
Obserwatorium Astronomiczne Uniwersytetu Warszawskiego

*Recenzja rozprawy doktorskiej Diogo Belloniego*  
Review of the PhD dissertation presented by Diogo Belloni

„On Cataclysmic Variable Properties in Evolving Star Clusters  
based on MOCCA Dynamical Simulations”

The PhD dissertation by Diogo Belloni consists of six chapters, the last five of which are his, as the first author, refereed articles published in Monthly Notices of the Royal Astronomical Society in the last two years. In the first chapter, Belloni presents main issues, objectives, methodology, and the most recent results of numerical simulations of Cataclysmic Variable (CV) properties in star clusters, particularly in globular clusters (GCs). The simulations are performed with the MOCCA code developed by Belloni's supervisor, dr hab. Mirosław Giersz, and his collaborators.

In the thesis, Diogo Belloni, with success provides explanations for issues that have emerged from observations and previous theoretical investigations of CVs in GCs. Among the most important results, in my opinion, are:

1. Clear explanation for the lack of dwarf nova (DN) outbursts in GCs as definitive answer to the observational result presented in my PhD thesis from 2007.
2. Numerical investigations of properties of bright and faint CVs in GCs.
3. Tests and improvements of the initial binary population to fit the present-day picture of star clusters via colour-magnitude diagrams.
4. Bringing strong arguments to the idea of the cluster origin of the Milky Way population.

Very recently, Belloni's results have been verified by observations of 47 Tucanae by Rivera Sandoval et al. (2018). Proposed in the Belloni's thesis multiple technique of searches for CVs in clusters is not new, but effective, indeed. Unfortunately, the available observational time and instrumentation on the world's largest telescopes is very limited.

My major question refers to the part on the cluster origin of the Galactic field population. The author adopted a constant metallicity of  $Z=0.02$  over the whole evolution time. It is widely known that the metal content has increased significantly from the beginning of the Galaxy. How the increasing metallicity over time would change the results?

I have a comment to the information provided on page 3 that Pietrukowicz et al. (2008) found two (not twelve) *bona fide* (not candidate) DNe in the photometric data for 16 Galactic GCs from the CASE survey. The total of twelve DNe were known at that time.

Belloni's thesis is well-organized and well-written. Practically all important details are provided. I have a remark to the presentation of general conclusions of the thesis that one below another would read more clear than all points stacked in the text.

Here are my minor comments:

In several places starting from page 15, the phrase "visual magnitude" should be changed to "V-band magnitude". The word "visual" refers (or rather referred in the past) to observations made by eye.

Under the middle panel of Fig. 1.3,  $V_{\text{absolute}}$  should be replaced with  $M_V$ . This is the official symbol for absolute brightness in the Johnson passband V.

There is a small inconsistency in Table 1.3. The author provides a column with  $\alpha_{\text{CEP}}$ , while elsewhere in the text he uses solely  $\alpha$  (without the index).

The text of the thesis is written in good English. I have found very few typos.

Page vi:  
there are typos at the abbreviations for AML and CAML

Page 4:  
X-rays sources → X-ray sources

Page 5:  
reaching the core-collapsed before → reaching the core collapse before

Page 32:  
1.7 GERAL Conclusions of this Thesis → 1.7 General Conclusions of this Thesis

To summary, the PhD candidate Diogo Belloni presented a dissertation which successfully solves several problems of stellar astrophysics and proves that the candidate can conduct a scientific research. In concluding the above review, I declare that the dissertation meets the requirements of Art. 13 of the Polish "Act on academic degrees and academic title". It also meets the usual requirements of the astronomical community. I propose the dissertation to be publicly defended and honoured.

*Konkludując powyższą recenzję stwierdzam, że rozprawa spełnia wymagania Art.13 „Ustawy o stopniach naukowych”. Spełnia także zwyczajowe wymagania środowiska astronomicznego. Wnoszę o dopuszczenie jej do publicznej obrony i wnioskuję o jej wyróżnienie.*

Warszawa, 10 maja 2018 r.

Paweł Pietrukowicz