

Thesis “Extra Galactic Globular Cluster machinery based on MOCCA code for Star Cluster simulations” presented by the candidate Agostino Leveque in fulfillment of the requirements for the degree of Doctor of Philosophy in Astronomy.

Review report by Roberto Capuzzo Dolcetta

In my opinion the title of the thesis should be changed because the “machinery” term sounds odd in a PhD thesis title. Something like “Extra Galactic Globular Cluster study based on MOCCA...” would be better.
But this is a detail.

The thesis concerns with the implementation of a series of modification of a pure existing code (the MOCCA code, developed by prof. M. Giersz on the outline of previous implementations of Monte Carlo simulation of the evolution of dense, spherical star clusters accounting for the time evolution over the relaxation time of the system). Due to that, MOCCA is suited to follow the secular evolution of a dense cluster, so it is not suited to follow evolution on a smaller time scale than the 2-body relaxation time. The author of the thesis made an attempt to somewhat couple short time evolution to the overall structural evolution of the clusters given by MOCCA. This leads to what the author called “machinery”.

In these framework, the thesis, after an introductory chapter, consists essentially in the collection of four papers published in 2021, 2022 and 2023 in Monthly Notices of the Royal Astronomical Society, which are collected in the thesis and constitute its bulk.

The final part of the thesis is devoted to description of the on going future work, with specific attention on the time evolution of the nuclear star cluster and super massive black hole growth in the Milky Way as expected by the use of the “machinery” developed.
A short chapter of concluding summary of results follows.

My opinion is that the thesis is well written, in a good English.
Anyway, I would have appreciated some better insight on the actual limitations (and advantages) of the scheme adopted and a better clarification that all the results presented have their main value in the statistical abundance of results, thing hard to be reached when more sophisticated and time consuming, but also more precise, schemes and methods are adopted to follow the multiple time scale evolution of real star clusters.
This can be done in the Introductory chapter. Regarding to the 4 following chapters where the four published papers (which is a good number of paper for a PhD thesis) are reported, I think that a sort of short summary of the specific paper content and main results should be given at the beginning of each chapter.

Summing up, I consider the doctoral thesis of Agostino Leveque to be an appreciable contribution and to meet the criteria prescribed by the law for a doctoral dissertation. Therefore, I request that this dissertation be admitted to a public defense.”

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