FACULTY
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Supervisor's report on Doctoral Thesis

Author: Camille Landri

Title: Theory and observations of two stars undergoing strong interaction

The doctoral thesis of Camille Landri addresses an important and timely issue of the theory and observations of interacting binary stars. The scientific interest in this field has always been very high, but it has been further reinvigorated in recent years thanks to new discoveries from time-domain astronomical surveys and the detection of gravitational waves from merging black holes and neutron stars.

Camille's thesis is divided into four Chapters. The first Chapter presents a general overview of binary stars and their evolution and interactions. The Chapter contains also a description of hydrodynamical methods commonly used for numerical work in this field (smoothed-particle and grid-based hydrodynamics). The Chapter concludes with a summary that presents the unifying theme of Camille's own results that are further elaborated in Chapters 2-4. The Chapter is accompanied by custom-made illustrations and diagrams, it reads well, and I did not find any significant typographical or factual errors.

Chapter 2 presents an analysis of photometry and spectroscopy of a peculiar dwarf nova using publicly available data and observations acquired by international collaborators. The paper resulting from this work was accepted in 2022 in Monthly Notices of the Royal Astronomical Society (MNRAS). In this project, Camille performed analysis of photometry and spectra and interpreted her findings in the light of the thermal instability model of outbursts in accretion disks. Camille used her skills in spectral analysis to help me with another paper published in 2022 (Pejcha, Cagaš, Landri, et al., Astronomy & Astrophysics, 667, A53), which is not part of the thesis.

In Chapter 3, Camille studied grazing encounters of compact stars with red supergiants. For this project, Camille used smoothed particle hydrodynamics code PHANTOM to set up stellar models and relaxed them to equilibrium, put a binary companion in a prescribed orbit, ran the calculations on various local and national clusters, and analyzed the results. She also heuristically added radiative cooling, dust formation, and wind driving from red supergiants using her own routines. I would like to particularly highlight Section 3.4, which presents extensive discussion of implications of the findings to a wide variety of astronomical phenomena illustrating Camille's scientific maturity and independence. This paper was published in MNRAS in 2024.

In Chapter 4, Camille studies the influence of more realistic initial conditions on the common envelope evolution. The research from this Chapter was recently submitted for publication to The Astrophysical Journal. This Chapter is noteworthy for two reasons. First, the numerical method is different from Chapter 3 – here Camille used grid-based hydrodynamical code

FLASH significantly expanding her toolbox. Second, the work was done in collaboration that she formed during her participation in the Kavli Summer Program in Astrophysics at MPA Garching in 2023.

To summarize, during her PhD Camille has acquired a unique skillset combining experience with smoothed particle hydrodynamics and grid-based hydrodynamics codes with photometric and spectroscopic analysis of observed astronomical events. Not many students achieve this during their PhDs. In my opinion, Camille's work presented in this thesis and her published papers show that she can perform independent creative scientific work. I strongly recommend her thesis for acceptance and awarding her the PhD degree. I wish Camille success during her postdoctoral position.

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