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für Astrophysik

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Thesis report for Frantisek Dinnber: " Propagation of star formation"

Dear evaluation committee,

in the following I will present a report on the doctoral thesis presented by Frantisek Dinnbier with the title: "Propagating star formation".

The thesis starts with a concise overview of the theory of propagating star formation. The most important aspects like star formation, stellar feedback in the form of winds, radiation and supernova explosions are covered and the necessary references are given. The first chapter is continued with a summary of possible triggering processes for star formation: collect and collapse, radiation driven implosion, and the triggered edge effect. The chapter is completed with an overview of potential observational signatures of these triggering effects. It is clear that this summary is an original contribution by the author and not simply a repetition of previous results. It is well structured and the author clearly understands what he is writing about.

Chapter 2 is a review of gravitational fragmentation of shells and layers. It is equally well structured as chapter 1 and covers the dispersion relation of stratified layers and several instabilities (e.g. thin shell instability) in sufficient detail. Chapter 3 is an overview of the FLASH code, which was used for the main thesis work. The focus is set on the TreeRay algorithm and the sink particle algorithm, both of which are used for the scientific studies.

Chapter 4 focuses on the implementation of gravitational force computation in mixed boundary conditions. An accurate implementation of this part into FLASH (and GANDALF) is far from trivial and the author has done an excellent job here. All details are explained and convincing tests are presented. It has to be pointed out that this implementation is also very useful for the international community, in particular the many FLASH users.

Chapter 5 is dedicated to the original scientific part of this thesis: the simulation of fragmenting layers. The author was able to investigate analytical estimates for the dispersion relation with direct numerical simulations. The agreement is good. The author was able to demonstrate that pressure confinement changes the evolution of a self-gravitating layer. At high ambient pressure the sheet fragments and the fragments coalesce, at low ambient pressure the layer fragments, without coalescence. In an application of a shell forming in an expanding HII region the author demonstrates that, for realistic conditions, the shell can only fragment into low mass cores with about 3 solar masses or less. This finding has important consequences. If no stars more massive than 8 solar masses can form in such a shell triggering further star formation is not possible. This is an important finding and partly contradicts previous claims made in the literature based on less detailed simulations. These results are published in a peer reviewed astrophysical journal (MNRAS).

Overall this is a very good PhD thesis. It is well written and clearly structured. The figures are of highest quality and the tables give all necessary information. The author has not only written a nice summary of previous work but has also presented his own contribution in great detail. In particular the implementation of non-periodic boundary conditions for gravity in the FLASH code is excellent numerical work. Also the scientific contribution to the community resulting from this thesis work is of high standard – and is published. I also highly value the author's honest statements on the limitations of the applied numerical methods. This information is crucial for the assessment of the overall results. The author has clearly demonstrated the ability for top-level research in computational astrophysics and also the ability to make creative and original contributions to astrophysical research.

Thorsten Naab, Garching, 02.02.2017