

## Report about the doctoral thesis of Ivana Ebrova

The doctoral thesis of Ivana Ebrova (in the following referred to as the candidate) titled „Shell Galaxies“ presents new approaches to the problem to constrain the gravitational potential of the host galaxy and the parameters of the formation process by using kinematics (and also photometry) of the shell system. The thesis consists of three major parts, first a review of the current state of knowledge about shell galaxies and the models for their creation, secondly a discussion of the shell kinematics based on a new model and test particle simulations, and thirdly a discussion of the effects on the model, when the simulations are extended by including dynamical friction and gradual disruption of the intruder galaxy. The paper version of the thesis is also augmented with a CDrom with movies from the simulations.

Section one is a very good introduction to both the observations (chapter 2-4) and the models (chapter 6-7). I especially value the careful work with the literature (I only miss very recent the paper of one of my students (Miskolczi et al. 2012), which is only a side topic in the context discussed here). I also like the good discussion of models in comparison to the observations. This block of the thesis may without much additional work well be extended into an review about the current state of knowledge about shell galaxies.

Section two details the new ideas for determining parameters using the line of sight velocity distribution (LOSVD) of the shells and comparison of the methods when using own simulations (using the test particle approach). The basic idea of Merrifield & Kujken (1998) is very much extended and improved in the thesis and enriched with new ideas. This is also the core of the published A&A paper Ebrova et al. (2012). Again the critical discussion of the methods is well done, too, but as observer I miss a little bit the direct connection to observation, which is done a little bit in section three, but also there more on a qualitative, than quantitative level.

The inclusion of dynamical friction and the gradual disruption of the satellite/intruder galaxy is a very important further step to make the presented methods usable for the interpretation of observational data. Chapter 16 is a nice presentation of the concept of dynamical friction and again are chapter 15 and 17-18 well presented descriptions of the methods. Chapter 21 gives very interesting results of the GADGET simulations and shows the prospect of the concept presented in this thesis. The conclusion section is short, but well done, but again a miss a bit a more quantitative discussion on the observability of the effect. Still, a couple of ideas are mentioned, and since the thesis is clearly the result of the theoretical study, this is a minor point.

Overall formal style of the thesis is very good, with careful and well readable text in good English and well prepared, meaningful figures. Sometimes the placing of the figures is less than ideal, with 2 pages between figure and discussion in the text (e.g. Fig.50 page 96), but is a very minor point. The list of references is very good and again shows the careful work of

the candidate. Again, the lack of a check for a consistent form of the page numbers (25-38 in some references, 347+- in the other) is an very minor point again.

The paper output (one refereed journal paper, 6 conference proceeding contributions) may have been a bit larger at the time of the defence, but the A&A paper is clearly a significant results and the content of the thesis clearly shows that at least 2 more papers are imminent. A short list stating the contributions of the other authors to the papers would have been helpful.

In total, this thesis is a very careful work, providing scientifically very interesting results, which will stimulate the observational astronomers, and has implications for the understanding not only of shell galaxies (mostly elliptical and S0) but stellar streams in the halos of spiral galaxies, too.

The content of the thesis without any doubt shows the ability of the candidate for careful and creative scientific work and I have no doubt that Ivana Ebrova will have a very good chance for a career in astronomy/astrophysics if she so chooses.

I therefore grade this thesis as

**very good**