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Supervisor's report on PhD Thesis submitted by Mgr. Ondřej Kopáček

Transition from regular to chaotic motion in black hole magnetospheres

Jiří Svoboda worked out his Thesis within the framework of doctoral studies in the field of Theoretical Physics, Astronomy and Astrophysics (the study program 4F1), a joint branch of the Charles University in Prague (Faculty of Mathematics and Physics) and the Astronomical Institute of the Academy of Sciences in Ondřejov during years 2007—2011. This Thesis was submitted for defense in summer 2011. It deals primarily with theoretical analysis of motion of electrically charged matter near magnetic stars and black holes immersed in magnetic fields of external origin.

The thesis discusses one of the current topics, namely, the onset of chaos in a relativistic system where the equations governing the motion of particles differ only slightly from equation admitting regular motion. The emphasis is given to the careful analysis and visualisation of motion characteristics, including their numerical integration. Critical discussion of previous results of other authors is also included. Furthermore, the Thesis examines the structure of magnetic fields near black holes and it suggests that the mutual interaction of electromagnetic and strong gravitational fields can lead to conditions favorable for magnetic reconnection.

This work consists of four chapters plus Appendices. The form of the text provides a self-contained exposition of the problem, although majority of new results have been published in recent papers. I can confirm that the contribution of Ondřej Kopáček on the common publications has been always very important. He carried out all computations and prepared the essential sections of these papers.

I appreciate Ondřej's careful approach towards scientific problems that he aims to solve. This is evident from the style of his publications and this thesis, which is very well focused on the actual content of the work and demonstrates that the author has a broad knowledge in the difficult field of relativistic astrophysics, as well as plenty of material for his future research.

Regarding the formal aspects, the print appears to be almost perfect. The volume of this thesis conforms to usual standards (slightly over 100 pages) and it demonstrates that the author has achieved new results and is abound with ideas that he can pursue in his own scientific career.

Besides the work on the two principal scientifc papers, during his PhD study Ondřej Kopáček participated at several international conferences and schools on mathematical aspects of chaotic systems and their context in astronomy, he presented his results in the form of posters and contributed talks, and he wrote several contributions for conference proceedings. Ondřej has also developed fruitful international collaboration with several colleagues abroad. Within the framework of the joint research project of the group, he visited Massachusetts Institute of Technology in Cambridge two times, and he presented recent results in a seminar talk.

Last but not least, I should mention active participation by Ondřej in science popularization, namely, his contribution to the translation of science popular book which appeared in print at the end of Year of Astronomy 2009.

I conclude that the Thesis contains new scientifically valuable results and it proves to be on sufficient level. I recommend this work to be admitted for the defense and advice that Ondřej Kopáček be awarded PhD degree.

Doc. RNDr. Vladimír Karas, DrSc.