



Vladimír Karas  
Astronomical Institute  
Academy of Sciences  
Boční II 1401  
CZ-14131 Prague

Email: vladimir.karas@cuni.cz

Prague, 1<sup>st</sup> May 2010

Prof. RNDr. Jiří Anděl, DrSc.  
Proděkan pro studijní záležitosti  
Matematicko-fyzikální fakulta UK  
Ke Karlovu 3  
12116 Praha 2

Supervisor's report on PhD Thesis submitted by Jiří Svoboda

### **Looking into the inner black hole accretion disc with relativistic models of iron line**

Jiří Svoboda worked out his Thesis within the framework of doctoral studies in the branch of Theoretical Physics, Astronomy and Astrophysics (F1), a joint programme of the Charles University in Prague (Faculty of Mathematics and Physics) and the Astronomical Institute of the Academy of Sciences in Ondřejov during years 2006—2010. This Thesis was submitted for defence in spring 2010 and it deals primarily with the interpretation of X-ray observational data from detectors on-board astronomical satellites operating in the energy range 2—10 keV. This spectral region is highly relevant for the discussion of effects of general relativity in accreting black holes. The thesis deals with one of current topics, namely, the processes shaping the iron line complex in both stellar-mass and supermassive black holes. The emphasis is given to careful analysis of the data and their interpretation in terms of physical processes. Critical discussion of previous results of other authors is also included.

This thesis consists of five chapters plus Conclusions. Chapter 1 provides a brief introduction to the subject and the relevant techniques employed later in the text. Chapter 2 discusses the computational tools applied to study the general relativistic in light propagation in Kerr metric. The original results are presented in Chapters 3 and 4. Content of these two chapters builds on two papers published recently (Svoboda et al. 2009, 2010) in the journal of *Astronomy & Astrophysics*. The author first discusses the effects of emission directionality in spin determination of accreting black holes, and then embarks on several issues concerning the interpretation of X-ray data in three objects

(the Galactic black hole GX 339-4, and two Seyfert galaxies, MCG–6-30-15 and IRAS 05078+1626) observed from XMM-Newton. The author demonstrates how various uncertainties in current data affect the interpretation of the observations and how these could be improved with future missions, namely, the International X-ray Observatory (IXO) that is currently under discussion.

I appreciate the careful approach of Jiří towards scientific problems that he aims to solve. This is evident also 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 lot of knowledge in the difficult field of data interpretation, as well as plenty of material for his future research. Regarding the formal aspects, the print appears to be perfect. The volume of this thesis conforms to usual standards (slightly over 100 pages) and it clearly 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 mentioned papers, during his PhD study Jiří Svoboda participated at several international conferences and schools on X-ray astronomy (e.g. recently in Bologna and Prague), presented his results in the form of posters and talks, and he wrote several contributions for conference proceedings. Jiří has also developed fruitful international collaboration with several colleagues abroad and within the framework of the joint research projects he visited institutes at University 'Roma Tre' in Italy, European Space Astronomy Centre in Spain, Copernicus Astronomical Centre in Poland, and Massachusetts Institute of Technology in Cambridge.

Last but not least, I should mention active participation by Jiří in science popularization, namely, his collaboration on the translation of science popular book which went to 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 defence and advice that Jiří Svoboda be awarded PhD degree.**

Vladimír Karas  
(Associate Professor of Astrophysics in Prague)