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Report on the Habilitation Thesis of Mr. Pavel Bakala, PhD.

Habilitation thesis of Dr. Bakala, titled "Computer Methods in Relativistic Astrophysics", brings a collection of author's papers on computer modelling of processes happening close to a rotating (Kerr) black hole. Main attention is given to a distant-observer picture of radiation emitted by disc-type accretion and to the effect of such a radiation on the accretion inflow itself. Crucial tools of the presented study have been several software packages in the development of which Dr. Bakala apparently played a primary role. In these codes, the gravitational background (generated by the black hole) and the test-particle/photon dynamics are described exactly within general relativity.

After a general-relativity and astrophysical background summarized in Introduction, the author describes, in the second chapter, the usage of the LSDcode+ software which computes several characteristics of radiation from typical accretion structures orbiting close to a Kerr black hole, as detected by a distant virtual camera (with several possible objectives). In the third chapter, another software package PT trajectories is explained which calculates the accretion flow subject to a radiation flux coming from the inner parts of the accretion system. The most interesting I consider models of a "cold" low-density thin disc whose inner part is shown to be strongly influenced by such radiation (the radiation-particle interaction is approximated in a manner usually adhered to when studying the Poynting-Robertson effect), whereas above a certain radius the disc remains "Keplerian".

The papers collected in the Thesis were published in respected international journals and the role of Dr. Bakala in their author team apparently was important. Also, the Thesis is well written, its structure, language, grammar and formal level are very reasonable, and this applies to the included figures and to the reference list as well. Therefore, I recommend this Thesis to be accepted as a Habilitation Thesis and, provided that other conditions are also fulfilled by the candidate, to award him the "docent" title.

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I beg to have one suggestion and one question:

- The author may consider to also employ, besides the local-observer frames mentioned in the Thesis (tied to static, ZAMO and freely falling observers), the Carter (also sometimes called "canonical") frame which is practically given by condition that the principal-null-congruence photons are purely radial in it. The Carter observer is time-like down to the horizon (similarly as ZAMO) and calculations typically come out simpler in the Carter frame than in LNRF (this mainly applies to those involving radiation).
- The Eddington luminosity limit is standardly defined for spherical accretion symmetry. Here it is used for disc geometry (actually a thin-disc one). What is its meaning in such a case?

Prague, 15th May 2018

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